



Springer Texts in Business and Economics

Toshihiro Ithori

Principles of Public Finance

 Springer

Springer Texts in Business and Economics

More information about this series at <http://www.springer.com/series/10099>

Toshihiro Ihori

Principles of Public Finance



Springer

Toshihiro Ihori
National Graduate Institute for Policy Studies
Minato-ku, Tokyo, Japan

ISSN 2192-4333 ISSN 2192-4341 (electronic)
Springer Texts in Business and Economics
ISBN 978-981-10-2388-0 ISBN 978-981-10-2389-7 (eBook)
DOI 10.1007/978-981-10-2389-7

Library of Congress Control Number: 2016956567

© Springer Science+Business Media Singapore 2017

This work is subject to copyright. All rights are reserved by the Publisher, whether the whole or part of the material is concerned, specifically the rights of translation, reprinting, reuse of illustrations, recitation, broadcasting, reproduction on microfilms or in any other physical way, and transmission or information storage and retrieval, electronic adaptation, computer software, or by similar or dissimilar methodology now known or hereafter developed.

The use of general descriptive names, registered names, trademarks, service marks, etc. in this publication does not imply, even in the absence of a specific statement, that such names are exempt from the relevant protective laws and regulations and therefore free for general use.

The publisher, the authors and the editors are safe to assume that the advice and information in this book are believed to be true and accurate at the date of publication. Neither the publisher nor the authors or the editors give a warranty, express or implied, with respect to the material contained herein or for any errors or omissions that may have been made.

Printed on acid-free paper

This Springer imprint is published by Springer Nature
The registered company is Springer Nature Singapore Pte Ltd.
The registered company address is: 152 Beach Road, #22-06/08 Gateway East, Singapore 189721, Singapore

Preface

This book is a standard, but new-style, textbook on public finance. It provides instructors and students with an overview of the literature so that students can attain an overall understanding of macroeconomic and microeconomic public finance. Conventional textbook offerings are mainly restricted to microeconomic public finance topics. However, the literature on public finance has grown dramatically, particularly theoretical studies and empirical analysis, with much of the focus on the macroeconomic effects of public services. This text intends to fill a gap in such literature by presenting a theoretically based, comprehensive explanation of public finance including macroeconomic topics.

Particular emphasis is directed at developing tools that can be applied theoretically and empirically to clarify essential economic concerns in the current public sector in advanced countries, including Japan. Such concerns include the macroeconomic effect of fiscal policy, the dependence on bonds to cover government deficits, and social security reform.

The main text explains the standard concepts of public finance, while the appendix offers various advanced topics together with case studies of Japan's circumstances. The material facilitates an understanding of how to investigate changes in the public sector, interpret results, and, essentially, undertake research on fiscal policy. The textbook is of value to a broad range of course offerings, including those with a general focus on fiscal policy, social security reform, and tax reform.

The main text is appropriate for undergraduates. The appendix is useful for graduate students who wish to learn about advanced research in this area and for practitioners who want to broaden their knowledge outside their own areas of expertise, especially with regard to Japan. I present the background of each result and try to give the reader a feel for how a particular area of the literature has developed. The technical results are provided, and an intuitive explanation for them is also given.

Each chapter is reasonably self-contained. A variety of models are studied in each chapter and are fully described so that the reader can open the book to any chapter and begin reading without missing any of the notations or techniques. Consequently, emphasis is placed on geometric and economic intuition rather than on the rigorous development of general results. In fact, I have purposely

limited the complexity such that the textbook can easily be read and understood by anyone with an understanding of basic economics. Although some advanced studies assume a sound comprehension of modern microeconomics and a good level of familiarity with basic calculus, I use no sophisticated mathematical analyses; instead, I use detailed explanations to supplement the understanding of more technical sections. This strategy is intended to make most sections of interest to a broader range of readers. I hope you will agree.

During the long gestation period of this book, I have incurred much gracious assistance, and it is now with pleasure that I acknowledge this. I am indebted to a number of colleagues and students for helpful conversations along the way. In particular, I would like to thank Junichi Itaya, Hirofumi Shibata, Tatsuo Hatta, Takero Doi, Hiroki Kondo, Masumi Kawade, Shun-ichiro Bessho, Ryuta Kato, Keigo Kameda, C.C. Yang, Martin McGuire, and especially Raymond Batina.

I wish to thank Kosuke Soga for arranging the camera-ready figures. I would like to thank Editage (www.editage.jp) for the English language editing. I am also grateful to Juno Kawakami and Misao Taguchi for their editorial assistance in preparing this book.

Tokyo, Japan
July 2016

Toshihiro Ihori

Contents

1	Public Finance and a Review of Basic Concepts	1
1	The Main Functions of the Public Sector	1
1.1	Resource Allocation	1
1.2	Redistribution	2
1.3	Stabilization	3
1.4	Dynamic Optimization	4
1.5	The Failure of Government	5
2	A Review of Basic Analytical Concepts	5
2.1	Constrained Maximization	5
2.2	Pareto Optimality	6
2.3	A Dual Approach	7
3	The Public Sector in Japan	8
3.1	The Role of Central Government	8
3.2	Intergovernmental Finance	9
3.3	The Budgetary System	10
3.3.1	The Budgetary Formula in Japan	10
3.3.2	The Budgetary Process	12
3.3.3	The Execution of the Budget and the Settlement of the Account	13
3.4	The Content of the General Account in Japan	14
3.4.1	The Category of Budget	14
3.4.2	Government Expenditure	14
3.4.3	Tax Revenue	15
3.4.4	Public Debt	16
4	Organization of the Book	16
4.1	Part One	16
4.2	Part Two	18
4.3	Appendix	18
	Appendix: Japan's Fiscal Management	19
	A1 The 1950s	21
	A2 The 1960s	21
	A3 The 1970s	22
	A4 The 1980s	22

A5 The 1990s	22
A6 The 2000s	23
A7 The 2010s	24
References	25

Part I Macroeconomic Aspects of Public Finance

2 The Macroeconomic Theory of Fiscal Policy I	29
1 The Simple Keynesian Model	29
1.1 The 45-degree Model	29
1.2 The Fiscal Multiplier	30
1.3 The Multiplier with Tax Rate	31
1.4 The Built-In Stabilizer	32
1.5 The Balanced-Budget Multiplier	33
2 The IS/LM Analysis	34
2.1 The Investment/Saving and Liquidity Preference/ Money Supply Equilibrium Model	34
2.2 The Size of the Multiplier in the IS/LM Model	35
2.3 Extreme Cases of the Zero Crowding-Out Effect	36
2.4 Direct Crowding Out	37
2.5 The Crowding-In Effect	38
3 The Open Economy	39
3.1 Extension to an Open Economy Model	39
3.2 The Fixed Exchange System	39
3.3 The Flexible Exchange Rate System: The Effect of Fiscal Policy	41
3.4 The Flexible Exchange Rate System: The Effect of Monetary Policy	42
3.5 Zero Capital Movement	42
4 The Efficacy of Fiscal Policy and the Policymaker	43
4.1 Three Viewpoints	43
4.2 The Lag of Policy	43
4.3 Lag of Monetary Policy	44
4.4 Lag of Fiscal Policy	44
4.5 Lag and Automatic Stabilizers	45
4.6 Rules Versus Discretion	46
Appendix: Public Investment in Japan	47
A1 Introduction	47
A2 The Efficacy of Public Investment as a Counter-Cyclical Measure	48
A3 Fiscal Policy and the Optimal Size of Public Investment	49
References	50

3	The Macroeconomic Theory of Fiscal Policy II	53
1	The Permanent Level of Fiscal Variables	53
1.1	Definition of the Permanent Level of an Economic Variable	53
1.2	The Government's Budget Constraint	54
2	Consumption and Saving Behavior	56
2.1	Optimization Over Time	56
2.2	The Permanent Income Hypothesis	57
3	The Labor Market and Supply Function	58
3.1	Labor Supply by Households	58
3.2	Labor Demand by Firms	60
3.3	Equilibrium in the Labor Market	61
4	Equilibrium in the Goods Market	62
5	The Effect of Fiscal Policy	63
5.1	Three Cases of Fiscal Expansion	63
5.2	Temporary Expansion	63
5.3	Permanent Expansion A	65
5.4	Permanent Expansion B	66
6	Evaluation of the Public Sector	66
6.1	Substitutability	66
6.2	The Multiplier Effect of Government Spending	67
6.3	Evaluation of Government Spending	68
	Appendix: The Size of Government Spending and the Private Sector's Evaluation	68
	A1 Introduction	68
	A2 Theoretical Considerations	69
	A2.1 Evaluation of Government Spending	69
	A2.2 Optimal Size of Government Spending	71
	A2.3 Optimizing Behavior	71
	A2.4 Indirect Test	72
	A3 Empirical Results	74
	A4 Conclusion	74
	References	75
4	Public Debt	77
1	Ricard's Neutrality Theorem	77
1.1	A Two-Period Model	77
1.2	The Implications of Public Debt Issuance	79
1.3	Debt Issuance in an Infinite Horizon Economy	79
2	The Shift of the Burden to Future Generations	80
2.1	A Two-Overlapping-Generations Model	80
2.2	The Efficacy of Keynesian Policy	81
2.3	The Shift of the Burden	82
3	Barro's Neutrality	82
3.1	The Inclusion of Bequests	82
3.2	A Simple Model with Bequests	83
3.3	Barro's Neutrality Theorem	84

4	Policy Implications of the Debt Neutrality Theorem	85
4.1	Policy Implications	85
4.2	Theoretical Assumptions	86
4.2.1	Perfect Capital Market	86
4.2.2	Lump-Sum Taxes	86
4.2.3	Anticipation of Future Tax Increases	87
4.2.4	Planning Period and Bequest Motive	88
4.3	Empirical Evidence	89
5	The Non-Keynesian Effect	89
5.1	What Is the Non-Keynesian Effect?	89
5.2	The Non-Keynesian Effect in the Real World	90
5.3	Simple Theory of the Non-Keynesian Effect	90
Appendix: Government Debt in an Overlapping-Generations Model		91
A1	Introduction	91
A2	The Basic Model of Overlapping Generations	92
A2.1	The Consumer Within the Model of Overlapping Generations	92
A2.2	Production Technology and Capital Accumulation	94
A3	Government Debt and Intergenerational Transfer	95
A3.1	The Transfer Program	95
A3.2	Some Remarks	96
A3.3	The Burden of Debt	97
A4	Debt Neutrality with Altruistic Bequests	98
References		100
5	Economic Growth and Fiscal Policy	101
1	A Simple Growth Model	101
1.1	Long-Run Growth Rate in the Harrod-Domar Model	101
1.2	The Effect of Fiscal Policy	102
1.3	The Incorporation of Public Investment	103
2	Optimal Public Investment	104
2.1	The Role of Public Spending	104
2.2	Public Investment in the Market Economy	104
2.3	Optimal Allocation Between Two Regions	106
2.4	Optimal Size of Public Investment	107
2.5	The Discount Rate of Public Investment	109
3	The Solow Model	110
3.1	Formulation of the Solow Model	110
3.2	Stability of the System	111
3.3	The Effect of Fiscal Policy	112

4	The Endogenous Growth Model	113
4.1	The Optimal Growth Model	113
4.2	The AK Model	114
4.3	Public Investment and Growth Rate	115
5	Inequality and Economic Growth	117
5.1	Income Redistribution and Tax Rate	117
5.2	Externality of Educational Investment	118
Appendix A: Taxes on Capital Accumulation and Economic Growth		118
A1	Introduction	118
A2	The Endogenous Growth Model	119
A2.1	Technology	119
A2.2	The Three-Period Overlapping-Generations Model	120
A2.3	The Altruistic Bequest Motive	122
A3	Economic Growth and Efficiency	122
A3.1	The First Best Solution	122
A3.2	Optimizing Behavior in the Market Economy	123
A3.3	The Circumstance in Which Physical Bequests Are Zero	123
A3.4	The Circumstance in Which Physical Bequests Are Operative	125
A4	Taxes and Economic Growth	126
A4.1	The Constrained Economy	126
A4.2	The Unconstrained Circumstance	127
A5	Conclusion	127
Appendix B: The Supply-Side Effect of Public Investment in Japan		128
B1	Earlier Studies	128
B2	Recent Studies	128
B3	Public Investment Management	130
B3.1	Constraints in Japan	130
B3.2	Public Investment Management Reform	131
B3.3	Strengthening Wide-Ranging Coordination	132
B3.4	Cost-Benefit Analysis	133
B4	Public Investment Management Reform	135
References		136
6	Fiscal Management	139
1	Understanding Fiscal Management	139
1.1	The Problem of Public Debt Issuance	139
1.2	Balanced-Budget Policy	140
1.3	The Efficacy of Keynesian Policy	141
1.4	The Tax-Smoothing Hypothesis	142
1.5	Compensation Policy	144
1.6	The Long-Run Argument for a Zero-Tax Nation	146
1.7	Overall Arguments on Fiscal Deficits	146

2	Fiscal Bankruptcy	147
2.1	The Possibility of Fiscal Bankruptcy	147
2.2	The Government Budget Constraint	148
2.3	Primary Balance	149
2.4	The Dynamics of Government Budget Constraint	150
2.5	Some Special Cases	150
2.5.1	$g = t$	151
2.5.2	$r = n$	151
2.5.3	$g + rb - t = 0$	152
2.6	The Rate of Interest and Fiscal Crisis	153
3	Fiscal Consolidation	154
3.1	Desirable Fiscal Consolidation	154
3.2	The Optimal Target of Fiscal Consolidation	155
3.3	Politically Weak Government	155
3.4	The Legal Constraint of Fiscal Consolidation	156
3.5	The EU and the Euro	156
	Appendix: Fiscal Deficits in a Growing Economy	158
	A1 Introduction	158
	A2 A Simple Growth Model	158
	A2.1 Analytical Framework	158
	A2.2 The Government's Objective	160
	A3 Optimal Deficits	161
	A3.1 Phase Diagram	161
	A3.2 Optimal Deficit During Transition	162
	A3.3 Macro IS Balance	163
	A3.4 Comparative Dynamics	163
	A3.5 Optimal Deficit in the Long Run	163
	A3.6 Numerical Example	164
	A4 Conclusion	165
	A4.1 Deficits and Growth	165
	A4.2 Deficit Ceilings and Fiscal Privilege	166
	A4.3 Hard Budget and Soft Budget Outcomes	166
	References	167
7	The Public Pension	169
1	Justification of the Public Pension	169
1.1	The Public Pension System	169
1.2	Justification	169
1.2.1	Income Redistribution	170
1.2.2	The Failure of Private Pensions	171
1.2.3	Paternalism	171
1.2.4	The Efficiency of a Compulsory Public Pension	172

2	Economic Effect of the Public Pension	172
2.1	The Funded System	172
2.2	The Pay-AS-You-GO System	173
3	Public Debt and the Public Pension	176
3.1	The Funded System and Public Debt Issuance Within the Same Generation	176
3.2	Pay-AS-You-GO System and Public Debt Issuance Among Generations	177
3.3	Generational Accounting	178
4	Public Pension Reform	179
4.1	The Aging Population in Japan	179
4.2	The DB System	180
4.3	The Move from DB to DC	180
4.4	A Fully Funded System	181
4.5	Intergenerational Conflicts	182
5	Privatization of the Pay-AS-You-GO System	182
5.1	A Simple Model	182
5.2	The Gain in Economic Welfare Through Privatization	183
	Appendix A: Intergenerational Conflict in an Aging Japan	185
	A1 Introduction	185
	A2 Medical Insurance	185
	A2.1 Japan's Health Care System	185
	A2.2 The Retired and Elderly	186
	A2.3 Issues of Medical Insurance	187
	A3 The Pension System	188
	A3.1 Japan's Public Pension System	188
	A3.2 Pension Reform in an Aging Japan	189
	A3.3 Outline of the 2004 Pension Plan Revision	190
	A3.4 Is the 2004 Reform Effective?	191
	Appendix B: Simulation Analysis in an Aging Japan	191
	B1 Introduction	191
	B2 The Model	192
	B3 Simulation Analysis in Ihori et al. (2005)	193
	B3.1 Demography	193
	B3.2 Government Deficits	193
	B3.3 The Social Security System	194
	B3.4 Taxes	194
	B3.5 Technological Progress	196
	B3.6 Simulation Results	196
	B4 Simulation Analysis in Ihori et al. (2011)	198
	B4.1 Assumptions	198
	B4.2 Simulation Results	198
	B5 Conclusion	200
	References	201

Part II Microeconomic Aspects of Public Finance

8	The Theory of Taxation	205
1	Taxation and Labor Supply	205
1.1	A Model of Labor Supply	205
1.2	Substitution Effect and Income Effect	207
1.3	The Cobb-Douglas Utility Function	207
2	The Efficiency of Taxation	208
2.1	A Comparison with Lump Sum Tax	208
2.2	The Size of the Excess Burden	210
2.3	The Excess Burden and the Substitution Effect	210
3	Interest Income Tax and Saving	211
3.1	The Life Cycle Saving Hypothesis	211
3.2	The Effect of Interest Income Tax: The Substitution Effect and the Income Effect	213
3.3	The Cobb-Douglas Utility Function	214
3.4	The Human Capital Effect	215
3.5	The Cobb-Douglas Utility Function Revisited	215
4	Investment and Tax	216
4.1	The Classical View	216
4.2	Corporate Tax and Borrowing Funds	217
4.3	Corporate Tax and Retained Earnings	218
4.4	The Cost of Capital	219
4.5	Depreciation	219
4.6	The Incidence of Corporate Income Tax in Japan	220
5	Consumption Tax	221
5.1	Shift of the Tax Burden and Price Determination	221
5.2	The Consumer as the Legal Taxpayer	222
5.3	The Burden of Tax and Incidence	222
	Appendix: The Savings Elasticity Controversy	224
	A1 Boskin (1978)	224
	A2 Summers (1981)	225
	References	227
9	Tax Reform	229
1	Labor Income Tax and Interest Income Tax	229
1.1	Exogenous Labor Supply	229
1.2	Comprehensive Income Tax	231
1.3	Expenditure Tax	232
1.4	Endogenous Labor Supply	232
1.5	The Negative Incentive Effect and Optimal Taxation	233

2	The Theory of Optimal Taxation	234
2.1	Theoretical Framework	234
2.2	The Ramsey Rule	234
2.2.1	The Inverse Elasticity Proposition	235
2.2.2	The Uniform Tax Rate Proposition	236
2.3	Mathematical Formulation	236
2.4	Heterogeneous Households	239
3	The Theory of Tax Reform	240
3.1	Optimal Taxation and the Theory of Tax Reform	240
3.2	The Fundamental Rule of Tax Reform	240
3.3	Application to Some Examples	242
3.3.1	Enlarging the Tax Base	242
3.3.2	Unifying Tax Rates	242
4	General Consumption Tax and Labor Income Tax	242
4.1	The Equivalence Theorem	242
4.2	A One-Period Model	243
4.3	Some Remarks	244
5	The Timing Effect of Taxation	245
5.1	The Overlapping-Generations Model	245
5.2	The Incidence of Tax Reform	246
5.3	Transitional Generations	246
5.4	The Effect on Saving and Economic Growth	247
6	Simulation Analysis of Tax Reform	247
6.1	Multi-Period Overlapping-Generations Growth Model	247
6.2	Comments by Evans (1983)	248
	Appendix A: Optimal Taxation in an Overlapping-Generations Economy	250
	A1 The Optimal Tax Rule	250
	A1.1 Overlapping-Generations Growth Model	250
	A1.2 Dual Approach	252
	A2 The First Best Solution	253
	A3 Second Best Solution	254
	A4 Optimal Taxation in the Second Best Case	256
	A4.1 The Modified Ramsey Rule	256
	A4.2 The Elasticity Term	256
	A4.3 The Implicit Separability Condition	257
	A4.4 Two Objectives and Intertemporal Efficiency	257
	A4.5 The Lagrange Multiplier	257
	A5 Heterogeneous Individuals and Distributional Objectives	258

Appendix B: Tax Reform Within Lump Sum Taxes	258
B1 Introduction	258
B2 Analytical Framework	259
B3 Lump Sum Tax Reform	260
B3.1 The Tax Postponement Effect	260
B3.2 The Effect on Savings	261
B3.3 The Welfare Effect of Tax Reform	262
B4 The Tax Timing Effect	262
B4.1 The Welfare Implication of the Tax Timing Effect	262
B4.2 Summary	263
B5 Some Remarks	264
References	265
10 Income Redistribution	267
1 Progressive Income Tax	267
1.1 Income Redistribution Policy	267
1.2 A Two-Person Model with Income Inequality	267
1.3 The Social Welfare Function	268
1.4 The Socially Optimal Point	269
1.5 The Optimal Income Tax Schedule	270
1.6 Perfect Equality When Income Is Uncertain	270
2 Endogenous Labor Supply	271
2.1 The Detrimental Outcome of Perfect Equality	271
2.2 Endogenous Labor Supply	272
2.3 A Linear Income Tax Schedule	273
2.4 The Tax Possibility Curve	274
3 The Optimal Income Tax	275
3.1 The Rawls Judgment	275
3.2 The Bentham Criterion	276
3.3 Optimal Redistribution	277
4 Nonlinear Income Tax	278
4.1 The First Best	278
4.2 Self-Selection Constraint	279
4.3 The Optimal Marginal Tax Rate	279
4.4 A Differentiated Linear Tax Schedule	281
4.5 The Recent Approach to the Optimal Marginal Tax Rate	282
5 Economic Constraint and Redistribution	282
5.1 Credibility	283
5.2 The Crowding-Out Effect	283
5.3 Expectation	283
5.4 Asymmetric Information	284
5.5 Stigma	284
5.6 Commitment	284

Appendix: Optimal Linear Income Tax	284
A1 Introduction	284
A2 The Model	285
A3 Shift of the Social Welfare Function	288
A4 Shift of the Tax Possibility Frontier	289
A4.1 The Maximin Case	290
A4.2 The Utilitarian Case	291
A5 Conclusion	292
References	293
11 The Theory of Public Goods	295
1 Public Goods	295
1.1 Public Goods and Private Goods	295
1.2 Formulation of Public Goods	296
1.3 Public Goods and Actual Government Spending	297
2 Optimal Provision of Public Goods: The Samuelson Rule	298
2.1 The Samuelson Rule: Diagramed Derivation	298
2.2 The Samuelson Rule: Mathematical Derivation	299
2.3 The Samuelson Rule: Simple Derivation	300
2.4 Numerical Example: A Two-Person Model of Public Goods	301
3 The Theory of Public Good Provision: The Nash Equilibrium Approach	302
3.1 The Nash Equilibrium Approach of Private Provision	302
3.2 A Two-Person Model	303
3.3 Efficiency of the Nash Equilibrium	305
3.4 Examples: Comparison	306
3.5 Criticism of the Nash Equilibrium Approach	307
4 The Theoretical Analysis of Public Goods: The Lindahl Equilibrium	308
4.1 The Lindahl Equilibrium	308
4.2 Efficiency of the Lindahl Equilibrium	309
5 The Free Rider Problem	310
5.1 Public Goods and the Free Rider Problem	310
5.2 Possibility of the Free Ride Problem	311
5.3 Game Theory Approach to the Free Rider Problem	312
5.4 The Clarke Tax	314
5.5 The Clarke Tax and a Balanced Budget	315
6 The Neutrality Theorem of Public Goods	316
6.1 The Neutrality Theorem	316
6.2 The Model of Neutrality Result	316

6.3	Perfect Crowding Out	318
6.4	Plausibility of the Neutrality Theorem	318
6.5	Concluding Remarks	319
	Appendix: Public Bads, Growth, and Welfare	320
A1	Introduction	320
A2	Analytical Framework	320
A3	Wealth Differentials	322
A3.1	The Neutrality Result	322
A3.2	Analytical Result	323
A4	Immiserizing Growth	325
A5	Conclusion	326
	References	327
12	Public Spending and the Political Process	329
1	The Failure of Government	329
1.1	Government Intervention	329
1.2	The Theory of Public Choice	329
1.3	Small Government	330
2	The Voting Model	331
2.1	Inequality and the Demand for Public Goods	331
2.2	Analytical Framework	331
2.3	The Median Voter Theorem	333
3	The Voting Model and Reality	334
3.1	The Paradox of Voting	334
3.2	Problems with the Median Voter Hypothesis	335
3.3	Interest Groups	336
4	Political Parties and Fiscal Policy	337
4.1	The Objective of Parties	337
4.2	The Convergence Theorem	338
4.3	Further Analysis of the Convergence Theorem	339
4.4	Extensions and Voting	340
4.5	The Political Business Cycle	340
4.6	The Partisan Business Cycle	341
5	Theoretical Model of the Partisan Business Cycle	342
5.1	The Macroeconomic Model	342
5.2	The Behavior of Two Parties	343
5.3	The Effect of the Election	344
5.4	The Probability of Winning the Election	346
6	Further Comments	346
6.1	Change of Government	346
6.2	The Evaluation of Public Spending	348
	Appendix A: Fiscal Privileges, Consolidation Attempts, and Pigouvian Taxes	349
A1	Introduction	349
A2	The Basic Model	350

A3 The Model Without Consolidation Attempts	351
A3.1 The Competitive Solution	351
A3.2 Pigouvian Tax	352
A4 The Model with Consolidation Attempts	354
A4.1 The Competitive Solution	354
A4.2 Pigouvian Tax	355
A4.3 The Consumption Tax	356
A5 Conclusion	357
Appendix B: Political Factors and Public Investment Policy in Japan	358
B1 Political Pressures from Local Interest Groups	358
B2 Intergovernmental Transfers in Japan	359
B3 The Impact of Interregional Transfers	359
B4 Efficient and Effective Public Investment Management	360
References	361
13 Local Public Finance	363
1 Intergovernmental Finance	363
1.1 Decentralization and Local Finance	363
1.2 The Decision System of Intergovernmental Finance	363
1.3 The Centralized System	364
1.4 The Decentralized System	365
1.5 Intergovernmental Finance	367
2 The Supply of Local Public Goods	367
2.1 Local Public Goods	367
2.2 The Optimal Provision of Local Public Goods	367
2.3 Voting with Their Feet: The Tiebout Hypothesis	369
2.4 Plausibility of the Tiebout Hypothesis	370
3 Tax Competition	371
3.1 The Competition for a Mobile Tax Base	371
3.2 Taxing Mobile Capital	373
4 The Time Consistency of a Tax Policy	375
4.1 The Time Consistency Problem	375
4.2 A Simple Model	375
5 The Principle of Local Tax	377
5.1 The Overlapping Tax Base	377
5.2 The Soft Budget Problem	377
5.3 The Benefit-to-Pay Principle	378
5.4 The Fixed Asset Tax	379
5.5 The Inhabitant Tax	379
5.6 The Consumption Tax	380
5.7 Basic Principles of a Local Tax System	380

6	Redistribution among Local Governments	381
6.1	Regional Diversity of Local Tax	381
6.2	The Three-Person Model of Regional Redistribution	381
6.3	Efficiency	383
7	Further Issues on Intergovernmental Finance	383
7.1	Local Public Debt	383
7.2	A Decentralized Fiscal System	384
	Appendix: An Analytical Model of Central and Local Governments in Japan	384
A1	The Local Allocation Tax in Japan	384
A2	An Analytical Model of Central and Local Governments	386
A2.1	The Soft Budget Constraint	386
A2.2	An Analytical Framework	387
A2.3	The Pareto Efficient Solution	389
A3	The Hard Budget Game	390
A3.1	The Second Stage	391
A3.2	The First Stage	391
A3.3	Outcome	392
A4	The Soft-Budget Game	393
A4.1	CG's Ex Post Transfer: The Second Stage	393
A4.2	LG's Behavior: The First Stage	395
A5	Welfare Implications	397
	References	398
	Index	399

About the Author

Toshihiro Ithori is a professor of economics at the National Graduate Institute for Policy Studies and a professor emeritus of the University of Tokyo. He has a B.A. and an M.A. from the University of Tokyo and a Ph.D. in economics from Johns Hopkins University. His major field of research is public economics. Details are at the website of the National Graduate Institute for Policy Studies.

List of Figures

Fig. 1.1	Share of expenditure in the system of Japanese government	10
Fig. 1.2	A representation of Japan's budgetary system	11
Fig. 1.3	General government public spending in developed countries	15
Fig. 1.4	General government fiscal balances and gross debt, 1990–2014	17
Fig. 1.A1	Trends in general account tax, revenues, total expenditures and government bond issues	19
Fig. 1.A2	Government bond issues and the bond dependency ratio	20
Fig. 1.A3	Transition of major expenditure items in the general account	20
Fig. 2.1	The 45-degree line model	30
Fig. 2.2	IS and LM curves	35
Fig. 2.3	The interest elasticity of money demand is infinite	36
Fig. 2.4	The interest elasticity of investment is zero	37
Fig. 2.5	The effect of fiscal policy in the fixed exchange regime	40
Fig. 2.6	The effect of fiscal policy in the flexible exchange rate regime	41
Fig. 2.7	The lag of economic policy	44
Fig. 3.1	The permanent level of variables and actual level of variables	54
Fig. 3.2	The government's budget constraint	55
Fig. 3.3	Consumption and saving	57
Fig. 3.4	Labor supply	59
Fig. 3.5	Labor demand	60
Fig. 3.6	Equilibrium in the labor market	61
Fig. 3.7	Equilibrium in the goods market	62
Fig. 3.8	The effect of fiscal policy (i) (a) , and (ii) (b)	64

Fig. 4.1	Overlapping generations model	80
Fig. 4.2	Barro's neutrality theorem	84
Fig. 4.3	The non-Keynesian effect	91
Fig. 5.1a	Optimal allocation between public and private investment	106
Fig. 5.1b	Non-optimal allocation between public and private investment	106
Fig. 5.2	Optimal allocation over time	108
Fig. 5.3	The macroeconomic production function	111
Fig. 5.4	Stability of the model	112
Fig. 5.5	Growth rate and tax rate	115
Fig. 5.6	Kuznets hypothesis	118
Fig. 6.1	Tax smoothing and temporal debt issue	142
Fig. 6.2a	The excess burden curve	143
Fig. 6.2b	Tax-smoothing hypothesis	144
Fig. 6.3a	Public debt in relation to per capita GDP: sustainable case	147
Fig. 6.3b	Public debt in relation to per capita GDP: unsustainable case	148
Fig. 6.4a	The dynamics of the Domar condition. $r > n$	151
Fig. 6.4b	The dynamics of the Domar condition. $r < n$	151
Fig. 6.5	The Bohn condition	152
Fig. 6.A1	Optimal growth	161
Fig. 6.A2	Comparative dynamics	162
Fig. 7.1	The pay-as-you-go system	174
Fig. 7.2	Consumption decisions. In the case of (a) $n = r$, (b) $n > r$, (c) $n < r$	175
Fig. 7.3	Public debt policy	177
Fig. 7.A1	Structure of the pension system	188
Fig. 7.B1	Aging rates	193
Fig. 8.1	Tax and labor supply	206
Fig. 8.2	Lump sum tax and labor income tax	209
Fig. 8.3	The excess burden	211
Fig. 8.4	Optimal saving	212
Fig. 8.5	The effect of interest income tax	214
Fig. 8.6	The effect of corporate income tax	218
Fig. 8.7	The firm as the legal taxpayer	221
Fig. 8.8	The consumer as the legal taxpayer	222
Fig. 8.9	Extreme cases of incidence. (a) Supply curve: infinite elasticity, (b) Demand curve: zero elasticity, (c) Supply curve: zero elasticity, (d) Demand curve: infinite elasticity q denotes quantity	223

Fig. 9.1	Labor income tax and interest income tax	230
Fig. 9.2	The optimizing behavior of a household	233
Fig. 9.3	(a) An inelastic good, (b) An elastic good	235
Fig. 9.4	The theory of tax reform	241
Fig. 10.1	Socially optimal point	269
Fig. 10.2	Extremely progressive income tax	270
Fig. 10.3	Perfect equality when income is uncertain	271
Fig. 10.4	A linear progressive income tax	273
Fig. 10.5	A linear regressive income tax	273
Fig. 10.6	The tax possibility curve	274
Fig. 10.7	Optimal income tax: the Rawls criterion	275
Fig. 10.8	Optimal income tax: the Bentham criterion	277
Fig. 10.9	The optimal tax schedule	278
Fig. 10.10	Optimal nonlinear income tax	280
Fig. 10.A1	The tax possibility frontier	286
Fig. 10.A2	Shift of the social welfare function	288
Fig. 10.A3	The maximin case	290
Fig. 10.A4	The utilitarian case	291
Fig. 11.1	The consumption possibility curve	297
Fig. 11.2	Optimal provision of public goods. (a) person 1, (b) person 2	299
Fig. 11.3	The Samuelson rule	302
Fig. 11.4	The Nash reaction function	304
Fig. 11.5	The Nash equilibrium	305
Fig. 11.6	The optimizing behavior	309
Fig. 11.7	The Lindahl equilibrium	310
Fig. 11.8	The Lindahl equilibrium and free riding	311
Fig. 12.1	Preferences for small or big government	332
Fig. 12.2	The median voter theorem	333
Fig. 12.3	Preference for public education	334
Fig. 12.4	The paradox of voting	335
Fig. 12.5	Multi-dimensional voting	336
Fig. 12.6	Generalizing the median voter hypothesis	336
Fig. 12.7	The convergence of policies	338
Fig. 12.8	The effect of the election	345
Fig. 12.9	Change of government	347
Fig. 12.10	The evaluation of public spending	348
Fig. 12.A1	The competitive solution without consolidation attempts	352
Fig. 12.A2	The competitive solution with consolidation attempts	355
Fig. 13.1	Fiscal decentralization	366
Fig. 13.2	The optimal level of population	369
Fig. 13.A1	Intergovernmental finance in Japan	385

List of Tables

Table 4.1	The non-Keynesian effect	90
Table 5.B1	Studies on the productivity effect of transportation-related public investment	129
Table 6.1	The fiscal consolidation targets in developed countries	157
Table 6.A1	Optimal deficit/GDP ratio in the long run	164
Table 7.1	The balance of the government budget (i)	176
Table 7.2	The balance of the government budget (ii)	177
Table 7.3	Useful indicators of fiscal policy	178
Table 7.4	Net payoff for each generation in relation to the pay-as-you-go (defined benefit) system	180
Table 7.5	The transition to a defined system in period 3	180
Table 7.6	The transition to a funded system	181
Table 7.7	Costs and benefits of each generation	184
Table 7.A1	Trends and projections for social security benefits (percentage of GDP)	185
Table 7.A2	Trends and projections for social security benefits (in trillion Yen)	186
Table 7.B1	Base simulation results	195
Table 7.B2	Base simulation results	199
Table 9.1	Tax collection from young and old generations	246
Table 9.B1	Tax reform and intergenerational incidence	263
Table 11.1	Public goods and private goods	296
Table 11.2	The streetlight game	313
Table 11.3	The Clarke tax	315
Table 13.1a	Outcome before move	382
Table 13.1b	Outcome after move	382

1 The Main Functions of the Public Sector

Public finance normally considers four main functions of the public sector. The first two deal with microeconomic aspects of public finance, while the other two deal with macroeconomic aspects of public finance. It is useful to consult basic textbooks on public finance such as Rosen (2014) and Stiglitz (2015) although these textbooks mainly deal with microeconomic issues of public finance.

The first part of this chapter explains the main functions of government and the basic concepts and techniques that are useful to know when studying public finance. The second part of this chapter explains the public sector and the budgetary process in Japan.

1.1 Resource Allocation

Why does a government impose taxes and provide public spending such as public consumption and public investment? Why does it also conduct many transfers? According to the fundamental theorem of microeconomics, as long as the private market is perfect, the price mechanism automatically adjusts demand and supply so that demand and supply are equalized and resources are efficiently allocated. In this regard, the private market provides any goods that people want. See Sect. 2.2 for a simple explanation of the optimality propositions of the market mechanism.

If people always consume private goods that can be provided efficiently in the private market, private firms take the lead. Intervention by the government is unnecessary. The provision by the government of the same goods as those of the private sector is not the government's role. When the market is perfect and private agents maximize their own interests, the private sector works more effectively than the government. In such a scenario, when and why would government intervention become desirable? This is the fundamental question in public finance.

In reality, the private market often fails because of several reasons such as externality, asymmetric information, and imperfect competition. In particular, the private market cannot provide some goods and services efficiently. These are called public goods and services. Public goods and public services have different properties compared with private goods and private services in the private market.

In this context, let us define public goods in accordance with two properties. As explained in Chap. 11, firstly it is impossible to exclude an agent from consuming goods, a situation that we call non-excludability. All agents living in a community can equally consume such goods. Further, the consumption of one agent does not reduce the consumption opportunity of another agent. We call this non-rivalness.

Consequently, non-excludability and non-rivalness are two main properties of public goods. If these two properties remain perfectly consistent, this situation is called the pure public good. Defense spending, diplomacy, the basic legal system, and measures against national disasters are examples of pure public goods.

These public goods are not well provided in the private sector. Because the benefit of public goods has positive externalities, such goods are provided too infrequently in the market. If agents voluntarily provide these goods, others can consume the benefit without paying for the burden. This is the free rider problem. Thus, the government is required to provide public goods as appropriate (see Chap. 11).

Since the market is inefficient with respect to the provision of public goods, the government should provide public goods as appropriate. This is the standard function of the public sector. Public finance investigates how and when the government should intervene in resource allocation in the market. In this regard, some argue that the government should only provide microeconomic measures such as the provision of public goods and improvements in the event of market failure. These measures are considered the main role of small government. Such an approach is also called cheap government or small nation, names that emphasize the efficiency criterion.

In order to provide public goods, the government needs to collect tax revenues. Imposing taxes in the private sector produces a burden on private agents, thereby harming economic activities. This is called the distortionary effect of taxation. With regard to the revenue side, public finance investigates how the government should collect taxes in order to minimize the distortionary effect of such taxes. This is an important topic of optimal taxation and tax reform. See Chaps. 8 and 9.

1.2 Redistribution

An important function of the public sector in addition to resource allocation is income redistribution. As explained in any standard textbook of microeconomics, even if the market is perfect and resources are efficiently allocated among economic agents, the outcome is not necessarily ideal. We could observe a large degree of income inequality *ex post*. The economic situation of agents depends on the initial state of asset holdings and/or good or bad luck, in addition to their efforts regarding

economic activities. The initial state of assets and human capital holdings among agents is predetermined before economic activities. Good or bad luck affects the economic performances of agents differently. Even if the market is perfect, ex post inequality of income and assets among agents is unavoidable to some extent.

Different arguments consider how we should intervene with regard to ex post inequality. One side may argue that strong intervention is desirable so as to realize equitable outcomes ex post. Another may argue that minimum intervention is desirable so as to enhance economic activities. However, if ex ante opportunity is unequal, many feel a degree of unfairness. Moreover, ex ante equality of opportunity does not necessarily mean ex post equality of outcome.

Thus, it is desirable to some extent for the government to tax income and the assets of the rich and transfer these to the poor. Progressive income tax, inheritance tax, social welfare programs, and public pension and medical insurance are imposed for redistribution measures. In order to discuss the normative role of income redistribution, it is necessary to specify a social judgment on equity. Chapter 12 explains two alternative judgments, the Bentham (or utilitarian) judgment and the Rawls (or maximin) judgment. It is also important to consider the economic impact and constraint of income redistribution. Perfect equality of income ex post is not desirable if the disincentive effect of progressive tax is incorporated.

Recently, the size of national economies has become larger and inequality of income and wealth among agents has also grown. In such a situation, in order to maintain social safety and promote economic activities, a larger degree of redistribution has become one of the main objectives for most developed countries. This is referred to as the idea of the welfare state.

In Keynesian economics, unemployment is regarded as non-voluntary; thus, the government has a duty to attain full employment by the use of fiscal measures. This argument criticizes the self-duty principle of one's own effort and provides the theoretical reason why a government should pursue the idea of a welfare state.

Hence, the second objective of public finance is to investigate the economic effects of public intervention from the viewpoint of equity and the government's desired role of redistribution to pursue the idea of a welfare state.

1.3 Stabilization

The third function of the public sector is to stabilize the macroeconomy. Because of exogenous negative shocks such as financial crises, private economic activity may remain in a recession for a long while. Even if the market mechanism is perfect in the long run, unemployment and idle capital equipment are situations that can occur in the short run. Moreover, in reality, price rigidity and pessimism cause the market mechanism to work badly, thereby encouraging a serious recession in the long run.

It is then desirable for the government to intervene in the private economy and alleviate the unwanted outcomes of negative shocks. In particular, according to Keynesian economics, the government should stimulate aggregate demand by

raising government spending and reducing taxes when the macroeconomy experiences underemployment and lacks aggregate demand. Further, a lack of effective demand cannot easily be cleared by the price mechanism. Thus, public finance should incorporate a stabilization policy for macroeconomic activities.

For example, expansionary fiscal policy is useful to stimulate aggregate demand in a recession. In addition, employment insurance is effective for alleviating the detrimental outcomes of unemployment. On the other hand, monetary restriction and public spending cuts are effective for reducing inflation and over-utilization of labor and capital in a boom. Public finance investigates how the government can avoid macroeconomic instability and stabilize the fluctuation of the business cycle by the use of fiscal measures.

However, Keynesian fiscal policy does not always work well. Neoclassical macroeconomics is rather skeptical about the efficacy of Keynesian measures. This is an important issue of macroeconomic public finance, as explained in Chaps. 2 and 3.

In a political economy, it is easy to conduct expansionary fiscal policy in a recession but it is difficult to conduct restrictive fiscal policy in a boom. Thus, the government deficit tends to increase and public debt accumulates over time. The sustainability of fiscal policy becomes uncertain with Keynesian fiscal policy. Chapter 4 examines the economic role of public debt and Chap. 6 investigates positive and normative issues on fiscal management and sustainability.

1.4 Dynamic Optimization

The attainment of optimal economic growth is also an important objective of government. The market economy does not necessarily achieve optimal growth. This is because private decisions on consumption, saving, and investment do not consider the interest of future generations appropriately. If the current generation only considers its own interest, optimal growth is not realized from the viewpoint of generational equity. Thus, it becomes the government's responsibility to consider the interest of future generations. The dynamic optimization problem of fiscal policy encompasses fiscal deficits, the burden of debt, and the productivity of public investment.

Further, a high level of economic growth is not always desirable. We have to consider the effect on the environment, among others. Public finance investigates how we should grow the economy in a way that is consistent with environmental quality as well as the interest of future generations.

We also investigate the effect of fiscal policy on growth. Public investment enhances economic growth. However, if the government raises taxes to finance various kinds of public spending, it may depress capital accumulation and economic growth. Similarly, an increase in government deficits and public pensions would crowd out private capital accumulation, thereby harming economic growth. The dynamic effect of fiscal variables is an important topic of macroeconomic public finance. Thus, Chap. 5 investigates the effect of fiscal policy on economic

growth. In addition, Chap. 7 examines the effect of public pensions on economic growth in an aging economy such as Japan's.

1.5 The Failure of Government

Although these four functions are important, the government may not behave efficiently. Because the market sometimes fails, the government could fail too. Since public economic activities are complicated, even an idealistic government cannot attain the best solution. Moreover, because of bureaucratic problems and so on, the government does not necessarily maximize social welfare in a political economy. Thus, we cannot assume an idealistic government in reality. Chapter 12 examines the outcome of fiscal policy in a political economy. Chapter 13 investigates the role of local governments in causing the failure of government and the policy implications of intergovernmental finance to correct such failure.

2 A Review of Basic Analytical Concepts

This section provides a brief review of basic concepts and techniques used in the following chapters. For more detailed arguments, see any basic textbooks on microeconomics, including Varian (2014).

2.1 Constrained Maximization

Consider the following constrained maximization problem:

$$\begin{aligned} & \text{Maximize } u(x_1, x_2) \\ & \text{subject to } g(x_1, x_2) = 0 \end{aligned} \quad (1.1)$$

where x_1 and x_2 are choice variables. $u(\cdot)$ is the objective function and $g(\cdot) = 0$ is the constraint.

The corresponding Lagrange function is given as

$$L = u(x_1, x_2) - \lambda g(x_1, x_2) \quad (1.2)$$

where the variable λ is called a Lagrange multiplier.

Differentiating the Lagrangian with respect to each of its arguments, the first order conditions lead to

$$\frac{\partial L}{\partial x_1} = \frac{\partial u}{\partial x_1} - \lambda \frac{\partial g}{\partial x_1} = 0, \quad (1.3.1)$$

$$\frac{\partial L}{\partial x_2} = \frac{\partial u}{\partial x_2} - \lambda \frac{\partial g}{\partial x_2} = 0, \text{ and} \quad (1.3.2)$$

$$\frac{\partial L}{\partial \lambda} = -g(x_1, x_2) = 0. \quad (1.3.3)$$

These three equations determine three unknown variables, x_1 , x_2 , and λ . The Lagrange multiplier at the solution measures the sensitivity of the optimal value of the objective function.

2.2 Pareto Optimality

The standard approach to welfare economics is based on the concept of “Pareto optimality,” a necessary condition for an economic optimum. A Pareto optimum is a situation in which no feasible reallocation of outputs and/or inputs in the economy could increase the level of utility of one or more individuals without lowering the level of utility of other individuals. An efficient social state is often called Pareto-optimal.

For example, suppose that there are fixed amounts X , Y of two goods (x, y) and that there are only two agents A and B . For simplicity, also assume that each agent's utility u_i is given respectively as a quasi-linear function. Thus,

$$u_A = u_A(x_A) + y_A \text{ and} \quad (1.4)$$

$$u_B = u_B(x_B) + y_B \quad (1.5)$$

where x_i is agent i 's consumption of good x and y_i is agent i 's consumption of good y . $i = A, B$. A Pareto optimal allocation under this circumstance is one that maximizes the utility of agent A , while holding agent B 's utility fixed at some given level of $\bar{u}$. Thus,

$$\begin{aligned} &\text{Maximize } u_A(x_A) + y_A \\ &\text{subject to } u_B(X - x_A) + Y - y_A = \bar{u}. \end{aligned} \quad (1.6)$$

Substituting the constraint into the objective function, we have the unconstrained maximization problem,

$$\text{Maximize } u_A(x_A) + u_B(X - x_A) + Y - \bar{u}. \quad (1.6')$$

The optimality condition is given as

$$\frac{du_A}{dx_A} = \frac{du_B}{dx_B}. \quad (1.7)$$

Now, we consider the relationship between the optimality condition (1.7) and competitive equilibrium. At an equilibrium price p^* , each consumer adjusts her or his consumption of good x to have

$$\frac{du_A}{dx_A} = \frac{du_B}{dx_B} = p^*. \quad (1.8)$$

This equation means that the necessary condition for Pareto optimality is satisfied; market equilibrium can produce a Pareto-optimal allocation of resources. This proposition is usually referred to as the first optimality theorem of welfare economics.

First Optimality Theorem Resource allocation is Pareto-optimal if there is perfect competition and no market failure.

The first basic theorem of welfare economics states that a competitive equilibrium is a Pareto optimum; namely, the equilibrium is one for which no utility level can be increased without decreasing some other utility level.

Further, any allocation that is Pareto-optimal must satisfy (1.7), which determines p^* . This implies that such a Pareto-optimal allocation would be generated by a competitive equilibrium. Thus, we have the second theorem of welfare economics.

Second Optimality Theorem Any specified Pareto-optimal resource allocation that is technically feasible can be established by a free market and an appropriate pattern of factor ownership.

The second basic theorem of welfare economics states that any Pareto optimum can be realized as a particular competitive equilibrium; namely, for each Pareto optimum there is an associated price system and a system of resource ownership that would attain, as a competitive equilibrium, this solution with differing distributions of utility. The theorem says that every Pareto-efficient allocation can be attained by means of a decentralized market mechanism.

2.3 A Dual Approach

Consider a standard utility maximization problem of a consumer:

$$\begin{aligned} & \text{Maximize } u(x_1, x_2) \\ & \text{subject to } p_1 x_1 + p_2 x_2 = M \end{aligned} \quad (1.9)$$

where x_i is her or his consumption of good i , p_i is a consumer price of good i , and M is her or his income ($i = 1, 2$). Then, the maximum utility u is a function of M and the price vector $\mathbf{p} = (p_1, p_2)$.

The indirect utility function indicates the maximum utility attainable at given prices and income:

$$u = U(\mathbf{p}, M). \quad (1.10)$$

From this equation, we may derive the expenditure function:

$$M = E(\mathbf{p}, u) \quad (1.11)$$

where $E(\cdot)$ indicates the minimum money cost at which it is possible to achieve a given utility at given prices.

The expenditure function summarizes the consumer's optimizing behavior and has the following properties.

- (i) $E(\mathbf{p}, u)$ is non-decreasing in $\mathbf{p}$.
- (ii) $E(\mathbf{p}, u)$ is homogeneous of degree one in $\mathbf{p}$.
- (iii) $E(\mathbf{p}, u)$ is concave in $\mathbf{p}$.
- (iv) $E(\mathbf{p}, u)$ is continuous in $\mathbf{p}$.
- (v) The compensated demand curve is $x_1(p_1, p_2^0, u^0) = \frac{\partial E(p_1, p_2^0, u^0)}{\partial p_1}$.

3 The Public Sector in Japan

3.1 The Role of Central Government

Let us explain the public sector of Japan in order to understand the government's role in Japan's national economy (see Doi and Ihori (2009) for more detailed explanations). The general government consists of the central government, local governments, and social security funds. If we add public enterprise to these, we have the public sector.

First, let us explain the context of central government in the public sector. The central government has a Cabinet Office and 11 ministries. At present, only one administrative organ is classified as an Office above the Ministerial Level. This is the Cabinet Office.

Cabinet Office

Ministry of Internal Affairs and Communications

Ministry of Justice

Ministry of Foreign Affairs

Ministry of Finance

Ministry of Education, Culture, Sports, Science, and Technology

Ministry of Health, Labor, and Welfare

Ministry of Agriculture, Forestry, and Fisheries

Ministry of Economy, Trade, and Industry

Ministry of Land, Infrastructure, and Transport
Ministry of the Environment
Ministry of Defense

The central government budget consists of the general account, special accounts, and government-affiliated agency budgets. The general account budget is the representative budget of the central government.

The central government collects tax revenues from direct taxes and indirect taxes, and engages in government expenditure such as the provision of public services. In addition, central government allocates tax to local governments and transfers subsidies to the social security fund. The latter supports public pensions and public medical insurance. Central government also provides loans to public enterprises; namely, public funds financed from the financial market through public debt are given to the special account, local governments, and some public agents.

3.2 Intergovernmental Finance

Local finance has a close relationship with national finance with regard to the following points.

- (i) In order to secure the independence of local finance, local governments have their own taxes that are collected as local taxes. At the same time, the allocation of the tax base between central government and local governments is appropriately determined.
- (ii) In order to correct any inequality of fiscal resources among local governments, central government provides a local allocation tax and a local given tax to local governments as a fiscal adjustment system.
- (iii) In order to maintain the standard of public service across all local governments, central government provides necessary subsidies.
- (iv) Local public debt can be issued by local governments in accordance with regulations and monitoring by central government.
- (v) With regard to direct public works of central government, local governments are required to pay some of the costs.

As shown in Fig. 1.1, the amount of local finance is almost the same as the amount of national finance if we adjust overlapping finance among local governments. The expenditure by central government includes subsidies to local governments such as the local allocation tax and other subsidies. However, expenditure by local governments includes contributions to central government's direct public works. When we adjust overlapping expenditure between local governments and central government, the amount of local finance is twice that of national finance. Chapter 13 discusses theoretically the economics of intergovernmental finance and then some topical issues in Japan.

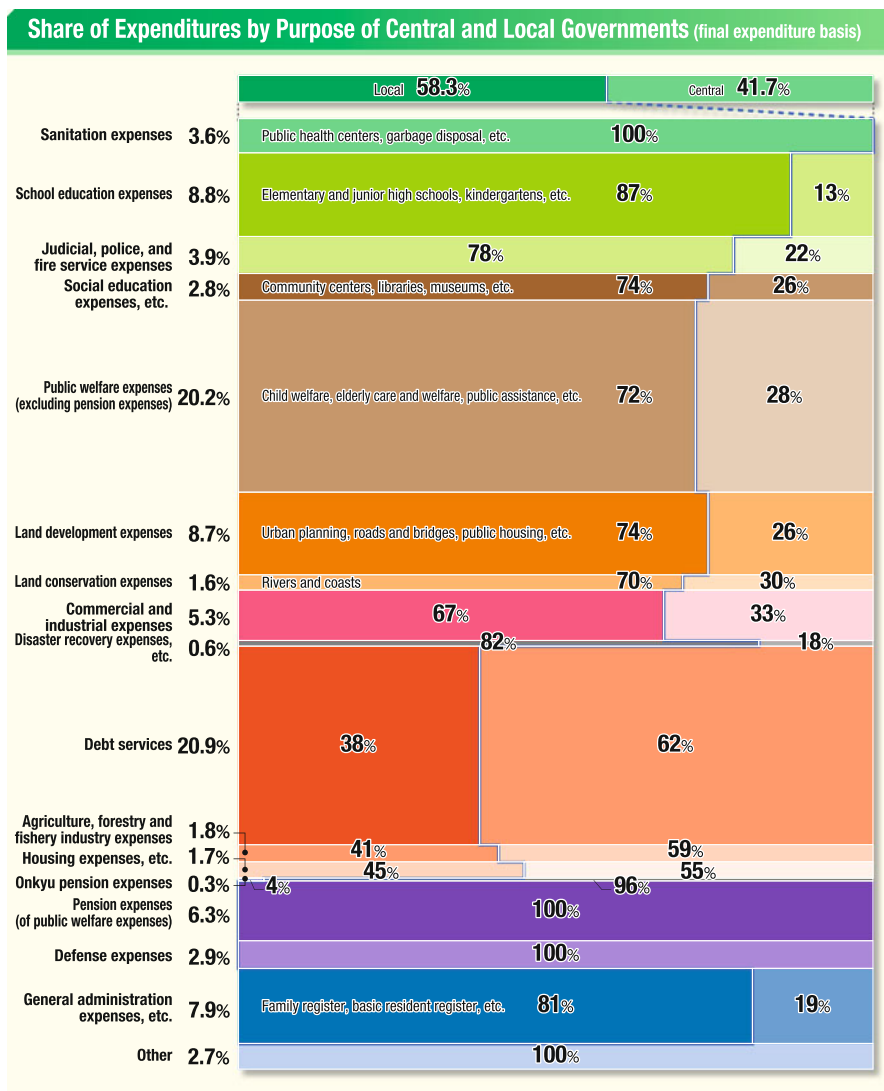


Fig. 1.1 Share of expenditure in the system of Japanese government (Source: FY2013 Settlement. White Paper on Local Public Finance, 2015—Illustrated. Ministry of Internal Affairs and Communications. http://www.soumu.go.jp/iken/zaisei/27data/chihouzaisei_2015_en.pdf)

3.3 The Budgetary System

3.3.1 The Budgetary Formula in Japan

The government budget summarizes the economic activities of the government and explains many features of the public sector. The budgetary system is determined by the constitution and laws. Figure 1.2 explains Japan's budgetary system. Central

Chart I-13 Budget Process

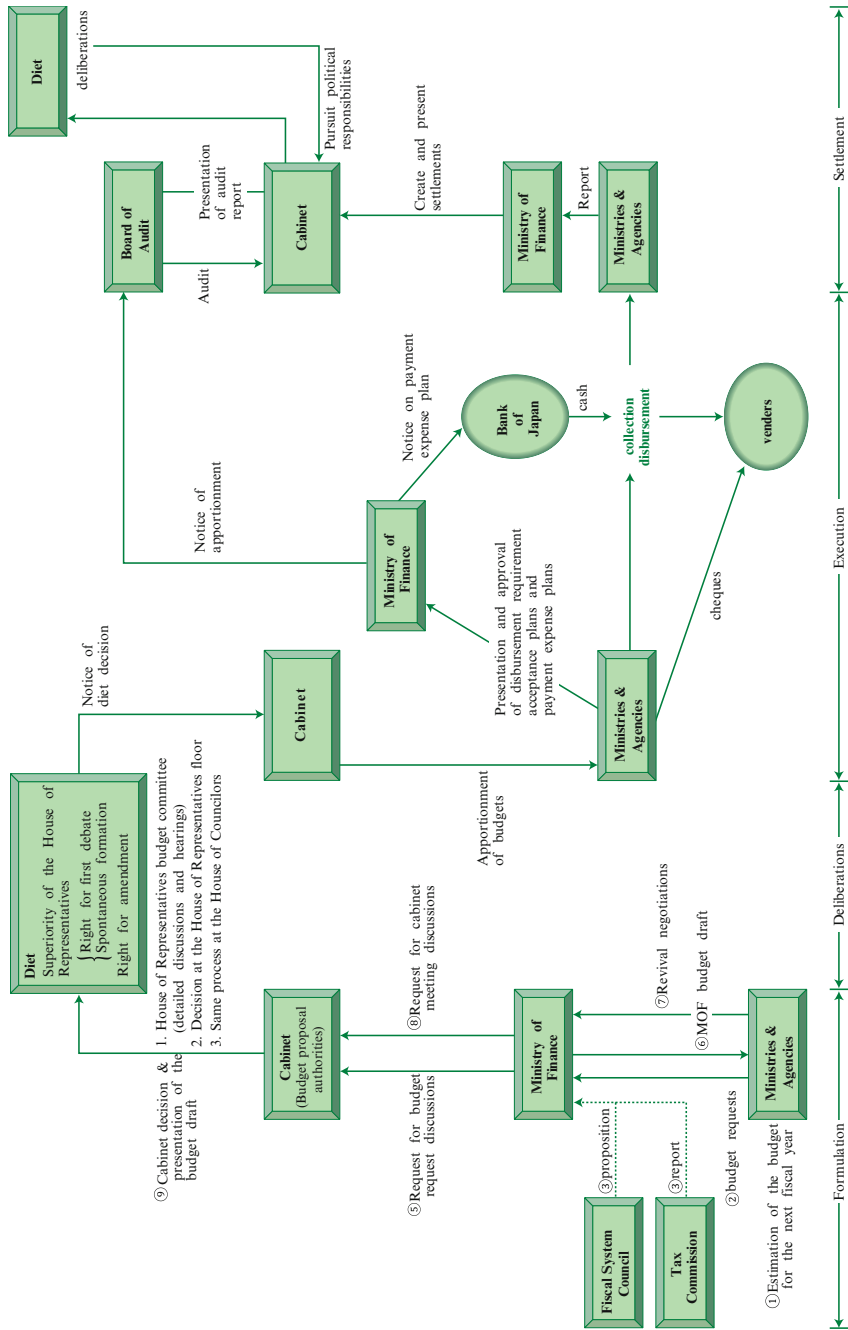


Fig. 1.2 A representation of Japan's budgetary system (Source: Understanding the Japanese budget 2004. Budget Bureau, Ministry of Finance. <https://www.mof.go.jp/english/budget/budget/fy2004/brief/2004.pdf>)

government's budgetary process is essentially prescribed by the country's Constitution and Public Finance Law enacted in 1947.

In order to manage revenue and expenditure efficiently, it is necessary to plan for a certain period. This accounting period is normally 1 year. In Japan, the accounting year begins on April 1 and ends on March 31. A budget must be compiled for each fiscal year.

The regular annual budget (initial budget) usually has to be approved by the National Diet, Japan's bicameral legislature, before the fiscal year begins. This process is referred to as the principle of preparing the budget on an annual basis. In addition, as a general rule, expenditure for each fiscal year must be covered by revenue from that fiscal year. This is called the fiscal-year-independence principle, or the 1-year-budget principle.

The budgetary formula to be presented at the Diet consists of the following five items.

- (i) General budget summary: This document summarizes the general principle of the budget and identifies the limit of debt issuance.
- (ii) Budget of revenue and expenditure: This is the main content of the budget and shows every item of revenue and expenditure, following the given criteria. Revenue is simply projected but expenditure sets the upper limit that the government may spend.
- (iii) Continuous expenditure: If the completion of expenditure takes more than 1 year, the budget declares expenditure according to each year and the total amount of expenditure.
- (iv) Carry-over allowance: If expenditure is expected to continue over the next year, the budget allows for this continuance in advance.
- (v) Burden of future debt: If a contract is made within the current year but actual spending is postponed to the following year, the budget allows an *ex ante* contract. When the expenditure occurs in the future, the budget must show this expenditure again.

3.3.2 The Budgetary Process

Let us explain the budgetary process in Japan. Each year, the cabinet submits a budget bill to the Diet. In countries such as Japan with a parliamentary system of government, the ruling party is normally the majority party; hence, a budget developed by the cabinet is easily approved by the Diet. Consequently, the way in which the budget is developed in the cabinet is important.

In May, each ministry begins to make proposals for next year's budget. By the end of August, each ministry must submit its budget proposals to the Ministry of Finance (MOF). Then, the MOF investigates these proposals and formulates the final budget by the end of December after negotiating with the corresponding ministries.

An examination by the Budget Bureau and negotiations between each ministry and the MOF continue for several months. The budget-making process is busy from September onward. At the same time, the government makes a projection of macroeconomic activities for the next fiscal year. Then, it determines the total

ceiling for issues such as expenditure, tax reforms, and the limit of public debt issuance.

The projection of macroeconomic variables is important because this in effect determines the tax revenue estimate for the next fiscal year. If economic growth is projected to be high, the government estimates a large increase in tax revenue, resulting in a larger budget. Recently, the projection for the following year's gross domestic product (GDP) has been too optimistic. It seems that political pressure to seek large spending results in such optimistic projections in order to make the initial budget consistent with fiscal consolidation targets. When the size of the budget is determined, money is allocated among each ministry.

In early December, the cabinet adopts the "Basic Principles of Budget Formulation." This articulates the basic principles of the upcoming budget. In accordance with the principles, the "Proposal of the Budget Bill by the MOF" is presented, usually in mid-December. Final negotiations between each ministry and the MOF are then held based on the MOF's proposal. In response to the final negotiations, the final budget bill is approved by the cabinet, usually at the end of December.

The cabinet submits the bill to the Diet, usually in the latter half of January. The House of Representatives (the Lower House) must discuss the bill before the House of Councilors (the Upper House), in accordance with the Constitution. If the two Houses decide on different versions of the budget, a joint committee of the two Houses is convened. If the House of Councilors cannot make a decision on the budget within 30 days of receiving the bill from the Lower House, the bill passed in the House of Representatives becomes the decision taken by the Diet. This is called the automatic enactment of the budget.

If the initial budget bill is not approved by the beginning of April, the cabinet proposes a provisional budget. This bill includes the minimum administration costs, such as salaries for civil servants. The provisional budget is absorbed into the initial budget after the initial budget bill has been approved. The cabinet can modify the initial budget during the fiscal year.

If the budget is approved but some additional expenditure then becomes necessary because of an unexpected natural disaster or negative macroeconomic shock, for example, the government creates a supplementary budget to add new expenditure and/or revise the budget's content to cope with the unexpected detrimental event. Any supplementary budget proposed by the cabinet has to be approved in the Diet.

3.3.3 The Execution of the Budget and the Settlement of the Account

If the budget is approved by the Diet, the cabinet allocates money to each ministry and the budget is executed. With regard to the revenue side, taxes are collected according to laws and contracts. Since the projection of a macroeconomy is imperfect in reality, the actual tax revenue is not the same as the projected amount. If the economy is more active than the projection, actual revenue is higher than anticipated. This is called a natural increase in taxes. In contrast, if the economy is less active than the projection, actual revenue is lower than anticipated. In such a situation, the government has to make a supplementary budget to issue more public bonds. Otherwise, it has to reduce expenditure to avoid a supplementary budget.

However, with regard to the expenditure side, the purpose and amount of spending are constrained by the budget. The government cannot overspend or spend outside the initial content.

When the fiscal year ends and budget execution is complete, the budget account is settled. The settlement is checked by the Board of Audit of Japan. In December, the Board submits the final report of the settlement to the Diet. Then, the settlement committee reviews it. This procedure does not need official approval but can put political pressure on the government for the efficient execution of the budget.

3.4 The Content of the General Account in Japan

3.4.1 The Category of Budget

The general account budget is the representative account of central government. Most national tax revenue, which is general taxes, comes into the general account. Proceeds from newly issued national government bonds also go into the general account. The main expenditure for policies of the central government is supposed to be reported in the general account. However, the amount of the general account budget is less than the (net) total amount of the special account budgets. Moreover, approximately half of expenditure in the general account is transferred into special accounts.

Special accounts are established by law in order to separate the costs of specific projects and specific revenue sources from the general account. Special accounts cover some public works, public pensions, fiscal transfers to local governments, and repayments of government debt. In some special accounts, designated national taxes can be collected directly. In addition, when the government initiates special items or manages special funds, special accounts are used. Such accounts are useful for clarifying their content and making administration efficient.

3.4.2 Government Expenditure

Let us review the size of government spending per GDP in terms of the central government's general account for the past 50 years. In the high growth era of the 1960s, the spending/GDP ratio was stable at about 10 %. Then, in the late 1970s, it began to rise, and in the 1980s its size was about 17 %. From 1990, it began to rise again. The expenditure content includes public works, education, and defense. Among other areas, social welfare spending has increased because of the effect of an aging population since the 1970s.

Let us now compare the size of public spending in Japan with other developed countries. In order to make a reliable comparison, we consider central government and local governments because intergovernmental finance differs among countries. Figure 1.3 shows general government public spending per GDP among developed countries. Japan's figure is almost the same as that of the US and smaller than most EU countries. In Japan, government consumption has been relatively small and government investment has been relatively large.

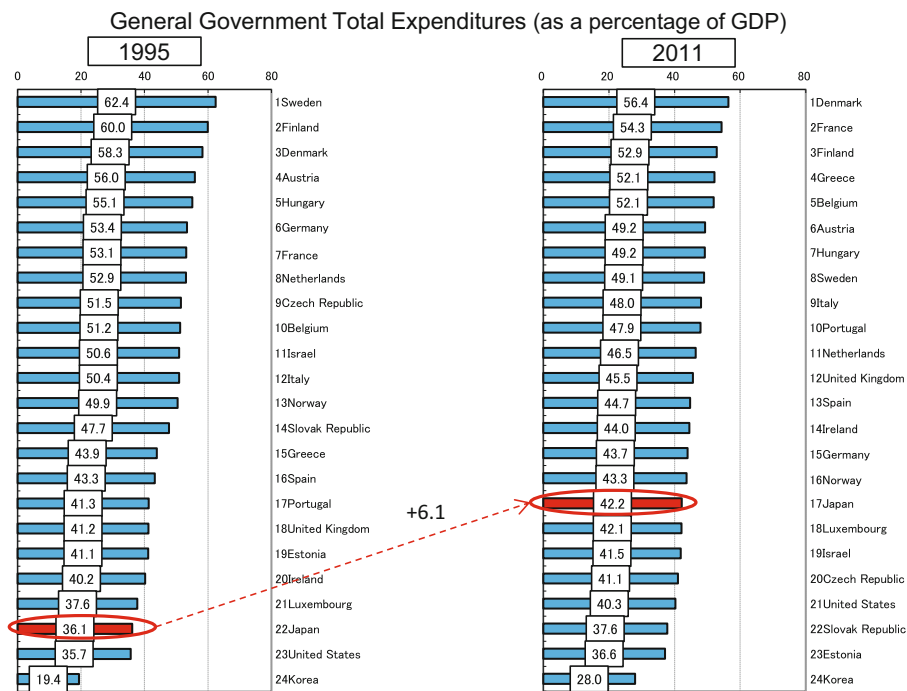


Fig. 1.3 General government public spending in developed countries (Source: Japanese public finance fact sheet, 2016 Ministry of Finance. <http://www.mof.go.jp/english/budget/budget/fy2016/03.pdf>)

If the size of spending in EU countries, particularly northern European countries, is considered desirable, then Japan's expenditure is still too small. The role of social welfare spending is partly shared by the private sector in Japan. Relatives and family members have played a large role in social welfare programs. However, since family structure has changed rapidly in Japan, we should not expect to rely on the private sector any more. Thus, we may argue that the size of public spending on social welfare is too small and hence should be increased.

In contrast, if the size of spending in the era of high economic growth before the 1970s is considered desirable, the recent increase in the size of public spending is already too much. An increase in public spending could crowd out private spending and depress private economic activities. In order to stimulate economic growth, we could argue that it may be necessary to restrain the increasing trend of public spending.

3.4.3 Tax Revenue

The national burden ratio is an indicator of tax burden, which is the tax revenue including social security contributions per national income. The national burden ratio of national and local taxes in Japan was about 30 % until the 1980s. It then

began to rise. Recently, it has been about 40 %. If we make a comparison with other developed countries, Japan's figure is larger than that of the US but smaller than that of the EU. In terms of an international comparison, Japan and the US are mainly dependent on direct tax, while the EU is mainly dependent on indirect tax.

3.4.4 Public Debt

In accordance with Japan's public finance law, public debt issuance is allowed only for financing public works, loans, and funds. This is because the redemption of public debt has moved to future generations and hence the burden of public debt has moved to future generations; thus, public debt is desirable only for expenditure that benefits future generations. The construction bond based on this principle was first issued in the budget of 1966, and since then has been issued every year.

It should be stressed that public works are not always productive. As explained in the Case Study of Chap. 2, the productivity of public investment in Japan has been declining. If the construction and maintenance cost of public capital is larger than the benefit of use of public capital, future generations do not benefit from public capital accumulation. In such a situation, we have to be careful about issuing the construction bond again.

Moreover, since 1975, a special law has been imposed so as to issue a deficit bond that is used for ordinary expenditure. This means that from 1975, the gap between public expenditure and tax revenue has become larger than the period following the issuance of the construction bond.

Owing to fiscal consolidation measures in the 1980s, the 1990 budget did not issue the deficit bond. However, from 1991, tax revenue was not as large as anticipated; hence, the deficit bond was issued again from 1994 (see Fig. 1.4).

4 Organization of the Book

4.1 Part One

In Part One, we cover the macroeconomic aspects of public finance. In Chap. 2, we discuss the macroeconomic effects of fiscal policy based on Keynesian models. This is a standard and conventional fiscal policy in a recession. In Chap. 3, we discuss the macroeconomic effects of fiscal policy based on neoclassical models. If the private agent is rational and forward-looking, the efficacy of fiscal policy depends on how the future fiscal situation is affected by current fiscal variables. The fiscal multiplier could be negative in the neoclassical framework. In Chap. 4, we consider the economic effect of public debt. In particular, we explain the burden of public debt on future generations and examine the plausibility of the debt-neutrality hypothesis, which argues in favor of the equivalence between tax finance and debt finance.

In Chap. 5, we investigate the long-run effects of fiscal policy on economic growth using several theoretical growth models. An increase in taxes normally depresses economic growth, although it could stimulate growth if public investment

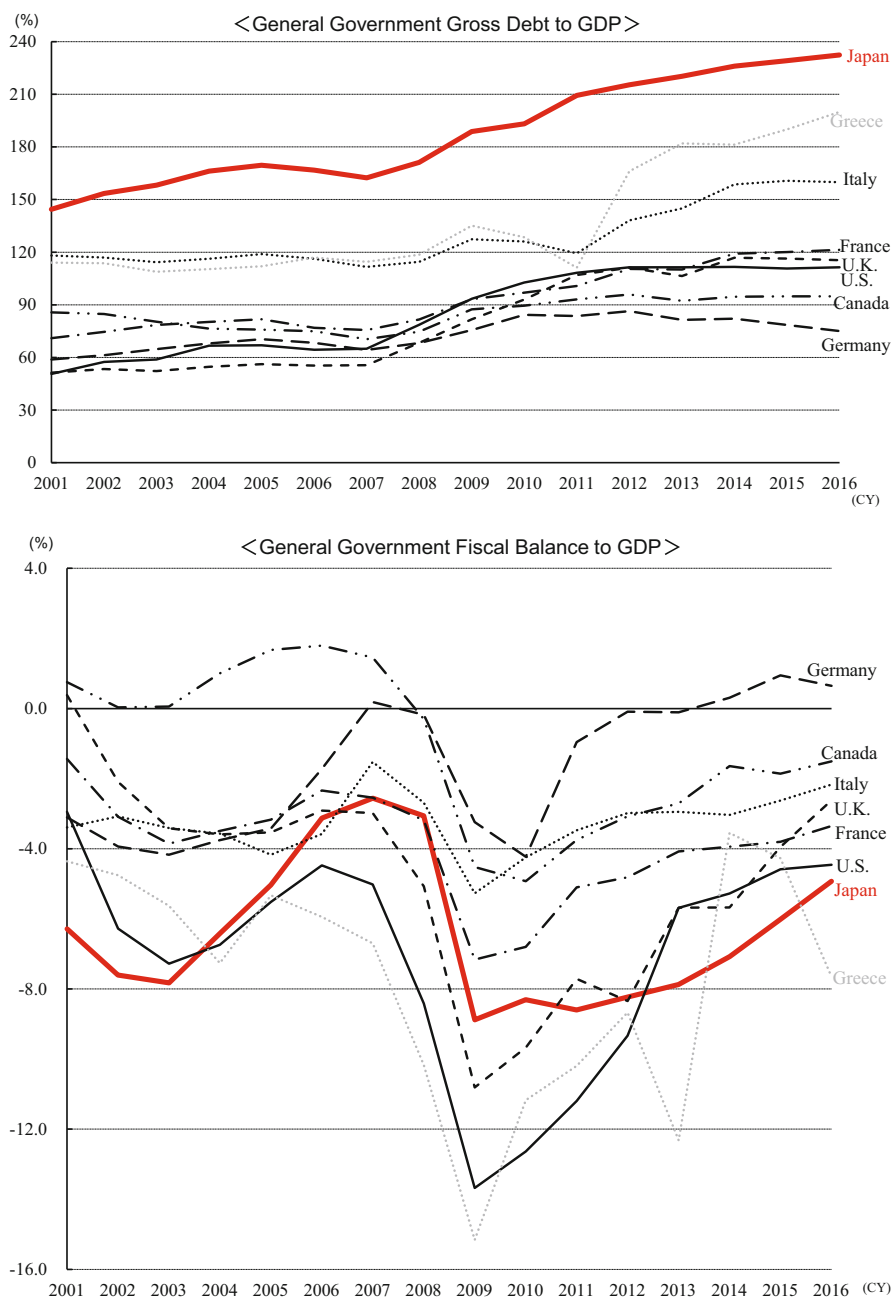


Fig. 1.4 General government fiscal balances and gross debt, 1990–2014 (Source: Japanese public finance fact sheet. 2016 Ministry of Finance)

is particularly productive. In Chap. 6, we examine desirable fiscal policy management and discuss the outcome of the accumulation of public debt. We also discuss plausible sustainability conditions and investigate how to attain fiscal consolidation. Finally, Chap. 7 considers the role of public pensions in an economy with an aging population such as that of Japan.

4.2 Part Two

In Part Two, we cover the microeconomic aspects of public finance, which many standard textbooks on public finance deal with. In Chap. 8, we examine the microeconomic effect of taxes on labor supply, saving, investment, and consumption. Income and substitution effects are key factors for investigating the impact of taxation. We also explain the excess burden of taxation. The notion of excess burden is a crucial concept from the viewpoint of efficiency, and the substitution effect is an important factor for identifying the size of the excess burden. In Chap. 9, we first compare labor income tax and interest income tax from the viewpoint of efficiency. We then investigate optimal taxation based on the Ramsey rule. We then discuss tax reforms by using the standard optimal-tax framework. In Chap. 10, we discuss an important policy issue of income redistribution by means of progressive income taxes based on plausible equity judgments. Progressive income tax is necessary in order to redistribute income; however, the degree of progressivity is constrained by efficiency considerations.

In Chap. 11, we explain the notion of public goods and investigate the outcomes of the public and private provision of public goods, based on the Samuelson rule. It is important to manage free rider incentives because public goods are non-excludable. In Chap. 12, we consider the political aspect of public finance using a voting model with heterogeneous agents. We also examine the impact of the behavior of politicians and political parties on fiscal policy. Finally, in Chap. 13 we discuss the economics of local public finance theoretically and highlight some interesting features of Japan's situation.

4.3 Appendix

We provide relevant appendixes to the chapters. The appendixes include advanced studies on the related topics of the main content and case studies with regard to Japan's public finance. The advanced studies contain some technical materials and mathematical models, which should be suitable for graduate students with advanced academic skills. The case studies are useful for students who are more interested in Japan's public sector.

Appendix: Japan’s Fiscal Management

Let us explain Japan’s fiscal management since 1950 following Doi and Ihori (2009). Figures 1.A1, 1.A2, and 1.A3 summarize trends in general account tax revenues, total expenditure, and government bond issues. Trends in the debt dependency ratio and major expenditure items are also shown.

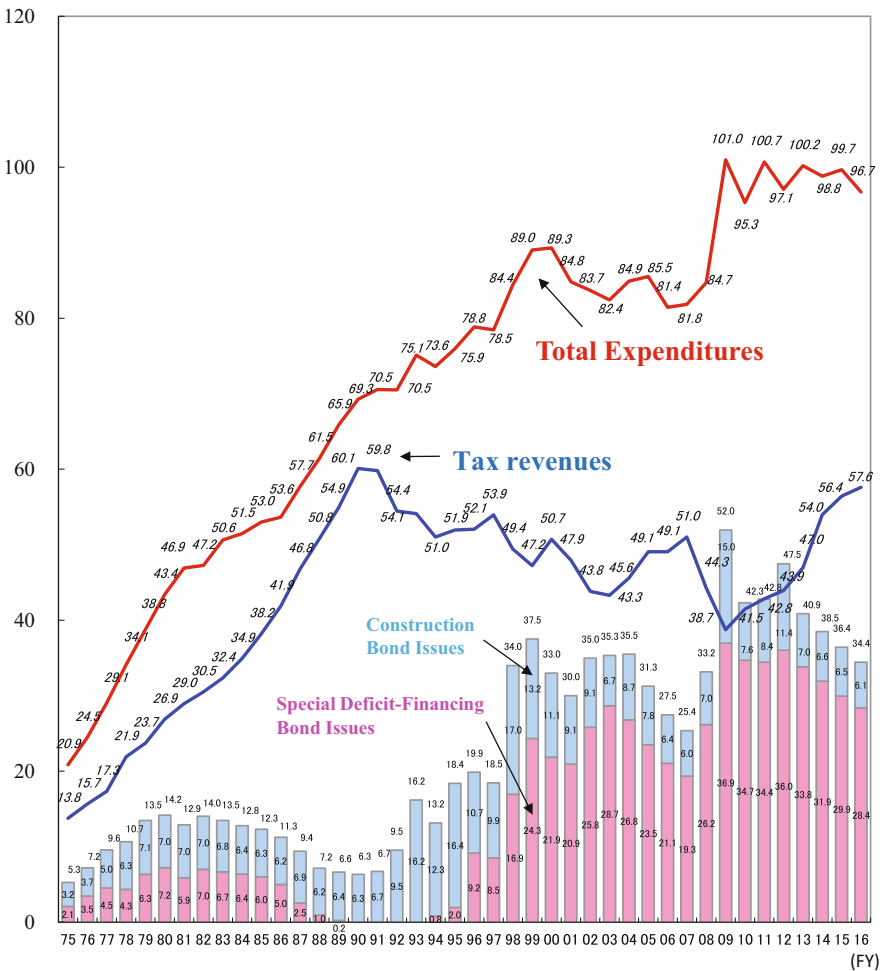


Fig. 1.A1 Trends in general account tax, revenues, total expenditures and government bond issues (Source: Japanese Public Finance Fact Sheet. 2016 Ministry of Finance. <http://www.mof.go.jp/english/budget/budget/fy2016/03.pdf>)

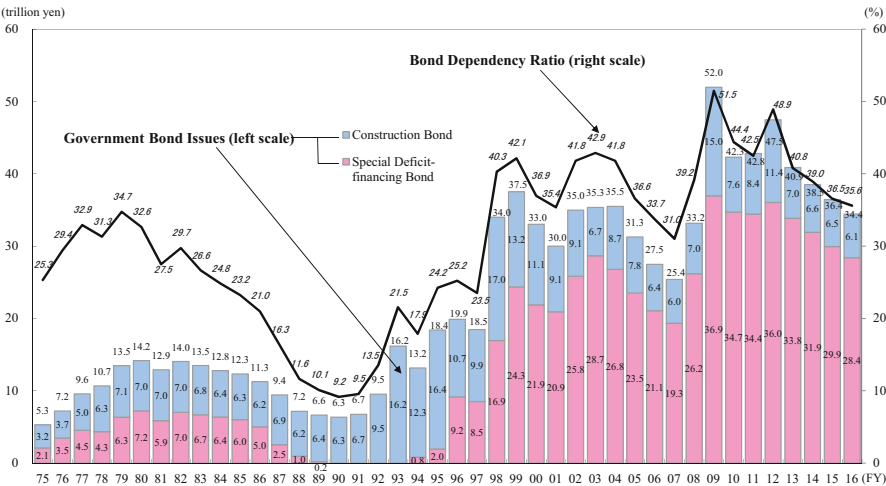


Fig. 1.A2 Government bond issues and the bond dependency ratio (Source: Japan’s fiscal condition (FY2016 draft budget). December 2015 Ministry of Finance. <http://www.mof.go.jp/english/budget/budget/fy2016/02.pdf>)

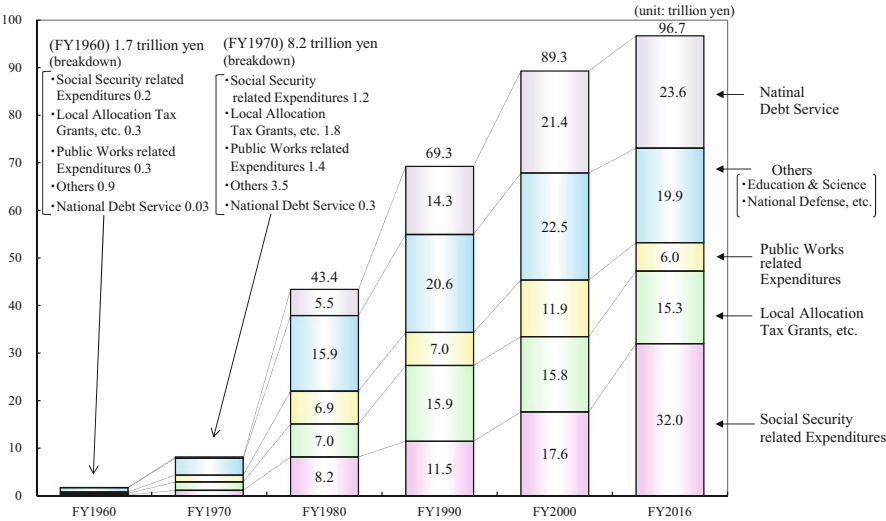


Fig. 1.A3 Transition of major expenditure items in the general account (Source: Japan’s Fiscal Condition (FY2016 draft budget). December 2015 Ministry of Finance. <http://www.mof.go.jp/english/budget/budget/fy2016/02.pdf>)

A1 The 1950s

The features of fiscal management in the 1950s can be summarized as follows. First, the fiscal investment and loan program was established to promote economic growth. Second, under the balanced budget principle, tax was not raised and an increase in tax revenue caused by economic growth was transferred to the private sector as a tax reduction; thus, the size of government was small in terms of public expenditure. As a result, the private sector had many resources for the accumulation of capital. Third, the fiscal built-in stabilizer mechanism was not used a great deal.

In a country with small government, business fluctuations in the 1950s were affected by the balance of payments under the fixed exchange rate system. When the economy was prospering, imports increased, thereby raising trade deficits. In order to maintain the fixed exchange rate, the monetary authority raised the rate of interest to reduce aggregate demand. However, when the economy was in a recession, a trade surplus occurred because of a decline of imports. Thus, the monetary authority reduced the rate of interest in order to stimulate aggregate demand. The stabilization policy was mainly conducted through monetary policy.

A2 The 1960s

In the 1960s, the balanced budget principle was maintained as in the 1950s. However, in the recession of 1965, the government first issued the deficit bond to finance a shortage of revenue. In 1966, the construction bond was issued and an excessive fiscal policy was temporarily employed to stimulate aggregate demand. However, restrictive fiscal management was then employed again to reduce the debt dependency ratio.

The fiscal management approach of the 1960s pursued the principle of small government as in the 1950s; thus, the government distributed resources to the private sector to promote private capital accumulation by reducing taxes and spending. However, at the same time, public capital, which was complemented with private capital, was accumulated for items such as roads and ports since public capital was too little and its productivity was large. Overall, public investment increased from the early 1960s.

The Japanese economy experienced high growth. The average real growth rate in the 1960s was about 10 %, producing a large increase in tax revenue. Then, in the late 1960s, the government gave subsidies to the agricultural sector, small-size firms, and less developed rural areas that had not benefited from high economic growth.

These measures involved a redistribution policy that used fiscal variables. Since economic growth led by private investment did not improve the living environment a great deal, the government provided money to improve amenities in urban areas. This expenditure was financed by the fiscal investment and loan program together with central government's general account.

A3 The 1970s

In the 1970s, the macroeconomy in Japan experienced serious fluctuations because of negative shocks caused by oil price increases. Thus, fiscal policy was required to stabilize the economy by the use of discretionary Keynesian measures. Fiscal management became the main political concern and stabilized the Japanese economy significantly. Following the first oil crisis in 1973, high economic growth ended. However, the budgetary structure still assumed high economic growth under the optimistic expectation that GDP and hence tax revenue would recover soon.

Actually, the macroeconomy was slow and the fiscal deficit increased. At the same time, in 1973, when medical services for elderly people became free in the first year of the welfare state, and pension benefits were raised, welfare spending began to increase rapidly. An increase in welfare spending together with the economic slowdown resulted in the fiscal deficit accumulating significantly. Figure 1.A1 illustrates trends in general account tax, revenues, total expenditure, and government bond issues.

A4 The 1980s

In 1980, the government had two objectives: fiscal consolidation and the structural reform of the administrative and fiscal systems. Because the Japanese economy faced a world recession due to the second oil crisis, there was a trade-off between the mid- and long-term objectives of fiscal consolidation and structural reforms, and the short-term stabilization policy to attain full employment. In the early 1980s, the government took restrictive measures to reduce the fiscal deficit but did not adopt discretionary stabilization measures to realize full employment.

In the late 1980s, the US economy recovered; hence, exports from Japan to the US increased, helping the recovery of the Japanese economy. As a result, the excessive fiscal policy of the US made it possible for Japan to conduct restrictive fiscal management during a boom. Then, Japan had a significant balance of payments surplus and serious trade conflicts.

During the 1980s, the fiscal balance improved. Based on structural reforms, fiscal management was rather restrictive but monetary policy was rather expansionary. Moreover, the bubble economy of the rapid increase in asset prices in the late 1980s raised tax revenue more than projected. Finally, the government could avoid issuing the deficit bond. This meant that the official target of fiscal consolidation was attained.

A5 The 1990s

After the bubble economy burst in the early 1990s, the economy was in recession for a long time, resulting in a decrease in tax revenue. Fiscal management again

became a serious matter. From 1994, the deficit bond was issued. Politically, Japan experienced a coalition government and the fiscal deficit accumulated rapidly.

In 1996, fiscal consolidation attempts were pursued and the Fiscal Structural Reform Act was implemented. However, in late 1997, the financial crisis experienced by Asian economies made Japan's macroeconomic situation worse. From April 1998, the government changed its fiscal management approach from fiscal consolidation to an excessive fiscal policy.

Thus, in May 1998, a supplementary budget was imposed to reduce income taxes and raise public works. The Fiscal Structural Reform Act was also revised in order to conduct more elastic fiscal management. Then, in July 1998, the Obuchi government employed more excessive fiscal measures. The Fiscal Structural Reform Act was abandoned.

In 1999, more excessive fiscal measures such as income tax cuts and subsidies to local governments were employed using several supplementary budgets. At this time, Japan's prime minister, Obuchi, became the worst offender for issuing public debt.

The purpose of these counter-cyclical fiscal measures was to stimulate aggregate demand by any means. The Japanese government justified this policy by arguing that if we could not attain economic recovery and fiscal consolidation at the same time, we could not attain either. However, although the fiscal deficit increased rapidly, the economy did not recover well.

The Obuchi administration's aggressive public spending policy was continued by Yoshihiro Mori, who became prime minister in April 2000. The free-spending measures were intended to encourage demand in any way possible in order to brighten the economic environment. The reasoning was that a policy of "chasing two rabbits at once"—meaning economic recovery and fiscal consolidation—fails to achieve either objective, and that the first priority should be recovery.

However, the "do everything possible" policy, intended to yield quick results, led to a runaway expansion of the deficit, raising concerns about the sustainability of the fiscal balance. As one non-essential public facility after another was built across the country, the cost of maintaining them increased massively. The expansionary economic policy pursued by the Obuchi and Mori administrations through more spending on public works and tax cuts raised questions about the macroeconomic impact of fiscal policy. Figure 1.A2 presents government bond issues and the bond dependency ratio.

A6 The 2000s

The Koizumi administration was in office from 2001 to 2006. The prime minister was very popular and the Council on Economic and Fiscal Policy played a key role in the conduct of a clear and reliable fiscal policy. The fundamental principle of budget making, together with spending and revenue decisions, were discussed and determined. Because the Council set the basic guidelines by the summer of each

year, the bargaining power of the MOF and other ministries, as well as politicians, was weakened.

The objective of the Koizumi administration for fiscal management was to limit new debt issuance in the general account to less than 30 trillion yen. In the initial budget of 2002, this target was realized, but the supplementary budget issued an additional debt of 5 trillion yen. Then, in 2003, the initial budget issued public debt of more than 40 trillion yen. Finally, in 2006, the target was attained, mainly because of the recovery of the macroeconomy.

In 2006, the government determined a mid-term guideline for fiscal consolidation known as the basic guideline of 2006. According to this guideline, the primary balance was to be in surplus by 2011. In order to achieve this, the main target was to reduce public spending by 11.4–14.3 trillion yen. However, in 2007 the global financial crisis occurred and this objective was abandoned. The government again took excessive fiscal measures to stimulate the aggregate economy. The fiscal deficit increased rapidly.

In 2007, the administration of Shinzo Abe aimed to stop debt accumulation by the early 2010s, a policy that has been continued by Shinzo Abe's successor, Yasuo Fukuda. The revised target was to restore the primary balance by 2011. However, the planned consolidation was not achieved because wasteful public spending was not eliminated following the successful lobbying activities of interest groups.

A7 The 2010s

In the 2009 general election, Japan underwent a change in government. The Democratic Party (DP) took over from the Liberal Democratic Party (LDP) for the first time by obtaining a large majority in the Lower House. Voters at the 2009 election supported the DP's proposal that significant wasteful spending exists in the government budget; thus, fiscal consolidation could easily be achieved by cutting such wasteful spending without raising consumption taxes. However, it transpired that the DP government could not identify large sources of wasteful spending. Consequently, although the new government intended to conduct macroeconomic and microeconomic fiscal reforms, it could not attain its objectives.

The DP government was finally forced to decide to raise the consumption tax rate from 5 to 10 % by 2015. This development helped to reduce the informational asymmetry between the Japanese government and the general voters with respect to the fiscal situation.

The LDP's Shinzo Abe, Japan's prime minister since 2012, now employs the so-called third arrow of Abenomics, which is a plan to pull the country out of its long economic slump. Since his concern is mainly the current macroeconomic situation, he has adopted conventional Keynesian fiscal policy to stimulate aggregate demand through public works in addition to nontraditional expansionary monetary policy. As a result, fiscal consolidation is still not handled well.

The Abe administration seems reluctant to raise consumption tax rate as scheduled, although it did raise it to 8 %, effective from April 2014. The Abe

administration postponed a further increase in the consumption tax rate to 10 % from October 2015 to April 2017. Then, in June 2016, it again postponed an increase in the consumption tax rate to 10 %, this time to October 2019. However, a commitment to fiscal consolidation is unclear unless the consumption tax rate is increased in the near future. Figure 1.A3 shows the transition of major expenditure items in the general account.

Questions

- 1.1 Justify the following government activities using four main functions of the public sector.
 - (a) Public education.
 - (b) The construction of highways.
 - (c) Garbage collection.
- 1.2 Explain the difference between two optimality theorems of the market mechanism and justify a redistribution policy even if the private market is perfect.
- 1.3 Compare the Japanese budgetary process with the counterpart in your country.

References

- Doi, T., & Ihori, T. (2009). *The public sector in Japan: Past developments and future prospects*. Cheltenham: Edward Elgar.
- Rosen, H. S. (2014). *Public finance*. London: McGraw-Hill.
- Stiglitz, J. E. (2015). *Economics of the public sector*. New York: W. W Norton & Company.
- Varian, H. R. (2014). *Intermediate microeconomics: Modern approach*. New York: Norton.

Part I

Macroeconomic Aspects of Public Finance

1 The Simple Keynesian Model

1.1 The 45-degree Model

In this chapter, we investigate the macroeconomic effect of fiscal policy using the simple Keynesian model. It is useful to look at any standard macroeconomics textbooks including Mankiw (2014) to understand Keynesian economics more fully.

First, let us explain the simplest 45-degree model in order to analyze the effect of the size of the multiplier on GDP. This model assumes that aggregate demand determines GDP in the goods market. The fundamental mechanism of the Keynesian model assumes that the economic variable that responds to excess demand (demand minus supply) is not price but quantity. Since the Keynesian model presupposes underemployment, the demand side should determine macroeconomic activity. This formulation is plausible for investigating macroeconomic activities in a recession.

The equilibrium condition for the goods market is given as

$$Y = C + I + G \text{ and} \quad (2.1)$$

$$C = cY \quad (2.2)$$

where Y is national income (GDP), C is consumption, I is investment, G is government spending, and c ($0 < c < 1$) is the marginal (and average) propensity to consume. Equation (2.1) means that production Y is conducted to meet aggregate demand $C + I + G$. This is the equilibrium condition in a goods market.

Equation (2.2) is a simple formulation of the consumption function, which means that consumption is a constant share of income. Parameter c denotes the (average = marginal) propensity to consume. $1 - c$ means the (average = marginal)

propensity to save. For simplicity, we assume here that the average propensity to consume, C/Y , is equal to the marginal propensity to consume, $\Delta C/\Delta Y$.

Substituting Eq. (2.2) into Eq. (2.1) and eliminating C , we have

$$Y = cY + I + G. \quad (2.3)$$

Suppose I is exogenously given and fixed as the constant in this section. Then, Eq. (2.3) uniquely determines the equilibrium level of Y as a function of policy variable G .

1.2 The Fiscal Multiplier

Then, according to Eq. (2.3), Y is only a function of G , the policy variable. Hence, it is easy to calculate the effect of an increase in G on Y , which is the size of the multiplier effect, $\Delta Y/\Delta G$.

From Eq. (2.3), if we have the difference and consider $\Delta I = 0$, we obtain

$$\Delta Y = c\Delta Y + \Delta G.$$

Hence, the fiscal multiplier $\Delta Y/\Delta G$ is written as

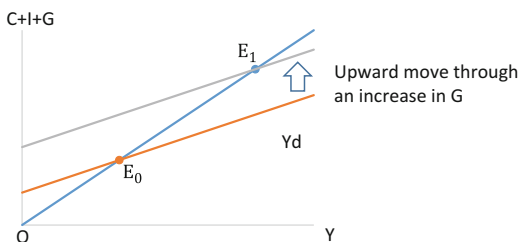
$$\Delta Y/\Delta G = 1/(1 - c). \quad (2.4)$$

The size of the multiplier is given as the inverse of the marginal propensity to save, $(1 - c)$.

For example, if $c = 0.8$, $I = 10$, and $G = 10$, then $Y = 100$. Suppose G is changed to 11 and government spending increases by 1 unit. We now have $Y = 105$. Because Y increases by 5 units, the multiplier is 5, which is the inverse of the marginal propensity to save, $1 - 0.8 = 0.2$.

Figure 2.1 shows the multiplier effect of government spending. The vertical axis denotes aggregate demand $C + I + G$, while the horizontal axis denotes income ($=$ production), Y . The left-hand side of Eq. (2.3) refers to the 45-degree line, while the right-hand side refers to the aggregate demand curve $Y_d (= cY + I + G)$. The slope of curve Y_d corresponds to the slope of C , the marginal propensity to consume, and

Fig. 2.1 The 45-degree line model



is less than the slope of the 45-degree line. The intersection of curve Y_d and the 45-degree line, E_0 , is the initial equilibrium point.

Since G is a shift parameter, an increase in G moves curve Y_d upward. The equilibrium point then moves from E_0 to E_1 and the magnitude of the horizontal move corresponds to the size of the fiscal multiplier. As easily expected in this figure, when the slope of curve Y_d becomes larger and closer to 1, the size of the multiplier becomes larger. In other words, the multiplier increases with the marginal propensity to consume. The multiplier effect comes from an induced increase in private consumption through an increase in GDP directly caused by an increase in government spending. If the marginal propensity to consume is high, an increase in GDP induces a large increase in private saving and raises GDP further. The cumulative increase in GDP caused by the cumulative increase in private consumption gives the magnitude of the multiplier.

Thus, Eq. (2.4) may be rewritten as

$$\Delta Y / \Delta G = 1 + c + c^2 + c^3 + \dots = 1 / (1 - c).$$

The term 1 captures the direct effect of government spending and the term $c + c^2 + c^3 + \dots$ captures the indirect cumulative increase in private consumption caused by an increase in government spending. Sometimes, Fig. 2.1 is called a Keynesian 45-degree diagram or a Keynesian cross diagram.

1.3 The Multiplier with Tax Rate

We now introduce taxes into the model. Suppose the tax function is given as

$$T = tY \quad (2.5)$$

where T is tax revenue and t is the tax rate. Then, the consumption function, Eq. (2.2), is rewritten as

$$C = c(Y - T) = c(1 - t)Y \quad (2.2')$$

where $Y - T$ is (current) disposable income. In the simple Keynesian model, private consumption depends upon current disposable income.

Substituting Eq. (2.2') into Eq. (2.1) and taking the difference, we have

$$\Delta Y = c(1 - t)\Delta Y + \Delta G.$$

From this equation, we can calculate the size of the fiscal multiplier with the tax rate, $\Delta Y / \Delta G$, in place of Eq. (2.4):

$$\Delta Y / \Delta G = 1 / [1 - c(1 - t)]. \quad (2.4')$$

Because t appears in (2.4'), the size of the multiplier with the tax rate is smaller than in (2.4) without the tax rate.

For example, if $c = 0.8$, $t = 0.25$, $I = 10$, and $G = 10$, then $Y = 50$. When G rises to 11 and government spending increases by 1 unit, we have $Y = 52.5$. Thus, Y increases by 2.5; namely, the multiplier, $\Delta Y/\Delta G$, is now 2.5 and not 5 for $t = 0$.

Thus, the multiplier decreases with the tax rate. When the tax rate is high, an increase in income caused by an increase in government spending does not result in a large increase in consumption; hence, the size of the multiplier becomes smaller than in Sect. 1.2. Note that the size of the multiplier originates from the extent to which private consumption increases in response to fiscal expansion. As expressed in Eq. (2.1), an increase in G raises Y by more than the original increase in G if and only if C increases. Namely, Eq. (2.4') may be rewritten as

$$\Delta Y/\Delta G = 1 + c(1 - t) + [c(1 - t)]^2 + [c(1 - t)]^3 + \dots = 1/[1 - c(1 - t)].$$

1.4 The Built-In Stabilizer

This fiscal multiplier effect is also consistent when I (not G) changes exogenously. In other words, when any exogenous demand variable changes, the aggregate demand changes by the magnitude of the fiscal multiplier. If investment I or export X changes exogenously, Y changes as well.

In this regard, if the multiplier effect is smaller, the magnitude of the fluctuations of effective demand is also smaller. Interestingly, this means that the system is more stable in response to an exogenous shock. Alternatively, if income tax is imposed, the system becomes more stable in the sense that the multiplier effect is smaller. This is called the built-in stabilizer effect of the tax system in the sense that the stabilizing effect of reducing the multiplier is automatically built into the fiscal system.

For example, suppose private investment declines because of pessimistic expectations or exogenous negative shock. Then, GDP declines, thereby inducing a decline in consumption. If the tax rate is high, a decline in disposable income is not so great because it also reduces the tax burden significantly. Thus, a decline in private investment does not result in a larger decline in GDP. This is the stabilizing effect of income tax.

We could have similar stabilizing effects in other fiscal measures where government spending is negatively correlated with income, or the tax burden is positively correlated with income. For example, unemployment benefit that automatically increases in recessions is an example of a built-in stabilizer. Another example is consumption tax, the burden of which is positively correlated with consumption and income. In this regard, a small multiplier is beneficial.

1.5 The Balanced-Budget Multiplier

If tax revenue T is a policy variable, we have

$$\Delta Y = c(\Delta Y - \Delta T).$$

Or, the size of the tax cut multiplier is now written as

$$-\Delta Y / \Delta T = c / (1 - c). \quad (2.6)$$

If the government raises taxes T and spending G by the same amount, what is the size of the multiplier? In this situation, the policy variable of fiscal policy is not the tax rate t but the tax revenue T . The tax rate is endogenously adjusted so as to realize the balanced-budget constraint, $G = T$. Thus, in the difference form, we also have a balanced-budget constraint,

$$\Delta T = \Delta G,$$

as a policy variable.

The equilibrium condition in the goods market is given as

$$Y = c(Y - T) + I + G.$$

Then, in the difference form, we have

$$\Delta Y = c\Delta Y - c\Delta T + \Delta G.$$

Since we also have to consider the balanced-budget constraint, substituting $\Delta T = \Delta G$ into the above equation, we finally derive

$$\Delta Y / \Delta G = 1. \quad (2.7)$$

Thus, the balanced-budget multiplier is always equal to 1 and is independent of the propensity to consume.

For example, if $c = 0.8$, $I = 10$, and $T = G = 10$, then $Y = 60$. When $T = G = 11$, and tax and spending increase by 1 unit, $Y = 61$. Thus, Y would increase only by 1 unit. This means that the multiplier is 1. An increase in G has the multiplier of $1/(1 - c)$, while an increase of T has the multiplier of $-c/(1 - c)$. Adding the two multipliers, we obtain $1/(1 - c) + [-c/(1 - c)] = 1$.

Alternatively, from the macro-balance equation we have

$$S + T - G = I.$$

Here, $S (= Y - T - C)$ denotes saving. The left-hand side means overall saving and the right-hand side means investment. This equation is another expression of the equilibrium condition in the goods market, (2.1).

As long as $G - T$ does not change and investment is exogenously fixed, S becomes fixed. Since S is an increasing function of disposable income, $S = (1 - c)(Y - T)$, disposable income $Y - T$ also becomes fixed under the balanced-budget policy. It follows that an increase in T is equal to an increase in Y . Thus, we have Eq. (2.7).

Usually, when we discuss the multiplier effect, we do not explicitly consider the financing method of government spending. This implicitly assumes that the government issues debt and taxes are fixed so that hence we can ignore the balanced-budget constraint or the economic effect of raising taxes. If government spending is financed by tax, the multiplier reduces to 1 in the Keynesian model, which is smaller than the conventional deficit-financing fiscal multiplier.

2 The IS/LM Analysis

2.1 The Investment/Saving and Liquidity Preference/Money Supply Equilibrium Model

In this section, we consider the standard Keynesian model of the investment/saving and liquidity preference/money supply equilibrium (IS/LM) framework, which incorporates the equilibrium conditions for the goods market and the money market. This model is called the IS/LM model.

The IS curve shows all combinations of interest rate r and income Y that satisfy income identity, the consumption function, and the investment function. The LM curve shows all combinations of interest rate r and income Y that satisfy the money demand relationship for a fixed level of money supply and a predetermined value of the price level.

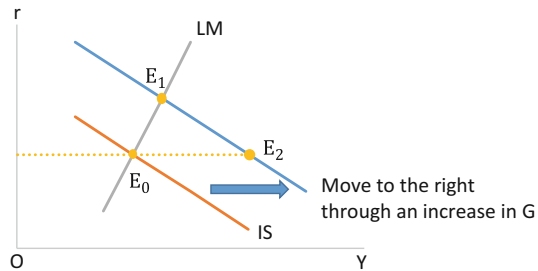
In addition to Eqs. (2.1) and (2.2), the model may be summarized by the following two equations:

$$I = I(r) = I_0 - \beta r \text{ and} \quad (2.8)$$

$$M = L(Y, r) = L_0 + \varepsilon Y - \gamma r. \quad (2.9)$$

Equation (2.8) is an investment function. The IS/LM model considers private investment as an endogenous variable that is determined by the rate of interest. Investment decreases with the rate of interest, r , ($\beta > 0$). Since the rate of interest is the cost of borrowing investment money, this assumption is plausible. Equations (2.1), (2.2), and (2.8) provide equilibrium in the goods market. The combination of Y and r that satisfies these equations determines the IS curve. Thus, substituting Eqs. (2.2) and (2.8) into Eq. (2.1), we have

$$Y = cY + I_0 - \beta r + G. \quad (2.10)$$

Fig. 2.2 IS and LM curves

This is the IS curve, which shows the combination of income and interest rate that equilibrates the goods market.

Equation (2.9) is an equilibrium condition for the money market. M denotes money supply and L denotes money demand. Money demand increases with income, reflecting the demand of economic transactions, and decreases with the interest rate and the opportunity cost of money holdings, ($\epsilon > 0$, $\gamma > 0$). The combination of Y and r that satisfies Eq. (2.9) determines the LM curve. Thus, from Eq. (2.9), we can obtain the LM curve, which denotes the combination of income and interest rate that is consistent with equilibrium in the money market.

The IS/LM model consists of two equations, (2.9) and (2.10). When compared with the simple 45-degree line model in Sect. 1, this current model makes investment endogenous as a decreasing function of interest. In addition, the model introduces money in order to determine the rate of interest.

Figure 2.2 shows the IS and LM curves. The vertical axis denotes interest rate and the horizontal axis denotes income. The IS curve given by Eq. (2.10) is downward sloping, while the LM curve given by Eq. (2.9) is upward sloping. Suppose Y increases; then, r should be reduced to maintain the equilibrium of the goods market by stimulating investment demand. Thus, the IS curve is downward sloping. However, in order to maintain the equilibrium condition of the money market, r should rise so as to depress money demand. Thus, the LM curve is upward sloping. The intersection of the curves determines the initial equilibrium point, E_0 .

2.2 The Size of the Multiplier in the IS/LM Model

Let us consider the size of the fiscal multiplier by using this IS/LM model. Government spending G appears in IS Eq. (2.10) as a shift parameter, but does not appear in LM Eq. (2.9). In Fig. 2.2, an increase in government spending moves the IS curve upward from IS to IS' . It does not affect the LM curve. The new equilibrium point is E_1 .

The movement from E_0 to E_1 may be decomposed into a move from E_0 to E_2 and a move from E_2 to E_1 . The movement from E_0 to E_2 corresponds to the multiplier effect at a given rate of interest, which is the multiplier effect in the 45-degree line model of Sect. 1.

The movement from E_2 to E_1 means that an increase in the interest rate depresses investment and hence income. This offsetting effect is called the crowding-out effect in the sense that an increase in public spending crowds out private investment. Through the increase in G , C increases but I decreases. The size of the crowding-out effect becomes larger if the elasticity of investment with respect to the interest rate is larger, and the elasticity of money demand with respect to the interest rate is smaller.

Note that the elasticity of investment with respect to the interest rate means the extent to which investment changes in response to an increase in the interest rate. The elasticity of money demand with respect to the interest rate has a similar meaning. If the elasticity of money demand with respect to the interest rate is small, an increase in G raises the rate of interest to a significant extent. Moreover, if the elasticity of investment with respect to the interest rate is large, an increase in the rate of interest reduces private investment significantly. Because of the crowding-out effect, the size of the fiscal multiplier in the IS/LM model is smaller than in the 45-degree line model.

2.3 Extreme Cases of the Zero Crowding-Out Effect

We now explain two extreme instances where crowding out would not occur at all. The first is the horizontal LM curve. Suppose the elasticity of money demand becomes infinite ($\gamma \rightarrow \infty$); hence, a small increase in the interest rate produces an infinite decrease in money demand. Then, as shown in Fig. 2.3, the LM curve becomes horizontal. In such a situation, any movement of the IS curve does not affect the rate of interest; thus, E_1 is the same as E_2 and the crowding-out effect becomes zero. If the rate of interest does not rise, investment does not decline.

Another extreme case is the vertical IS curve. If the interest elasticity of investment is zero ($\beta \rightarrow 0$) and hence an increase in the interest rate does not depress investment demand at all, as shown in Fig. 2.4, the IS curve becomes

Fig. 2.3 The interest elasticity of money demand is infinite

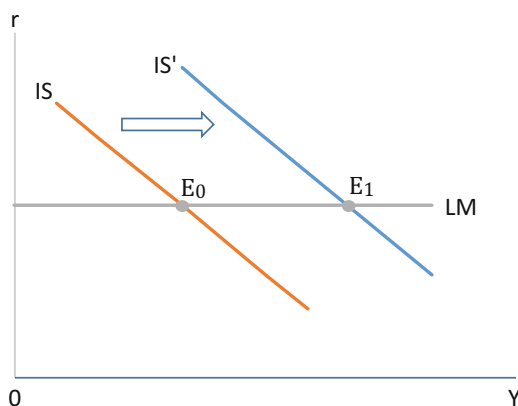
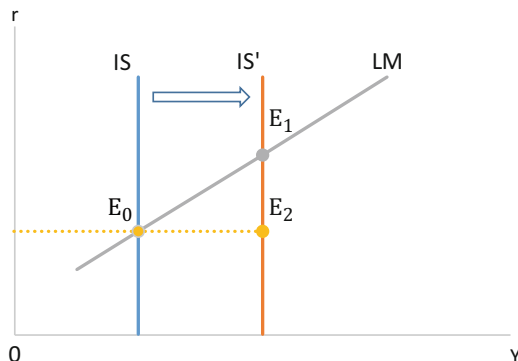


Fig. 2.4 The interest elasticity of investment is zero



vertical. Then, an increase in interest rate due to an upward movement of the IS curve would not depress investment demand at all. E_2 and E_1 correspond to the same Y . Thus, the crowding-out effect does not occur. If investment is not affected by the rate of interest, a rise of interest does not reduce investment.

Generally, the interest elasticity of money demand is finite and the interest elasticity of investment demand is negative. In this regard, we may observe the crowding-out effect to some extent. In other words, the multiplier in the IS/LM model is smaller than in the 45-degree line model by the amount of the crowding-out effect. We would normally expect the crowding-out effect in the IS/LM model to reduce the size of the multiplier.

If we consider taxes, how would the analytical result be altered? In the framework of the IS/LM model, as in the 45-degree line model, if tax depends on income, the multiplier effect becomes smaller. In this sense, the built-in stabilizer works just as well. The balanced-budget multiplier is now less than unity because an increase in the rate of interest depresses investment.

2.4 Direct Crowding Out

So far, we have not considered the benefit of public spending. Needless to say, government consumption is useful and raises the utility of consumers. An interesting possibility is that an increase of government spending may simply act as a substitute for similar private spending. This being so, government spending may not always stimulate aggregate spending as predicted in the standard IS/LM model. This is an example of direct crowding out. In other words, if we incorporate the benefit of government spending and the rational response of private agents, we should consider the offsetting behavior of such agents. This behavior may reduce the multiplier effect of fiscal policy due to direct crowding out.

For example, if the government provides a good that most people would like to consume, or public investment that produces benefits in the near future, such spending would likely compete with private consumption in the current period;

hence, it would directly crowd out private consumption. Namely, if the government raises public spending that is perfectly substitutable with private consumption, it would reduce private consumption. Alternatively, public investment that produces benefits would also soon be substitutable with current private consumption and hence depress private consumption or investment. If this direct crowding out is relevant, the macroeconomic effect of fiscal policy becomes limited, as explained in Chap. 3.

However, if public spending is used for projects that do not provide immediate benefits to consumers, the crowding-out effect does not occur. In such an instance, fiscal policy would work well. For example, in Japan, public infrastructure spending in the 1960s was very effective because it provided benefits for long periods and did not crowd out private consumption. Indeed, it induced significant private investment. Thus, the multiplier effect was large.

Since the 1990s, though, public capital has accumulated to a significant extent and future benefits have reduced. Consequently, public works have become types of social welfare program that are intended to provide current benefits. These changes have contributed to a reduction in the size of the multiplier effect of public spending by crowding out private consumption and not inducing private investment. See the case study of this chapter for the performance of public investment in Japan.

2.5 The Crowding-In Effect

In contrast to the crowding-out effect, fiscal policy may crowd in private investment, resulting in positive externalities in some cases. For example, if an increase in public investment is so effective that people believe that a boom may come soon, many firms are likely to invest more. Consequently, other firms increase their investments. This is a desirable outcome of the crowding-in effect, which comes from the positive effect on people's attitude about future economic conditions.

In the high-growth era of Japan in the 1960s, one reason why macroeconomic fiscal policy was so successful was the signaling effect of the government's policy. Private investment requires suitable circumstances in order to make future profits. Uncertainty about future macroeconomic activities depresses private investment. If the government provides reliable and optimistic information on future macroeconomic activities and/or fiscal policy and private agents accept it, it stimulates private investment. Thus, if a private agent believes the optimistic government scenario and follows it, the scenario may become reality. This is an example of a self-fulfilling expectation.

It is important for the efficacy of fiscal policy that public spending, especially public investment, produces a profitable outcome for private agents. If a public investment project makes private firms more productive, the crowding-in effect occurs. In such a situation, the government may only stimulate a small number of private firms and/or industries. However, because of the crowding-in effect, this policy may produce more investment in the whole economy.

Thus, the government may make fiscal policy more effective by inducing a small but core number of firms and consumers to follow its lead. If the crowding-in effect is large, the size of the multiplier may become large even if fiscal policy initially targets a small part of the private sector.

3 The Open Economy

3.1 Extension to an Open Economy Model

We now extend the IS/LM model to an open economy. The equilibrium condition in the goods market is now rewritten as

$$Y = C(Y) + I(r) + G + X(e, Y) \quad (2.11)$$

where X denotes trade surplus, which is exports EX minus imports IM ($X = EX - IM$), and e denotes exchange rate (for example, 1 dollar = e yen). An increase in e means a depreciation of the home currency, the yen, stimulating exports and depressing imports. Thus, an increase in e raises net exports X . In addition, an increase in income stimulates imports and reduces net exports. Imports increase with income. The marginal propensity to import, $m = \Delta M / \Delta Y = -\Delta X / \Delta Y$, is between 0 and 1. For simplicity, we do not consider changes in taxes here.

The equilibrium condition in the money market is the same as in the closed economy and given as before.

$$M = L(Y, r) \quad (2.9')$$

When the world capital market is perfect, because of the arbitrage behavior of capital movement, the rate of interest in the home country r is equal to the world rate of interest, r^* .

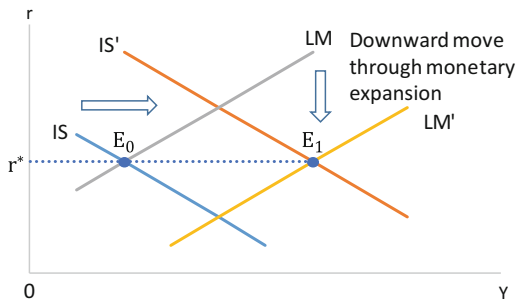
$$r = r^* \quad (2.12)$$

From this point on, we consider the small open country situation where the home country cannot manipulate the world rate of interest.

3.2 The Fixed Exchange System

In an open economy, it is important to specify how the exchange rate is determined. First, we assume a fixed exchange system. In this system, e is fixed at a given rate, e^* . In order to achieve this, the government needs one policy variable to be assigned for this objective. A plausible assumption is that monetary policy is used for this objective. Figure 2.5 shows the effect of fiscal policy in such a situation.

Fig. 2.5 The effect of fiscal policy in the fixed exchange regime



Let us investigate the effect of fiscal policy in this open economy. An increase in government spending moves the IS curve upward and to the right to the IS' curve as in the closed economy model. This raises the rate of interest and induces capital inflow in the open economy. Note that capital moves to a country with a higher rate of interest. If monetary policy is not accommodated, it will appreciate the home currency (say, Japan's currency, the yen). In other words, e is reduced.

In the fixed exchange system, the monetary authority has to buy foreign assets in order to avoid the appreciation of e . This raises money supply M in the home country; hence, as M is a shift parameter of the LM curve, the LM curve moves downward and to the right as does the LM' curve. The market is in equilibrium at the world rate of interest, and the equilibrium point moves from E_0 to E_1 .

The size of the multiplier is almost the same as in the 45-degree line closed model. We do not observe the crowding-out effect since money supply is increased to maintain the interest rate to the world interest rate. Compared with the 45-degree line model in a closed economy, the multiplier becomes smaller because imports depend on income in the open economy.

The fiscal multiplier is now $1/(1 - c + m)$. Here, m refers to the marginal propensity to import ($m = -\Delta X/\Delta Y$). Namely, from Eq. (2.11) in the difference form we have

$$\Delta Y = c\Delta Y + \Delta G + \Delta X.$$

Considering the definition of m , $m = -\Delta X/\Delta Y$, we obtain as the fiscal multiplier,

$$\Delta Y/\Delta G = 1/(1 - c + m). \quad (2.13)$$

For example, if the marginal propensity to consume is 0.8 and the marginal propensity to import is 0.3, the multiplier is 2, which is smaller than 5 in the closed economy. However, since the rate of interest is fixed, the crowding-out effect does not occur here.

3.3 The Flexible Exchange Rate System: The Effect of Fiscal Policy

The above result depends upon the assumption that capital movement is perfect and the rate of interest is given by the world market. In this situation, monetary policy cannot be used as an independent policy because the fixed exchange rate has to be supported by the accommodated monetary policy. Monetary policy loses freedom of choice or its effect on the economy.

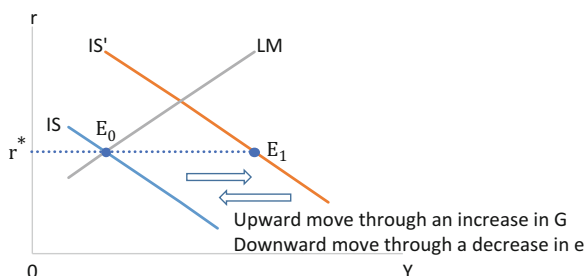
We now consider the flexible exchange rate system where the exchange rate is determined so as to attain equilibrium in the exchange market. In this instance, it is unnecessary to accommodate monetary policy. If an interest rate increases because of government spending, capital inflows occur in an open economy. Further, the excess demand for the home currency makes the home currency appreciate. As shown in Fig. 2.6, expansionary fiscal policy initially moves the IS curve upward and to the right to the IS' curve.

We need to consider the impact of the appreciation of the home currency. In the IS/LM diagram, the exchange rate e is a shift parameter. Since e appears in the net export function, it may move the IS curve. Appreciation of the exchange rate (a decline of e) stimulates imports and depresses exports. This depresses aggregate demand in the home country; the IS curve then moves downward. Namely, an original upward movement of the IS curve because of expansionary government spending is offset by a downward movement of the IS curve because of the associated appreciation of the home currency, the yen.

The new equilibrium point is the same as the initial point, E_0 . This is because income does not change in the money market as long as the rate of interest and money supply do not change. The downward movement of the IS curve occurs so long as the rate of interest is higher than the world rate. Thus, the associated appreciation of the home currency completely offsets the initial expansionary effect of government spending. In other words, the multiplier of fiscal policy becomes zero here. Thus,

$$\Delta Y / \Delta G = 0 \quad (2.14)$$

Fig. 2.6 The effect of fiscal policy in the flexible exchange rate regime



3.4 The Flexible Exchange Rate System: The Effect of Monetary Policy

As for the effect of monetary policy, we have shown that in the fixed exchange rate system, monetary policy loses its policy meaning. However, we have another situation in the flexible system. In the flexible exchange rate system, the exchange rate is endogenously determined so that the monetary authority can change money supply by its own volition.

An expansion of money supply moves the LM curve to the right and the rate of interest tends to decline. This causes depreciation of the exchange rate (the yen depreciates), which stimulates exports. The IS curve then moves upward. Thus, monetary policy is very effective at stimulating aggregate demand.

To sum up, fiscal policy is effective in the fixed exchange rate system, while monetary policy is effective in the flexible exchange rate system. In contrast, fiscal policy is ineffective in the flexible exchange rate system, while monetary policy is ineffective in the fixed exchange rate system.

3.5 Zero Capital Movement

We now briefly consider the situation whereby capital does not move across countries. In this instance, the rate of interest in the home country may be endogenously determined. We obtain qualitatively similar results on fiscal policy as in the closed economy.

In the fixed exchange rate system, an increase in income through expansionary fiscal policy reduces net exports, resulting in a reduction of the supply of foreign assets. In order to maintain the fixed exchange rate, monetary policy is adjusted. Namely, accommodated monetary policy has to buy foreign assets by selling domestic currency. Hence, a reduction of money supply moves the LM curve to the left, partly offsetting the effect of fiscal policy. Thus, the multiplier becomes smaller than in the closed economy.

In the flexible exchange rate system, the current account is equal to the trade account; hence, the exchange rate is determined in order to make net exports zero. Since $X = 0$, the IS curve and the LM curve are the same as in the closed economy. An increase in government spending raises imports and reduces net exports. However, this change is completely offset by the appreciation of the exchange rate so as to maintain $X = 0$. Thus, the effect of fiscal policy is the same as in the closed economy. In other words, we have the same size of multiplier as in the closed economy. This is called the isolation effect of the flexible exchange rate system.

In reality, capital moves across countries but the world capital market is not perfect. Thus, it may be useful to investigate the circumstance in which the domestic rate of interest is partially affected by the world market. The impact of fiscal policy in such a situation is a combination of the perfect capital market example and the zero capital market example.

4 The Efficacy of Fiscal Policy and the Policymaker

4.1 Three Viewpoints

The conventional counter-cyclical fiscal policy is to manage aggregate demand using discretionary fiscal measures. Needless to say, fiscal policy is conducted by fiscal authorities. By highlighting the ability of the policymaker, we may evaluate the efficacy of discretionary fiscal measures from the following three viewpoints: (1) timing, (2) effectiveness, and (3) the purpose of the policymaker.

With regard to timing (1), an important issue is the seriousness of the policy lag. This relates to the ability of the policymaker. Theoretically, this point is associated with the issue of “rule versus discretion” in economic policy. The efficacy of fiscal policy (2) is the cause of most concern in academic research. Can Keynesian fiscal measures really control macroeconomic fluctuations? What should be the size of the fiscal multiplier? These questions are key policy issues regarding fiscal management. Conflicting views exist between neoclassical and Keynesian economists (or between new macroeconomics and conventional Keynesian economics). We discuss these points in Chap. 6 after explaining the alternative view of neoclassical macroeconomics in Chap. 3.

The purpose of policymakers (3) is intensively discussed in the political economic literature, in which many academic results have been accumulated. For example, studies investigate how a ruling party’s interests affect fiscal policy during the process of policymaking and enforcement. Even if a policy is beneficial from viewpoints (1) and (2), fiscal policy is not ideal if the purpose of the policymaker is not benevolent but biased. We discuss this political issue in Chap. 12.

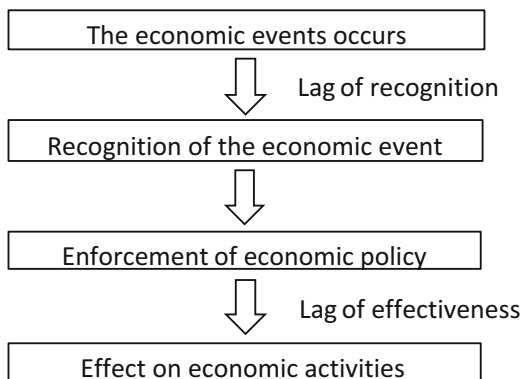
4.2 The Lag of Policy

In this section, we discuss the problem of timing (1). When we consider the efficacy of discretionary policy, a policy lag matters. In reality, any policy requires some degree of time lag before it is implemented. This is called a policy lag problem. However, the problem is not the lag itself; instead, it is whether the policy authority anticipates a policy lag precisely.

Policy or time lags are another complicating factor in macroeconomic policy. There are three types of lag. First, there is recognition lag (see Fig. 2.7). Economic data provides a rearview mirror to observe the economy. For example, even if the economy is becoming worse, it may take some time until GDP begins to decline. We may discover only after the fact that the economy has been in recession for a year, or that our estimate of the natural rate of unemployment is too optimistic. In addition, with regard to social welfare measures, it takes some time to specify who is really being hurt by a recession.

Second, there is implementation lag. The policy authority may recognize a recession appropriately; however, the Diet may take some time to enact a stimulative tax cut or spending program. In other words, even if the policy action is

Fig. 2.7 The lag of economic policy



recognized as necessary, it may take a while to make and conduct plans because of administrative issues such as adjustments among policy authorities and the resolution of the Diet.

Finally, there is impact lag. When a policy is implemented, it may be a while before it actually affects the economy.

4.3 Lag of Monetary Policy

Consider monetary policy. There may be a lag of several quarters between a cut in interest rates and the response of aggregate demand. For example, a drop in interest rates is supposed to raise the cost of foreign goods because of depreciation; however, even if the exchange rate moves in the right direction at once, it may take time for foreign producers to increase the prices of their exports. Further, even after prices change, some time may elapse before domestic buyers switch from imported products to domestic products.

Hence, with regard to monetary policy, the second lag, implementation lag, may be short but the third lag, impact lag, may be large. For example, the Bank of Japan usually holds policy decision meetings twice a month to discuss monetary policy. These meetings are the main opportunity for the Bank to change the target interest rate or money supply. Thus, the Bank may change the policy promptly if necessary. However, a change in the target interest rate affects the investment of firms and the consumption of households gradually. Consequently, the purpose of a country-cyclical policy may take some time to achieve.

4.4 Lag of Fiscal Policy

However, in the case of discretionary fiscal policy, the lag of implementation may be significant but the lag of impact will be short. Namely, in order to implement discretionary fiscal policy, a budget approved by the Diet must normally be

developed. This takes some time. For example, when the central government gives money to local governments, which engage in discretionary measures, central government should first take budgetary action. If the adjustment of intergovernmental financing takes some time, the lag of implementation becomes significant.

Once the budget is approved, though, fiscal action may affect aggregate demand by changing government spending directly. Alternatively, fiscal action may affect the investment and consumption of private agents through changes in taxes and transfers. It should also be noted that although the lag of impact may be short, this does not necessarily mean that the magnitude of the impact is large.

4.5 Lag and Automatic Stabilizers

The combination of model uncertainty and time lags makes a mockery of the notion of “fine tuning” the economy so that it always performs at its best. Instead, policymakers try to adjust slowly and more or less grope their way forward to find the best outcome that they can achieve. Thus, both monetary policy and fiscal policy have merits and demerits with respect to policy lags. Moreover, the lag of recognition may be serious for both policies.

Consequently, it is hard to conduct appropriate discretionary policy at the right time. Even if a discretionary policy is effective in the short run, as suggested by the standard Keynesian model, it may be undesirable to use it unless it is implemented at the right time.

For example, suppose the economy is in a recession and the government is required to engage in expansionary monetary and fiscal policies. This may take some time; consequently, actual implementation may occur after the economy has already recovered. If so, the expansionary policy may not stabilize output fluctuations but in fact destabilize the economy. Alternatively, even if social welfare measures are needed in a recession, their implementation could take a while. However, such measures may not necessarily be desirable anymore because the economy will already have recovered.

If the government can anticipate the time lag precisely, it can make the necessary decisions. However, it is hard to anticipate the size of lags correctly. Thus, it may be desirable not to use discretionary policy but to use monetary and fiscal rules to smooth out fluctuations in output. This is the issue of rules versus discretion.

Those who support discretion argue that the government may anticipate policy lags to a significant extent so that a discretionary policy can produce the desirable impact at the right time. However, those who emphasize the merit of rules are not confident about the correct anticipation of policy lags or the effectiveness of discretionary policy. Rather, they are concerned with the distortionary effect of bad discretionary intervention. From such a perspective, automatic built-in stabilizers and/or rules are better for the avoidance of distortionary costs. For example, fiscal authorities should maintain the public investment/GDP ratio as fixed over time. Alternatively, monetary policy should increase money supply at a given fixed rate.

Which argument is appropriate depends upon the capabilities of the government, the nature of business cycle risks, the macroeconomic situation, and fiscal conditions.

4.6 Rules Versus Discretion

When comparing a discretionary policy and automatic stabilizers, it is useful to evaluate each tool from the viewpoints of rules and discretion. The issue of rules versus discretion could be discussed from the perspective of dynamic or time inconsistency. The optimal policy at present may not be optimal after time has passed and the economic situation changes. This is called dynamic (or time) inconsistency.

For example, suppose the government promises to conduct a certain policy in the future. However, the policy may not be optimal when the economic situation changes in the future and the government reconsiders the optimization problem. Such a policy may be called time inconsistent.

In a dynamic world, an asset accumulated in the present is a stock variable; thus, it is initially given at this point. Taxing the asset constitutes a lump sum tax; hence, the tax does not affect private agents and revenue can be collected without any distortionary costs. Since an asset is a stock variable, raising tax rates results in raising revenue. However, if the government imposes a high tax rate from the beginning, it raises the cost of asset accumulation and depresses the incentive to save. Thus, the optimal policy is that the government promises not to tax asset accumulation from the current date; then, once the asset is sufficiently accumulated, the government raises tax rates to collect tax revenue.

When the future arrives, the promise of zero tax is undesirable for the government. By raising tax rates on assets, the government may reduce other distortionary taxes, which is desirable for resource allocation. Since the government intends to maximize the social welfare of households, it has an incentive to break the promise in order to improve social welfare. The initial promise of maintaining zero tax in the future is not time consistent simply because the policymaker has an incentive to break it in the future.

If the private sector does not pay attention to the government's future action, the dynamic inconsistency problem does not create any costs. By breaking the promise, the government can increase social welfare. However, it is plausible to assume that the private sector will pay attention to future government behavior; thus, the credibility of policy matters. Chapter 13 discusses this issue from the viewpoint of time inconsistency.

When a policymaker faces dynamic inconsistency, the policymaker changes a policy after a certain time. Sooner or later, the private sector may begin to anticipate such policy changes. For example, once the private sector anticipates future increases in tax rates, this depresses private savings immediately. Hence, a policy of zero tax in these circumstances does not stimulate savings. As a result, social welfare may amount to less expenditure than when the policymaker does not raise

tax rates in the future. Thus, it may be desirable to restrict the freedom of policy options in the future with rules. This is an example of why rules can be better than discretion.

Thus, it may be more desirable to adopt predetermined rules as fiscal policy rather than conduct discretionary fiscal measures. By doing so, we may attain more stable macroeconomic activities. For example, a rule may be to increase public investment at a given growth rate. Moreover, the built-in stabilizer of the fiscal system is a typical example of non-discretionary fiscal policy. The built-in stabilizer affects macroeconomic activities counter-cyclically and instantaneously, so it certainly stabilizes aggregate demand fluctuations. Considering the uncertain lags of discretionary measures, it may be desirable to use the built-in stabilizer more than discretionary measures.

From the viewpoint of Keynesian economics, discretionary measures are desirable because the government can anticipate lags of policy; thus, the size of the multiplier should be significantly large. However, from the viewpoint of neoclassical economics, rules are desirable because the government cannot anticipate lags of policy correctly; thus, the size of the multiplier should be significantly limited. Since discretionary measures produce distortions, it is better for the government not to conduct any discretionary measures even in a recession unless the recession is permanent.

Appendix: Public Investment in Japan

A1 Introduction

As explained in Chap. 1, Japan's current fiscal situation is the weakest of all the G7 countries. This phenomenon can partly be attributed to a slowdown in economic growth since the 1990s and partly to increases in public works and social welfare spending owing to the adoption of Keynesian fiscal measures in an aging society. In this appendix, we first examine the macroeconomic effects of fiscal policy empirically. The multiplier effect of public works has decreased considerably in recent years; thus, its efficacy in stimulating aggregate demand is controversial. Consequently, we pay attention to the supply-side effect of public investment, as explained in Chap. 4.

Whether public capital provision is efficient in Japan is a crucial question from a normative perspective. The supply-side effect of public investment has decreased in recent years. In Japan, government spending, including public investment, has been gradually rising because of political pressure from local interest groups, resulting in large budget deficits. Thus, it is important to consider the role of political factors in public investment policies.

A2 The Efficacy of Public Investment as a Counter-Cyclical Measure

With regard to a normal business cycle, output fluctuations cause recessions temporally and repeatedly. As long as the macroeconomic condition is sustainable, a recession should be temporary. Thus, the government may still attain the potential growth path in the long run. Although expansionary fiscal measures may be needed in a recession, built-in stabilizers can achieve macroeconomic stabilization faster than discretionary fiscal measures if we consider the problem of policy lags seriously, as explained in Sect. 4 of the main text of this chapter.

It is usually desirable to have a small deficit during a recession in the event of ordinary fluctuations. This policy implication holds for both the Keynesian and neoclassical models, as explained in Chap. 6. Whereas the Keynesian model utilizes fiscal deficits as a tool for stabilizing measures, the neoclassical model utilizes fiscal deficits as a tool for smoothing out tax revenues over time.

To sum up, an automatic built-in stabilizer must be primarily used for ordinary fluctuations, whereas an expansionary discretionary policy must be implemented for severe fluctuations. Moreover, the discretionary policy measure should be consistent with long-run fiscal sustainability. From the viewpoint of fiscal consolidation, it may also be useful to impose automatic fiscal stabilizing mechanisms on the budgetary system; thus, if deficits increase, public spending automatically decreases and taxes automatically increase. Moreover, it is desirable to improve the fiscal condition before another recession occurs.

Considering the above developments, many studies on Japan's public investment empirically examine the macroeconomic effects of public investment policy as a tool of discretionary fiscal measures. There are competing arguments regarding the efficacy of such policy. One is that the effects of public investment policy were highly significant in 1990s; hence, the recession would have deepened without fiscal expansion.

In contrast, another argument is that public investment policy did not have an adequate expansionary effect to increase macroeconomic activity; hence, unlimited public investment expenditure simply worsened the fiscal crisis.

These opposing arguments, which lead to different policy implications, originate from different understanding of the macroeconomic analytical framework. Namely, the former argument is based on the conventional Keynesian model of liquidity-constrained agents, whereas the latter is based on the neoclassical model of rational agents.

Using the vector autoregression (VAR) method, Ihori et al. (2002) showed that fiscal policies generated limited effects on output in Japan. Namely, tax policies did not have a stronger effect on output than changes in government expenditure. Further, the effect of public investment policies was too marginal to recover macroeconomic activities, which is consistent with the latter view based on the neoclassical model of rational agents. In this study, we showed that the multiplier effect of public works has considerably reduced in recent years; hence, its efficacy in stimulating aggregate demand is controversial.

Some recent studies, including those of Kato (2010), Watanabe et al. (2010), and Hirai and Nomura (2012), estimated fiscal multipliers using recent data in Japan and found the limited effects of public investment.

When the fiscal situation becomes severe, fiscal reconstruction may stimulate private consumption and investment because of the “non-Keynesian” effect (see Chap. 4 for a detailed explanation of this effect). Contrary to the conventional “Keynesian effect,” this effect implies that if public investment spending is wasteful or if the fiscal condition is adverse, fiscal consolidation measures such as a reduction in public investment spending and/or an increase in taxes tend to stimulate private demand. If a non-Keynesian effect actually occurs, the government can attain fiscal sustainability and economic recovery simultaneously.

This argument is consistent with the analytical understanding that fiscal conditions and the usefulness of public investment influence the effectiveness of counter-cyclical policies. The deteriorating fiscal situation in Japan and the declining benefit of public works may suggest that the “non-Keynesian” effect has had some relevance in recent years.

According to Nakazato (2002) and Kameda (2008), among others, during sustainable periods in Japan, when the ratios of fiscal deficit and debt outstanding to GDP were smaller than a certain level, the standard Keynesian effect could be observed. However, during unsustainable periods, when both ratios were significantly higher than a certain level, a non-Keynesian effect occurred. In these situations, expansionary fiscal measures such as increasing public investment spending and/or decreasing tax revenues depressed private demand, thereby deteriorating the fiscal situation. Chapter 4 explains the non-Keynesian effect to some extent.

A3 Fiscal Policy and the Optimal Size of Public Investment

The optimal size of public investment depends upon the way in which counter-cyclical fiscal policy is needed and its effect. Since the benefit of counter-cyclical fiscal measures has been limited recently in Japan, we must pay more attention to the supply side of public investment than the demand side. With severe fiscal constraints, Japan’s public investment policy must be reformed so as to attain sustainability.

In order to attain a sustainable public investment policy, it may also be useful to impose the stable public investment policy rule. For example, we may impose an institutional setting on both counter-cyclical fiscal policy and pro-cyclical public investment management. In the standard budgetary system, built-in stabilizers have been imposed such that social welfare spending is automatically raised and taxes are automatically reduced in a recession as a result of progressive income tax, the social welfare system, unemployment benefits, and so on.

Automatic built-in stabilizers usually improve the macroeconomic situation. In addition, the government may impose automatic public investment expenditure stabilizers on the budgetary system. Namely, even if fiscal conditions worsen, the

budgetary system may automatically maintain the predetermined level of public investment expenditure over time by raising taxes or issuing debt. At the same time, this rule implies that the government should not heavily use public investment as a Keynesian discretionary fiscal measure.

However, automatic public investment stabilizers are fiscal rules that must be utilized over time as commitments, such as to maintain the optimal size of public investment even under a recession, which are built into the budgetary system. Such commitments are effective for stable public capital accumulation in a political economy. If the size of public works is predetermined automatically and the interest groups can anticipate this rule in advance, they have no incentives to demand further public investment.

Further, even when public investment is raised because of inefficient cost factors, the tax burden will automatically be increased further in the near future so as to meet the sustainable government budget. Hence, interest groups should recognize the cost of public investment; consequently, they have an incentive to cooperate immediately with the government's efforts for efficient and effective public investment reforms.

In order to attain stable public investment for sustainability, public investment management is necessary from the long-run perspective. An ex ante public investment stabilization rule is a more feasible and credible method for stimulating aggregate demand than discretionary measures such as an ex post public investment increase. Moreover, the former is more effective for reducing the cost of public works and attaining fiscal sustainability than the latter in a political economy.

Questions

- 2.1 The multiplier of raising public investment is always greater than that of reducing taxes. However, many voters tend to support tax reduction more than an increase in public investment. Why?
- 2.2 Many countries ask other countries to conduct more expansionary fiscal measures but they would not like to do so by themselves. Why?
- 2.3 In the simple Keynesian model, assume that the consumption function is given by

$$C = 200 + 0.75(Y - T)$$

Investment is 100 and government spending and taxes increase by both 100. What is the fiscal multiplier?

References

- Hirai, K., & Nomura, M. (2012). Causality between government spending and revenue in Japan. *Kagawa University Economic Review*, 74, 259–282 (in Japanese).

- Ihori, T., Nakazato, T., & Kawade, M. (2002). Japan's fiscal policies in the 1990s. *The World Economy*, 26, 325–338.
- Kameda, K. (2008). An empirical analysis of non-Keynesian effects on private demand in Japan. *Kwansei Gakuin University Economic Review* (in Japanese).
- Kato, H. (2010). An examination of the impact of public spending on private demand. *Meiji University Economic Review*, 78, 167–206 (in Japanese).
- Mankiw, N. G. (2014). *Principles of macroeconomics*. New York: The Dryden Press.
- Nakazato, T. (2002). Issues on non-Keynesian effects in Japan. *Economic Analysis*, 163. Economic and Social Research Institute (in Japanese).
- Watanabe, Yabutomo, T. R., & Ito, S. (2010). An estimation of fiscal multipliers using institutional information. In T. Ihori (Ed.), *Fiscal policy and social security* (pp. 143–177). Tokyo: Keio University Press (in Japanese).

1 The Permanent Level of Fiscal Variables

1.1 Definition of the Permanent Level of an Economic Variable

In this chapter, we investigate the multiplier of government spending using a neoclassical macroeconomic model. In the neoclassical model, households behave rationally over time so that they may anticipate future economic conditions, including future fiscal policy, and current fiscal policy. Thus, when current government spending changes, the way in which it affects future fiscal variables has an important policy implication. In this situation, the notion of a permanent level of fiscal variables becomes useful. First, let us explain this notion.

For simplicity, imagine a two-period model with current (period 1) and future (period 2) periods. The permanent level of an economic variable Y is Y_p and is defined as the value that has the same value in both periods. At the same time, the present value is also equal to that of the original values, Y_1 and Y_2 . Namely, if Y_1 and Y_2 are given, Y_p is defined as the following equation:

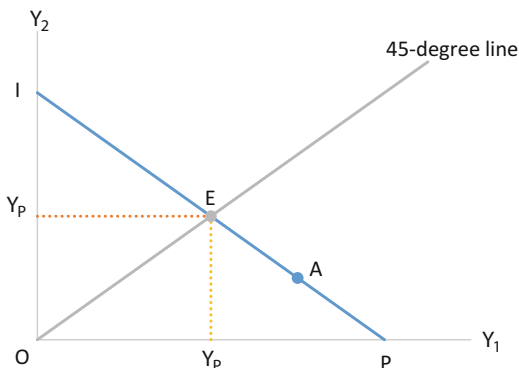
$$Y_p \left[1 + \frac{1}{1+r} \right] = Y_1 + \frac{1}{1+r} Y_2. \quad (3.1)$$

Here, r is the rate of interest.

Figure 3.1 shows the relationship between the permanent level of variables and the actual level of variables. Suppose Y_1 and Y_2 are given at point A. We can then draw the budget line that gives the same present value of Y_1 and Y_2 ; namely, point A on Line PI, which corresponds to Eq. (3.1), is associated with the actual combination of Y , (Y_1 , Y_2).

Following the definition of the permanent level, point E, which is the intersection of Line PI and the 45-degree line, is associated with the permanent level, Y_p . Any point on Line PI is associated with the same present value; thus, its permanent

Fig. 3.1 The permanent level of variables and actual level of variables



value is the same. Simultaneously, at any point on the 45-degree line, the value is the same in both periods. Hence, the permanent value is given by point E.

For example, suppose $r = 0$ for simplicity. $Y_1 = 10$, $Y_2 = 50$. Then, Y_p is given as

$$Y_p[1 + 1] = 10 + 50.$$

Thus, $Y_p = 30$. In other words, $Y_1 = Y_2 = 30$ gives the same present value of the actual pattern of $Y_1 = 10$, $Y_2 = 50$ if $r = 0$. If $r = 0.25$, then

$$Y_p[1 + 0.8] = 10 + 0.8 \times 50.$$

Thus,

$$Y_p = 50/1.8 = 27.77 \dots$$

1.2 The Government's Budget Constraint

Following this definition, permanent levels of government spending G and taxes T are given respectively as G_p and T_p , which satisfy the following equations.

$$G_p \left[1 + \frac{1}{1+r} \right] = G_1 + \frac{1}{1+r} G_2 \text{ and}$$

$$T_p \left[1 + \frac{1}{1+r} \right] = T_1 + \frac{1}{1+r} T_2$$

where G_1 and T_1 are government spending and taxes for period 1 respectively, and G_2 and T_2 are government spending and taxes for period 2 respectively.

Now, the government's budget constraints in both periods are given as

$$G_1 = T_1 + B \text{ and} \quad (3.2)$$

$$(1 + r)B + G_2 = T_2 \quad (3.3)$$

where B is one-period maturity public debt.

When a budget deficit occurs in period 1 as an amount of $G_1 - T_1$, one-period public debt B is issued in accordance with the amount. Since one-period maturity public debt has to be redeemed in period 2, the amount of $(1 + r)B$ is needed for debt redemption. In addition, government spending in period 2, G_2 , needs money. The total spending, $(1 + r)B + G_2$ in period 2 must be financed by raising taxes. Since period 2 is the end period in the two-period model, the government cannot issue new bonds in period 2.

Eliminating B from Eqs. (3.2) and (3.3), government budget constraint in the present value is given as

$$G_1 + \frac{1}{1+r}G_2 = T_1 + \frac{1}{1+r}T_2. \quad (3.4)$$

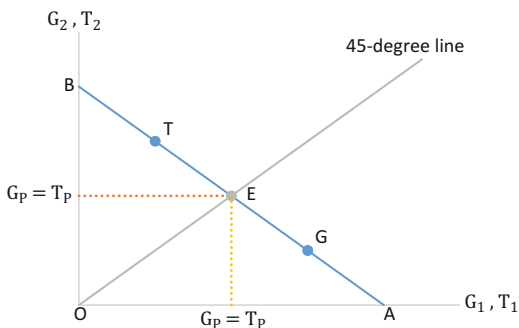
Using the notation of permanent variables, this equation is equivalent to

$$G_p = T_p \quad (3.4')$$

The permanent level of government spending must be equal to the permanent level of tax revenue, irrespective of the size of bond issuance.

Figure 3.2 shows this relationship. In this figure, point G on line AB associated with Eq. (3.4) denotes the actual combination of government spending (G_1, G_2), while point T shows the actual combination of taxes (T_1, T_2). Point E denotes the permanent level. Since the present value is the same between spending and taxes, the permanent level is also the same between spending and taxes. The government may choose any combination of government spending and taxes on line AB . Point G could be different from point T ; however, Eqs. (3.4) or (3.4') requires that G and T are on the same budget line AB . The government may choose B under this constraint.

Fig. 3.2 The government's budget constraint



Debt issuance, B , corresponds to the gap between point G and point T . By changing B , the government may choose any point T on AB at the given level of G . However, since E does not change, we always have $G_p = T_p$. This means that the present value amount of the tax burden is determined by the present value amount of government spending, independent of the amount of public debt.

As explained later, rational households are indifferent about the financing method as long as government spending is fixed. As explained in Chap. 4, this corresponds to the Ricardian neutrality theorem of public debt.

2 Consumption and Saving Behavior

2.1 Optimization Over Time

In the neoclassical model, households' consumption behavior is derived by optimization over time. Using a simple two-period model, we explain households' forward-looking behavior. For a useful textbook on macroeconomics based on the neoclassical approach, see Barro (2008).

Consumers' utility may depend on the first period's consumption, C_1 , and the second period's consumption, C_2 . Thus, the representative household's utility function is given as

$$U = U(C_1, C_2) = V(C_1) + \frac{1}{1+\rho} V(C_2) \quad (3.5)$$

where ρ is the rate of time preference. An increase in ρ means that the agent discounts the utility from future consumption to a significant extent. When ρ is high, the agent evaluates the utility from present consumption more than the utility from future consumption.

The budget constraint in each period is given respectively as

$$Y_1 = C_1 + S + T_1 \text{ and} \quad (3.6)$$

$$Y_2 + (1+r)S = C_2 + T_2 \quad (3.7)$$

where Y_1 and Y_2 denote labor income in each period. S denotes savings. For simplicity, these incomes are exogenously fixed in this section. We explain the optimizing behavior of labor supply in Sect. 3.

Equation (3.6) means that income in the first period Y_1 may be divided between first period consumption, saving, and tax payment. Equation (3.7) means that the second period income Y_2 plus interest income and savings $(1+r)s$ may be divided between second period consumption C_2 and tax payment T_2 .

By eliminating S from these two equations, we have the present value budget constraint of a private agent as

$$C_1 + \frac{1}{1+r}C_2 = Y_1 - T_1 + \frac{1}{1+r}(Y_2 - T_2) = (Y_p - T_p)\left(1 + \frac{1}{1+r}\right). \quad (3.8)$$

Or

$$C_p = G_p - T_p \quad (3.8')$$

The present value of consumption, the left-hand side of Eq. (3.8), is equal to the present value of disposable income, the right-hand side of Eq. (3.8), which is equal to the present value of permanent income minus permanent government spending; namely, the present value of permanent disposable income.

Households determine first-period and second-period consumption so as to maximize the utility given by Eq. (3.5) subject to Eq. (3.8).

2.2 The Permanent Income Hypothesis

If the rate of interest r is equal to the rate of time preference ρ , as shown in Fig. 3.3, the optimal point E , which is a tangent to the indifference curve on AB , is also on the 45-degree line. The slope of an indifference curve is given as

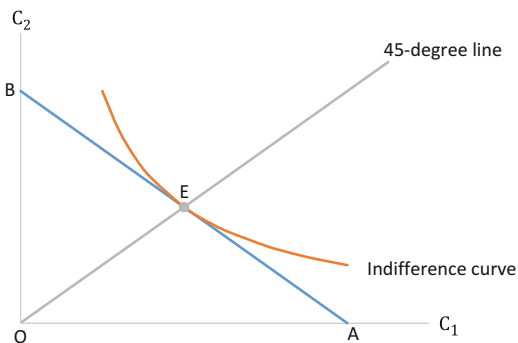
$$\frac{dC_2}{dC_1} = (1 + \rho) \frac{V'(C_1)}{V'(C_2)}.$$

This value reduces to $1 + \rho$ on the 45-degree line where $C_1 = C_2$. If $r = \rho$, this value is equal to $1 + r$. Hence, the slope of an indifference curve is equal to the slope of the budget line at point E . Namely, the optimality condition is satisfied at point E .

Thus, we have as the consumption function,

$$C_1 = C_2 = Y_p - G_p. \quad (3.9)$$

Fig. 3.3 Consumption and saving



In other words, households consume permanent disposable income in each period. Further, the optimal level of consumption is the same over time. This is consumption-smoothing behavior.

Note that the rate of time preference corresponds to the slope of an indifference curve, while the rate of interest corresponds to the slope of the budget line. The time preference rate ρ refers to the way in which the consumer evaluates present utility compared with future utility. The higher the time preference rate, the longer the period of the future that is evaluated.

Generally speaking, the time preference and the interest rate are not always equalized. If the interest rate becomes higher, future consumption is evaluated more than present consumption. However, if the time preference rate is higher, present consumption is evaluated more than future consumption. If both rates are almost the same, consumption does not vary much over time. In reality, we observe that consumption fluctuations are not significant compared with income fluctuations in the short run. The permanent income hypothesis can explain effectively such stable consumption movements over time by using a simple model.

In the long run, consumption may increase as economic growth occurs. As explained in Chap. 5, if the rate of interest is greater than the rate of time preference, consumption rises.

In the permanent income hypothesis, the marginal propensity to consume from increases in permanent income is close to 1. This is not inconsistent with the Keynesian model, which states that the marginal propensity to consume from current income Y_1 is less than 1. In the Keynesian model, an increase in Y_1 raises both C_1 and S ; thus, an increase in C_1 is less than an increase in Y_1 . This reaction is qualitatively true, as in the permanent income hypothesis. Note that an increase in Y_p is normally less than an increase in Y_1 . Hence, a change in C_1 is almost the same as a change in Y_p . The significant difference to the Keynesian consumption function is that consumption depends only upon permanent disposable income.

From this point on, we use Eq. (3.9) as the consumption function of the neoclassical model.

3 The Labor Market and Supply Function

3.1 Labor Supply by Households

Next, let us formulate labor supply by households. For simplicity, we have so far assumed that labor income is fixed and households do not choose their leisure and labor supply optimally. In the neoclassical model, households optimally allocate leisure and labor supply among the initial holdings of time (24 h per day and so on). In the labor market, the wage rate is determined so as to attain full employment. The neoclassical macroeconomic model does not consider involuntary unemployment at least in the long run.

The standard utility function is given as

$$U = U(c, L) \quad (3.10)$$

where c is consumption and L is labor. Utility U increases with c and decreases with L . The budget constraint is given as

$$c = wL \quad (3.11)$$

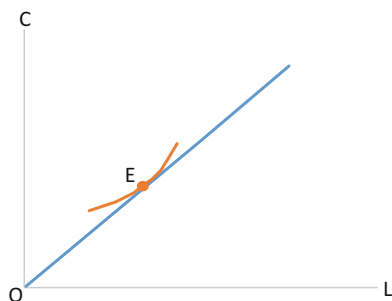
where w is wage rate. The right-hand side of Eq. (3.11) means labor income. The household optimally determines its labor supply to maximize its utility (3.10) subject to its budget constraint (3.11).

As shown in Fig. 3.4, the point E, where the budget line is tangent to an indifference curve, is optimum. At this point, the marginal benefit of raising labor supply, the slope of the budget line, is equal to the marginal cost, the slope of the indifference curve.

An increase in wage raises the relative attractiveness of labor supply compared with leisure, a situation that is the substitution effect. However, such an increase raises the demand for leisure and reduces labor supply since leisure is a normal good. This corresponds to the income effect. Thus, if the substitution effect is greater than the income effect, it stimulates labor supply. See Chap. 8 for further explanations of substitution and the income effects on labor supply.

Let us now investigate the effect of the interest rate on labor supply. It seems that this effect is rather marginal in the static model discussed above. However, if we consider an intertemporal framework, this effect could be important. Suppose the agent chooses consumption and labor in two periods, the present and a future period. An increase in the interest rate causes an intertemporal substitution effect that attracts future goods and leisure consumption compared with current goods and leisure consumption. As explained in Sect. 1, if the rate of interest increases, future consumption is stimulated because of the substitution effect. We may regard leisure as a component of consumption. Then, because of an increase in the interest rate, the intertemporal substitution effect means that current leisure consumption declines and current labor supply increases.

Fig. 3.4 Labor supply



Thus, if the substitution effect is large enough, an increase in r or w stimulates labor supply, L_s . We assume this. Then, households' labor supply increases with the interest rate, r , and wage rate, w .

$$L_s = L_s(r, w). \quad (3.12)$$

3.2 Labor Demand by Firms

Labor demand L_d by firms decreases with wages and increases with the rate of interest. w is the cost of employment and r is the cost of renting capital. When w/r is higher, it is more profitable to substitute capital with labor. We may explain this relationship based on a simple optimization problem of a representative firm.

Suppose the representative firm's profit π is given as

$$\pi = Y - wL - rK \quad (3.13)$$

where Y is output, w is wage, r is the rental cost of capital, L is labor and K is capital. For simplicity, the price of output is assumed to be 1. The production function is given as

$$Y = F(K, L). \quad (3.14)$$

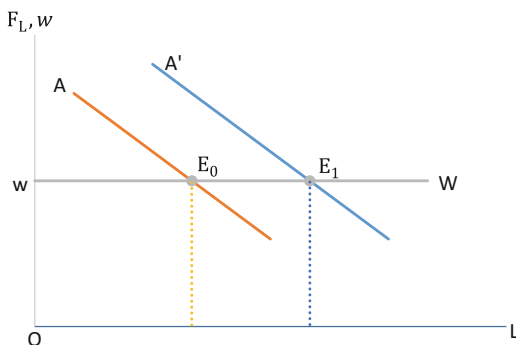
The firm maximizes profit (3.13) subject to Eq. (3.14). The optimality conditions are given as

$$F_K = r, F_L = w \quad (3.15)$$

where F_K is the marginal productivity of capital and F_L is the marginal productivity of labor.

As shown in Fig. 3.5, labor demand is determined by the intersection of wage line W and the marginal productivity of labor curve A at point E_0 . When wage w increases, the W curve moves upward and labor demand is depressed. When the

Fig. 3.5 Labor demand



rental cost of capital increases, it depresses demand for capital. If K decreases, the marginal product of labor increases; thus, it moves the A curve upward to A' , stimulating labor demand. The intersection then moves from point E_0 to E_1 in Fig. 3.5. If the capital market is perfect, the rental cost of capital is equal to the rate of interest.

Thus, labor demand L_d decreases with wage, w , and increases with the interest rate, r .

$$L_d = L_d(w, r). \quad (3.16)$$

3.3 Equilibrium in the Labor Market

As shown in Fig. 3.6, the equilibrium point in the labor market is given as point E , where Eqs. (3.12) and (3.16) are valid at the same time.

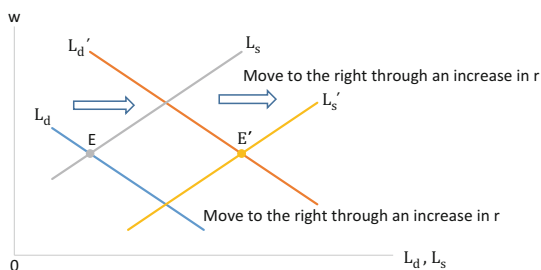
$$L_s(w, r) = L_d(w, r).$$

In this figure, the vertical axis is the wage rate and the horizontal axis is labor. This figure is drawn at a given rate of interest; thus, r is a shift parameter. In the neoclassical framework, because of the price mechanism, wages are adjusted so as to realize this equilibrium at all times. Thus, full employment is attained in the labor market and involuntary unemployment does not occur. Figure 3.6 shows the initial equilibrium point, F , where L_d and L_s curves intersect.

Since labor supply increases with the rate of interest, an increase in r moves the supply curve, L_s to $L_{s'}$, to the right. Similarly, such an increase moves the demand curve, L_d to $L_{d'}$, to the right and upward. At the new equilibrium E' , wages do not change significantly and labor supply increases; namely, an increase in r stimulates labor employment and hence production. This relationship may be summarized as the supply function of goods.

In other words, the aggregate supply function, which shows GDP associated with the rate of interest, is an increasing function of r . Thus,

Fig. 3.6 Equilibrium in the labor market



$$Y_s = Y_s(r) \quad (3.17)$$

where Y_s denotes the supply of GDP. Since capital does not change in the short run, labor supply determines output, Y . Equation (3.17) shows that full employment output increases with the rate of interest. For simplicity, from this point, we assume that wages are fixed even if the rate of interest changes. Alternatively, the impact of changes in wages is assumed to be limited.

4 Equilibrium in the Goods Market

The supply of goods is given by Eq. (3.17), while the aggregate demand is given as $C + I + G$, where the consumption function is given by Eq. (3.9). Thus, the equilibrium condition in the goods market is given as

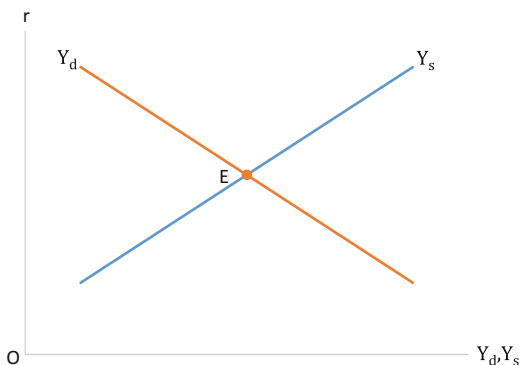
$$Y_s(r) = C(Y_p - G_p) + I(r) + G. \quad (3.18)$$

Investment demand I decreases with the interest rate, r , as in the Keynesian model.

Let us investigate the effect of r on $Y_p - G_p$. A change in r may affect $Y_p - G_p$ ambiguously. As shown in Fig. 3.2, if G_1 and G_2 are not so divergent, namely if point G is close to point E , a change in r does not greatly affect G_p . If $Y_1 > Y_2$, an increase in r raises Y_p . However, an increase in r may stimulate current labor supply and Y_1 , thereby depressing Y_2 . Since these effects offset each other, for simplicity we assume that r does not affect $Y_p - G_p$.

Based on these arguments, r does not affect consumption, although it depresses investment. Thus, demand decreases with r . In contrast, supply increases with r . These curves are shown in Fig. 3.7. In this figure, the vertical axis denotes the rate of interest, r , and the horizontal axis denotes the demand and supply of output, Y_d and Y_s . The aggregate supply curve Y_s increases with interest rate r , while the aggregate demand curve Y_d decreases with r . The intersection of both curves, at point E , shows the equilibrium point in the goods market.

Fig. 3.7 Equilibrium in the goods market



This figure looks like the IS/LM figure of the Keynesian model in Chap. 2, where the IS curve is downward sloping and the LM curve is upward sloping. The intersection of both curves shows the equilibrium point in the goods market. However, the economic implications are completely different; namely, equilibrium is always at full employment and involuntary unemployment does not exist in the neoclassical model. In addition, consumption depends upon permanent disposable income, not current disposable income. Using this neoclassical model, let us investigate the multiplier effect of government spending.

5 The Effect of Fiscal Policy

5.1 Three Cases of Fiscal Expansion

Government spending may include current spending and/or future spending. The same is true for taxes. The size of the multiplier depends upon how government spending and taxes change over time. In the neoclassical model, households behave rationally in the sense that they optimize consumption and saving plans in consideration of future fiscal changes and current fiscal policy. In this regard, it is useful to investigate the effect of fiscal policy in the following three cases.

- (i) Temporary expansion: Current government spending increases but permanent government spending does not ($\Delta G > 0$, $\Delta G_p = 0$).
- (ii) Permanent expansion A: Current government spending does not increase but permanent spending increases ($\Delta G = 0$, $\Delta G_p > 0$).
- (iii) Permanent expansion B: Both current and permanent government spending increase ($\Delta G = \Delta G_p > 0$).

In case (i), future spending declines in order to offset current expansion; thus, permanent government spending remains fixed. In case (ii), future government spending is committed to increase; thus, permanent spending increases although current spending remains fixed. Case (iii) is regarded as the sum of case (i) and case (ii).

5.2 Temporary Expansion

First, we investigate case (i). Figure 3.8a shows the effect of fiscal policy in this situation. An increase in government spending moves the aggregate demand curve, Y_d to $Y_{d'}$, to the right. Hence, the equilibrium point moves from E_0 to E_1 . Income increases and the rate of interest rises.

These properties are qualitatively the same as in the IS/LM figure of the Keynesian model. Further, the movement from E_0 to E_1 may be divided into two parts: a move from E_0 to E_2 and a move from E_2 to E_1 . The first movement from E_0 to E_2 corresponds to the effect of fiscal policy at a given rate of interest; the second

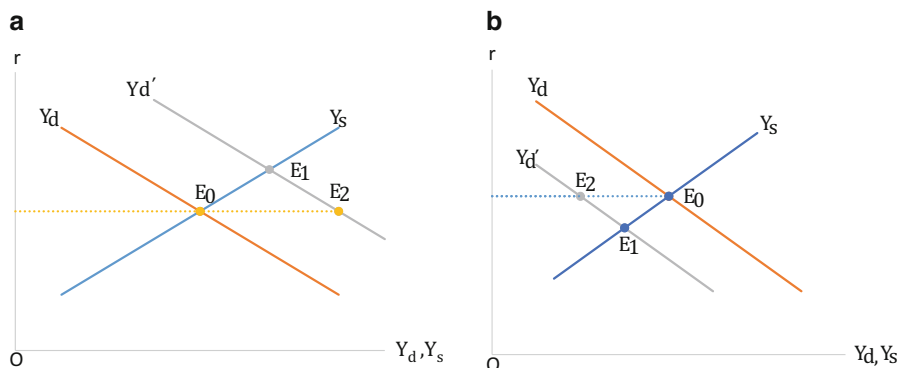


Fig. 3.8 The effect of fiscal policy (i) (a), and (ii) (b)

movement from E_2 to E_1 corresponds to the crowding-out effect of the increasing rate of interest. This interpretation is also similar to the Keynesian model.

However, a significant difference exists in the size of the multiplier. In the neoclassical model, the horizontal distance between E_0 and E_2 corresponds to a size of 1 and the direct impact of government spending increases; namely, even if the interest rate does not change, the size of the multiplier is at most 1.

Imagine that the interest rate is fixed; thus, investment demand does not change. Consequently, we have only to consider the effect on private consumption. Moreover, consumption does not change because $Y_p - G_p$ does not change in accordance with the definition of temporary expansion when G increases in case (i).

Case (i) is a combination of an increase in G_1 and a decrease in G_2 . Although the direct effect of increasing G_1 raises Y_1 , a reduction in G_2 in the second period reduces Y_2 ; hence, Y_p does not change. By definition, $G_p = T_p$ does not change. Thus, $Y_p - G_p$ does not change, and the aggregate demand increases only by the magnitude of an increase in G . The multiplier is 1 as a result of the move from E_0 to E_2 .

Indeed, the rate of interest rises. The movement from E_2 to E_1 means that an increase in the rate of interest depresses investment demand, thereby reducing income and the size of the multiplier. To sum up, the size of the multiplier from E_0 to E_1 is positive but less than unity. Thus, we have

$$0 < \Delta Y / \Delta G < 1 \quad (3.19)$$

which is smaller than in the Keynesian macroeconomic model. Namely, an increase in current government spending without permanent government spending partially crowds out private investment and does not affect private consumption.

5.3 Permanent Expansion A

Next, let us consider case (ii). Here, current government spending G_1 does not change. An increase in G_p depresses consumption since permanent tax rises. Namely, an increase in G_p means an increase in T_p , and hence reduces permanent disposable income by the same amount; as a result, consumption declines by the same amount. Note that the marginal propensity to consume from permanent disposable income is 1.

Although a future increase in G_2 raises Y_2 , Y_1 declines because of a reduction of consumption at G_1 , these being fixed. Further, a combination of a decrease in Y_1 and an increase in Y_2 means that Y_p does not change. In Fig. 3.8b, the aggregate demand curve Y_d moves to Y_d' to the left. The equilibrium point moves from E_0 to E_1 . At E_1 , the rate of interest declines. Income also declines to some extent.

As in Fig. 3.8a, the movement to a new equilibrium may be considered as movement through point E_2 . The movement from E_0 to E_2 means that private consumption declines by the amount of an increase in G_p ; in other words, the multiplier is -1 from E_0 to E_2 . The movement from E_2 to E_1 means that a decline in the rate of interest induces investment demand, resulting to some extent in the crowding-in effect. Thus, income increases but cannot completely offset the original decline during the movement from E_0 to E_2 . To sum up, the multiplier is negative but larger than -1 . Thus, we have

$$-1 < \Delta Y / \Delta G_p < 0. \quad (3.20)$$

The negative multiplier occurs in the neoclassical macroeconomic model. This is an interesting and seemingly paradoxical result. An increase in permanent government spending excluding current government spending crowds out private consumption completely and partially crowds in private investment. The crowding-out effect is greater than the crowding-in effect; hence, the multiplier becomes negative.

A natural conjecture is that a promise of expansionary fiscal policy in the near future would stimulate the current economy because agents may have more optimistic expectations about the future macroeconomic situation. However, our analysis in this section suggests that such a conjecture is not necessarily valid because future fiscal expansion also means an increase in the permanent tax burden, thereby reducing consumption demand from that point on.

In order to stimulate current aggregate demand, the government should not promise future fiscal expansion. This promise only means an increase in the permanent tax burden. If the government intends to raise GDP in the current period, the government should raise spending at once although the fiscal multiplier is less than expected in the Keynesian model.

5.4 Permanent Expansion B

Finally, let us consider case (iii). This case may be regarded as a combination of case (i) and case (ii). In case (i), the Y_d curve moves to the right, and in case (ii) it moves to the left. The size of each move is the same and is 1. Thus, if both moves occur at the same time, both effects cancel out perfectly, so that the Y_d curve does not move after all. Further, the equilibrium point does not move, neither income nor interest changes, and the multiplier is zero.

When government spending increases permanently from the present period, a reduction of private consumption completely offsets an increase in government spending; thus, the aggregate demand does not increase. Government spending crowd outs private consumption and not private investment.

A permanent increase in government spending means a permanent increase in taxes; hence, permanent disposable income declines, depressing consumption. This negative effect completely offsets the positive direct effect of expansionary government spending. The fiscal multiplier then becomes zero. Thus, we have

$$\Delta Y / \Delta G_p = 0. \quad (3.21)$$

An increase in permanent government spending with current government spending crowds out private consumption completely but does not affect private investment.

The three cases predict different multiplier effects. Although the size of multiplier depends on how fiscal policy affects future fiscal variables, the effect of fiscal policy is generally limited. Thus, we can say that the multiplier in the neoclassical model is much smaller than in the Keynesian model.

6 Evaluation of the Public Sector

6.1 Substitutability

So far, we have not investigated the benefit of government spending in the utility function. In Keynesian economics, even wasteful public spending can be useful in stimulating aggregate demand. If we include the benefit of government spending in the model, how is the neoclassical framework altered?

For simplicity, let us denote by θ the degree of substitutability between private consumption C and public spending G . Thus,

$$C^* = C + \theta G. \quad (3.22)$$

Here, effective consumption C^* appears in the utility function. Hence,

$$U = U(C_1^*, C_2^*) = V(C_1^*) + \frac{1}{1+\rho} V(C_2^*). \quad (3.5')$$

So far, we have assumed that $\theta = 0$. In terms of $\theta > 0$, we may add two channels to the analytical results.

One is the direct effect on private consumption. If the government raises public spending to almost the same level as private consumption, the latter directly declines. For example, if public education is very similar to private education, households reduce spending on private education when public spending on education increases. If a unity unit of government spending is the same as a θ unit of private spending, private consumption declines by the θ amount. This direct crowding out occurs if government spending actually increases. Further, the crowding out directly reduces private consumption at a given level of C_p^* . This is the direct substitution effect.

Another effect is on permanent income. If government spending is useful, it raises households' effective income, $Y_p - G_p + \theta G_p$. The degree of θ refers to how useful government spending is for households. A unity increase in government spending raises permanent income by θ amount, raising private consumption by θ amount. This effect occurs if permanent government spending increases.

Considering Eq. (3.22), private budget constraint is rewritten as

$$C_p^* = Y_p - G_p + \theta G_p. \quad (3.23)$$

Then, from the optimizing behavior we have

$$C_1^* = C_p^* = Y_p - G_p + \theta G_p \quad (3.24)$$

which is the consumption function in this section. Effective consumption is equal to permanent effective disposable income.

An increase in G_p raises permanent effective disposable income by the amount of θG_p , which is the third term in the right-hand side of the equation. This stimulates private consumption by the amount of θG_p . This is the permanent income effect.

6.2 The Multiplier Effect of Government Spending

Based on these arguments, let us investigate the multiplier effect of government spending again. In case (i), temporary expansion does not affect permanent income even if $\theta > 0$. We do not have the permanent income effect. Thus, because of the direct substitution effect, private consumption declines by the amount of θ . Namely, in Fig. 3.8a, the direct effect from E_0 to E_2 is now $1 - \theta$, and the multiplier becomes less than $1 - \theta$.

In case (ii), since current government spending does not change, we do not have the direct substitution effect between government spending and private consumption. However, we have the permanent income effect. Permanent government spending produces an increase in effective permanent income by the amount of θ .

Thus, in Fig. 3.8b, the movement from E_0 to E_2 produces an expansionary effect by the size of $-1 + \theta$. Since an increase in permanent government spending raises the tax burden by 1 and the benefits of government spending by θ , effective permanent income does not decline more than -1 . The multiplier becomes more than $-1 + \theta$ and less than θ .

Case (iii) is the sum of case (i) and case (ii). Since the direct income effect and the permanent income effect offset each other, the multiplier remains 0, irrespective of the size of θ .

6.3 Evaluation of Government Spending

In reality, how much is θ ? If θ is greater than 1, in cases (i) and (ii) the sign of the multiplier changes to its opposite. In this regard, the benefit of government spending is significantly large. When the initial level of government spending is small, the marginal benefit of spending is large. The marginal benefit decreases with the size of government spending. The multiplier effect deals with the marginal impact of government spending. Thus, θ should reflect the marginal evaluation of government spending. Since government spending increases greatly in a welfare state, the value of θ is not as large and is likely to be less than 1.

The Advanced Study of this chapter investigates more fully the effect of θ on consumption.

Appendix: The Size of Government Spending and the Private Sector's Evaluation

A1 Introduction

It is well known that higher government deficits have generally been accompanied by rapid growth in the relative size of public sectors. The causes of increased public sector deficits may lie in those structural factors which can cause public expenditure to expand faster than available revenue: high income elasticities of demand for public goods, adverse demographic trends that raise the ratio of dependents to the working population, planning and control deficiencies, and a downward rigidity in public spending programs. Whatever the cause of increased deficits, in the long run the size of government will be determined by the evaluation of the private sector.

This appendix explicitly incorporates the evaluation of the private sector regarding government spending and investigates the effects of government spending (including transfer payments) on private sector behavior. Thus, is private consumption sensitive to changes in government spending? In addition, to what extent, if any, is the scale of government evaluated as too much or too little by the private sector?

As explained in Chap. 2, the conventional Keynesian approach to modeling private sector consumption and saving behavior involves a rather asymmetric set of

assumptions about how the private sector perceives the various elements of government fiscal policy. As explained in the main text of this chapter, Bailey (1971) and Barro (1974) developed an alternative neoclassical approach to modeling private sector consumption and saving behavior based on a rational evaluation of the consequences of government fiscal policy. Further, Kormendi (1983) obtained support for his “consolidated approach” to fiscal policy by finding a substantial degree of substitutability between government spending and private consumption in the US economy.

The argument advanced in this appendix is that the private sector's evaluation of the size of government spending (including transfer payments) should be analyzed within an explicit intertemporal optimization framework. In this sense, this appendix is an extension of section 6 in the main text of this chapter. Section A2 develops theoretical considerations. Section A3 describes an empirical work on how the private sector perceives the size of government spending for the Japanese economy. Section A4 concludes this appendix.

A2 Theoretical Considerations

A2.1 Evaluation of Government Spending

The basic model is the standard infinite-horizon model where individuals act as though they are infinitely lived. The agent has time-separable preferences over private consumption, C , and the size of government spending, G ; namely the goods and services flowing from the government sector, GE , plus government transfer payments to individuals, TR . Thus, $G = GE + TR$.

Specifically, the individual's utility function is given by

$$V_t = \sum_{j=0}^{\infty} \left(\frac{1}{1+\delta} \right)^j U(C_{t+j}^*) \quad (3.A1)$$

where δ is a constant rate of time preference and $U()$ is a time-invariant, concave momentary utility function. $C^* = C + \theta G$ denotes the level of “effective” consumption. A unit of government expenditure yields the same utility as θ units of private consumption.

The index of the private sector's evaluation of government, θ , reflects the private sector's evaluation of how the size of government spending is beneficial to the private sector. In a strict sense, the evaluation of government purchases is different from that of transfer payments. For example, if government consumption is perfectly substitutable with private consumption, the evaluation of government consumption is unity ($\theta = 1$). In contrast, if individuals are perfectly identical, the private sector would be concerned only with net transfer payments (transfer payments TR minus taxes T), not with total transfer payments TR . In such an instance, the evaluation of transfer payments is zero ($\theta = 0$). In a real economy, individuals are not identical, and the private sector does not distinguish between

negative transfer payments and taxes. Here, the evaluation of transfer payments reflects some sort of beneficial externality.

It would be more desirable to allow for the possibility that the evaluation of government purchases is different from that of transfer payments. However, with respect to the fiscal reconstruction movement in recent years, it seems that the size of government spending is the primary concern. Thus, for a first approximation, it is assumed that individuals are concerned with the size of government spending including total transfer payments.

In the perfect capital market, the representative individual may accumulate or decumulate assets at the assumed constant real rate of interest r . Her or his budget constraint in period t is given by

$$\frac{W_{t+1}}{1+r} - W_t + C_t = Y_t - T_t + TR_t \quad (3.A2)$$

where W is beginning-of-period holdings of one-period assets (which include government debt), Y is labor earnings, T is tax payments, and TR is transfer payments. Under the solvency condition, forward substitution in (3.A2) yields

$$\sum_{j=0}^{\infty} \left(\frac{1}{1+r} \right)^j C_{t+j} = W_t + \sum_{j=0}^{\infty} \left(\frac{1}{1+r} \right)^j (Y_{t+j} - T_{t+j} + TR_{t+j}). \quad (3.A3)$$

Here, the left-hand side of Eq. (3.A3), the present discounted value of private consumption, is equal to the right-hand side of Eq. (3.A3), the initial asset holdings plus the present discounted value of after-tax labor earnings (net of transfers).

The government budget constraint in period t is

$$\frac{B_{t+1}}{1+r} - B_t = GE_t - T_t + TR_t \quad (3.A4)$$

where B is beginning-of-period outstanding government debt of one-period maturity and GE is government purchases. Under the solvency condition, government budget constraint (3.A4) may be utilized to produce, in terms of present values,

$$\sum_{j=0}^{\infty} \left(\frac{1}{1+r} \right)^j T_{t+j} = B_t + \sum_{j=0}^{\infty} \left(\frac{1}{1+r} \right)^j (GE_{t+j} + TR_{t+j}). \quad (3.A5)$$

Here, the left-hand side of Eq. (3.A5), the present discounted value of tax revenue is equal to the right-hand-side of Eq. (3.A5), the initial government debt plus the present discounted value of government spending. The representative individual is assumed to be forward-looking with regard to the fiscal variables of the government. He or she recognizes the future tax obligations implicit in current debt issuance, which allows an equivalence between tax and debt finance of a given government expenditure stream.

A2.2 Optimal Size of Government Spending

Thus, the private and public sectors can be integrated by substitution of the government budget constraint (3.A5) into the private budget constraint (3.A3) to obtain the effective lifetime budget constraint,

$$\sum_{j=0}^{\infty} \left(\frac{1}{1+r} \right)^j C_{t+j}^* = W_t - B_t + \sum_{j=0}^{\infty} \left(\frac{1}{1+r} \right)^j (Y_{t+j} + \theta^* G_{t+j}), \quad (3.A6a)$$

where θ^* is defined by

$$\theta^* = (\theta - 1)e + \theta(1 - e) \quad (3.A6b)$$

and $e (= GE/G)$ is the government purchases/government spending ratio. The last term arises because a higher level of government spending imposes a negative (positive) wealth effect on the representative individual as long as $\theta^* < (>) 0$. If $\theta^* > 0$, a higher level of government spending has a desirable wealth effect and the initial level of government spending may be evaluated as too little. However, if $\theta^* < 0$, a higher level of government spending has an undesirable wealth effect and the initial level of government spending may be evaluated as too much. In this sense, $\theta^* = 0$ is associated with the optimal size of government spending. Substituting $\theta^* = 0$ into (3.A6b), we have $\theta = e$. Thus, the size of government spending may be evaluated as too little (too much) if $\theta > e$ ($\theta < e$).

A2.3 Optimizing Behavior

The maximization of the representative individual's objective function (3.A1), subject to the effective intertemporal budget constraint (3.A6a), yields as the first-order necessary condition

$$\Delta U^{t+j} = \lambda \left(\frac{1+\delta}{1+r} \right)^j \quad (j = 0, 1, 2, \dots) \quad (3.A7)$$

together with the intertemporal budget constraint (3.A6a, 3.A6b).

Here, $\Delta U^{t+j} \equiv dU(C_{t+j}^*)/dC_{t+j}^*$, and λ is a Lagrange multiplier attached to (3.A6a, 3.A6b) in the consumer's maximization problem. Consideration of the choice of consumption in the adjacent periods ($t, t+1$) then leads to the Euler equation,

$$\Delta U^{t+j} = \left(\frac{1+\delta}{1+r} \right)^j \Delta U^t. \quad (3.A8)$$

In order for the representative individual to choose an optimal interior time path for consumption, it must be that he or she cannot improve her or his welfare standing by reducing consumption in one period t and by increasing consumption during

another period, say $t+1$. The cost of reducing consumption during period t would be a reduction in utility, ΔU^t . The benefit of this action would be a gain in utility during period $t+1$, $(1+r)\Delta U^{t+1}$, which would be subjectively discounted to $(1+r)/(1+\delta)\Delta U^{t+1}$.

A2.4 Indirect Test

We consider an indirect test to evaluate the size of government. For simplicity, government expenditures are initially set at the stationary level, $G_{t+j} = \bar{G}$ ($j = 0, 1, 2, \dots$). Let $\{\bar{C}_{t+j} \text{ (} j = 0, 1, 2, \dots \text{)}\}$ and $\{\bar{C}_{t+j}^* \text{ (} j = 0, 1, 2, \dots \text{)}\}$ denote the initially optimal private consumption program and the effective consumption program respectively. From Eq. (3.A8), $\{\bar{C}_{t+j}^*\}$ satisfies

$$\Delta U(\bar{C}_{t+j}^*) = \left(\frac{1+\delta}{1+r}\right)^j \Delta U(\bar{C}_t^*) \quad (j = 1, 2, \dots) \quad (3.A9)$$

Suppose the government increases the level of government spending in period $t+1$ only, $\Delta G_{t+1} > 0$. At the beginning of period t , this policy change may be unknown to the representative individual.

(i) Unanticipated Case.

If the representative individual does not anticipate ΔG_{t+1} in period t , how will he or she determine C_{t+1} ? Because he or she does not know ΔG_{t+1} until period $t+1$, $C_t = \bar{C}_t$. In period $t+1$, he or she knows ΔG_{t+1} . $C_{t+1} = \bar{C}_{t+1} - e\Delta G_{t+1}$ is optimal if and only if $\theta^* = 0$ ($\theta = e$) at $G_{t+1} = \bar{G}$. It follows that $\Delta C_{t+1} = \Delta C_{t+1} + \theta\Delta G_{t+1} = 0$ at $\Delta C_{t+1} = -e\Delta G_{t+1}$. Hence, the private consumption program $\{\bar{C}_{t+1} - e\Delta G_{t+1}, \bar{C}_{t+1}, \bar{C}_{t+2}, \bar{C}_{t+3}, \dots\}$ satisfies the Euler Eq. (3.A9) at the beginning of period $t+1$.

If $\theta^* > 0$ ($\theta > e$), $\Delta C_{t+1}^* > 0$ at $\Delta C_{t+1} = -e\Delta G_{t+1}$. Hence under the private consumption program $\{\bar{C}_{t+1} - e\Delta G_{t+1}, \bar{C}_{t+1}, \bar{C}_{t+2}, \bar{C}_{t+3}, \dots\}$, only C_{t+1}^* is increased compared with the initial equilibrium. Hence, $C_{t+1}^* > \bar{C}_{t+1}^*$ and $C_{t+1+j}^* (j = 1, 2, \dots)$. Thus, we have

$$\Delta U(\bar{C}_{t+1+j}^*) > \left(\frac{1+\delta}{1+r}\right)^j \Delta U(\bar{C}_{t+1}^*) \quad (j = 1, 2, \dots). \quad (3.A10)$$

Consequently, in order to restore the Euler equation, the optimal private consumption program in the unanticipated case $\{C_{t+1}^u, C_{t+2}^u, C_{t+3}^u, \dots\}$ satisfies

$$C_{t+1}^u < \bar{C}_{t+1} - e\Delta G_{t+1} \quad (3.A11)$$

$$C_{t+1+j}^u > \bar{C}_{t+1+j} \quad (j = 1, 2, \dots)$$

However, if $\theta^* < 0$, we have

$$C_{t+1}^u > \bar{C}_{t+1} - e\Delta G_{t+1} \quad \text{and} \quad (3.A12)$$

$$C_{t+1+j}^u < \bar{C}_{t+1+j}$$

(ii) Anticipated Case.

We now consider the situation where ΔG_{t+1} is known to the representative individual in period t . It is possible for him or her to change C_t . If $\theta^* = 0$ ($\theta = e$), as in the unanticipated case, the private consumption program $\{\bar{C}_{t+1} - e\Delta G_{t+1}, \bar{C}_{t+1}, \bar{C}_{t+2}, \bar{C}_{t+3}, \dots\}$ is optimal and satisfies the Euler equation at the beginning of period t . It is not necessary to change C_t . If $\theta^* > 0$ ($\theta > e$), under the private consumption program $\{\bar{C}_t, C_{t+1}^u, C_{t+2}^u, \dots\}$ we have

$$\Delta U(C_{t+1+j}^*) = \left(\frac{1+\delta}{1+r}\right)^j \Delta U(C_{t+1}^*) \quad (j = 1, 2, \dots) \quad (3.A13)$$

and $C_{t+1+j}^* > \bar{C}_{t+1+j}^*$. Thus, considering Eq. (3.A9), we obtain

$$\Delta U(C_{t+j}^*) < \left(\frac{1+\delta}{1+r}\right)^j \Delta U(C_t^*). \quad (3.A14)$$

In order to restore the Euler equation at the beginning of period t , the optimal private consumption program in the anticipated case $\{C_t^a, C_{t+1}^a, C_{t+2}^a, \dots\}$ satisfies

$$C_t^a > \bar{C}_t \quad \text{and} \quad (3.A15)$$

$$C_{t+j}^a < C_{t+j}^u \quad (j = 1, 2, \dots).$$

However, if $\theta^* < 0$ ($\theta < e$), we have

$$C_t^a < \bar{C}_t \quad \text{and} \quad (3.A16)$$

$$C_{t+j}^a > C_{t+j}^u \quad (j = 1, 2, \dots).$$

If $\theta^* > 0$, the marginal benefit of government expenditure is greater than the marginal cost. G is too little. However, if $\theta^* < 0$, the marginal benefit of government expenditure is greater than the marginal cost. G is too much.

Equations (3.A15) and (3.A16) imply that if G is initially too little, unanticipated government expenditures in period $t+1$ have a relatively more expansionary effect

on private consumption in period $t+1$ than anticipated government expenditures, and vice versa. An intuitive explanation is as follows: If G is initially too little, an increase in G_{t+1} raises G_{t+1}^* and $U(C_{t+1}^*)$. If the representative individual anticipates this change in period t , it is desirable for him or her to transfer private consumption from period $t+1$ to period t . If he or she does not anticipate government expenditures, it is impossible to transfer from period $t+1$ to period t . Thus, unanticipated government action raises private consumption at this time more than anticipated government action.

A3 Empirical Results

Ihori (1987) clarified empirically the normative implications of actual government expenditures by estimating a private consumption function for Japan. Based on theoretical considerations, the relative effects of anticipated expansion and unanticipated expansion tell us the discrepancy between actual and optimal government expenditures. Thus, it is necessary to estimate a private consumption function that includes anticipated and unanticipated government expenditures as explanatory variables.

The empirical results suggest that anticipated government expenditures have a relatively more expansionary effect on private consumption than unanticipated government expenditures. Hence, based on the theoretical analysis in Sect. A2, the implication of these results is that government expenditures after the mid-1970s are perceived as too much. However, before the mid-1970s, the results suggest that government expenditures are perceived as less than the optimum.

A4 Conclusion

This appendix has investigated the question of how the private sector perceives the size of government spending within an explicit optimizing framework. We have shown that if government spending is initially too little, unanticipated government expenditures have a relatively more expansionary effect on private consumption than anticipated government expenditures, and vice versa. Moreover, empirical analysis may provide some evidence of a discrepancy between actual and optimal government spending. Section A3 reported a finding that for the Japanese economy, the level of government spending was regarded as too little in the 1960s, but is regarded as too much in recent years.

In the real world, all individuals are not forward-looking with regard to fiscal affairs. However, rich individuals may well be forward-looking and may engage in major intergeneration transfers. If so, normative evaluation of the level of government spending is largely based on rich individuals' judgments. It follows that in the 1960s, the size of government was perceived as too small by rich individuals. Poor

individuals would regard the size of government as too small in any case. This would explain why the size of government spending has increased since the 1970s.

It is now recognized that the Ricardian debt neutrality is more likely to hold in recent years at higher levels of government deficit. If so, middle-income individuals have been forward-looking in recent years. Further, the evaluation of the size of government in the 1980s may well be shared by most people. This would explain why the size of government spending grew more slowly in the 1980s.

Most business people now favor small government. The change in attitude has probably been caused by the fear that further increases in fiscal burdens will fall on the business community. Such a concern is the foundation of the fiscal reconstruction movement in recent years. This appendix suggests that the concern is shared by households.

Questions

- 3.1 In the two-period model, the government collects taxes T_i and spends G_i ($i = 1, 2$). The government may also issue one-period maturity debt, B . Suppose $T_1 = 10$, $G_1 = 20$, and $G_2 = 15$. If the rate of interest is 10 %, what is T_2 ?
- 3.2 Say whether the following statements are true or false and explain the reasons.
 - (a) In the neoclassical model, the fiscal multiplier is less than unity.
 - (b) If the government raises public spending to almost the same level as private consumption, private consumption directly declines.
 - (c) A promise of expansionary fiscal policy in the near future would stimulate the current economy.

References

- Bailey, M. J. (1971). *National income and the price level: A study in macroeconomic theory* (2nd ed.). New York: McGraw-Hill.
- Barro, R. J. (1974). Are government bonds net wealth? *Journal of Political Economy*, 82, 1095–1117.
- Barro, R. J. (2008). *Macroeconomics: A modern approach*. Mason: Thomson/Southwestern.
- Ihori, T. (1987). The size of government spending and the private sector's evaluation. *The Journal of Japanese and International Economies*, 1, 82–96.
- Kormendi, R. C. (1983). Government debt, government spending, and private sector behavior. *American Economic Review*, 73, 994–1010.

1 Ricard's Neutrality Theorem

1.1 A Two-Period Model

In order to investigate the burden of public debt, it is useful to explain Ricard's neutrality theorem. We employ a simple two-period model as in Chap. 3. In this regard, a household optimizes consumption for two periods, namely period 1 (current period) and period 2 (future period).

The household's utility function is given as

$$U = U(c_1, c_2) \quad (4.1)$$

where c_1 represents consumption in period 1 and c_2 represents consumption in period 2. The agent earns income Y_1 in period 1 and consumes or saves. In period 2, the agent consumes from savings and interest on savings.

The government issues public debt in period 1 and the private agents buys it. In period 2, the government redeems the public debt with interest. The government imposes taxes in period 1, T_1 , and period 2, T_2 . For simplicity, the government does not spend. Thus, $G_1 = G_2 = 0$. This is not a crucial assumption. As long as government spending is fixed, the analytical result should be the same.

Thus, the budget constraints for the agent and government are written as follows.

$$c_1 = Y_1 - s - b - T_1 \quad (4.2)$$

$$c_2 = (1 + r)b + (1 + r)s - T_2 \quad (4.3)$$

$$b + T_1 = 0 \quad (4.4)$$

$$(1 + r)b = T_2 \quad (4.5)$$

where s denotes savings for private assets and b denotes public debt issuance; T_1 and T_2 denote taxes in period 1 and period 2 respectively; Y_1 denotes income in period 1; and r is the rate of interest. Eqs. (4.2) and (4.3) summarize the private budget constraints and Eqs. (4.4) and (4.5) summarize the government budget constraints in the two periods.

Households buy public debt as a means of saving. Since we assume that public bonds and private saving are perfect substitutes without uncertainty for the agent, public debt should have the same rate of return as a private asset in the market. Thus, the rate of interest for public debt is equal to the rate of interest for a private asset. Consequently, households are indifferent about using either public debt or capital as a means of saving.

If $b > 0$, from the government budget constraint in period 1, Eq. (4.4), $T_1 < 0$. In other words, the government issues debt so as to reduce taxes (or give subsidies) in period 1 and raises taxes in period 2 so as to redeem debt ($T_2 > 0$). Note that the government does not spend at all: $G_1 = G_2 = 0$.

From Eqs. (4.2), (4.3), (4.4), and (4.5), household budget constraint and government budget constraint in terms of present value are given respectively as

$$c_1 + \frac{1}{1+r}c_2 = Y_1 - \left[T_1 + \frac{1}{1+r}T_2 \right] \text{ and} \quad (4.6)$$

$$T_1 + \frac{1}{1+r}T_2 = 0. \quad (4.7)$$

Substituting Eq. (4.7) into Eq. (4.6), we have as the integrated budget constraint

$$c_1 + \frac{1}{1+r}c_2 = Y_1. \quad (4.8)$$

A household determines optimal saving/consumption behavior so as to maximize the lifetime utility given by Eq. (4.1) subject to Eq. (4.8). Since public debt b does not appear in Eq. (4.8), any changes in b would not affect the consumption/saving behavior of households at all. In other words, public debt is neutral with respect to economic variables. This is called the debt neutrality theorem or Ricardian equivalence.

Consider the following numerical example. Suppose $T_1 = -30$, $T_2 = 33$, $G_1 = G_2 = 0$, and $r = 0.1$. Thus, from the government budget constraint, $b = 30$. Further, the permanent tax revenue T_p is 0. The government then reduces T_1 from -30 to -50 by raising debt issuance b from 30 to 50. T_2 becomes 55 but does not affect T_p ; hence, consumption does not change either.

Suppose that $T_1 = 10$, $T_2 = 50$, $G_1 = 30$, $G_2 = 30$, and $r = 0$. Then, from the government budget constraint, $b = 20$. Further, the permanent tax revenue T_p is 30. The government then reduces T_1 from 10 to 5 by raising debt issuance b from 20 to 25. This does not affect T_p ; hence, consumption does not change either. In this circumstance, only private demand for b is raised by the increase of 5 in the amount of new debt issuance.

1.2 The Implications of Public Debt Issuance

The rational household is concerned with the present value of the tax burden. As shown in Eq. (4.7), the present value of the tax burden is zero, which is equal to the present value of government spending, independent of debt issuance. When the government issues debt, tax may be reduced in period 1. However, in period 2, tax should be raised by the same amount in terms of present value. As long as government spending is zero (or, in general, is fixed), the current tax reduction can completely offset the future tax increase so that the total tax burden does not change.

Based on the argument in Chap. 3, permanent government spending should be the same as permanent tax revenue. Although public debt issuance can change the combination of the tax burden over time, it cannot change the permanent level of tax revenue or the tax burden. When a consumer behaves optimally, based on permanent disposable income, public debt does not affect real economic variables. This is called Ricard's debt neutrality theorem.

Imagine that the government increases debt issuance by reducing T_1 . Since c_1 and c_2 are independent of b , an increase in debt b does not affect private savings, s , with regard to private capital accumulation. In other words, a household raises the demand for public debt by the same amount of debt issuance. Further, the household spends the same amount on consumption as before by allocating an increase in its disposable income because of a tax reduction on the entire public debt. Thus, the total of $b + T_1$ remains at the original value. The household can then pay a higher amount of tax in period 2 without reducing future consumption. Moreover, a tax reduction caused by issuing public debt leads to an increase in private savings by the same amount, so that consumption is not stimulated in period 1.

This means that the wealth effect of public debt on consumption is zero: $\Delta c_1 / \Delta b = 0$. The wealth effect of public debt on consumption is a key effect in the Keynesian model in order to ensure the efficacy of fiscal policy. If government spending is fixed, an increase in public debt means a decrease in taxes. Thus, the wealth effect of public debt is the same as the multiplier effect of tax reduction. In the Keynesian model of Chap. 2, the multiplier of tax reduction is given as $-\Delta Y / \Delta T = c / (1 - c) > 0$. When Ricardian debt neutrality holds, the efficacy of Keynesian fiscal policy is uncertain and the Keynesian policy loses its efficacy.

1.3 Debt Issuance in an Infinite Horizon Economy

Let us investigate Ricardian debt neutrality in an infinite horizon economy. Suppose the government issues public debt in period 0 by b_0 in order to finance government spending G_0 and roll over the redemption forever. Namely, from period 1 onward, the government pays the interest payment of rb_0 in each period but does not redeem b_0 . For simplicity, the government does not conduct any spending from period 1 onward and collects taxes to finance the interest payment, rb_0 , in each period.

The government budget constraint in each period is given as

$$G_0 = b_0$$

$$T_1 = rb_0, T_2 = rb_0, \dots$$

Thus, the present value of the future tax burden is given by

$$rb_0 \left[1 + \frac{1}{1+r} + \frac{1}{(1+r)^2} + \dots \right] = b_0$$

which is the same as the initial bond issuance. In other words, even if the government does not redeem the outstanding public debt, the present value of the future tax burden is equal to the present value of government spending. Thus, the Ricardian neutrality result holds in an infinite horizon economy as long as the private agent rationally recognizes the future tax burden correctly.

2 The Shift of the Burden to Future Generations

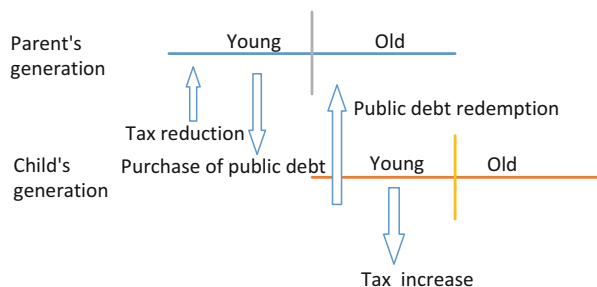
2.1 A Two-Overlapping-Generations Model

It takes some time to redeem public debt in reality. The government may impose taxes for redemption in future generations. If we consider multiple generations in the model, the tax burden among generations becomes a crucial point. Considering this point, the Ricardian neutrality theorem does not necessarily hold. Let us explain this conjecture by using the overlapping generations model.

In this regard, we should imagine two overlapping generations, the parent's generation and the child's generation, as shown in Fig. 4.1. Both generations live for two periods, and when the parent becomes old in period 2, the child becomes young in period 2. In this sense, two generations overlap in period 2. We call the first generation the parent's generation, and the second generation the child's generation.

The government issues public debt in period 1 when the parent is young and redeems it in period 2. Thus, the behavior of the government is the same as in

Fig. 4.1 Overlapping generations model



Sect. 1. If the government levies taxes on the parent's generation to redeem the public debt, the analysis in Sect. 1 holds. We still have Ricardian neutrality.

The only difference is that the government may now levy taxes on the child's generation instead of the parent's generation in period 2. Namely, we now consider a situation in which the government imposes a tax for redemption in period 2 on the child and not on the parent.

In other words, the budget constraints are given as

$$c_1^p = Y_1 - s - T_1 - b \text{ and} \quad (4.2')$$

$$c_2^p = (1 + r)b + (1 + r)s \quad (4.9)$$

for the parent and

$$c_1^c = Y_2 - s - T_2 \text{ and} \quad (4.10)$$

$$c_2^c = (1 + r)s \quad (4.11)$$

for the child. c_1^p means the consumption of the parent and c_1^c means the consumption of the child. Subscript 1 means consumption when young and 2 means consumption when old. Superscript p means parent and superscript c means child.

Note that the parent's budget constraint in period 1, Eq. (4.2'), is the same as in Sect. 1. The budget constraint in period 2 is rewritten as Eq. (4.9) without taxes for redemption since here the parent's generation does not pay taxes to redeem the public debt. Equations (4.10) and (4.11) represent the child's budget constraints. Y_2 is the child's income when young in period 2. The child pays taxes in period 2, T_2 , for redemption of the public debt.

2.2 The Efficacy of Keynesian Policy

The present value budget constraints for two generations are given respectively as

$$c_1^p + \frac{1}{1 + r} c_2^p = Y_1 - T_1 \text{ and} \quad (4.12)$$

$$c_1^c + \frac{1}{1 + r} c_2^c = Y_2 - T_2. \quad (4.13)$$

A decrease in tax in period 1, T_1 , increases the disposable income of the parent ($Y_1 - T_1 = Y_1 + b$); namely, an increase in b raises the parent's income, thereby stimulating her or his consumption. Thus, issuing public debt stimulates current consumption. This is the positive wealth effect of public debt on private consumption in period 1. From this viewpoint, we may justify the Keynesian fiscal policy in period 1 if there is a recession in this period. This policy certainly raises private consumption.

2.3 The Shift of the Burden

However, the foregoing reduces the child's permanent disposable income by $T_2 > 0$. Thus, the child's consumption declines. The larger the public debt, the larger the increase in the parent's income and utility. However, at the same time, the larger the public debt, the larger the decrease in the child's income and utility. In this sense, the burden of public debt is transferred or moved from the parent's generation to the child's generation.

Additionally, when public debt is issued, the parent increases consumption, c_1^p , and reduces savings, s . From the government budget constraint, Eq. (4.4), $b + T_1$ does not change. Thus, an increase in c_1^p means a decrease in s by the same amount. A decrease in the parent's savings means a decrease in the capital stock available for the child's generation in the macroeconomy, thereby reducing the marginal product of labor and the child's wage income, Y_2 . In other words, public debt depresses capital accumulation and negatively affects the welfare of future generations. This is the second channel whereby the burden of debt is moved to the future generation.

These two effects depress the welfare of future generations. Thus, it is plausible to say that the burden of debt is moved to the future generation as long as taxes to finance the redemption of public debt are imposed on the future generation. This explains the standard understanding of the burden of public debt. We normally expect a movement of the burden to future generations.

3 Barro's Neutrality

3.1 The Inclusion of Bequests

The reason why the burden of public debt is transferred to a future generation is that the government conducts income redistribution between two generations, as shown in Eqs. (4.12) and (4.13). The government reduces taxes on the parent's generation and raises taxes on the child's generation using debt issuance. This is a redistribution policy between two generations.

However, redistribution between two generations could be conducted by the private sector as well as by public policy. This is known as bequest adjustment from parents to children. If we include bequests in the model, public redistribution by public debt issuance could be completely offset and public debt may not affect real economic variables. This argument was first highlighted in Barro's paper in 1974. The concept is called Barro's debt neutrality theorem.

Barro argued that when the government borrows, members of the older generation realize that their heirs will be less prosperous because the tax burden will be moved to their heirs. Imagine further that the older generation cares about the welfare of their descendants and does not want their descendants' consumption levels to reduce. One possibility is simply to increase bequests by an amount that is

sufficient to pay the extra taxes that will be due in the future. The result is that nothing really changes. Each generation consumes exactly the same amount before the government borrowed. In effect, private individuals offset the intergenerational effect of government debt policy; thus, tax and debt finance are essentially equivalent.

3.2 A Simple Model with Bequests

Let us define the present value of the life cycle consumption of the parent's generation and the child's generation as C_1 and C_2 respectively. Thus,

$$c_1^p + \frac{1}{1+r} c_2^p \equiv C_1 \text{ and}$$

$$c_1^c + \frac{1}{1+r} c_2^c \equiv C_2.$$

Lifetime utility increases with the present value of life cycle consumption. In other words, the lifetime utility V of each generation increases with C_1 and C_2 respectively.

Imagine that the parent is also concerned with the utility of the child in addition to her or his own utility in the context of consumption. Thus, the parent's utility function is given as

$$U = V(C_1) + \delta V(C_2) \quad (4.14)$$

where $0 < \delta < 1$ denotes the discount factor that shows how much the parent cares about the child. In this sense, the utility function is based on altruistic preferences. This may imply the degree of the bequest motive. If $\delta = 0$, the parent does not leave any bequests because an increase in bequests always reduces the parent's utility U by reducing consumption. However, the higher the value of δ , the larger the amount that the parent leaves.

Let us denote bequests by e . We assume that the parent leaves a bequest e when young. Thus, the lifetime budget constraints are rewritten respectively in place of Eqs. (4.12) and (4.13) as

$$C_1 = Y_1 - e - T_1 \text{ and} \quad (4.15)$$

$$C_2 = Y_2 + (1+r)e - T_2. \quad (4.16)$$

Equation (4.15) is the parent's budget constraint and Eq. (4.16) is the child's budget constraint. Note that bequests appear in Eq. (4.16) as $e(1+r)$ because the child lives in one period later than the parent. Because the parent leaves a bequest e when young, the child receives a bequest of $(1+r)e$ when young. Bequest e when the

parent is young produces interest income re when the child receives it. Hence, the child receives a bequest by the amount of $(1+r)e$.

3.3 Barro's Neutrality Theorem

The parent maximizes Eq. (4.14), subject to Eqs. (4.15) and (4.16), by choosing C_1 and e at given levels of T_1 and T_2 . From Eqs. (4.15) and (4.16), we may eliminate e and obtain the integrated budget constraint between two generations.

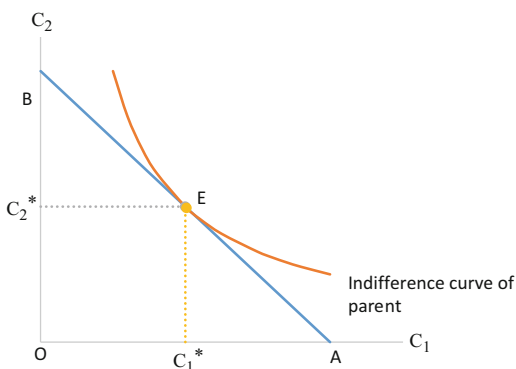
$$C_1 + \frac{1}{1+r}C_2 = Y_1 + \frac{1}{1+r}Y_2 - \left[T_1 + \frac{1}{1+r}T_2\right] = Y_1 + \frac{1}{1+r}Y_2 \quad (4.17)$$

The last equation comes from the government budget constraint, Eq. (4.7). Equation (4.17) means that T_1 and T_2 do not appear; hence, this equation is independent of generational redistribution or public debt issuance. Alternatively, the total amount of tax revenue is equal to the total amount of government spending, which is fixed.

In other words, even if the government issues public debt over generations and imposes taxes for redemption in future generations, this does not affect Eq. (4.17) as long as government spending is fixed. Thus, C_1 and C_2 are independent of public redistribution policy. Public debt does not affect the utility of the parent, child, or consumption in each period. Further, public debt issuance does not have any real impact on economic variables. Thus, we have the debt neutrality theorem again, which in this instance is called Barro's debt neutrality theorem.

In Fig. 4.2, the vertical axis denotes C_2 and the horizontal axis denotes C_1 . Figure 4.2 draws an indifference curve with regard to Eq. (4.14) and a budget line AB with regard to Eq. (4.17). As in the standard two-period model of consumption over time in Chap. 3, the optimal point is given by point E where the budget line is tangent to an indifference curve. Since the budget line AB does not move according to public redistribution policy, the optimal point E associated with the optimal consumption levels C_1^* and C_2^* does not change.

Fig. 4.2 Barro's neutrality theorem



Even if the government changes T_1 and T_2 by public debt issuance, C_1^* and C_2^* remain fixed at the initial optimal level. In other words, the household determines e so as to maintain $T_1 + e$ as fixed. For example, if the government reduces the tax burden on the present generation by issuing b and raises the tax burden T_2 on the future generation, the present generation reacts by increasing bequest e by the same amount. As a result, public redistribution between two generations is completely offset by private redistribution through bequests.

It is true that a bequest cannot be negative. If Y_1 is very low and/or if δ is very low, the optimal value of e may be negative. In such an instance, the actual level of e is given by 0 at the corner solution. Then, an increase in b cannot result in a decrease in e by the same amount. Thus, we do not have the neutrality result. Further, Barro's argument does not hold if the parent's generation is poor and hence a bequest is not possible. We discuss the plausibility of this proposition in the next section.

4 Policy Implications of the Debt Neutrality Theorem

4.1 Policy Implications

It seems plausible to assume that taxes for debt redemption are imposed on future generations to some extent. Even in such an instance, Barro's neutrality theorem implies that public debt may not transfer the tax burden to future generations as long as positive bequests are made. In the real economy, a lot of bequests are transferred from the parent's generation to the child's generation. In this sense, the debt neutrality proposition may be more applicable to the real economy in accordance with Barro's neutrality theorem rather than the original Ricardian neutrality theorem. We now discuss the policy implications of this proposition.

Imagine that this neutrality result is maintained. We then have many interesting and strong policy implications. First, the wealth effect of public debt is zero and fiscal deficits do not have any positive effects on the macroeconomy. Thus, the Keynesian fiscal policy loses its efficacy. An increase in deficits does not stimulate aggregate demand. Further, interest is not raised and investment demand is not depressed. An increase in public debt supply induces the same increase in demand for public debt.

Moreover, public redistribution between two generations is also ineffective. As explained in Chap. 7, a pay-as-you-go public pension conducts redistribution from younger generations to older generations. In an aging society, this redistribution between generations becomes huge and creates serious problems in terms of intergenerational equity. However, if the neutrality theorem holds, we do not have to worry about this issue. Private redistribution by means of bequests could offset the bad outcome of public redistribution. These policy implications seem very strong but paradoxical.

However, it is useful to note that the debt neutrality theorem is only concerned with alternative financing of a given amount of government spending. It does not consider the macroeconomic effect of government spending. If revenue from debt finance is used for public spending, this has a real impact on the macroeconomy. In Chap. 3, we discussed the multiplier effect of government spending in the neoclassical model where the debt neutrality theorem is implicitly assumed. When government spending changes in a real economy, fiscal policy should have some impact on the economy, although the size of multiplier becomes very small in a neoclassical model. In accordance with debt neutrality, changes in government spending are more important than financing the means for ensuring the efficacy of fiscal policy.

4.2 Theoretical Assumptions

Let us discuss some theoretical conditions and the plausibility for debt neutrality. The debt neutrality proposition requires a number of key assumptions about the economic environment and the behavior of economic agents. These assumptions include (1) perfect capital markets with no borrowing constraints on consumers; (2) non-distortionary taxes; (3) full certainty about the path of future taxes, government budget policies, and earnings; and (4) an equal planning horizon for private and public sectors. Ricardian neutrality needs (1)–(3), while Barro's neutrality needs (1)–(4). We now discuss each of these assumptions.

4.2.1 Perfect Capital Market

The debt neutrality theorem presupposes that a household optimizes consumption/saving decisions based on present value budget constraint. This formulation is valid in a perfect capital market because the rational consumer may save and/or borrow at the same rate of interest. In reality, it may be difficult to borrow based on future income, or borrowing may require a high rate of interest. If so, the agent cannot optimize based on present value budget constraint. In such conditions of liquidity constraint, the debt neutrality theorem is not maintained.

There is substantial evidence that at least a modest fraction of the population is liquidity constrained at a given point in time. Liquidity constraints raise the marginal propensity to consume out of temporary tax changes to a large multiple of the small amount predicted under perfect capital markets. Altig and Davis (1989) showed that borrowing constraints imply the non-neutrality of government debt irrespective of whether the transfer motive is in use. However, Hayashi (1987) provided examples from the literature on imperfect capital markets in which debt neutrality holds despite the existence of borrowing constraints. His examples suggest that it is important to identify how the exact nature of imperfections in loan markets is identified.

4.2.2 Lump-Sum Taxes

With regard to lump-sum taxes that have no distortionary effects, a household is only concerned with the present value of the tax burden. Thus, debt neutrality is

maintained. However, as explained in Chap. 8, if a tax has distortionary effects on microeconomic variables, the household would also be concerned about the marginal tax rate as well as the present value of taxes. Since the marginal tax rate depends upon how much tax revenue applies in each period, the debt neutrality theorem is not maintained.

Distortionary taxes in general imply that financial policy may not be neutral. Changes in the timing of distortionary taxes can affect private sector and economy-wide allocation through their induced wealth, redistribution, and intertemporal substitution effects. Such taxes lead to deviations from debt neutrality. For example, Abel (1983) showed how a different type of non lump-sum tax, a progressive tax on bequests or capital, changes the relative cost of current consumption and bequests, and thus introduces an incentive to consume more at the present time.

In this regard, it is desirable to use debt issuance as a buffer so that tax revenue does not fluctuate a great deal over time. For example, imagine that a temporary increase in government spending is necessary because of emergency events such as a serious natural disaster or war. Thus, from the long-run viewpoint, the government should issue debt temporarily rather than immediately raise taxes. This implies the tax-smoothing hypothesis, as explained in Chap. 6.

In other words, rather than relying on taxes in the emergency period, it is desirable to spread taxes over time so as to reduce the total size of the excess burden of taxes. Alternatively, we could say that it is optimal to use debt issuance to finance the emergency costs rather than tax increases.

4.2.3 Anticipation of Future Tax Increases

If a tax increase in the future is uncertain, a household cannot ignore the timing of taxes even if it intends to consider present value budget constraint. Thus, the debt neutrality theorem is not maintained. For example, if future disposable income is uncertain, the size of a bequest also becomes uncertain. In this situation, 1 yen in the current period is relevant to the present value of 1 yen in the future. Thus, the private sector cannot completely offset public redistribution policy by the private redistribution of bequests.

Although current tax cuts may indeed be associated with future increases in taxes, the exact timing of increases, the type of tax to be increased, and the incidence of the tax across individuals are all uncertain. This uncertainty may lead to deviations from neutrality. Feldstein (1988) also showed that when earnings are uncertain, the substitution of deficit finance for tax finance, or the introduction of an unfunded social security program, raise consumption even if all bequests reflect intergenerational altruism.

The uncertainty of future income means that bequests are also uncertain. This uncertainty of future bequests means that an individual will not generally be indifferent about receiving an additional dollar of income when she or he is young or her or his children later receiving an equivalent amount with a present value of 1 yen.

4.2.4 Planning Period and Bequest Motive

A necessary condition for Barro's debt neutrality is that households and government have the same planning horizons and use the same discount factor in their present-value calculations. This condition is satisfied if the altruistic bequest motive is fully operative.

If the planning period of a household is not equal to that of the government, the debt neutrality theorem is not maintained. The Ricardian neutrality theorem is not sustained across generations, although Barro's neutrality theorem could still be maintained because of altruistic bequest adjustments. However, the non-altruistic bequest motive does not lead to a neutrality result.

For example, consider a selfish bequest motive such that the utility of the person giving the bequest increases with the bequest. Thus, in place of Eq. (4.14), we have

$$U = V(C_1) + \delta e. \quad (4.18)$$

With this formulation, the parent does not consider the welfare of the child. The preference is not altruistic. The planning period of the parent is limited to the period of her or his life. Further, the parent is unconcerned about fiscal policy in the future. Thus, debt neutrality is not maintained.

It is important to investigate the nature of the bequest motive. In particular, it is useful to evaluate the plausibility of an altruistic bequest motive in reality. Weil (1987) addressed questions about the operativeness of an altruistic transfer motive in overlapping-generation economies. His numerical analysis of a parametric version of his model indicates that a parent must "love their children" very much for the transfer motive to operate.

However, Altig and Davis (1989) obtained a different conclusion. In terms of reasonable lifetime productivity profiles and a modest desire to smooth consumption intertemporally, parents need to love their children only a little for the transfer motive to operate in the loan economy. Whatever the situation, though, the extent of altruistic transfer motives is a key determinant of the long-run and short-run savings response to government deficits.

Bernheim and Bagwell (1987) showed that if families were interconnected via altruism in complicated networks, any change in relative prices would be completely neutralized. Such families would completely rob the price system of its ability to allocate resources. This conclusion is simply untenable. It tends to cast serious doubt on Barro's model of altruism. In this circumstance, changes in the stock of debt will have real effects on the economy, and a model in which the agent experiences a finite horizon can capture the effects in a reasonably tractable way. In this sense, the original Ricardian neutrality seems more plausible than Barro's neutrality.

4.3 Empirical Evidence

Barro's provocative hypothesis on the irrelevance of government fiscal policy has been the subject of much debate. Further, a number of econometric studies have analyzed the relationship between budget deficits and saving. The evidence is rather mixed. Among professional economists, the Ricardian model also has critics and adherents.

Leiderman and Blejer (1988) and Seater (1993) presented a useful survey of empirical evidence on the impact of government budget variables on private consumption and on the debt neutrality hypothesis. Homma et al. (1984) and Ihori (1989) conducted empirical studies on debt neutrality in Japan. In addition, Ihori et al. (2001) estimated a consumption function and investigated the degree of debt neutrality for the period 1970I–1998II.

In many empirical studies, including those of Homma et al. (1984), Ihori (1989), and Ihori et al. (2001), the adaptive or static expectation hypothesis is employed to arrange the consumption equation into a testable equation. However, in recent empirical researches that use the permanent income hypothesis, rational expectation is assumed when deriving testable conditions. Ihori and Kondo (2002) applied this method for Japanese data.

Considering prior studies on the Japanese economy, we may derive the following implications for fiscal policy in Japan. First, the strong version of debt neutrality (Barro's neutrality) is not perfectly valid; hence, government debt has some real effects and the debt burden can be transferred to future generations. Second, people are still concerned about the long-run effects of fiscal policy; however, the private sector should have enough information to know the structure of the government's budget constraint. It is plausible to surmise that behavior in the real world may fall between these extremes: the strong version of Barro's debt neutrality and the simple Keynesian hypothesis. In other words, the weak version of Ricardian neutrality is significantly valid.

5 The Non-Keynesian Effect

5.1 What Is the Non-Keynesian Effect?

As mentioned in Chap. 2, the non-Keynesian effect is as follows. A decrease in government spending and/or an increase in taxes can stimulate aggregate private demand in a situation where government spending is inefficient or the government deficit is large. In this regard, the government may attain fiscal consolidation and macroeconomic recovery at the same time. The plausibility of this seemingly paradoxical effect depends on the fiscal situation, the sustainability of fiscal reform, and/or the anticipation of future fiscal policy.

Note that debt neutrality means that there is no effect on private consumption if government spending is fixed and a positive effect on private demand if government spending declines. The conventional Keynesian effect normally means that there is

Table 4.1 The non-Keynesian effect

	Tax increase	Spending cut
Keynesian effect	Private demand –	Private demand –
Non-Keynesian effect	Private demand +	Private demand +
Debt neutrality	Private demand 0	Private demand +

a negative effect on private consumption because of a tax increase and a negative effect on private demand if government spending declines. Thus, the non-Keynesian effect is just opposite to the Keynesian effect. See Table 4.1 for a comparison of these effects.

5.2 The Non-Keynesian Effect in the Real World

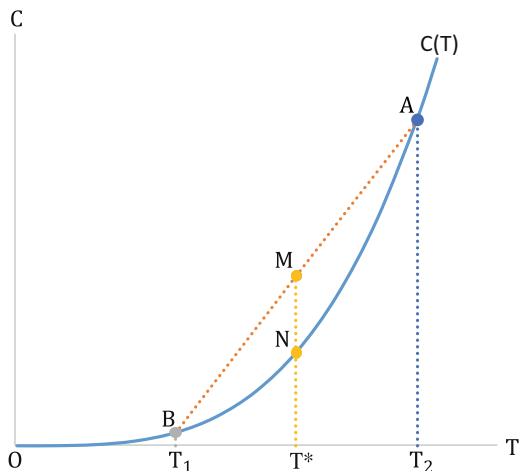
The non-Keynesian effect seems paradoxical from the conventional theoretical viewpoint. However, we can sometimes observe this effect in the real world. For example, some European countries such as Denmark and Ireland in the 1980s suffered from significant deficits. Then, in order to cope with the associated problems, such countries conducted fiscal consolidation reforms. Denmark experienced an increase in private demand, although the government employed a restrictive fiscal policy, which corresponds to the non-Keynesian effect.

However, Ireland experienced the standard Keynesian effect in the sense that fiscal consolidation had negative impacts on macroeconomic activities. Ireland then conducted drastic fiscal reforms in 1987. Such fiscal consolidation attempts were successful in that both fiscal consolidation and economic recovery were attained. An increase in private consumption during this period cannot be explained comprehensively by the conventional Keynesian model. A decrease in government spending resulted in a better fiscal situation in the future, stimulating private consumption immediately.

5.3 Simple Theory of the Non-Keynesian Effect

The non-Keynesian effect may be explained in Fig. 4.3. The $C(T)$ curve denotes the excess burden of tax, T , which is convex and increasing with tax, T . The excess burden is an additional burden to pay taxes caused by distortions of taxation. When the government raises taxes, the excess burden rises more than the tax revenue, as explained in Chap. 8.

In the two-period model, suppose T_1 is low and T_2 is high, so that in period 1 the government deficit is large but in period 2 the government has to raise a large amount of taxes. We implicitly assume that government spending is almost the same in the two periods. Suppose for simplicity that the rate of interest is zero; if so, the total excess burden is associated with point M. The government then raises T_1 to reduce the deficit in period 1; namely, the government collects T^* in each period so

Fig. 4.3 The non-Keynesian effect

that the government budget is balanced in each period. Then, the total excess burden declines to point N.

We may formulate the effective disposable income as the (permanent) disposable income minus the (permanent) excess burden. When the total excess burden declines by the increase in T_1 , it raises the effective disposable income in period 1, stimulating private consumption in period 1. In other words, an increase in tax stimulates private consumption in period 1. This is the non-Keynesian effect.

We may say that in ordinary times, when the fiscal deficit and public debt are not high, the conventional Keynesian effect is likely to occur. However, in an emergency when the fiscal deficit and public debt are large, the paradoxical non-Keynesian effect is likely to occur and an increase in taxes may stimulate private consumption.

In the context of several empirical studies on Japan, we cannot reject the non-Keynesian effect with respect to government spending in recent years. In other words, since the 1980s, when the fiscal deficit was high, a decrease in government spending has stimulated private consumption. This suggests that fiscal consolidation, with reducing public spending, may be effective in order to attain fiscal sustainability. See the case study of Chap. 2, Appendix, for a discussion of the non-Keynesian effect in Japan's case.

Appendix: Government Debt in an Overlapping-Generations Model

A1 Introduction

This appendix examines the economic effect of government debt in a simple dynamic model of economic growth. We first show that tax-financed transfer payments and public debt have the same effect on long-run equilibrium. We also

show that if lump sum taxes are appropriately adjusted, debt policy is not effective; hence, the government deficit is a meaningless policy indicator. We then examine the burden of debt and show that an increase in a constant amount of government debt per worker crowds out capital accumulation in the long run.

This appendix also investigates the role of government debt in the altruism model. As explained in the main text of this chapter, Barro (1974) extended Ricardian neutrality to the strongest proposition of debt neutrality. The altruism model means that households can be represented by the families that act as though they are infinitely lived. This appendix explains Barro's (1974) idea intuitively.

A2 The Basic Model of Overlapping Generations

A2.1 The Consumer Within the Model of Overlapping Generations

We investigate the burden of debt in a simple growth model of overlapping generations based on Diamond (1965). This model is useful to investigate the impact of public debt on generations and capital accumulation in a dynamic context. This is a classical model for investigating the role of public debt in a growing economy (see Ihuri, 1996).

Consider a closed economy populated by overlapping generations of two-period-lived consumers and firms. In this model, one young and old generation exist at any point in time. The young have no nonhuman wealth, and the lifetime resources of the young correspond to the labor earnings they receive. There may be population growth. Output is durable and may be accumulated as capital. For simplicity, it is assumed that there is no capital depreciation. The physical characteristics of the endowment are important in overlapping-generation economics since durable goods represent an alternative technology for transferring resources through time.

An agent of generation t is born at time t and considers him- or herself "young" in period t and "old" in period $t + 1$. The agent dies at time $t + 2$. When young, the agent of generation t supplies one unit of labor inelastically and receives wages w_t , out of which the agent consumes c_t^1 and saves s_t in period t . An agent who saves s_t receives $(1 + r_{t+1})s_t$ when old, which the agent then spends entirely on consumption, c_{t+1}^2 , in period $t + 1$. r_t is the rate of interest in period t . There are no bequests, gifts, or other forms of net intergenerational transfers to the young. In each period, two generations are alive, the young and the old.

A member of generation t faces the following budget constraints:

$$c_t^1 = w_t - s_t \text{ and} \quad (4.A1)$$

$$c_{t+1}^2 = (1 + r_{t+1})s_t. \quad (4.A2)$$

From Eqs. (4.A1) and (4.A2), her or his lifetime budget constraint is given as

$$c_t^1 + \frac{1}{1+r_{t+1}} c_{t+1}^2 = w_t. \quad (4.A3)$$

Further, her or his lifetime utility function is given as

$$u_t = u(c_t^1, c_{t+1}^2). \quad (4.A4)$$

The utility function $u(\cdot)$ increases in the vector (c^1, c^2) , twice continuously differentiable and strictly quasi-concave. Thus,

$$\frac{\partial u}{\partial c_t^1} = u_1(c_t^1, c_{t+1}^2) > 0 \text{ for } (c^1, c^2) > 0 \text{ and}$$

$$\frac{\partial u}{\partial c_{t+1}^2} = u_2(c_t^1, c_{t+1}^2) > 0 \text{ for } (c^1, c^2) > 0.$$

Future consumption is a normal good,

$$u_1 u_{12} > u_2 u_{11} \text{ for } (c^1, c^2) > 0,$$

where $u_{12} = \partial^2 u / \partial c^1 \partial c^2$ and $u_{11} = \partial^2 u / \partial c^1 \partial c^1$. Starvation is avoided in both periods,

$$\lim_{c^1 \rightarrow 0} u_1(c^1, c^2) = \infty \text{ for } c^2 > 0 \text{ and}$$

$$\lim_{c^2 \rightarrow 0} u_2(c^1, c^2) = \infty \text{ for } c^1 > 0.$$

A consumer born in period t maximizes her or his lifetime utility (4.A4) subject to the lifetime budget constraint (4.A3) for given w_t and r_{t+1} . For simplicity, we assume that the agent is capable of predicting the future course of the economy and that he or she adopts this prediction as her or his expectation of r_{t+1} . Such rational or perfect foresight expectations are independent of past observations and must be self-fulfilling.

Solving this problem for s_t yields the optimal saving function of the agent,

$$s_t = s(w_t, r_{t+1}), \quad (4.A5)$$

where $\partial s / \partial w = s_w > 0$ follows from the normality of second period consumption. The sign of $\partial s / \partial r = s_r$ is ambiguous since the substitution effect and the income effect offset each other, as explained in Chap. 8.

A2.2 Production Technology and Capital Accumulation

The aggregate macroeconomic production function is

$$Y_t = F(K_t, N_t),$$

where Y_t is total output, K_t is capital stock, and N_t is labor supply. We assume constant returns to scale technology, so that the production function may be rewritten as

$$y_t = f(k_t), f' > 0, f'' < 0, \quad (4.A6)$$

where $y_t = Y_t/N_t$ and $k_t = K_t/N_t$. y_t is per capita output and k_t is the amount of capital per worker in period t . The production function is well behaved and satisfies the Inada condition: $f(0) = 0, f'(0) = \infty, f'(\infty) = 0$.

The population grows at the rate of $n (> -1)$. Thus,

$$N_t = (1 + n)N_{t-1}. \quad (4.A7)$$

Competitive profit maximization and neoclassical technology require that firms hire labor and demand capital in such a way that

$$f'(k_t) = r_t \quad \text{and} \quad (4.A8)$$

$$f(k_t) - f'(k_t)k_t = w_t. \quad (4.A9)$$

Equations (4.A8) and (4.A9) imply that the marginal product of capital is equal to the rate of interest and that the marginal product of labor is equal to the wage rate. Constant returns to scale and atomistic competition mean that payments to factors of production exhaust every profit-maximizing producer's revenue, leaving nothing for profit. Since the markets for renting and purchasing physical capital are competitive, the opportunity cost of owning capital for one period should equal the rental rate.

From Eqs. (4.A8) and (4.A9), w_t may be expressed as a function of r_t . Thus,

$$w_t = w(r_t), w'(r_t) = -k_t < 0, w'' > 0, \quad (4.A10)$$

where $w(\cdot)$ is called the factor price frontier.

In an equilibrium situation, agents can save by holding capital. In this type of economy, equilibrium in the financial market requires

$$s_t N_t = K_{t+1}$$

or

$$s_t = (1 + n)k_{t+1}. \quad (4.A11)$$

A3 Government Debt and Intergenerational Transfer

A3.1 The Transfer Program

We shall assume that the government issues debt b_t to the younger generation in period t . This debt has one-period maturity and will be repaid in the next period with interest at the same rate of return as on capital. b can be negative, in which case b means “negative debt”; namely, the government lends b to each individual of the younger generation and will recover this credit with interest.

Let us denote the (per-capita) lump sum tax levied on the younger generation and the older generation in period t by T_t^1 and T_t^2 respectively. Suppose for simplicity that the government does not make any public expenditure. Then, the government budget constraint in period t is

$$b_{t-1}N_{t-1}(1 + r_t) - b_tN_t = T_t^1N_t + T_t^2N_{t-1} \quad (4.A12)$$

where N_t is the number of people in generation t .

The following cases are of considerable interest.

- (a) $T^2 = 0$. The tax collected to finance interest costs minus new debt issuance is a lump sum tax on the younger generation. This debt issue corresponds to Diamond’s internal debt.
- (b) $T^1 = 0$. The tax collected to finance interest costs minus new debt issuance is a lump sum tax on the older generation.
- (c) $b = 0$. The government does not issue debt. The government levies the lump sum tax T^1 on the younger generation and transfers it to the older generation in the same period. This corresponds to the unfunded pay-as-you-go system.

The private budget constraints of generation t , (4.A1) and (4.A2), are rewritten as follows:

$$c_t^1 = w_t - s_t - b_t - T_t^1 \text{ and} \quad (4.A1')$$

$$c_{t+1}^2 = (s_t + b_t)(1 + r_{t+1}) - T_{t+1}^2. \quad (4.A2')$$

Each individual’s lifetime disposable income ($\hat{w}_t$) is given by ($w_t - T_t^1$) and her or his disposable income in the younger period t minus ($T_{t+1}^2/(1 + r_{t+1})$) the present value of the tax in the older period $t + 1$. Thus, the lifetime budget constraint (4.A3) is rewritten as

$$c_t^1 + \frac{1}{1 + r_{t+1}} c_{t+1}^2 = \hat{w}_t, \quad (4.A3')$$

where $\hat{w}_t = w_t - T_t^1 - \frac{1}{1 + r_{t+1}} T_{t+1}^2$.

Considering (4.A3'), capital accumulation equation (4.A11) may be rewritten as

$$w_t - c^1(\hat{w}_t, r_{t+1}) - b_t - T_t^1 = (1+n)k_{t+1}. \quad (4.A13)$$

Let us define effective taxes by

$$\tau_t^1 = b_t + T_t^1 \quad \text{and} \quad (4.A14.1)$$

$$\tau_{t+1}^2 = -(1+r_{t+1})b_t + T_{t+1}^2. \quad (4.A14.2)$$

τ^1 and τ^2 are net receipts from the young and old. These two equations (4.A14.1 and 4.A14.2) are government budget constraints in period t and period $t+1$. Thus, dynamic equilibrium can be summarized by the following two equations:

$$\tau_t^1 + \frac{1}{1+n} \tau_t^2 = 0 \quad \text{and} \quad (4.A15)$$

$$w(r_t) - c^1 \left[w(r_t) - \tau_t^1 - \frac{\tau_{t+1}^2}{1+r_{t+1}}, r_{t+1} \right] - \tau_t^1 = -(1+n)w'(r_{t+1}). \quad (4.A16)$$

Equation (4.A15) is the government budget constraint. Equation (4.A16) comes from Eq. (4.A13) and is the capital accumulation equation. b , T^1 , and T^2 do not appear in these two equations.

In other words, fiscal action is comprehensively summarized by a sequence of effective taxes $\{\tau_t^1\}$ and $\{\tau_t^2\}$. One of b , T^1 , and T^2 is redundant in order to attain any fiscal policy. The three cases (a), (b), and (c) are equivalent so long as two of b , T^1 , and T^2 are adjusted to attain the same $\{\tau_t^1\}$ and $\{\tau_t^2\}$. In cases (a) and (b), the government budget is not balanced. But in case (c), the government budget is balanced since $b=0$. This means that the government deficit is not a useful policy indicator to summarize fiscal action. This is supported by Kotlikoff (1992), who said that if lump sum taxes are appropriately adjusted, debt policy is not effective and the government deficit is a meaningless policy indicator.

A3.2 Some Remarks

Tax-financed transfer payments (case (c)) and Diamond's internal debt (case (a)) have the same effect on competitive equilibrium. In other words, this national debt can be regarded as a device that is used to redistribute income between the younger and older generations. Any intergenerational redistribution that can be supported by debt and taxes can also be supported just with taxes and without debt.

As Auerbach and Kotlikoff (1987) and Buitier and Kletzer (1992) stressed, unfunded social security can be easily managed as an explicit government debt policy. The government can label its social security receipts from young workers as either "borrowing" or "taxes." It can also label benefit payments to retired people as either "principal plus interest payments" with respect to the government's borrowing or "transfer payments." The economy's real behavior is not altered by such

relabeling. This makes one wary of relying on official government debt numbers as indicators of the government's true policy with respect to intergenerational redistribution.

Based on this understanding, Kotlikoff (1992) proposed a notion of generational accounting. As stressed by Kotlikoff (1992), generational accounting is a relatively new tool of intergenerational redistribution. It is based on the government's intertemporal budget constraint, which requires that the government's bill is paid by current or future generations. Moreover, Fehr and Kotlikoff (1995) showed how changes in generational accounts relate to the generational incidence of fiscal policy. See Chap. 7 for a further discussion of this issue.

If lump sum taxes are appropriately adjusted among generations, debt policy is meaningless. The government deficit is not a useful policy indicator. This result corresponds to Ricardian debt neutrality. The agent is concerned only with lifetime budget constraint; period-to-period budget constraint is meaningless. However, this result does not necessarily deny the effectiveness of fiscal policy with respect to intergenerational redistribution. As shown in (4.A15) and (4.A16), changes in $\{\tau_t^1\}$ and $\{\tau_t^2\}$ have real effects.

A3.3 The Burden of Debt

If there is no freedom to adjust lump sum taxes appropriately, then changes in government debt have real effects. This situation has been investigated in terms of debt burden. Let us define the relative burden ratio v with

$$v_t = \frac{T_t^2}{T_t^1(1+n)}, \quad (4.A17)$$

which is assumed to be constant. When v is exogenously fixed, changes in b have real effects.

Suppose a constant amount of debt per worker (b) is maintained. Considering Eq. (4.A13), the long-run competitive capital/labor ratio with debt policy, $\bar{k}(b, v)$, is determined by

$$a(\hat{w}, r) = (1+n)k + b, \quad (4.A18)$$

where $a = s + b$. From Eqs. (4.A12) and (4.A17), we have

$$\hat{w}_t = w_t - \left\{ \frac{r_t - n}{(1+v)(1+n)} + \frac{v(r_{t+1} - n)}{(1+r_{t+1})(1+v)} \right\} b. \quad (4.A19)$$

Substituting Eq. (4.A19) into Eq. (4.A18) and taking the total derivative of k with respect to b in a steady state, we have

$$\frac{dk}{db} = \frac{\frac{\partial a}{\partial b} - 1}{1+n - \frac{\partial a}{\partial k}}. \quad (4.A20)$$

From the assumption of the stability of the system, the denominator is positive; and from the assumption of the normality of the utility function, the numerator is negative. Thus, dk/db is definitely negative. Further, an increase in b reduces k . This result is referred to as the burden of debt, as explained in Sect. 2.3 of this chapter. See also Diamond (1965), who maintained that an increase in a constant amount of government debt per worker crowds out capital accumulation in the long run.

A4 Debt Neutrality with Altruistic Bequests

Barro (1974) extended the conventional neutrality result (Ricardian neutrality) to the strongest proposition of Barro's debt neutrality. Under certain conditions, debt policy is meaningless, even if lump sum taxes are not adjusted appropriately among generations.

Barro studied the effect of debt policy in the altruism model of overlapping generations. The altruism model means that households can be represented by the families that act as though they are infinitely lived. He showed that public intergenerational transfer policy becomes ineffective once we incorporate altruistic bequests into the standard overlapping-generations model. Let us explain intuitively his idea in this section.

A representative individual born at time t has the following budget constraints:

$$c_t^1 = w_t - s_t - b_t - T_t^1 + \frac{e_t}{1+n} \quad \text{and} \quad (4.A21)$$

$$c_{t+1}^2 = (1+r_{t+1})(s_t + b_t) - e_{t+1} - T_{t+1}^2, \quad (4.A22)$$

where $e_t/(1+n)$ is the inheritance received when young and e_{t+1} is the individual's bequest that is determined when old.

In the altruism model, the parent cares about the welfare of her or his offspring instead of the bequest itself. The parent's utility function is given as

$$U_t = u_t + \sigma_A U_{t+1}, \quad (4.A23)$$

where u_t is the utility from the parent's own consumption, $u(c_t^1, c_{t+1}^2)$, and σ_A is the parent's marginal benefit of her or his offspring's utility.

An individual born at time t solves the following problem of maximization:

$$\begin{aligned} W_t = & u[w(r_t) - s_t - b_t - T_t^1 + \frac{e_t}{1+n}, (1+r_{t+1})(s_t + b_t) - T_{t+1}^2 - e_{t+1}] + \\ & \sigma_A \left\{ u \left[w(r_{t+1}) - s_{t+1} - b_{t+1} - T_{t+1}^1 + \frac{e_{t+1}}{1+n}, (1+r_{t+2})(s_{t+1} + b_{t+1}) - T_{t+2}^2 - e_{t+2} \right] \right. \\ & \left. + \sigma_A U_{t+2} \right\}. \end{aligned} \quad (4.A24)$$

The optimal conditions with respect to s_t and e_{t+1} are

$$\frac{\partial u}{\partial c_t^1} = (1 + r_{t+1}) \frac{\partial u}{\partial c_{t+1}^2} \text{ and} \quad (4.A25.1)$$

$$(1 + n) \frac{\partial u}{\partial c_{t+1}^2} = \sigma_A \frac{\partial u}{\partial c_{t+1}^1}. \quad (4.A25.2)$$

Since the first order conditions are independent of government debt, the public intergenerational policy due to debt issuance is completely neutral. It would not affect the real equilibrium. In this regard, Barro (1974) said that if the altruistic bequest motive is operative, public intergenerational policy is neutral.

Equations (4.A25.1) and (4.A25.2) give the long-run rate of interest, r_A , in the altruism model r_A . Thus,

$$n = \sigma_A(1 + r_A) - 1. \quad (4.A26)$$

which is independent of b .

Let us define effective bequests with

$$e_t^* = \tau_t^2 + e_t. \quad (4.A27)$$

Recognizing Eqs. (4.A14.1), (4.A14.2), (4.A15), and (4.A27), Eqs. (4.A21) and (4.A22) may be rewritten as

$$c_t^1 = w_t - s_t + \frac{1}{1+n} e_t^* \text{ and} \quad (4.A21')$$

$$c_{t+1}^2 = (1 + r_{t+1})s_t - e_{t+1}^*. \quad (4.A22')$$

Substituting Eqs. (4.A21') and (4.A22') into Eqs. (4.A25.1) and (4.A25.2), it is easy to see that Eqs. (4.A25.1) and (4.A25.2) determine the optimal path of $\{e_t^*\}$. Public intergenerational transfer through changes between τ^1 and τ^2 (or b , T^1 , and T^2) is completely offset by appropriate changes in private transfer, e . When the government changes b , the private sector changes bequests so as to maintain the optimal path of effective bequests, which is determined by Eqs. (4.A25.1) and (4.A25.2).

Questions

4.1 Say whether the following statements are true or false and explain the reasons.

- When a consumer behaves optimally, based on permanent disposable income, public debt does not affect real economic variables.
- Debt issuance moves the fiscal burden to future generations and hurts intergenerational equity.

- (c) When the fiscal deficit and public debt are large, the conventional Keynesian effect is likely to occur and an increase in taxes may depress private consumption.

4.2 Explain the theoretical assumptions for Barro's neutrality and discuss the plausibility of these assumptions.

References

- Abel, A. B. (1983). *The failure of Ricardian equivalence under progressive wealth taxation* (NBER working paper No. 1983). Cambridge, MA: National Bureau of Economic Research.
- Altig, D., & Davis, S. J. (1989). Government debt, redistributive policies, and the interaction between borrowing constraints and intergenerational altruism. *Journal of Monetary Economics*, 24, 3–29.
- Auerbach, A., & Kotlikoff, L. (1987). *Dynamic fiscal policy*. Cambridge: Cambridge University Press.
- Barro, R. J. (1974). Are government bonds net wealth? *Journal of Political Economy*, 82, 1095–1117.
- Bernheim, B. D., & Bagwell, K. (1987). Is everything neutral? *Journal of Political Economy*, 96, 308–338.
- Buiter, W. H., & Kletzer, K. M. (1992). *Government solvency, Ponzi finance and the redundancy and usefulness of public debt* (NBER working paper No.4076). Cambridge, MA: National Bureau of Economic Research.
- Diamond, P. A. (1965). National debt in a neoclassical growth model. *American Economic Review*, 55, 1126–1150.
- Fehr, H., & Kotlikoff, L. K. (1995). *Generational accounting in general equilibrium* (NBER working paper no. 5090). Cambridge, MA: National Bureau of Economic Research.
- Feldstein, M. S. (1988). The effect of fiscal policies when income are uncertain: A contradiction to Ricardian equivalence. *American Economic Review*, 78, 14–23.
- Hayashi, F. (1987). Tests for liquidity constraints: A critical survey. In T. Bewley (Ed.) *Advances in econometrics* (pp. 91–120). Fifth world congress. Cambridge: Cambridge University Press.
- Homma, M., Abe, H., Atoda, N., Ihori, T., Kandori, M., & Mutoh, T. (1984). *The debt neutrality hypothesis: Theoretical and empirical analysis for the Japanese economy*. Keizai Bunseki, Economic Planning Agency, (in Japanese).
- Ihori, T. (1989). The degree of debt neutrality: Some evidence for the Japanese economy. *Economic Studies Quarterly*, 40, 66–74.
- Ihori, T. (1996). *Public finance in an overlapping generations economy*. London: Macmillan.
- Ihori, T., & Kondo, H. (2002). Debt neutrality proposition and private consumption. In T. Ihori & M. Sato (Eds.), *Government deficit and fiscal reform in Japan* (pp. 13–25). Boston: Springer.
- Ihori, T., Doi, T., & Kondo, H. (2001). Japanese fiscal reform: Fiscal reconstruction and fiscal policy. *Japan and the World Economy*, 13, 351–370.
- Kotlikoff, L. J. (1992). *Generational accounting; Knowing who pays, and when, for what we spend*. New York: The Free Press.
- Leiderman, L., & Blejer, M. I. (1988). Modeling and testing Ricardian equivalence. *IMF Staff Papers*, 35, 1–35.
- Seater, J. J. (1993). Ricardian equivalence. *Journal of Economic Literature*, 31, 142–190.
- Weil, P. (1987). Love thy children: Reflections on the Barro debt neutrality theorem. *Journal of Monetary Economics*, 19, 377–391.

1 A Simple Growth Model

1.1 Long-Run Growth Rate in the Harrod-Domar Model

In the short-run macroeconomic model, investment is an important component of aggregate demand. Certainly, investment is a part of current effective demand. At the same time, it may increase production capacity by accumulating capital stock in the long run. This is an important function of public investment. It is also useful to investigate the impact of taxes on economic growth, since public investment is normally financed by taxes and an increase in taxes in the private sector depresses private investment. Thus, in this chapter, we investigate the supply-side effect of public investment and the impact of fiscal policy on long-run economic growth.

First, we explain how economic growth is determined by using a simple dynamic model. From the supply side, GDP is determined by three factors: capital stock, labor input, and technology level. We may formulate this relationship as the macroeconomic production function.

$$Y = AK \quad (5.1)$$

Equation (5.1) is one of the fundamental equations for an economic growth model, where Y represents income, K capital, and A productivity. The equation specifies the productive effect of investment or the supply effect of capital stock. Namely, production capacity Y can be increased by the amount of A per capital stock, K . Full employment of K may produce AK amounts of output. A denotes the technology level of a country. For simplicity, we do not consider in this section the constraint of labor supply in production.

Next, we formulate the capital accumulation equation,

$$\Delta K = I = sY, \quad (5.2)$$

where s is the propensity to save (or the saving rate) and ΔK denotes an increase in capital stock or investment I . The right-hand side of Eq. (5.2) means a simple saving function as in the Keynesian model of Chap. 2. In a closed economy, saving is used for investment. From Eqs. (5.1) and (5.2), we have

$$\Delta K = sAK.$$

Alternatively, the growth rate ω is determined as

$$\omega = \Delta K/K = sA. \quad (5.3)$$

The long-run growth rate ω is given by the saving rate s multiplied by productivity A . The higher the saving rate and productivity, the higher the growth rate. Since Y and A are linearly related by Eq. (5.1), the growth rate of Y is the same as the growth rate of K , ω .

This model of economic growth was originally formulated by Harrod (1939) and Domar (1946). Thus, it is called the Harrod-Domar model. In Harrod and Domar's formulation, the inverse of productivity $1/A$ is called the capital/output ratio or the capital coefficient, K/Y .

1.2 The Effect of Fiscal Policy

Now let us introduce the income tax rate t in order to investigate the effect of fiscal policy on economic growth. Suppose the government imposes a linear income tax t to finance public consumption. Equation (5.2) may be rewritten as

$$\Delta K = s(1 - t)Y. \quad (5.4)$$

For simplicity, we assume that saving is proportional to disposable income as in the conventional Keynesian model in Chap. 2. Thus, substituting Eq. (5.4) into Eq. (5.2), economic growth is determined as

$$\omega = \Delta K/K = s(1 - t)A, \quad (5.5)$$

which decreases with the tax rate.

An increase in the tax rate reduces private savings and hence the economic growth rate. Namely, when the government raises the tax burden on the private sector, private saving declines. This reduces capital accumulation and the long-run growth rate. It seems plausible to find a negative relationship between tax and growth rate.

1.3 The Incorporation of Public Investment

So far, we have assumed that government spending financed by taxes is used only for ordinary spending and does not affect production capacity; we can then confirm the negative effect of tax on growth. However, in reality, a part of tax revenue (and public spending) is used for public investment and contributes to the expansion of macroeconomic production capacity by improving the social infrastructure. If we incorporate the supply-side benefit of public investment into the model, how is the result altered?

Considering this possibility, we now assume that a part of public spending is used for public investment, which accumulates public capital and raises production capacity by the size of λ (< 1) in terms of private investment. Here λ is the share of public investment in public spending. We also assume that public capital and private capital are perfect substitutes. Then, the capital accumulation equation $\Delta K = I = S$ is rewritten as

$$\Delta K = S + \lambda gY,$$

where $g = G/Y$ is government spending per GDP and G is government spending, S denotes savings for private capital accumulation, and λgY means public investment for public capital accumulation. Based on this equation, the growth rate ω is given as

$$\omega = [s(1 - t) + \lambda g]A, \quad (5.6)$$

where $t = T/Y$ is tax per GDP and T is tax revenue. Namely, the growth rate is higher by the amount of λg . A higher λ means a higher growth rate ω .

In the long run, the government budget must be balanced. Government budget constraint is given as

$$tY = gY. \quad (5.7)$$

Considering this equation, Eq. (5.6) is now rewritten as

$$\omega = [s + (\lambda - s)t]A. \quad (5.6')$$

If the ratio of public investment from tax revenue λ is greater than the private saving rate s , an increase in the size of government spending enhances economic growth (and vice versa). Thus, the relationship between the tax rate and economic growth is generally ambiguous; it depends upon the sign of $\lambda - s$ in this simple model.

In reality, public capital and private capital are not necessarily perfect substitutes. Let us denote θ as the relative productivity of public capital in terms of private capital. $\theta \lambda gY$ means the contribution to capital accumulation by public investment. Then, the saving-investment equation in the economy is

$$\Delta K = S + \theta \lambda g Y.$$

Hence, Eq. (5.6') is rewritten as

$$\omega = [s + (\theta \lambda - s)t]A. \quad (5.6'')$$

If θ is low, the sign of $(\theta \lambda - s)$ is likely to become negative, and an increase in t reduces ω . In other words, if the productivity of public capital is very low compared with the amount of public capital, an increase in the tax rate is likely to reduce the growth rate. Such a negative relationship occurs even if λ is high.

2 Optimal Public Investment

2.1 The Role of Public Spending

At a given time, the resources available for a country are limited. If resources are used for public services, resources for private consumption are reduced. Thus, the opportunity cost of public services is a reduction of the resources available for the private sector. If the public sector is more productive than the private sector, it is better for the public sector to provide useful services. However, if the private sector is more efficient than the public sector at utilizing resources, it is worse for the public sector to use a lot of resources. The size of public spending should be determined by the efficiency and usefulness of public spending compared with private spending. In this section, let us investigate the optimal level of public investment from the viewpoint of optimization between the two sectors.

In the market economy, private firms' investments are determined by profit-maximizing conditions in the market. Private investment projects determined in the perfect competitive market are generally desirable from the perspective of efficient resource allocation. If public investment increases, the resources available for private investment are reduced. This could also depress private consumption. Hence, the cost of public investment is the benefit of private consumption and/or private investment. When the government spends on public investment, it is necessary to consider the cost for the private sector. If the private market is not perfect and has some failures, the public sector may have a greater role in public investment even if public investment and private investment have the same returns on the economy.

2.2 Public Investment in the Market Economy

The optimal rule of public investment may be discussed from three viewpoints: sector allocation between public and private investment, interregional allocation, and intertemporal allocation. First, we investigate the optimal allocation of a given amount of investment (or capital) between the private and public sectors.

The optimal allocation rule is given as follows:

The marginal product of public investment = the marginal product of private investment

The marginal product of public investment is the size of the marginal increase in GDP when investment increases by one unit. The purpose of the efficiency of production is to maximize GDP because production is useful for consumption and investment.

Suppose the macroeconomic production function is given as

$$Y = F(K_G, K_P), \quad (5.7')$$

where K_G is public capital and K_P is private capital. The feasibility condition is written as

$$K_G + K_P = \bar{K}, \quad (5.8)$$

where $\bar{K}$ is exogenously given total capital. In this section, we do not consider capital accumulation; instead, we investigate the allocation of capital. Capital and investment are regarded as the same. Thus, for simplicity, total capital is assumed to be fixed.

The government may choose the allocation of public and private capital between sectors. Thus, the government maximizes Eq. (5.7') subject to Eq. (5.8). The optimal condition is

$$F_{KG} = F_{KP}, \quad (5.9)$$

where F_{KG} is the marginal product of public capital and F_{KP} is the marginal product of private capital. For simplicity, we assume that the marginal product of public capital is equal to the marginal product of public investment and that the marginal product of private capital is equal to the marginal product of private investment. Hence, we do not consider the difference between investment and capital here. Eq. (5.9) means the optimal condition stated above. This condition is explained in Fig. 5.1a.

In Fig. 5.1a, the vertical axis denotes the marginal product of public investment and that of private investment, and the horizontal axis denotes the given amount of total investment or capital. The larger the investment, the lower the marginal product. Thus, the marginal product curve is downward sloping. O_AO_B corresponds to $\bar{K}$.

Investment projects are conducted in accordance with more profitable projects. An increase in investment raises GDP. The increase in GDP corresponds to the area below the marginal product curve. In order to maximize the area, the optimal allocation of investment should be set at point E, the intersection of both marginal

Fig. 5.1a Optimal allocation between public and private investment

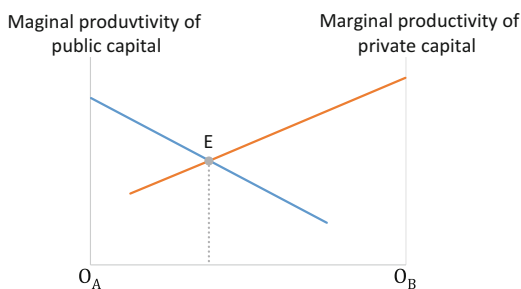
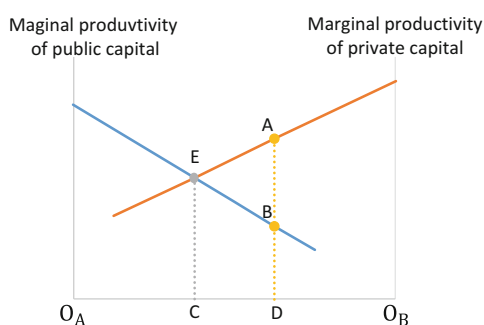


Fig. 5.1b Non-optimal allocation between public and private investment



product curves of public capital and private capital. At this point, we attain the optimal allocation of investment between two sectors.

If this optimal condition does not hold, we may have points A and B in Fig. 5.1b, where the marginal product of public investment is lower at point B than the marginal product of private investment at point A. Then, the area of triangle ABE is lost. In other words, GDP at the optimal allocation associated with point C is greater than GDP at the non-optimal allocation associated with point D by the area ABE.

2.3 Optimal Allocation Between Two Regions

Next, let us investigate the optimal rule of regional allocation between two regions, region A and region B. This rule proposes how a given amount of public investment should be allocated between two regions. The optimal rule is similar to the allocation rule between sectors.

Suppose the macroeconomic production function is now given as

$$Y = F(K_{GA}, K_{GB}), \quad (5.7'')$$

where K_{GA} is public capital in region A and K_{GB} is public capital in region B. For simplicity, private capital is fixed. The feasibility condition is now written as

$$K_{GA} + K_{GB} = \bar{K}, \quad (5.8')$$

where $\bar{K}$ is a given amount of public capital. The optimal allocation rule between two regions is given as:

The marginal product of public investment in region A = the marginal product of public investment in region B

Alternatively, this condition may be expressed as

$$F_{KGA} = F_{KGB}, \quad (5.10)$$

where F_{KGA} is the marginal product of public investment in region A and F_{KGB} is the marginal product of public investment in region B.

An intuitive explanation is similar to the optimal allocation between private capital and public capital, shown in Fig. 5.1a. In order to maximize GDP, it is desirable to allocate more public investment in the region that has a higher marginal product.

For example, imagine that the marginal product in region A is higher. By investing more in region A, GDP increases more. As public investment in region A increases, the marginal product declines. Similarly, if the marginal product in region B becomes higher than in region A, a reallocation of public investment from region A to region B increases GDP. This mechanism is also the same as in Sect. 2.2 and as shown in Fig. 5.1b.

Thus, it is optimal to equate the marginal product among regions by adjusting regional allocations. In Japan, the marginal product of public capital in the urban metropolitan areas has been consistently higher than in remote rural areas. Public capital in rural areas is too much, while public capital in urban areas is too little. This is mainly because the political pressure from the rural areas is stronger than from the urban areas. As a result, the regional allocation of public capital is not efficient in Japan. See the case study of this chapter, [Appendix A](#), for further explanations of Japan's public investment.

2.4 Optimal Size of Public Investment

So far, the total amount of public investment is fixed. Finally, then, let us investigate the amount of public investment that should be conducted.

In a simple two-period model, we have the following constraints:

$$\bar{Y}_1 = C_1 + K_G \text{ and} \quad (5.11)$$

$$C_2 = K_G + F(K_G), \quad (5.12)$$

where $\bar{Y}_1$ is the output available in period 1, which is exogenously given. Equation (5.11) is the budget constraint in period 1. Equation (5.12) is the budget constraint in period 2, which means that public capital and the output from public capital are used for consumption in period 2. C_1 and C_2 are the outputs used for consumption in both periods. K_G is public capital.

The government intends to maximize total consumption over time. In other words, the government maximizes the total consumable output given by the following function by choosing K_G :

$$C_1 + \frac{1}{1+\rho} C_2 = \bar{Y} - K_G + \frac{1}{1+\rho} [K_G + F(K_G)], \quad (5.13)$$

where ρ is the discount rate of future consumption.

Then, the optimal rule for the size of public investment is given as follows:

The marginal product of public investment = the rate of time preference

Alternatively, this condition means

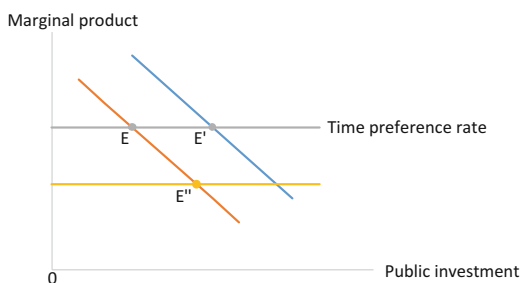
$$F_{KG} = \rho. \quad (5.14)$$

The rate of time preference ρ compares utility from current consumption with utility from future consumption. People normally evaluate current utility more than future utility. The rate of time preference means the relative evaluation of current utility compared with future utility. If this rate is high, people pay significant attention to evaluating current utility.

For example, if the rate of time preference is 10 %, amounts of 100 for current utility and 110 for future utility are equivalent for the agent. If the rate becomes 20 %, amounts of 100 for current utility and 120 for future utility are equivalent. The higher the rate of time preference, the larger the evaluated current consumption. Thus, public investment becomes desirable only if it produces a large benefit in the future. Note that public investment requires funds and thus a sacrifice in current consumption. Figure 5.2 illustrates optimal allocation over time.

In Fig. 5.2, the vertical axis denotes the marginal product of public investment and the horizontal axis denotes the level of public investment. E is the initial

Fig. 5.2 Optimal allocation over time



optimal point. As shown in Fig. 5.2, if the marginal product curve of public investment somehow moves upward ($E \rightarrow E'$) or the rate of time preference exogenously declines ($E \rightarrow E''$), the optimal level of public investment rises. However, if the marginal product curve of public investment moves downward or the rate of time preference rises, the optimal level of public investment declines.

In Japan, significant public investment has been conducted following World War II. The reason is that in Japan the initial level of public capital was too little in the 1950s; hence, the marginal product of public investment has been significantly large. In addition, the government has been politically stable and the rate of time preference has been significantly low.

2.5 The Discount Rate of Public Investment

As discussed so far, the discount rate of public investment should be the profit rate of private investment and the rate of time preference. In the perfect capital market, consumers choose the consumption/saving decisions that equate the rate of time preference to the market rate of interest. Similarly, firms choose investment decisions so as to equate the marginal product of investment to the market rate of interest. Thus, the discount rate of public investment is given by the market rate of interest.

However, some arguments suggest that the market rate should not necessarily be used for the discount rate of public investment. People live in a finite horizon; hence, they are not greatly concerned with the distant future. If people are myopic, public investment based on the market rate of interest could be insufficient even if the capital market is perfect. If so, the government, as an agent of future generations, may employ a lower discount rate of public investment than the market rate; thus, the government may stimulate public investment, a situation that is socially desirable.

If people are myopic, they do not optimize consumption/saving behavior from the viewpoint of government; hence, private saving is at too low a level. In this regard, the optimal discount rate is given as the weighted average of the market rate of interest and the discount rate. This average rate is not necessarily equal to the market rate of interest. This argument highlights that a gap exists between the optimizing period of households and the existing period of the economy. For example, private agents live for 80 years and do not consider interests beyond their lives. However, the government exists in perpetuity and also considers the welfare of future generations. In this regard, the market rate of interest, which reflects private agents' preferences, is not desirable for the discount rate of public investment.

In addition, if the capital market is imperfect in some way, it is difficult to use the market rate of interest as the discount rate of public investment. For example, capital income taxes, imperfect competition, and uncertainty about future economic situations may produce multiple rates of interest in the market. If so, the discount rate based on the market rate does not necessarily maximize economic welfare.

In a political economy, voters do not accept the cost of public investment by issuing public debt. By doing so, the cost of public investment is moved to future generations. Current voters may have an incentive to adopt a lower discount rate.

3 The Solow Model

3.1 Formulation of the Solow Model

We investigate the effect of fiscal policy on economic growth using the Solow model, which is the standard growth model of neoclassical economics (see Solow 1956). This model assumes that capital and labor are substitutable in production. Namely, if the wage rate is higher and the rate of interest is lower, hiring labor is more costly than hiring capital. Hence, substitution from labor to capital occurs, and capital accumulation is stimulated. However, if the wage rate is smaller and the rate of interest is higher, labor employment is encouraged more than capital employment. Thus, if the wage rate and the rate of interest are sufficiently adjusted so as to employ existing capital and labor fully, neither capital nor labor is underemployed. We may assume that the price adjustment mechanism in factor markets would work very well in the long run. If so, it is plausible to assume that capital and labor are fully employed when associated with long-run growth.

Let us denote K and L as the existing amounts of capital and labor respectively. Then, GDP is determined in the macroeconomic production function by existing capital and labor. Hence, in the neoclassical model, the macroeconomic production function, which specifies the technical relation between output, Y , and inputs, K and L , may be formulated as follows:

$$Y = F(K, L). \quad (5.15)$$

This production function is linearly homogeneous and has decreasing returns with respect to each input. Namely, if capital and labor increase by the same proportion, output increases in the same way; however, if either capital or labor increases, the size of the increase in output is not the same as the size of the increase in either input.

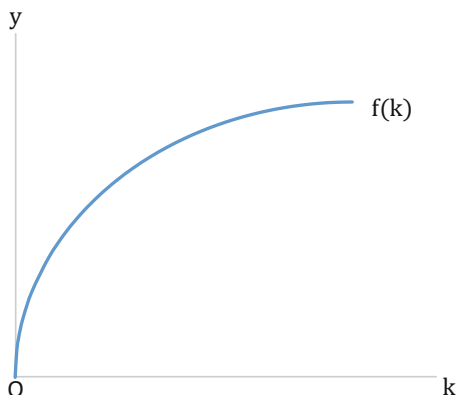
Thus, we may rewrite the macroeconomic production function as follows:

$$y = F(k, 1) = f(k), \quad f'(k) > 0, \quad f''(k) < 0, \quad (5.16)$$

where $y = Y/L$ means per capita income and $k = K/L$ means capital/labor ratio or capital intensity. Equation (5.16) may be drawn in Fig. 5.3. Because an increase in K raises Y at a given level of L , the marginal product of capital, $F_K = f'(k)$, declines.

How would capital and labor increase over time? This is a crucial question to determine economic growth. We assume that labor exogenously grows at a given rate, n . Thus,

Fig. 5.3 The macroeconomic production function



$$\Delta L = nL. \quad (5.17)$$

With regard to capital accumulation, we have to formulate the saving function because saving becomes investment and enhances capital accumulation, as in the simple growth model of Sect. 1. For simplicity, we assume that a given portion, s , of disposable income, $(1 - t)Y$, goes to savings, which is the same as in the simple Keynesian model. Thus,

$$\Delta K = s(1 - t)Y. \quad (5.18)$$

The three equations, (5.16), (5.17), and (5.18), summarize the Solow growth model.

3.2 Stability of the System

From these three equations, we derive the fundamental equation of the Solow model. Note that by definition we have

$$\frac{\Delta k}{k} = \frac{\Delta K}{K} - \frac{\Delta L}{L}.$$

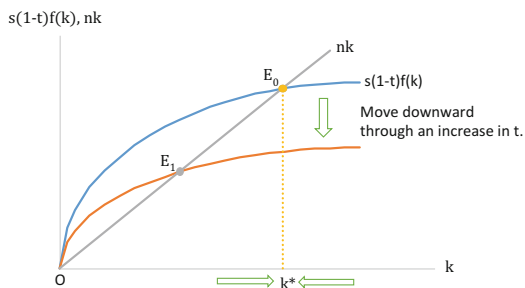
Alternatively, considering Eq. (5.17), we have

$$\Delta k = \frac{\Delta K}{L} - nk.$$

Substituting Eq. (5.18) into the above equation, we finally obtain the fundamental equation of economic growth:

$$\Delta k = s(1 - t)f(k) - nk. \quad (5.19)$$

Fig. 5.4 Stability of the model



Changes in capital intensity Δk are determined by the gap between per capita savings, $s(1-t)f(k)$, and the savings that are necessary to keep capital intensity fixed, nk .

This equation is drawn in Fig. 5.4. In this figure, we draw both the $s(1-t)f(k)$ curve and the nk line. The intersection of the curves, E_0 , represents the long-run equilibrium point. If capital intensity is smaller than long-run equilibrium intensity, k^* , the $s(1-t)f(k)$ curve is above the nk line. Then, in accordance with Eq. (5.19), k increases. However, if k is greater than k^* , the $s(1-t)f(k)$ curve is below the nk line, and in accordance with Eq. (5.19), k declines. Thus, the economy would converge to the long-run level, k^* , irrespective of the initial level of k .

In this sense, the system is dynamically stable. In the neoclassical model, capital and labor are always fully employed because of adjustments of wages and the rate of interest in the factor market. In the long run, equilibrium capital intensity remains constant and capital, labor, GDP, and other economic variables grow at the exogenously given population growth rate, n .

3.3 The Effect of Fiscal Policy

Fiscal policy cannot affect the long-run growth rate, n . However, it may affect long-run capital intensity, k^* . As shown in Fig. 5.4, an increase in t moves the $s(1-t)f(k)$ curve downward; hence, the long-run equilibrium point moves from E_0 to E_1 . Thus, long-run capital intensity declines; namely, an increase in the tax rate depresses capital accumulation. During the transition from E_0 to E_1 , K declines more than L , which means that the growth rate of capital is less than the growth rate of labor, n , during the transition. In this sense, an increase in the tax rate reduces the growth rate during the transition.

So far, we have assumed that tax revenue is used for government consumption. Now, as in Sect. 1, let us introduce public investment. First, we assume that all government spending is used for public investment, $\lambda = 1$ and $\theta = 1$. Then, under the balanced budget rule, we have

$$tf(k) = gf(k).$$

Further, Eq. (5.19) may be rewritten as

$$\Delta k = s(1 - t)f(k) - nk + tf(k) = [s + t(1 - s)]f(k) - nk. \quad (5.19')$$

In this regard, an increase in t moves the $[s + t(1 - s)]f(k)$ curve upward. Hence, an increase in government spending enhances capital intensity and capital accumulation. Generally, if we consider the case of $\lambda < 1$, then we have to compare λ and s . If $\lambda > s$, an increase in government spending stimulates capital accumulation as in Sect. 1, and vice versa.

When capital accumulation is extended in the long run, K grows at a greater rate than n during the transition. Thus, the growth rate of GDP, ω , is also greater than n during the transition. In other words, such fiscal policy also stimulates economic growth ω during the transition, although the long-run growth rate is given by the population growth rate, n . If it is plausible to assume $\lambda < s$, an increase in the tax rate depresses capital accumulation. Further, even if $\lambda > s$, the productivity of public investment may be smaller than the productivity of private investment, with low productivity of public capital compared with private capital, θ . If so, the sign of $\theta\lambda - s$ becomes negative; hence, we still have a negative relationship between tax and capital accumulation.

4 The Endogenous Growth Model

Let us investigate the effect of fiscal policy using an endogenous growth model. In this model, the conventional neoclassical model is modified to have an endogenous growth rate. The endogenous growth model generally incorporates externalities of human capital accumulation and/or research development so as to determine economic growth endogenously. There are many formulations of endogenous economic growth (e.g., Romer 2011).

4.1 The Optimal Growth Model

We formulate a very simple version of the endogenous growth model in order to analyze the effect of fiscal policy in Sect. 4.2. Before doing this, it is useful to formulate the optimal growth model in this section. In the optimal growth model, households optimize consumption/saving behavior over time. The optimal allocation of consumption over time is determined by the relationship between the time preference and the interest rate, as explained in Chap. 3. If the rate of interest r is greater than the rate of time preference ρ , the agent greatly prefers future consumption to present consumption. Thus, the growth rate of consumption, ω_c , increases with the rate of interest and decreases with the time preference rate.

We may formulate this as follows:

$$\omega_c = \beta(r - \rho). \quad (5.20)$$

β is a positive constant. We may also regard ω_c as the economic growth rate because it corresponds to the growth rate of GDP and/or capital. In the optimal growth model, saving/consumption behavior is endogenously determined in order to maximize lifetime utility. In this sense, the model is a sophisticated version of the neoclassical growth model and is called the optimal growth model.

As explained in Sect. 2, economic growth normally enhances capital intensity and reduces the marginal product of capital. In the competitive market, the rate of interest is equal to the marginal product of capital. Thus, economic growth reduces the rate of interest over time. In the long run, the rate of interest declines so that it is equal to the exogenously given time preference rate.

Then, Eq. (5.20) means that economic growth stops even in the optimal growth model. This corresponds to long-run equilibrium in the neoclassical growth model, as shown in Fig. 5.4. If labor grows exogenously, consumption and capital grow at the rate of n in the long run, while per capita consumption and per capita capital stock do not grow in the long run. This property is a key outcome of the conventional neoclassical growth model. As long as labor supply is exogenously given, we cannot derive the endogenous growth rate in the long run.

4.2 The AK Model

In contrast, an endogenous growth model incorporates the mechanism whereby capital accumulation does not lead to a reduction in the rate of interest or the marginal product of capital. For example, if a broader concept of labor supply grows at the same speed as capital, capital accumulation does not reduce capital intensity or the marginal product of capital. Since population grows exogenously, we need to introduce a mechanism that allows for labor supply in an efficiency unit to grow endogenously in a way that is consistent with the speed of capital accumulation.

One plausible explanation why labor supply in an efficiency unit increases is to regard labor supply as the use of human capital. Another plausible explanation is to consider the externality of technological progress. Namely, when capital accumulation occurs, educational investment or technological progress produces externality over the economy, so that labor supply in an efficiency unit may grow even if actual labor supply does not grow. Alternatively, one could assume that public capital may have positive spillovers on skill levels of labor supply. For example, infrastructure facilities related to public education would be beneficial for stimulating human capital accumulation.

Following this understanding, we may formulate the macroeconomic production function as follows:

$$Y = F(K, KL) = F(1, L)K = AK. \quad (5.21)$$

Here, the second input of production function, KL , denotes labor supply in an efficiency unit. An increase in K stimulates labor supply in an efficiency unit by KL . The second equality comes from the property of linear homogeneity of $F()$, which is the standard assumption. We denote $F(1, L) = A$ (constant). For simplicity, we assume that $L = 1$ and the population does not grow. However, even if $L = 1$, capital accumulation can enhance labor supply in an efficiency unit.

This formulation of the AK production function is consistent with that in Sect. 1. However, in this section, labor population may not grow but nonetheless does not impose a constraint on economic growth, contrary to the Harrod-Domar model. A unique outcome of this model is that by considering labor supply in an efficiency unit and the positive spillover effect of capital accumulation on the productivity of labor, productivity does not decline despite the exogenous labor supply constraint.

The AK production function, Eq. (5.21), means that the marginal product of capital is always given as A ; thus, capital accumulation does not result in a reduction of the marginal product of capital. In accordance with Eqs. (5.20) and (5.21), the economic growth rate is given as follows:

$$\omega = \beta(A - \rho). \quad (5.22)$$

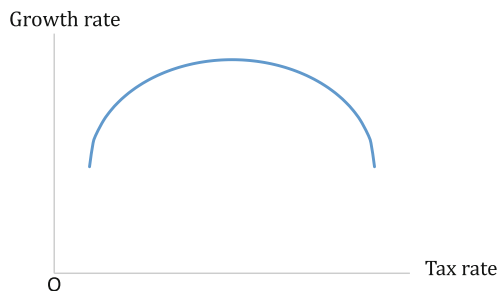
Even if the population does not grow, the long-run growth rate may be positive. This is the simplest version of the endogenous growth model and is called the AK model, where the exogenous population growth does not limit the economic growth rate.

So far, A is regarded as an exogenous variable. If A is affected by fiscal policy, then it may affect the growth rate in the long run.

4.3 Public Investment and Growth Rate

Using the AK model, let us investigate the effect of fiscal policy on the economic growth rate. The government uses tax revenue only for public investment. The relationship between the tax rate and economic growth may be drawn in Fig. 5.5. If the tax rate is low, an increase in the tax rate raises the growth rate; however, if the tax rate is high enough, a further increase may reduce the growth rate.

Fig. 5.5 Growth rate and tax rate



An increase in the tax rate is associated with public investment, which affects the growth rate in two ways. The first effect is that an increase in the tax rate directly reduces the private rate of return on capital. The second effect is that an increase in the tax rate enhances public capital stock, thereby raising the marginal product of private capital. This effect can also raise the growth rate. When the size of government is small, the second effect predominates. Because the marginal product of public capital declines, the first effect is likely to predominate because the size of government becomes larger. If both effects completely offset each other, the growth rate is maximized (see Barro and Sala-i-Martin (2004) among others).

If we incorporate public capital into the Cobb-Douglas production function, we may have the following production function:

$$Y = AK^{1-\alpha}g^\alpha, \quad (5.23)$$

where g denotes public capital. For simplicity, labor supply is normalized to unity, $L = 1$, and public investment is assumed to be the same as public capital. Thus, g means the spillover effect of public capital.

The government budget constraint is

$$g = tK \quad (5.24)$$

where t is a tax rate on capital stock and all the taxes are used for public investment.

Then, substituting (5.24) into (5.23), the production function reduces to

$$Y = At^\alpha K. \quad (5.25)$$

This equation suggests that the marginal product of capital is given by At^α in place of A .

Thus, the growth equation is rewritten as

$$\omega = \beta((1 - t)At^\alpha - \rho). \quad (5.26)$$

Because a capital stock tax is imposed, the effective marginal product of capital is now $(1 - t)At^\alpha$. Thus, the long-run growth rate depends on the tax rate.

The first term of the right-hand side of Eq. (5.26) increases with t if t is low and decreases if t is high, as shown in Fig. 5.5. A unique tax rate exists that maximizes the growth rate, which is the optimal tax rate. Equation (5.26) theoretically explains the nonlinear property of the growth curve in Fig. 5.5.

The relationship between the size of government and the growth rate has been empirically investigated. According to the data until 1990, Japan experienced the highest growth rate and public investment/GDP ratio among developed countries. The US experienced the smallest growth rate and public investment/GDP ratio. The EU countries on average experienced modest growth rates and public investment/GDP ratios. These facts suggest that a positive correlation may exist between the growth rate and the public investment rate.

However, if we conduct empirical studies on a greater number of countries for periods that include years that are more recent, it may be difficult to confirm a definite positive correlation between the two rates. Moreover, if we consider the relationship between the size of government, including public consumption, and public investment, we may find some negative correlations between economic growth and the size of government.

Among others, Barro (1991) reported empirical evidence using cross-country data for 98 countries in the period 1960–1985. It was shown that the growth rate of real per capita GDP is positively related to initial human capital and negatively related to the initial level of real per capita GDP. Countries with higher human capital also have lower fertility rates and higher ratios of physical investment to GDP. Growth is inversely related to the share of government consumption in GDP, but insignificantly related to the share of public investment. Growth rates are positively related to measures of political stability and inversely related to a proxy for market distortions.

5 Inequality and Economic Growth

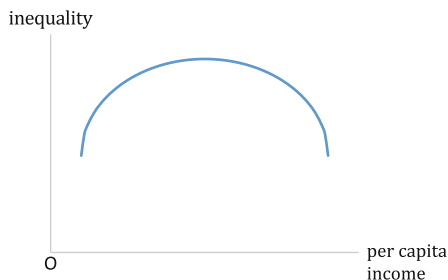
5.1 Income Redistribution and Tax Rate

Long-run growth rates among many countries diverge. Growth rates among developing countries particularly diverge. We do not see any evidence that many countries would converge with the same growth rate in the long run. The endogenous growth model may explain why the long-run growth rate may differ among countries. In this section, we investigate this issue from the viewpoint of fiscal aspects.

An interesting fact is that the larger the inequality, the smaller the growth rate. If we trace the growth rate of a country over the long run, a country with a large degree of inequality experiences a low growth rate, while a country with a small degree of inequality experiences a large growth rate. We may explain this outcome using the endogenous growth model in the political economy.

Suppose that the actual tax rate in each country is determined by the majority rule of democracy, as explained in Chap. 12. In a country with a small degree of inequality, voters are not greatly concerned about redistribution. Thus, the tax rate is set to maximize the growth rate. However, in a country with a high degree of inequality, people want significant redistribution. In order to attain a fair outcome for income redistribution, the tax rate is set higher than the growth-maximizing rate. As a result, the economic growth rate is less in a country with higher inequality.

However, in the early stage of growth, income inequality may enhance growth, while aggressive redistribution may depress growth. This is because in the early stage of growth, it is necessary for some elite groups to learn the experiences of economic growth in developed countries. By doing so, developing countries may start to grow. If an aggressive redistribution policy is conducted in the early stage of growth, it may damage the elite. In this regard, even elite groups cannot try to learn

Fig. 5.6 Kuznets hypothesis

from developed countries. Then, all people may be equally poor and the country does not grow a great deal. The non-linear relationship between economic growth (or per capita income) and income inequality, namely the idea that growth initially enhances inequality but later reduces inequality, is called the Kuznets hypothesis (see Kuznets 1955). Figure 5.6 explains this hypothesis.

5.2 Externality of Educational Investment

If educational investment has externalities, the foregoing effect is larger. Namely, if an individual receives education when young, she or he may accumulate her or his human capital. Let us assume that such educational investment has positive externalities for the macroeconomy in the sense that it may raise income for many people. If all individuals can engage in a certain level of educational investment, the economic growth rate is significantly high.

However, educational investment requires a great deal of money. Even if such investment is profitable, poor agents may not obtain money for educational investment because of liquidity constraints. Hence, they cannot engage in educational investment. If inequality exists to a large degree, many people cannot accumulate human capital, resulting in lower growth. In this regard, redistribution is desirable. However, aggressive redistribution may raise the tax rate too high, thereby depressing growth. Thus, by considering fiscal aspects, we may explain to some extent the divergence of economic growth rates among countries.

Appendix A: Taxes on Capital Accumulation and Economic Growth

A1 Introduction

There are two types of capital from the viewpoint of origin; life cycle capital (capital accumulated from life cycle behavior) and transfer capital (capital derived from intergenerational transfers). We observe a large amount of intergenerational transfers (educational investment and physical bequests) in the real economy (see

Kotlikoff and Summers 1981). Hence, it is important to analyze the effect on economic growth of taxation on two types of capital accumulation.

It is generally believed that an increase in capital income taxes (i.e., taxation on capital accumulation) reduces economic growth. It should be noted that the effect on capital accumulation is not necessarily the same as the effect on the rate of economic growth. In order to explore this point, models of endogenous growth that explicitly distinguish transfer capital from life cycle capital are useful.

There have been several attempts to consider endogenous growth by using a framework of overlapping generations. Jones and Manuelli (1990) showed that a redistributive policy financed by income tax can be used to induce positive growth. Azariadis and Drazen (1990) presented models of endogenous growth in which the accumulation of human capital is subject to externalities. Buiter and Kletzer (1993) investigated international productivity growth differentials by incorporating human capital accumulation.

Caballe (1995) showed that lump sum intergenerational transfer policies are ineffective when altruistic bequests are fully operative. He then investigated the effect of several fiscal policy experiments for bequest-constrained economies and unconstrained ones.

In this advanced study, we formulate the human capital accumulation process in a different way so as to obtain clearer results with respect to the degree of externality. Namely, this appendix incorporates three types of tax on capital (a tax on life cycle physical capital income, a tax on human capital income, and a tax on transfer physical capital or bequests) into an endogenous growth model with an altruistic bequest motive. The analytical results depend upon whether bequests are operative or not.

When bequests are not operative and the externality effect of human capital is small, the laissez-faire growth rate may well be too high. An increase in a tax on human capital income (a wage income tax) may raise the rate of economic growth, while an increase in a tax on life cycle physical capital income (an interest income tax) will reduce the growth rate. If bequests are operative, the laissez-faire growth rate is too low. A tax on life cycle capital income will not affect the growth rate, while an increase in taxes on transfer capital income (a wage income tax and a bequest tax) will reduce the growth rate.

This advanced study is organized as follows. Section A2 presents an overlapping-generations model of endogenous growth. Section A3 compares the competitive laissez-faire growth rate with the efficient one. Section A4 investigates the effect on economic growth of taxation on capital accumulation and considers how to attain the first best solution. Finally, Sect. A5 concludes the appendix.

A2 The Endogenous Growth Model

A2.1 Technology

A general feature of standard models of endogenous growth is the presence of constant or increasing returns in physical capital and human capital. Firms act competitively and use a constant-returns-to-scale technology.

$$Y_t = AK_t^{1-\alpha}H_t^\alpha \quad (5.A1)$$

where Y is output, K is physical capital, and H is human capital. A is a productivity parameter which is taken here to be multiplicative and to capture the idea of endogenous growth in accordance with Rebelo (1991).

A2.2 The Three-Period Overlapping-Generations Model

In order to make the point clear, consider a three-period overlapping-generations model similar to those of Batina (1987), Jones and Manuelli (1990), Caballe (1995), and Buiter and Kletzer (1993). The number of households of each generation, n , is normalized to one. In period $t-1$, when the household of generation t is young, the parent of generation $t-1$ can choose to spend private resources other than time on human capital formation of her or his child, B_{t-1} , and physical savings (bequests) for her or his child, M_{t-1} .

The stock of human capital used by generation t during period t , H_t , is assumed to be a sum of a function of transfer input, B_{t-1} , and the average level of human capital achieved by the prior generation, $\hat{H}_{t-1}$.

$$\hat{H}_t = (1 - \delta)H_t + \bar{H}_t \quad (5.A2)$$

where $\delta = 1 - \frac{1}{n}$. $\bar{H}_t$ is the ratio of the others' human capital to the total number of people. n is the total number of individuals of each generation. The first term reflects the effect of the parent's own human capital on the average human capital and the second term reflects the effect of the others' human capital on the average level. When $n \rightarrow \infty$, the parent would not recognize the externality effect of her or his own capital, and hence the externality effect of human capital is perfect. When $n = 1$, she or he considers her or his own capital and the average level as equivalent; the externality effect is absent. Thus, δ may be regarded as the degree of externality. This extra term, $\hat{H}_{t-1}$, embodies a similar kind of externality as in Romer (1986), and reflects the fact that production is a social activity.

Thus, we have

$$H_t = \hat{H}_{t-1} + B_{t-1}. \quad (5.A3)$$

All human capital is inherited either genetically or through educational expenditure B by parents. The externality effect in the accumulation of human capital is not fully considered by parents when they decide how much to invest in their children's education.

During middle age, the household choice of generation t concerns how much to consume, c_t^1 ; to save for old age, s_t ; to save for her or his child, M_t ; and to spend on the human capital formation of her or his child, B_t . The entire endowment of labor time services in efficiency units H_t is supplied inelastically in the labor market. Thus, wage income $h_t H_t$ is obtained where h_t is the wage rate. In the last period of

life (“old age” or “retirement”), households do not work or educate themselves, and consume c_{t+1}^2 .

The government imposes taxes on capital accumulation and tax revenue is returned as a lump sum transfer to the same generation. This is a standard assumption of the differential incidence. Otherwise, the tax policy would include the intergenerational redistribution effect such as debt issuance or unfunded social security.

Thus, the middle-age budget constraint is given by

$$c_t^1 + s_t + B_t + M_t + \theta_B h_t H_t + \theta_M (1 + r_t) M_{t-1} = h_t H_t + (1 + r_t) M_{t-1} + R_t^1. \quad (5.A4.1)$$

Substituting (5.A3) into (5.A4.1), we have

$$c_t^1 + s_t + M_t + H_{t+1} + \theta_B h_t H_t + \theta_M (1 + r_t) M_{t-1} = (\hat{H}_t + h_t H_t) + (1 + r_t) M_{t-1} + R_t^1. \quad (5.A4.1')$$

The old-age budget constraint is given by

$$c_{t+1}^2 + \tau r_{t+1} s_t = (1 + r_{t+1}) s_t + R_{t+1}^2, \quad (5.A4.2)$$

where θ_B is a tax on income from human capital (a wage income tax), θ_M is a tax on physical bequests, τ is a tax on income from life cycle physical capital (an interest income tax), R_t^1 is a lump sum transfer to the young in period t , and R_t^2 is a lump sum transfer to the old in period t .

The government budget constraints with respect to generation t for the middle-age period t and the old-age period $t + 1$ are given respectively by

$$R_t^1 = \theta_B h_t H_t + \theta_M (1 + r_t) M_{t-1} \text{ and} \quad (5.A5.1)$$

$$R_{t+1}^2 = \tau r_{t+1} s_t. \quad (5.A5.2)$$

Taxes on human capital accumulation are represented by taxes on wage income, $\theta_B h_t H_t$. Note that from Eq. (5.A2), $H_t = \hat{H}_t$ holds in the aggregate economy.

The feasibility condition in the aggregate economy is given by

$$c_t^1 + c_t^2 + K_{t+1} + H_{t+1} = Y_t + K_t + H_t. \quad (5.A6)$$

Physical capital accumulation is given by

$$s_t + M_t = K_{t+1}. \quad (5.A7)$$

Recall that both life cycle saving and bequests provide funds for physical capital accumulation in the aggregate economy. Note also that human capital accumulation is given by Eqs. (5.A2) and (5.A3). The rates of return on the two types of capital are given respectively by

$$r = \partial Y / \partial K = A(1 - \alpha)k^{-\alpha} \text{ and} \quad (5.A8.1)$$

$$h = (Y - rK) / H = \partial Y / \partial H = A\alpha k^{1-\alpha} \quad (5.A8.2)$$

where $k = K/H$ is the physical capital/human capital ratio.

A2.3 The Altruistic Bequest Motive

An individual born at time $t - 1$ consumes c_t^1 in period t and c_{t+1}^2 in period $t + 1$, and derives utility from her or his own consumption. Thus,

$$u_t = \log c_t^1 + \varepsilon \log c_{t+1}^2, \quad 0 < \varepsilon < 1. \quad (5.A9)$$

Here, ε reflects the private preference of old-age consumption or life cycle savings. For simplicity, we assume a log-linear form throughout this appendix. The qualitative results would be the same in a more general functional form.

In the altruism model, the parent cares about the welfare of her or his offspring. The parent's utility function is given by

$$U_t = u_t + \rho U_{t+1} = \log c_t^1 + \varepsilon \log c_{t+1}^2 + \rho U_{t+1}. \quad (5.A10)$$

$0 < \rho < 1$. ρ reflects the parent's concern for the child's well-being.

A3 Economic Growth and Efficiency

A3.1 The First Best Solution

We first analyze the growth path that would be chosen by a central planner who maximizes an intertemporal social welfare function. The objective of the planner at time t is the same as that of the altruistic individual, the "head of the family," living at time t . Since the planner does not discriminate between H_t and $\hat{H}_t$, the maximization problem faced by the planner is

$$\text{Max } \sum_{t=0}^{\infty} \rho^t u_t \text{ subject to Eq. (5.A6)}$$

Solving c_t^2 in Eq. (5.A6) and substituting the objective function, we obtain the following first-order conditions for the planner's optimization problem by calculating the derivatives with respect to c_t^1, K_t, H_t , respectively.

$$1/c_t^1 = \varepsilon(1 + r_{t+1})/c_{t+1}^2, \quad (5.A11.1)$$

$$1/c_t^1 = \rho(1 + r_{t+1})/c_{t+1}^1, \text{ and} \quad (5.A11.2)$$

$$r_t = h_t \quad (5.A11.3)$$

together with the transversality condition,

$$\lim_{t \rightarrow \infty} \rho^t K_t / c_t^1 = 0. \quad (5.A11.4)$$

Equations (5.A11.1, 5.A11.2, 5.A11.3, and 5.A11.4) imply that the economy moves right from the first period on a path of balanced growth. The optimal growth rate, γ^* , is given by

$$\gamma^* = \rho(1 + r^*) \quad (5.A12)$$

where r^* is given by

$$r^* = h^* = A\alpha k^{*1-\alpha}, \text{ and } k^* = \alpha/(1 - \alpha). \quad (5.A13)$$

A3.2 Optimizing Behavior in the Market Economy

An individual born at time t solves the following problem of maximization. She or he chooses s_t , H_{t+1} , and M_t , given $\bar{H}_{t+1}$ in Eq. (5.A2). Substituting Eqs. (5.A2), (5.A4.1'), and (5.A4.2) into (5.A10), we have

$$\begin{aligned} U_t = & \log[\hat{H}_t + (1 - \theta_B)h_t H_t + (1 - \theta_M)(1 + r_t)M_{t-1} - H_{t+1} - s_t - M_t + R_t^1] \\ & + \varepsilon \log[(1 + (1 - \tau)r_{t+1})s_t + R_{t+1}^2] + \rho \{ \log[(1 - \delta)H_{t+1} \\ & + \bar{H}_{t+1} + (1 - \theta_B)h_{t+1}H_{t+1} + (1 - \theta_M)(1 + r_{t+1})M_t \\ & - H_{t+2} - s_{t+1} - M_{t+1} + R_{t+1}^1] + \varepsilon \log[(1 + (1 - \tau)r_{t+2})s_{t+1} + R_{t+2}^2] \\ & + \rho U_{t+2} \} \end{aligned} \quad (5.A14)$$

The optimality conditions with respect to s_t , H_{t+1} , and M_t are respectively

$$1/c_t^1 = [1 + (1 - \tau)r_{t+1}]\varepsilon/c_{t+1}^2, \quad (5.A15.1)$$

$$1/c_t^1 = \rho[1 - \delta + (1 - \theta_B)h_{t+1}]/c_{t+1}^1, \text{ and} \quad (5.A15.2)$$

$$1/c_t^1 \geq \rho(1 - \theta_M)(1 + r_{t+1})/c_{t+1}^1 \text{ with equality if } M_{t+1} > 0. \quad (5.A15.3)$$

s cannot be zero; otherwise, c^2 would be zero, which is inconsistent with optimizing behavior. H cannot be zero either; otherwise, Y would be zero, which is inconsistent with optimizing behavior. However, M could become zero. If the private marginal return of educational investment is higher than the private marginal return of bequests at $M=0$, intergenerational transfer is operated only in the form of human capital investment.

A3.3 The Circumstance in Which Physical Bequests Are Zero

Suppose the government does not levy any taxes: $\tau = \theta_B = \theta_M = 0$. If $1 - \delta + h > 1 + r$ at $M=0$, we have the corner solution where bequests are zero. From Eqs. (5.A4.2) and (5.A15.1), we have

$$s = c^1 \varepsilon. \quad (5.A16)$$

Substituting Eq. (5.A16) into Eq. (5.A4.1'), we have

$$H_{t+1} + \left[\frac{1}{\varepsilon} + 1 \right] s_t = (1 + h_t) H_t. \quad (5.A17)$$

However, from Eq. (5.A15.2) we have in the steady state

$$H_{t+1} = \rho(1 - \delta + h_t) H_t. \quad (5.A18)$$

Hence, considering Eqs. (5.A7), (5.A17), and (5.A18), the steady-state physical capital/human capital ratio $\hat{k}$ is uniquely given as a solution of (5.A19). Thus,

$$1 + \left(\frac{1}{\varepsilon} + 1 \right) k = \frac{1 + h}{(1 + h - \delta)\rho}. \quad (5.A19)$$

The left-hand side of Eq. (5.A19) increases with k , while the right-hand side of Eq. (5.A19) decreases with k . When ε increases, the left-hand side decreases, so that $\hat{k}$ increases. When ρ decreases, the right-hand side increases, so that $\hat{k}$ increases.

However, considering Eqs. (5.A8.1) and (5.A8.2), $1 - \delta + h > 1 + r$ at $M = 0$ if and only if

$$A\alpha\hat{k}^{-\alpha} \left[\hat{k} - \frac{1 - \alpha}{\alpha} \right] > \delta \quad (5.A20)$$

or

$$\hat{k} > \tilde{k}, \text{ where } \tilde{k} \text{ satisfies } A\alpha\tilde{k}^{-\alpha} \left[\tilde{k} - \frac{1 - \alpha}{\alpha} \right] = \delta. \quad (5.A21)$$

When there are less incentives to leave bequests, we may well have the corner solution of $M = 0$. When ε is larger and ρ is smaller, inequality is more likely (see Eq. (5.A21)).

The laissez-faire growth rate is given by

$$\gamma_{M=0} = \rho \left(1 - \delta + A\alpha\hat{k}^{1-\alpha} \right) \quad (5.A22)$$

where $\hat{k}$ is given by Eq. (5.A19). An increase in the intragenerational preference for life cycle capital ε raises the physical capital/human capital ratio $\hat{k}$, leading to a higher rate of return on human capital and higher economic growth. An increase in the intergenerational preference ρ has two effects. It stimulates intergenerational transfer from the old to the young, inducing high growth. However, it reduces $\hat{k}$ and the rate of return on human capital, h , depressing economic growth.

Considering Eqs. (5.A19) and (5.A22), we have

$$\frac{\partial \gamma}{\partial \rho} = (1 + h - \delta) \frac{(1 + h - \delta)[(1 + h)(1 - \rho) + \rho\delta - (1 - \alpha)h]}{\delta(1 - \alpha)h + [(1 + h)(1 - \rho) + \rho\delta](1 + h - \delta)}. \quad (5.A23)$$

Thus, if $\frac{1+\alpha h}{1+h-\delta} > \rho$, then $\frac{\partial \gamma}{\partial \rho} > 0$ (and vice versa). In other words, if α and δ are high, it is likely that $\frac{\partial \gamma}{\partial \rho} > 0$. However, it should be stressed that $\frac{\partial \gamma}{\partial \rho} < 0$ is also possible. In the bequest-constrained economy, an increase in the parent's concern for the child's welfare does not necessarily raise the growth rate.

Since $1 - \delta + h > 1 + r$, $h > r$. Hence, $r < r^* = h^* < h$. It is possible that $1 - \delta + h > 1 + h^*$. In such a circumstance, $\gamma_{M=0} > \gamma^*$: The laissez-faire growth rate in the constrained equilibrium is too high. If the externality effect is absent ($\delta = 0$), $1 + h > 1 + h^*$, the laissez-faire growth rate is always too high.

The laissez-faire economy may not attain the first best solution because of two reasons. First, the externality effect in the accumulation of human capital is not considered by the parent. This means that the competitive growth rate becomes too low. Second, M_t cannot be negative because there is no institutional mechanism to enforce such a liability on future generations. Human capital is too little and the marginal return of human capital is too high, which means that the competitive growth rate becomes too high. When δ is lower, it is more likely that the second effect predominates and the laissez-faire growth rate is too high.

A3.4 The Circumstance in Which Physical Bequests Are Operative

When $M > 0$, Eqs. (5.A15.2) and (5.A15.3) have equality. Hence, we have

$$1 - \delta + h = 1 + r. \quad (5.A24)$$

k is given by $\tilde{k}$, which is defined by the following equation:

$$A \alpha k^{-\alpha} \left[k - \frac{1 - \alpha}{\alpha} \right] = \delta \quad (5.A25)$$

Thus, the unconstrained growth rate is given by

$$\gamma_{M>0} = \rho \left(1 - \delta + A \alpha \tilde{k}^{1-\alpha} \right) = \rho \left[1 + A(1 - \alpha) \tilde{k}^{-\alpha} \right]. \quad (5.A26)$$

From Eq. (5.A25), $\tilde{k}$ is independent of ρ or ε . Equation (5.A26) shows that the life cycle saving motive ε does not affect the growth rate, while an increase in the transfer-saving motive ρ definitely raises the growth rate.

Since $h > h^*$ and $r < r^*$, we always have

$$\gamma_{M>0} < \gamma^*.$$

When physical bequests are operative, the competitive economy could be different from the first best solution only because of the externality effect of human capital. Thus, the laissez-faire growth rate is always too low.

A4 Taxes and Economic Growth

A4.1 The Constrained Economy

We now consider the effect of taxes on capital accumulation in the bequest-constrained economy of $M=0$. When taxes are incorporated, Eq. (5.A19) may be rewritten as

$$1 + \left\{ \frac{1+r}{\varepsilon[1+(1-\tau)r]} + 1 \right\} k = \frac{1+h}{[1+(1-\theta_B)h-\delta]\rho}. \quad (5.A19')$$

Considering Eq. (5.A8.1), it is easy to find that the right-hand side of (5.A19') increases with k , while the left-hand side of (5.A19') decreases with k . Hence, as in Sect. A3.3, the steady-state physical capital/human capital ratio $\hat{k}$ is uniquely determined.

In this instance, Eq. (5.A22) may be rewritten as

$$\gamma_{M=0} = \rho \left[1 - \delta + (1 - \theta_B) A \alpha \hat{k}^{1-\alpha} \right]. \quad (5.A22')$$

An increase in the tax on life cycle capital income (an increase in the interest income tax), τ , reduces $\hat{k}$ and hence depresses the growth rate.

However, the effect of an increase in the tax on income from human capital (an increase in the wage income tax), θ_B , on the growth rate is ambiguous. It directly reduces the growth rate, while it indirectly raises the growth rate by increasing $\hat{k}$ and h . Namely, an increase in the wage income tax raises the physical capital/human capital ratio, and hence increases h . If this indirect effect predominates, an increase in the wage income tax raises the growth rate.

Finally, let us consider how to attain the first best solution by using capital taxes. The optimal levels of τ and θ_B are given respectively by

$$\tau = 0 \text{ and} \quad (5.A27)$$

$$1 - \delta + (1 - \theta_B) A \alpha \left(\frac{\alpha}{1 - \alpha} \right)^{1-\alpha} = 1 + A \alpha \left(\frac{\alpha}{1 - \alpha} \right)^{1-\alpha}. \quad (5.A28)$$

From Eq. (5.A28), the optimal level of θ_B is negative so long as $\delta > 0$. Further, in order to attain $k^* = \hat{k}$, an additional lump sum intergenerational transfer from the young to the old, such as debt issuance or unfunded social security, is also needed. Such a policy can substitute for negative bequests.

A4.2 The Unconstrained Circumstance

When $M > 0$, Eqs. (5.A15.2) and (5.A15.3) have equality. Hence, we have

$$1 - \delta + (1 - \theta_B)h = (1 - \theta_M)(1 + r). \quad (5.A29)$$

In this circumstance, $\hat{k}$ is given by Eq. (5.A29); hence, the growth rate is given by

$$\gamma_{M>0} = \rho \left[1 - \delta + (1 - \theta_B)A\alpha\hat{k}^{1-\alpha} \right] = \rho(1 - \theta_M) \left[1 + A(1 - \alpha)\hat{k}^{-\alpha} \right]. \quad (5.A26')$$

An increase in θ_B raises $\hat{k}$ and reduces r . Hence, from the second equality of (5.A26'), it reduces the growth rate. An increase in θ_M reduces $\hat{k}$ and h . Hence, from the first equality of (5.A26'), it also reduces the growth rate. In other words, an increase in any tax on transfer capital definitely reduces the growth rate when bequests are operative. Equation (5.A26') is independent of τ ; the tax rate on life cycle capital income does not affect the growth rate.

The optimal level of θ_B is given by Eq. (5.A28), which is the same as in the constrained circumstance. Note that $\theta_M = \tau = 0$ at the first best solution. In this instance, market failure comes only from the externality effect of human capital. A subsidy for human capital accumulation raises the growth rate and can attain the first best solution.

A5 Conclusion

This appendix has incorporated the altruistic bequest motive into an endogenous growth model of overlapping generations. We have shown that the impact on the growth rate of taxes on capital accumulation differs depending upon whether bequests are operative or not. When bequests are zero, an increase in a tax on human capital accumulation may not reduce the rate of economic growth, while an increase in a tax on life cycle physical capital reduces the growth rate. If bequests are operative, a tax on life cycle capital accumulation does not affect the growth rate, while an increase in any tax on transfer capital (educational investment or bequests) reduces the growth rate. Our analysis has explored the paradoxical possibility that taxes on capital accumulation may not reduce the rate of economic growth in several instances.

Finally, in the bequest-constrained economy, the laissez-faire growth rate may be too high if the externality effect is small. A subsidy for human capital accumulation and a lump sum transfer from the young to the old can attain the first best solution. In the unconstrained economy, market failure comes only from the externality effect of human capital. A subsidy for human capital accumulation raises the growth rate and can attain the first best solution.

Appendix B: The Supply-Side Effect of Public Investment in Japan

B1 Earlier Studies

In this case study, we examine the supply-side effect of public investment in Japan. Whether public capital provision is efficient in Japan is a crucial question from a normative perspective. Some empirical studies have analyzed the productivity of public capital in Japan. In the 1990s, Iwamoto (1990) and Mitsui and Ota (1995) calculated the marginal productivity of public capital based on the estimated production function. They concluded that the level of public capital was considerably low in Japan until the early 1980s.

Ihori and Kondo (1998) investigated the effect of public investment on private consumption by estimating the consumption function from 1955 to 1996. They found that in the 1960s, public investment had a significant impact on private consumption; however, this impact decreased after 1980. The evidence suggests that the total level of public capital was not considerably low in the 1990s. Ihori and Kondo (1998) and Ihori and Kondo (2001) found that the causality relationship between public works and private consumption was significant during the entire sample period (1957–1994). Moreover, this causality was strong, and the impulse response of private consumption to public works was substantial during 1958–1975. However, both causality and the impulse response reduced subsequently.

Thus, the aggregate level of public capital might have been sufficient or considerably high in the last part of 1958–1975. As shown in Asako et al. (1994), if the allocation of public works is appropriately revised, then it can stimulate macroeconomic activities and enhance economic welfare.

Ihori and Kondo (2001) investigated the efficacy of public works for the Japanese economy. They investigated the productivity of disaggregated public capital goods by estimating the productivity of income related to public capital, or labor income, based on the aggregate production function approach. While not definitive because of limited data availability, their results suggest that the allocation of public works was not optimal in Japan. Namely, there still existed large differences among the marginal productivity levels of the various types of public capital. The infrastructures for railways, telephone networks, and postal services were not large enough until the early 1990s. Thus, if public works spending was reallocated to projects in order to improve economic efficiency, it could have stimulated private consumption and enhanced economic welfare in Japan.

To sum up, the supply-side effect of public investment has decreased in recent years. The aforementioned studies commonly conclude that public capital was productive, but its productivity has declined in recent years. In addition, see Aso and Nakamoto (2008) for a similar conclusion.

B2 Recent Studies

Recently, Miyazaki (2004, 2014) surveyed studies on the productivity effect of public investment in several fields. Among others, Hayashi (2003) and Hatano (2006) estimated the productivity effect of road capital in the Kyushu area,

considering the network properties of transportation capital. Further, Nakazato (2001, 2003), Miyazaki (2004, 2014), and Hayashi (2010) estimated the productivity of road capital and its effect on the economic growth of several regions by dividing regions in accordance with the prefectural per capita GDP. Miyazaki (2004, 2014) empirically examined the supply-side effect of transportation-related public capital using contemporary econometric methods. In particular, he analyzed the effect in two areas: the Tokyo metropolitan area and other rural areas.

Most studies on the productivity effect of public investment in various fields use three approaches: (i) the estimation of production function; (ii) the regression of growth convergence; and (iii) growth accounting. In Japan, several studies have used the first two approaches to show the productivity effect of transportation-related public investment.

Table 5.B1 summarizes the main empirical results so far in Japan. The standard econometric approach is to use the panel data for 47 prefectures.

Some researchers point out that road investment expenditure in a rural area has negative spillover effects on the area in that it results in a concentration of the population. This is because firms are induced to move from the rural area to the Tokyo metropolitan area and/or some core cities in other areas. Such movements cause and/or increase inequality among regions. Namely, the accumulation of road capital increases productivity in urban areas, which are characterized by high concentrations of industry, while it does not raise productivity in rural areas, which are characterized by low concentrations of industry. Productivity in some rural areas could even reduce because newly accumulated road capital facilitates the easy movement of firms and workers to urban areas. In order to verify this concern, it is necessary to investigate how transportation capital has affected productivity in areas with different income levels and industry concentrations.

For this purpose, Miyazaki (2014) estimated the following production function:

$$\log Y_{it} = D_i + D_t + \alpha \log N_{it} + \beta \log K_{it} + \gamma_1 \log G_{it} + \gamma_2 D_{tokyo} \log G_{it} + u_{it}$$

where u_{it} represents a random term and D_{tokyo} represents a dummy variable that takes the value of 1 for the Tokyo metropolitan area (Tokyo, Kanagawa, Saitama, and Chiba) and 0 for others. Since Miyazaki (2014) found the productivity-enhancing effect of road capital only for downtown Tokyo, he added a second dummy variable to capture the effect of concentration in downtown Tokyo. His

Table 5.B1 Studies on the productivity effect of transportation-related public investment

Production function approach	Time series data	Kawakami and Doi (2002)
	Panel data	Hayashi (2003), Miyazaki (2004) and Hatano (2006)
Regression of growth convergence		Nakazato (2001, 2003) and Hayashi (2010)

Source: Miyazaki (2014)

estimation is based on the difference generalized method of moments (GMM) method, presented by Arellano and Bover (1995). In order to develop a dynamic model, he incorporated the first difference lag with respect to variables by using two models: the autoregressive distributed lag (ADL) model and the state-dependent dynamic model. The former incorporates the first difference into dependent and independent variables, and one-period lagged variables of production inputs; the latter focuses on the dependent variables that include the lagged independent variables. The estimation results are as follows.

1. ADL model. For either the Tokyo metropolitan dummy or the Tokyo downtown dummy, the coefficient of the current road capital stock is significantly negative, while that of the one-period lagged road capital stock is significantly positive. Note that the effect of inputs on productivity has a lag in the ADL model. We can include the effect of the lagged variable as a proxy of the productivity effect. Thus, we can say that road construction in the Tokyo area has a significantly positive effect on the overall economy.
2. State-dependent model (1). If a dummy is used for the Tokyo metropolitan area, we do not obtain a significant result. However, if a dummy is used for the Tokyo area, we have a significantly positive effect, irrespective of the length of the lag periods.
3. State-dependent model (2). The coefficient of road capital γ_1 becomes significantly negative if the three-moment lagged instrumental variable is used. However, we do not obtain any significant results if the two-moment lagged instrumental variable is used. This suggests that road construction may not necessarily stimulate aggregate demand in regions other than the Tokyo metropolitan area.

To sum up, Miyazaki (2014) confirmed a large productivity effect of road capital accumulation in the Tokyo metropolitan area, especially the downtown Tokyo area. However, he did not obtain a definite result for many rural areas. Thus, road capital accumulation may even contribute to stagnation in some rural areas.

B3 Public Investment Management

B3.1 Constraints in Japan

This section discusses public investment management reforms in Japan. There are several constraints to efficient and effective public investment management. First, it must be stressed that the social infrastructure was intensively constructed during the high-growth period in Japan. This infrastructure is assumed to be rapidly deteriorating because it is 30–50 years old.

For instance, a comparison of the social infrastructure that is more than 50 years old today with that in the next 20 years reveals that the demand for roads and bridges will surge from approximately 8 % to 53 %. In addition, the ratio for river management facilities, such as drainage pump stations and water gates, will rise from approximately 23 % to 60 %; for sewer lines, it will increase from

approximately 2 % to 19 %; and for harbor quays, it will grow from approximately 5 % to 53 %.

The Ministry of Land, Infrastructure, Transport, and Tourism (MLIT) White Paper (2011) has estimated that the total renewal cost of infrastructure for the 50 years from 2011 to 2061 is approximately 190 trillion yen. However, looking at the present fiscal scenario of Japan, it is estimated that even a portion of the total renewal cost (approximately 30 trillion yen or 16 % of the entire amount) will be difficult to accomplish. Hence, it is more important to renew the existing public capital appropriately than to construct new projects. If the existing public capital is not appropriately maintained, managed, and renewed because of a lack of funds, the malfunction of the infrastructure could negatively affect the economy and people's lives. Moreover, the possibility of accidents or disasters due to deterioration could become a serious concern over time.

Japan faces several social constraints regarding the renewal of public capital. An important constraint is demographic. Since Japan is an aging society, the aging population, combined with low birth rates, implies that the population will decrease considerably. Since the benefit of public capital depends heavily upon the number of people who may use it, population decline would reduce the benefit of public capital in the long run. Thus, in principle, it is undesirable to construct new public projects when the population is declining.

Japan also faces many environmental issues and energy constraints, particularly after the awful Fukushima nuclear power plant accident in 2011. Further, with the national finances in deficit, public funds for public investment must be limited. In order to implement proper infrastructure maintenance, management, and renewal measures so as to meet the various demands of the present era, the government needs to achieve effective and efficient facility operations and management in a planned manner through comprehensive and strategic management.

B3.2 Public Investment Management Reform

Under the above circumstances, it is important to estimate accurately the size of existing infrastructures and their degrees of deterioration and renewal costs. At the same time, it is necessary to acquire accurate information on the future demands of a society that has a declining and aging population. In order to achieve this, efficient and effective public investment management reforms are needed. These should include planned and effective maintenance, management, renewal, disposition, utilization, exploitation, consolidation, and privatization. In particular, the following options should be regarded as important in Japan.

1. Routine management must be emphasized to enhance efficiency in daily cleaning, maintenance, repairs, and so on.
2. Management must be based on a long-term perspective. Total cost reduction can be realized through preventive maintenance based on a long-term perspective (e.g., life extension projects).
3. A small number of useful projects must be preferred to a large number of unwanted/non-essential projects. Under the significant direction of a strategic

infrastructural operation known as “selection and intensification,” we need to evaluate individual management strategies and introduce innovative approaches that are different from those in the past. In order to achieve this, we must introduce new advanced technology, and review existing regulations and programs, to attain more efficient infrastructure management.

4. The major infrastructure management method implemented so far includes that of the designated administrator system. This system was introduced recently by local governments to reduce the cost of maintaining existing public capital.
5. Privatization is also an effective tool for cost reduction. With regard to road management, four highway-related public corporations in Japan were privatized in 2005. These corporations are making efforts to secure debt repayment by implementing highway business activities through the three Nippon Expressway Companies (East, Central, and West Nippon Expressway Companies) and the Japan Expressway Holding and Debt Repayment Agency. They are also employing diverse service provisions through efficient operations by applying the expertise of the private sector. Regarding airport management, the New Kansai International Airport (fully owned by the state) was established on April 1, 2012 under the *Act on Integrated and Efficient Establishment and Management of Kansai International Airport and Osaka International Airport as a Unit*, enacted in May 2011. Osaka International Airport, which was controlled by the national government, has been operated together with Kansai International Airport under a new company (the New Kansai International Airport) as a single unit from July 1, 2012.

B3.3 Strengthening Wide-Ranging Coordination

Considering the issue of rapid aging in Japan, it is usually expected that the share of social welfare expenditures in national spending will increase rapidly each year, while the share of public works expenditures will decline. Hence, raising public funds to finance public investment expenditures is severely limited. However, while the financial constraints on the government’s budget are aggravating, the household and firm sectors still hold huge financial assets. The household sector holds financial assets worth 1700 trillion yen in 2016. Among others, people who are 60 years old or above hold the highest share of cash and bank deposits (60 %).

In order to achieve sustainable growth by enhancing the vitality of Japan’s regions despite the extremely tight fiscal situation, it is indispensable for Japan to utilize the funds of the private sector. In this sense, Public-Private Partnerships (PPPs) and Private Finance Initiatives (PFIs) are useful ways to promote public-private coordination. Namely, in addition to the projects executed by the national government, the subsidized projects of local public authorities, and local independent projects, all of which have constituted the major implementation methods of public works, the government must develop other methods such as PPPs and PFIs so that private funding, knowledge, and human resources in the private sector are utilized. PPP/PFI projects can mainly include comprehensive private consignment, the designated administrator system, the PFI method, and the concession system.

With the aim of expanding projects based on the PFI system, the MLIT has invited PPP projects from local public authorities and the private sector since 2011. The purpose is to develop a new PPP/PFI system and to promote the formation of specific projects. The targeted categories include the following three functions:

1. Pioneering PPP support projects;
2. The promotion of PPP projects; and
3. Encouraging PPP projects for earthquake disaster reconstruction.

A total of 144 applications have been collected.

Finally, it is also useful to develop business operators such as nonprofit organizations (NPOs) that engage in activities of public interest for a community. They can usually raise only a limited amount of money because they rely on official support and/or donations. Thus, more private funds should be allocated to NPO activities. It would be useful to have a “voluntary funds” scheme in which private funds can be utilized to provide services of a public nature.

As part of such a scheme, an entity called a “community fund” must be introduced to serve as a financial intermediary and coordinator for those companies and individuals who work for the community and those who want to provide financial assistance in some way. The purpose here is to raise funds from voluntary community citizens, corporations, local governments, and so on, and to invest these funds in business projects of public interest that can positively contribute to the community. By establishing such a “flow-of-funds” scheme through these private institutions, funds from a community will become available to use within that community.

To sum up, it is important to consider the following options.

1. Japan should promote various public capital accumulation and management operations such as the further selection and intensification of public works, rationalization, the consolidation of facilities, disposal, utilization, and exploitation to suit regional needs.
2. Japan should further utilize private funds, skills, and expertise in the public sector by promoting PPP, PFI, etc.
3. Japan should support and foster new public investment activities and a system of self-help and mutual assistance through the private sector by developing NPOs, etc.

B3.4 Cost-Benefit Analysis

Needless to say, the role of public works is to secure safety and comfort. It is also important to secure the efficiency and transparency of public investment projects. By improving pleasant living standards and preserving the natural environment, we can vitalize local communities and the overall economy in modern society. In order to improve the efficiency of public works, the government must launch and/or continue only those projects whose necessity is confirmed and discontinue those whose necessity has diminished or where progress is inadequate. It is also useful to

disclose the evaluation methods and results to ensure the transparency of public works.

Regarding the methods of evaluation, the government should conduct comprehensive evaluations, including cost-effective analysis. It should thus check whether a new project deserves to be launched and decide whether an existing project should be continued or discontinued after considering all the relevant issues comprehensively. These evaluations should include those aspects of public works that are hard to express in monetary terms.

We may describe the workflow of project evaluation as follows. In the planning stage, policy targets must be clarified and several policy proposals must be compared and evaluated. In the evaluation stage, the necessity of a new project must be carefully evaluated to decide whether to launch the project. In the reevaluation stage, the necessity of a project should be reviewed to decide whether to continue or discontinue the project. In the ex-post evaluation stage, the effects, benefits, and environmental impacts of a project must be analyzed after its completion and, if necessary, appropriate measures and planning must be discussed for future projects.

There are some controversial arguments in Japan regarding evaluations in terms of benefit (B)/cost (C) ratio, B/C. In principle, government officers who carry out a project must understand that B/C is just one of the indices in the evaluation process. Evaluation should be comprehensive, taking into account many different factors beyond the standard B/C. The current B/C is incomplete because it fails to take into account factors relating to the environment and safety, among others.

However, many citizens believe that transparency regarding public investment projects has still a long way to go. People distrust the disclosed figures, suspecting some window dressing with political bias toward the overestimation of benefit, B. They conjecture that the calculations are made by government-friendly consultants. The natural belief of most voters in Japan is that accurate estimations of B/C should be at the center of all evaluations. Since efficiency matters the most, evaluations should begin with high B/C scores.

Thus, we have some serious concerns regarding the current evaluation system in Japan. Many voters still criticize public works regarding their necessity. They also find fault with the current evaluation system. Evaluation methods have two difficulties. The first is the limitation of accuracy. Evaluation requires an element of prediction; thus, inevitably, it involves a degree of error in the results. The second difficulty relates to the limitation of estimation technology. Some projects' effects are not measurable. Even though some effects can be quantified, many cannot be expressed in monetary terms. Moreover, the use of evaluation results has two associated problems. First, it is unclear how evaluation results are related to decision-making. Although comprehensive evaluations are made, including cost-benefit analysis and much other data, it is hard to understand how such results are used in priority setting, budget allocation, and other decision-making in the actual political process. Second, it is important but hard to disclose all information on evaluations.

B4 Public Investment Management Reform

Finally, it is important to conduct microeconomic reforms to revamp public investment management drastically. Considering the Japanese government's severe fiscal constraint coupled with rapid aging, public investment operations must be made more efficient. An important policy objective in Japan is to achieve an efficient government through public investment management reforms based on the principles "from public sector to private sector" and "from the state to the regions."

In view of the severe fiscal situation in Japan, public investment projects that provide few benefits compared to the burden they impose are not sustainable. In order to ensure the efficiency of public spending, privatization and decentralization reforms are useful for bridging the gap between the benefits and the financial burdens. These reforms are necessary in order to reduce wasteful public projects.

As explained in Doi and Ihuri (2009), the Japanese government introduced the Fiscal Investment and Loan Program (FILP) and privatized, merged, and abolished several state-owned companies. These steps are desirable, but only in the first phase of the structural reforms of public investment management. However, the reforms have not proceeded at a fast pace, owing to resistance from interest groups.

Further decisive efforts are needed to make the public sector, including public investment management, more efficient. Confidence in future public investment management should be enhanced by implementing structural reforms more fervently. A successful outcome of fiscal reorganization, including the reform of public investment management by utilizing private skills and funds, may increase the overall political support for the drastic fiscal reforms that the country needs today.

Through continued deficit reduction and a revamp of the public investment management system using macroeconomic and microeconomic measures, Japan can build an efficient and equitable public sector and bequeath to future generations strong public capital. This will enable future generations to achieve a dynamic economy and society, and improve their standards of living in an aging Japan.

Questions

5.1 Consider the simple growth model:

$$\begin{aligned}S &= 0.2(1 - t)Y \\ Y &= 0.3K\end{aligned}$$

If the tax rate $t = 0.2$, what is the growth rate?

5.2 Suppose an increase in the tax rate promotes capital accumulation and economic growth. How can you explain this positive relation?

5.3 Public capital is often not so productive compared with private capital. Explain why.

References

- Arellano, M., & Bover, O. (1995). Another look at the instrumental variables estimation of error component models. *Journal of Econometrics*, 68, 29–51.
- Asako, K., Tsuneki, A., Fukuda, S., Teruyama, H., Tsukamoto, T., & Sugiyama, M. (1994). Productivity effect of public capital and welfare evaluation of public investment policy. *Economic Analysis*, 135, 2–90 (in Japanese).
- Aso, Y., & Nakamoto, J. (2008). Macroeconomic effects of public capital accumulation. *Financial Review*, 89, 6–29 (in Japanese).
- Azariadis, C., & Drazen, A. (1990). Threshold externalities in economic development. *Quarterly Journal of Economics*, 105, 501–526.
- Barro, R. J. (1991). Economic growth in a cross section of countries. *The Quarterly Journal of Economics*, 106, 407–443.
- Barro, R. J., & Sala-i-Martin, X. (2004). *Economic growth*. New York: McGraw-Hill.
- Batina, R. G. (1987). The consumption tax in the presence of altruistic cash and human capital bequests with endogenous fertility decisions. *Journal of Public Economics*, 34, 329–365.
- Buiter, W. H., & Kletzer, K. M. (1993). Permanent international productivity growth differentials in an integrated global economy. In T. M. Anderson & K. O. Moene (Eds.), *Endogenous growth* (pp. 77–103). Cambridge: National Bureau of Economic Research.
- Caballe, J. (1995). Endogenous growth, human capital, and bequests in a life-cycle model. *Oxford Economic Papers*, 47, 156–181.
- Doi, T., & Ihori, T. (2009). *The public sector in Japan: Past developments and future prospects*. Cheltenham: Edward Elgar.
- Domar, E. (1946). Capital expansion, rate of growth, and employment. *Econometrica*, 14, 137–147.
- Harrod, R. F. (1939). An essay in dynamic theory. *The Economic Journal*, 49, 14–33.
- Hatano, E. (2006). Spillover effects of public capital and agglomeration, In “A research on the effect of road network accumulation on industrial agglomeration”, *Zaiseikeizaikyokai* (pp. 73–85) (in Japanese).
- Hayashi, M. (2003). Public capital and local public service: An evaluation of local public capital using the capitalization hypothesis. *Economic Analysis*, 171, 30–48 (in Japanese).
- Hayashi, H. (2010). Road investment and local economy: An empirical analysis considering regional interdependence. *Keizai-Ronshu*, 63, 59–75 (in Japanese).
- Ihori, T., & Kondo, H. (1998). Public investment and private consumption: Government deficits and multiplier. *Financial Review*, 47, 106–133 (in Japanese).
- Ihori, T., & Kondo, H. (2001). Efficiency of disaggregate public capital provision in Japan. *Public Finance and Management*, 1, 161–182.
- Iwamoto, Y. (1990). An evaluation of public investment policy in postwar Japan. *Economic Review*, 41, 250–261 (in Japanese).
- Jones, L. E., & Manuelli, R. E. (1990). Finite lifetimes and growth (NBER Working Paper No.3469).
- Kawakami, T., & Doi, M. (2002) Port capital formation and economic development in Japan: A vector autoregression approach (Discussion Paper No. 1010), Policy and Planning Sciences, University of Tsukuba.
- Kotlikoff, L. J., & Summers, L. H. (1981). The role of intergenerational transfers in aggregate capital accumulation. *Journal of Political Economy*, 89, 706–732.
- Kuznets, S. (1955). Economic growth and income inequality. *American Economic Review*, 45, 1–28.
- Mitsui, K., & Ota, K. (Eds.). (1995). *Productivity of social capital and government financial intermediation*. Tokyo: Nihon Hyoron Sha (in Japanese).
- Miyazaki, T. (2004). Productive effect of road capital. *Applied Regional Economic Research*, 9, 39–48 (in Japanese).
- Miyazaki, T. (2014) Productivity analysis of transportation capital, Nikkouken, DP (in Japanese).

- Nakazato, T. (2001). Transportation capital and economic growth. *Japan Economic Research*, 43, 101–117 (in Japanese).
- Nakazato, T. (2003) Public capital accumulation and economic growth, (ESRI Discussion Paper Series No. 51), Economic and Social Research Institute (in Japanese).
- Rebelo, S. (1991). Long run policy analysis and long run growth. *Journal of Political Economy*, 99, 500–521.
- Romer, P. M. (1986). Increasing returns and long-run growth. *Journal of Political Economy*, 94, 1002–1035.
- Romer, D. (2011). *Advanced macroeconomics*. New York: McGraw-Hill.
- Solow, R. M. (1956). A contribution to the theory of economic growth. *The Quarterly Journal of Economics*, 70, 65–94.
- White Paper On Land, Infrastructure, Transport And Tourism In Japan. (2011). Ministry of Land, Infrastructure, Transport and Tourism.

1 Understanding Fiscal Management

1.1 The Problem of Public Debt Issuance

Government spending may be financed by taxes or public debt issuance. Government deficit is the difference between tax revenue and spending. The deficit is financed by public debt issuance, which involves borrowing money from the private sector. Many developed countries, including Japan, have suffered from fiscal deficits for many years. They have accumulated a large amount of public debt outstanding. In this chapter, we investigate the positive and normative aspects of fiscal management with deficits and public debt issuance, based on the analytical results of prior chapters.

Many people believe that fiscal deficits and public debt issuance are harmful in themselves. The fiscal authority usually considers that the target of fiscal consolidation is the elimination of fiscal deficits and the cessation of the new issuance of public debt simply because public debt can create bad and serious outcomes. In this context, it is said that there are several difficulties with regard to public debt. Among them, the following are the most notable.

- (i) Public debt issuance crowds out private investment and/or consumption demand by raising the rate of interest, as explained in Chap. 2. If the government intends to avoid the crowding-out effect and rely on money finance, the likely result is hyperinflation due to excessive money supply.
- (ii) Deficit-covering debt issuance moves the fiscal burden to future generations and hurts intergenerational equity. Since deficit-covering bonds are used for government consumption, they do not provide benefits for future generations. Thus, in contrast to construction bonds, which are used for public investment, deficit-covering bonds simply move the burden to future generations without any benefits. Moreover, the benefit of construction bonds is not so significant

- if the productivity of public investment is low. Then, even construction bonds do not provide a net benefit for future generations.
- (iii) A large amount of public debt issuance results in a large amount of debt redemption and interest payments, a situation that impairs the flexibility of fiscal management on budgeting. In particular, refunding deficit-covering bonds induces further refunding by enlarging the size of the deficit. This may lead to a vicious circle of refunding.
 - (iv) Under political pressure in a democratic country, debt finance is more easily conducted than tax finance. Voters do not accept an increase in taxes in any situation. As a result, fiscal discipline is harmed, inducing larger wasteful spending and larger deficits.

1.2 Balanced-Budget Policy

Let us investigate desirable fiscal management regarding deficits and public debt. There are three plausible arguments in relation to public debt issuance: the arguments for (1) reducing deficits, (2) raising deficits, and (3) adjusting certain optimal targets.

First, let us explain the argument for the balanced-budget rule or the reduction of deficits. Since the fiscal authority takes the cost of public debt issuance seriously, it is plausible for the authority to insist on reducing any deficit in any situation as a high priority. In this regard, the authority is usually concerned with the flexibility of budgeting.

The government worries about problem (iii) the most. In addition, considering the lack of political control on fiscal spending in reality, problem (iv) is important. In particular, from the viewpoint of public choice theory (see Chap. 12), the government may not behave in a way that maximizes the welfare of general voters; hence, problem (iv) is very serious.

As the size of government becomes larger and the role of government becomes more complicated, the gap between taxpayers and receivers of benefits from public services becomes larger. Taxpayers are always against an increasing tax burden; however, recipients of benefits always demand more benefits. When both groups place significant political pressure on the government, the tax burden does not increase a great deal but government spending increases significantly. A plausible but bad outcome is to issue public debt. Future generations cannot play an important role in such a current policy decision in a democracy based on voting. As a result, the fiscal deficit increases. If this political process of budgeting is harmful, it may be desirable to impose the balanced-budget rule on the fiscal management system.

However, although the balanced-budget policy could stabilize the fiscal balance in the short run, it may destabilize macroeconomic activities. Namely, it does not pay much attention to the merits of debt finance and the stabilizing effect on macroeconomic activities. Keynesian fiscal policy emphasizes the benefit of stabilization policy as explained in Chap. 2.

In contrast, if the debt neutrality theorem holds, as in Chap. 4, Keynesian fiscal policy loses many of its policy implications because counter-cyclical fiscal policy does not affect macroeconomic activities. Further, public redistribution between generations could be offset by private redistribution through altruistic bequests.

1.3 The Efficacy of Keynesian Policy

The typical argument for raising fiscal deficits and utilizing public debt is the Keynesian policy that uses fiscal deficits as a tool of counter-cyclical policy. Namely, if the economy is in a recession, the government should raise a fiscal deficit and issue more public debt so as to stimulate the aggregate economy by raising spending and/or reducing taxes.

However, if the economy is experiencing a boom, it should reduce the deficit and reduce public debt so as to depress aggregate demand. Such Keynesian management can be successful if the efficacy of discretionary fiscal policy is significant and the timing of discretionary action is appropriate.

Let us discuss the first point. We can observe the non-Keynesian effect in the extreme case where fiscal deficits are very high, as explained in Chap. 4. But such a case is rare. It is plausible to suppose that Keynesian policy, qualitatively, has a stabilizing effect on the economy in a recession.

However, serious doubts exist about the magnitude and timing of this effect. If the effect is not large, the government is forced to issue more debt in order to stimulate aggregate demand. Hence, deficits do not easily become smaller when the economy recovers. Then, we have to worry about the sustainability of this policy.

With regard to the second point of timing, it is difficult to conduct discretionary policy measures at the appropriate time, as explained in Chap. 2. For example, in Japan, changes in fiscal action need the approval of the Diet, which may hesitate about a decision. Hence, the efficacy of discretionary policy is limited even if the government is benevolent.

In a political economy, the cost of public debt (iv) becomes serious. In a recession, it is generally easy to enforce excessive fiscal policy; however, in a boom, it is difficult to employ restrictive fiscal policy in a political economy. Many voters support a tax cut or a spending increase in a recession but do not support a tax increase or spending cut in a boom. As a result, Keynesian policy tends to be conducted only in a recession. If so, biased Keynesian policy toward expansionary measures accumulates fiscal deficits in the long run.

The cumulative issuance of public debt may lead to catastrophic fiscal deterioration. Since public debt moves the fiscal burden to future generations, the present generation has a political bias toward excessive spending compared with tax finance. Such an incentive raises the possibility of fiscal bankruptcy. Too much public debt eventually means a significant tax increase and/or spending cut in order to achieve fiscal consolidation. If limits on tax increases and/or spending cuts exist, cumulative debt issuance finally results in the bankruptcy of government budgeting. We shall discuss this point in Sect. 2 of this chapter.

1.4 The Tax-Smoothing Hypothesis

As explained above, using a fiscal deficit for stimulating aggregate demand has limited effects. Contrary to Keynesian policy, the tax-smoothing hypothesis uses counter-cyclical measures so as to smooth the tax burden over time.

Imagine that a bad shock occurs and GDP declines. Then, tax revenue would also decline. Fiscal deficits normally increase because of a decline in taxable income at a given level of spending. With the balanced-budget rule, the government has to raise tax rates. Alternatively, the balanced-budget rule means a huge cut in government spending.

Such a response hurts private agents and destabilizes tax revenue and government spending in the long run. From the viewpoint of smoothing the tax burden over time, tax revenue or the tax rate should be stabilized. Similar smoothing behavior should also be applied to government spending. The tax-smoothing hypothesis means that the government uses a fiscal deficit and public debt so as to alleviate fiscal fluctuations in response to exogenous GDP shock.

Figure 6.1 explains this policy. The vertical axis denotes the size of spending G and taxes T , and the horizontal axis denotes time or periods. Suppose during period AB that a negative shock such as a natural disaster or war occurs and government spending G has to be raised temporally. Then, it is desirable to raise taxes T from period A by a small amount. Further, most temporal spending during AB should be financed by temporal debt issuance. This is the tax-smoothing response.

The tax-smoothing hypothesis may be explained in a simple two-period model. Suppose levying taxes T_i produces excess burden C_i in period $i = 1, 2$. Thus,

$$C_i = C(T_i), \quad C' > 0, \quad C'' > 0. \quad (6.1)$$

This excess burden increases with T_i . As explained in Chap. 8, the shape of this function is convex, as shown in Fig. 6.2a. The slope of this curve increases with taxes. The objective of government is to minimize the present value of the total excess burden at the given level of government spending. The present value of the total excess burden H is expressed as

$$H = C(T_1) + \frac{1}{1+r} C(T_2). \quad (6.2)$$

Fig. 6.1 Tax smoothing and temporal debt issue

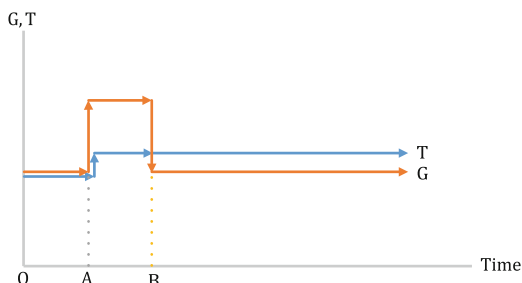
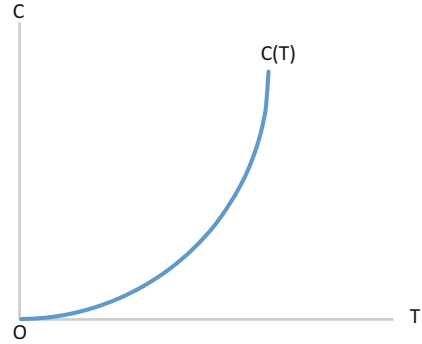


Fig. 6.2a The excess burden curve



The government budget constraint in each period is given as

$$G_1 = T_1 + B_1, \quad \text{and} \quad (6.3)$$

$$G_2 + (1 + r)B_1 = T_2, \quad (6.4)$$

where G_i is government spending in period i ($i = 1, 2$) and B_1 is public debt issued in period 1. r is the rate of interest. The present value government budget constraint is given by

$$T_1 + \frac{T_2}{1 + r} = G_1 + \frac{G_2}{1 + r}. \quad (6.5)$$

We also assume that the optimal time path of government spending (G_1, G_2) is exogenously given.

Thus, the government minimizes the total excess burden (6.2) by choosing T_1 and T_2 , subject to its budget constraint (6.5) at given levels of G_1 and G_2 .

The optimal condition is given as

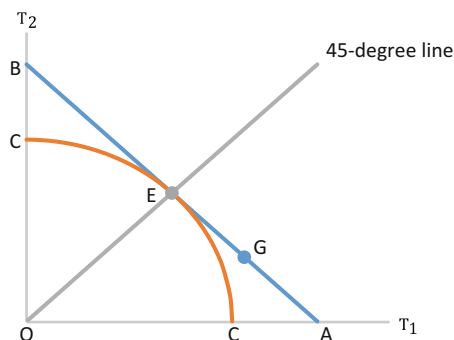
$$T_1 = T_2, \quad (6.6)$$

which is the tax-smoothing condition. It is optimal to collect the permanent level of tax in each period. Figure 6.2b explains this outcome. The CC curve means the combination of T_1 and T_2 that gives a constant value of H , the slope of which is given by

$$(1 + r) \frac{C'(T_1)}{C'(T_2)},$$

which is equal to $1 + r$ if $T_1 = T_2$. Line AB is the government budget constraint, the slope of which is given by $1 + r$. Point G denotes the combination of given levels of G_1 and G_2 . At the optimal point E, line AB is tangent to curve CC. Since point E is on the 45° line, it is optimal to have the tax-smoothing condition (6.6).

Fig. 6.2b Tax-smoothing hypothesis



Economic intuition is as follows. Since the excess burden of taxes increases with taxes, it is desirable to maintain a stable time path for taxes over time. Then, as in period 1, G_1 is greater than T_1 in Fig. 6.2b and the government should issue public debt by the amount of $G_1 - T_1$. Fluctuations of government spending should be absorbed by issuing debt so that tax revenue may be stabilized. This is the tax-smoothing hypothesis.

In reality, when a large shock such as a national disaster or war occurs, government spending increases considerably but temporally. In such a situation, the balanced-budget rule is undesirable; rather, the government should issue public debt to meet the temporal need of a revenue increase. See Barro (1995).

1.5 Compensation Policy

As long as a policy to rescue poor people in a disaster is needed, it is meaningful to have a deficit in a recession. Based on this understanding, there is an argument to utilize a fiscal deficit as a tool of compensation policy in a recession. The purpose of this policy is to support poor people who suffer badly from a recession.

In this regard, fiscal measures do not have to stimulate macroeconomic activity. Rather, this policy aims to improve the welfare of the poor people of a nation during a recession. In other words, if a recession is a disaster, the government should alleviate the bad outcomes. Whether the government can recover the economy does not matter. Even if fiscal policy cannot affect GDP, it is desirable to compensate for the bad outcomes of a recession.

In Sect. 1.4, we explained the tax-smoothing hypothesis. Similar smoothing behavior should also be applied to private consumption.

If saving/borrowing tools are available, consumption can be more stable than income; hence, long-run welfare can be enhanced through a household's optimizing behavior. However, when economic fluctuations make income significantly volatile, consumption may also be volatile without saving/borrowing measures. Especially since the poor cannot use saving/borrowing measures easily, they suffer from a decline in consumption in a recession. Then, in order to smooth private consumption over time, the government may adjust the fiscal deficit in terms of saving/

borrowing for these households. This is the smoothing hypothesis of private consumption over time. Put another way, this proposal corresponds to smooth consumption over time in place of a household's optimizing behavior.

Let us explain this policy in a simple theoretical model in a two-period economy. The budget constraint of a representative poor agent is given by

$$c_1 = w_1 - T_1, \quad \text{and} \quad (6.7)$$

$$c_2 = w_2 - T_2, \quad (6.8)$$

where w_i is an exogenously given income and T_i is a tax payment in period i ($i = 1, 2$). Because w_1 is low and the poor agent cannot save, consumption c_1 and c_2 are equal to disposable income. The government budget constraint is the same as in Sect. 1.4.

The objective of government is to maximize the present value utility of the representative poor agent. Thus,

$$W = U^1(w_1 - T_1, G_1) + \rho U^2(w_2 - T_2, G_2) \quad (6.9)$$

by choosing T_1, T_2, G_1, G_2 . $0 < \rho < 1$ is the discount factor. In the neoclassical framework, w_1, w_2 are not affected by fiscal policy but exogenously given.

Then, the optimality conditions are given by

$$U_c^1 = U_G^1 = \rho(1+r)U_c^2 = \rho(1+r)U_G^2. \quad (6.10)$$

Here, U_c^1 is the marginal utility of consumption and U_G^1 is the marginal utility of government spending. These equations relate respectively to the optimal condition of public spending and the consumption-smoothing condition over time.

Imagine that w_1 declines but that w_2 increases. In order to keep the present discounted value of income fixed, we also assume $dw_1 = -\frac{1}{1+r}dw_2 < 0$. Namely, the present is in a recession, while the future is experiencing a boom. With such income fluctuation, it is optimal to have $dT_1 = dw_1 < 0$ and $dT_2 = dw_2 > 0$. In other words, the government should decrease tax T_1 in period 1 and raise tax T_2 in period 2 so that disposable income, including the subsidy, may not change in either period.

In order to achieve this, the government should increase the deficit in period 1 by an amount equal to the fall in income: $dB_1 = -dw_1 > 0$. Public goods, G_1, G_2 , remain fixed at the original optimal values. This is a counter-cyclical fiscal policy that smoothes private consumption and public goods over two periods. In other words, the intertemporal smoothing condition normally suggests the establishment of conventional counter-cyclical fiscal policy as the first best solution.

1.6 The Long-Run Argument for a Zero-Tax Nation

From the long-run perspective, some argue that government deficits should be used as a tool for attaining optimal economic growth. Such people insist that optimal growth may be attained by eliminating any taxes and financing government spending from the profits of government assets. If a nation abolishes taxes, the distortionary effects of taxes are absent. Thus, such a zero-tax approach should affect private saving and investment favorably. In other words, without taxation private economic activity should be enhanced.

However, to achieve this situation, the government must first raise taxes to a large extent so that the government may accumulate sufficient surplus for a while. Then, the government should invest its assets and earn a significant return by providing necessary public services. In other words, the long-run benefits of zero taxes require the short-run costs of a large tax burden.

This argument for a zero-tax nation emphasizes long-run benefits more than short-run costs. In particular, it is desirable to reduce the tax rate on capital income to zero in the long run in order to attain optimal growth. In this sense, the argument is interesting from the theoretical viewpoint.

The issue explores the benefit of raising taxes at an early stage of fiscal consolidation. Namely, since capital does not change in the short run, taxing capital would not cause serious distortions in the short run. In contrast, raising taxes for a long time could hurt capital accumulation. It is desirable to attain fiscal consolidation as soon as possible. Then, the government may reduce the tax rate as much as possible. This strategy is beneficial for future generations.

However, it should also be stressed that this argument has difficulties because of realistic policy recommendations. Since the current generation would suffer from a significant tax burden, it is not politically feasible for the government to accumulate a great deal of assets from the beginning of the policy.

1.7 Overall Arguments on Fiscal Deficits

As explained, there is much controversy about fiscal deficits. One important issue is the effect of a counter-cyclical fiscal policy. If the effect is marginal, we should pay significant attention to the cost of this policy. For example, we should worry about the transference of the fiscal burden to future generations. In contrast, if Keynesian policy is very effective and the government performs very well, it becomes desirable to utilize the benefit of fiscal deficits to a great extent. So far, the empirical evidence on the efficacy of Keynesian measures is mixed. Thus, among professional economists, the Keynesian model has critics and adherents.

Nevertheless, there is a certain level of agreement about the policy implications of a fiscal deficit. First, a fiscal deficit could be beneficial in some instances; indeed, we should utilize a fiscal deficit in a recession. Some may argue that even if the multiplier effect of a fiscal policy is small, it is desirable to use a fiscal deficit to alleviate the bad outcome of a macro shock. Although there are disagreements on

the mechanism of a recession and the seriousness of unemployment, many people agree that a fiscal deficit in a recession has benefits. Second, long-run expanding fiscal deficits are normally detrimental. If fiscal management is not sustainable, it also hurts the overall economy as well as the public sector.

2 Fiscal Bankruptcy

2.1 The Possibility of Fiscal Bankruptcy

In this section, we discuss the sustainability problem of fiscal management. Namely, we investigate how fiscal management is sustainable and when fiscal bankruptcy may occur.

The long-run dynamics of a fiscal deficit depend upon the initial amount of public debt outstanding and future fiscal situations, such as future government spending, new debt issuance, and tax revenue. With regard to households, the financial situation after borrowing money depends on the initial amount of borrowing and future disposable income, living costs, and the amount of repayments. If the initial borrowing is large and future net income is small, the household faces difficulties repaying the debt. A similar analysis can be applied to the possibility of fiscal bankruptcy.

Figure 6.3 presents two cases: bankruptcy and non-bankruptcy. Figure 6.3a is a non-bankruptcy case whereby public debt grows less than the growth of GDP. Figure 6.3b is a bankruptcy case whereby public debt grows more than the growth of GDP.

Since interest payments cause additional pressure to issue new debt, if the net balance of spending and tax revenue, or the primary balance, in each period is zero, the speed of public debt accumulation is given by the rate of interest. Thus, if the growth rate of GDP is greater than the rate of interest, the debt/GDP ratio does not diverge and the government can redeem the public debt that is outstanding. This is because taxes would increase at the same speed as the GDP growth rate. In this regard, it may be desirable to issue debt to some extent.

Fig. 6.3a Public debt in relation to per capita GDP: sustainable case

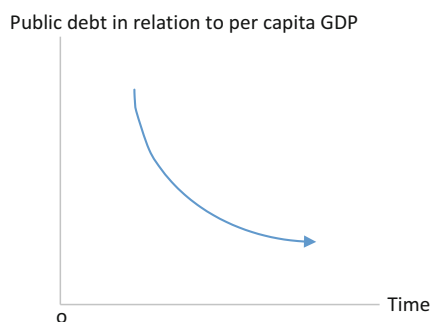
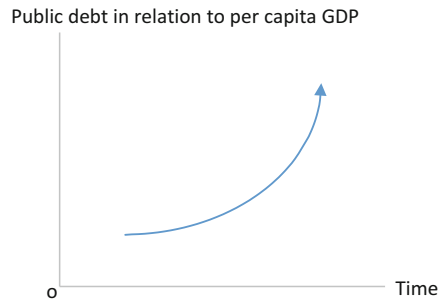


Fig. 6.3b Public debt in relation to per capita GDP: unsustainable case



For households, the non-bankruptcy case means that income grows at a rate greater than the rate of interest. The higher the growth rate of income, the easier it is to repay the amount borrowed. Similarly, even if the net balance is in deficit and government spending is greater than tax revenue in each period, the government can issue new debt. This is valid if the growth rate is greater than the rate of interest.

If the rate of interest is greater than the growth rate, we have difficulties. In this regard, if the net balance, the primary balance, is in deficit, public debt grows more than GDP and the government would eventually go bankrupt, as shown in Fig. 6.3b. Hence, in a plausible situation where the rate of interest is greater than the growth rate, there is a limit on public debt issuance. The government has to satisfy the sustainability condition in the long run; namely, it is necessary to earn a net surplus to meet the public debt that is outstanding in the long run.

2.2 The Government Budget Constraint

The above arguments suggest that if fiscal management is sustainable, we have the following budget constraint in the long run.

The present value of the net balance (or the primary balance) of tax revenue and government spending = the net public debt outstanding in the initial period.

In the two-period model, the government budget constraints are given by

$$B_1 = G_1 - T_1 + (1 + r)B_0, \quad \text{and} \quad (6.11)$$

$$(1 + r)B_1 + G_2 = T_2, \quad (6.12)$$

where B_0 is the size of bond issued at period 0 and B_1 is the size of bond issued at period 1. B_0 is a new variable in the government budget constraint since it is useful to include the initial public bond outstanding to examine the sustainability issue.

From these budget constraints, the present value budget constraint becomes

$$G_1 - T_1 + \frac{1}{1+r}(G_2 - T_2) = (1+r)B_0. \quad (6.13)$$

The primary balance or net balance denotes the difference between G_i and T_i ($i = 1, 2$). If $G_i > T_i$, the primary balance is in deficit, and if $G_i < T_i$, it is in surplus. Equation (6.13) means that the present value of total primary surplus, the left-hand side, should be at least equal to the present value of initial public debt. Otherwise, if we have the following inequality

$$G_1 - T_1 + \frac{1}{1+r}(G_2 - T_2) < (1+r)B_0, \quad (6.14)$$

the government cannot redeem the debt outstanding; hence, the government budget becomes unsustainable.

2.3 Primary Balance

As mentioned in Sect. 2.1, an analogy may be applied to households. With regard to households, the initial borrowing should be equal to the present discount value of the net surplus, and the difference between income and living expenses. In other words, the consumer cannot borrow money to an extent greater than the present value of available future repayments. Similarly, in order to attain fiscal sustainability, the present value of the net surplus between tax revenue and government spending should be at least equal to the initial public debt that is outstanding.

The net balance of tax revenue and government spending ($T - G$) is the primary balance. We may call the surplus of this balance, which is the budget surplus excluding interest payments on public debt, the primary surplus. In other words, the primary deficit is given by the difference between public debt issuance and interest payments on public debt. With regard to households, the primary surplus corresponds to the surplus between income and living expenses. Note that the standard definition of fiscal balance is the difference between spending, including interest payment $G + rB$ and taxes T , $G + rB - T$. The primary deficit ($G - T$) is smaller than the conventional deficit ($G + rB - T$) by the amount of the interest payment, rB .

The primary deficit (or surplus) is a useful indicator for judging whether fiscal management is sustainable in the long run. As explained above, sustainable government budget constraint means that the present discounted value of the future primary surplus should be at least equal to the initial public debt outstanding. In other words, in order to redeem public debt, the government should earn at least the same amount of fiscal surpluses in the future. Fiscal deficits cannot accumulate forever.

If the government has issued a lot of public debt already, it is necessary to earn a lot of primary surpluses in the long run. Producing a primary deficit is not sustainable in the long run. Hence, if public debt increases with a primary deficit, this

situation is not sustainable. In contrast, if public debt increases but primary deficit decreases, this situation is sustainable in the long run. This is because the primary balance would become surplus sooner or later. From this viewpoint, it is necessary to have a negative relationship between public debt and primary surplus in the long run in order to attain the sustainability of fiscal management.

2.4 The Dynamics of Government Budget Constraint

We may explain the above arguments using government budget constraint. Thus,

$$\Delta B = G + rB - T \quad (6.15)$$

where G is government spending, B is public debt, T is tax revenue, and r is the rate of interest. ΔB denotes the new issuance of public debt. In terms of per capita GDP ($= Y$), we have

$$\frac{\Delta B}{Y} = g + rb - t \quad (6.16)$$

where $g = G/Y$, $b = B/Y$, and $t = T/Y$. By definition, we have the following dynamics:

$$\frac{\Delta B}{B} - \frac{\Delta Y}{Y} = \frac{\Delta b}{b} \quad (6.17)$$

Thus, multiplying by b on both sides of Eq. (6.17), we have

$$\Delta b = \frac{\Delta B}{Y} - \frac{\Delta Y}{Y} b. \quad (6.18)$$

Substituting Eq. (6.16) into Eq. (6.18), we finally derive the fundamental equation of dynamic government budget constraint:

$$\Delta b = g + rb - t - nb = (g - t) + (r - n)b, \quad (6.19)$$

where $n = \Delta Y/Y$ is the growth rate. The first term of the right-hand side of Eq. (6.19) denotes the primary deficit and the second term denotes the difference between the interest rate and the growth rate multiplied by the debt/GDP ratio.

2.5 Some Special Cases

Based on Eq. (6.19), we consider some special cases.

2.5.1 $g = t$

In this case, Eq. (6.19) reduces to

$$\Delta b = (r - n)b. \quad (6.20)$$

If $r > n$, the government budget is unsustainable and vice versa. In order to maintain sustainability, we need the condition $r < n$. This is called the Domar condition. It clarifies the importance of the sign of $r - n$ (see Domar 1944).

Figure 6.4a explains the dynamics of $r > n$. b increases as long as $r > n$. Further, Fig. 6.4b explains the opposite case of stable dynamics. Note that even if $g > t$ and we have the primary deficit, the dynamics are qualitatively the same as long as $g - t$ is fixed and independent of b . If $g - t$ is fixed at any value, the same argument holds. However, if $g - t$ is affected by b , the Domar condition is irrelevant. For this case, we need the Bohn condition.

2.5.2 $r = n$

In this case, Eq. (6.19) reduces to

Fig. 6.4a The dynamics of the Domar condition. $r > n$

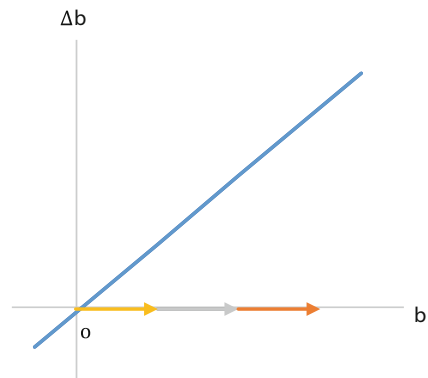
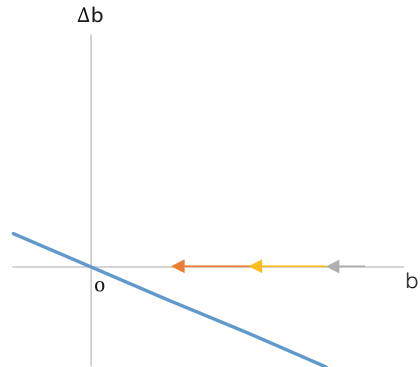


Fig. 6.4b The dynamics of the Domar condition. $r < n$



$$\Delta b = g - t. \quad (6.21)$$

If $g > t$, the government budget is unsustainable and vice versa. This clarifies the importance of the sign of $g - t$. If the primary balance is exogenously given, the government budget goes bankrupt in the case of primary deficit, $g - t > 0$.

However, the government intends to conduct consolidation measures to reduce the primary deficit if b is very high. Thus, the primary deficit, $P = g - t$, may well be a function of b .

$$P = P(b) \quad (6.22)$$

If P decreases with b , the budget constraint may be sustainable even in the region of $P > 0$. This condition, $P'(b) < 0$, is called the Bohn condition. If $r - n$ is fixed at any value, the same argument holds. In such an instance, the condition for maintaining sustainability is given as $P' + r - n < 0$. The absolute value of P' should be greater than $r - n$ (see Bohn 1995).

As explained in Fig. 6.5, if the $P(b)$ curve is downward sloping and intersects the $\Delta b = 0$ line at point E, E becomes a stable equilibrium point. Even if b is initially very high, b declines to the equilibrium level at point E gradually.

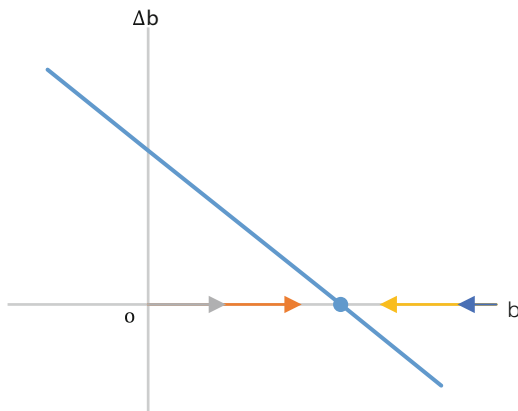
2.5.3 $g + rb - t = 0$

In this case, Eq. (6.19) reduces to

$$\Delta b = -nb. \quad (6.23)$$

If $n > 0$, the government budget is sustainable and vice versa. If $g + rb - t$ is fixed at any value, the same argument holds. In such an instance, positive economic growth is necessary to maintain sustainability. Note that even if the fiscal deficit, $g + rb - t$, is very high, we may attain the sustainability condition as long as the fiscal deficit per GDP is fixed in a growing economy.

Fig. 6.5 The Bohn condition



In the EU, the 28 member states of the European Union have agreed, under the Stability and Growth Pact (SGP), to facilitate and maintain the stability of the Economic and Monetary Union. All member states must respect the following criteria:

- (i) An annual budget deficit no higher than 3 % of GDP; and
- (ii) A national debt lower than 60 % of GDP.

In other words, target b is 0.6 and target $g + rb - t$ is 0.03. These criteria are consistent with dynamic government budget constraint if $n = 0.05$. Namely, a 5 % growth rate is necessary to attain sustainable fiscal management with the EU criteria.

2.6 The Rate of Interest and Fiscal Crisis

So far, we have assumed that the rate of interest is exogenously given. In reality, the interest rate may depend upon the fiscal situation. The relationship between a fiscal deficit and the rate of interest is not simple. Generally speaking, if the public debt outstanding is high and/or new debt issuance is large, a high rate of interest is required in the market to meet demand. However, in Japan, despite the significant issuance of public debt since the 1990s, the rate of interest on this debt has been low. Let us now investigate the relation between the rate of interest and a fiscal crisis.

Theoretically, the rate of interest can be low in the market despite a large fiscal deficit if accommodated monetary policy is expansionary and reduces the level of interest rates to almost zero. This could explain low interest rates in Japan. However, suppose monetary policy is fixed and we only consider the effect of the fiscal situation on the real rate of interest. Still, this seemingly paradoxical outcome of low interest rates may occur if investors are optimistic about future fiscal management despite the bad fiscal situation in the short run.

Investors may optimistically believe that although the current fiscal outcome looks very bad, the fiscal balance will become a surplus sooner or later; hence, the government budget should be sustainable in the long run. However, if a fiscal deficit continues to increase and public debt accumulates for a long time, investors may change their optimistic anticipation. If this change occurs, the reliability of public debt is doubtful and the rate of interest begins to rise.

In order to analyze the relation between the rate of interest and a fiscal crisis, the response of government to a fiscal crisis is crucial. Imagine that a fiscal crisis occurs. Consequently, investors do not believe in current fiscal management and do not want to hold public debt any more. They also demand immediate redemption of the existing public debt. In response to this fiscal crisis, the government has two options.

One option is to declare default and not redeem public debt any more. Another option is to raise tax revenue in order to redeem all public debt. The second option is

feasible if the cost of a significant increase in taxes is low. Theoretically, it is possible to raise large amounts of tax in the short run. However, when the tax burden is biased, a significant tax increase for a small part of the private sector produces a huge amount of excess burden on them and induces strong resistance from those taxpayers. If so, the cost of a tax increase in the short run is large. However, if the tax burden is uniformly imposed on a wide range of people, the tax increase is not a significant cost for a large number of taxpayers. From this viewpoint, the efficiency and uniformity of the tax structure is crucial in order to determine the possibility of default.

3 Fiscal Consolidation

3.1 Desirable Fiscal Consolidation

The reduction of a fiscal deficit is not the final target of fiscal reform. The final target of fiscal consolidation is to reform the content of a government budget efficiently and equitably. Nevertheless, it is important to reduce the excessive burden on future generations. In order to realize successful fiscal consolidation, it is necessary to reduce government spending, increase taxes, and reduce the new issuance of public debt.

In this section, we investigate how the government may reduce fiscal spending and fiscal privileges, and increase taxes, in a political economy. See the advanced study of Chap. 12, Appendix, for a more formal analysis of fiscal consolidation in a political economy.

In reality, many interest groups such as labor unions, management unions, agricultural groups, lawyers, and medical doctors conduct various political activities to seek group-specific benefits, tax-related privileges, and specific public works. The accumulated fiscal deficit may be regarded as the outcome of these privileges. If so, successful fiscal consolidation means that the government has to reduce these fiscal privileges. In other words, fiscal consolidation requires interest groups to assist with an improvement in the fiscal situation by accepting a reduction of fiscal privileges.

For simplicity, imagine that fiscal privileges occur only in the net tax burden for each interest group. Benefits may be regarded as a negative tax burden. Group-specific public works, which benefit only a small number of regions, could also be regarded as privileges for specific interest groups. However, the government provides nationwide public goods that provide benefits across the nation, such as the fundamental services of administrative works, national defense, and diplomacy. Thus, total public spending is the sum of nationwide public goods and fiscal privileges.

In what way would each interest group be willing to accept reductions in fiscal privileges? It is interesting to investigate this issue in a political economy (see Chap. 12). For simplicity, we assume that this issue is determined by comparing private benefits and the cost of reductions.

The private benefit of accepting a reduction of privileges is an increase in nationwide public goods that are available through a reduction in privileges. This is the positive effect of fiscal consolidation. Since each interest group is a member of a nation, it may receive the benefit of fiscal consolidation to some extent.

An improvement of the fiscal situation may raise the provision of nationwide public goods, which should benefit each interest group. However, the reduction of a group's own fiscal privileges is harmful. It may reduce the group's utility directly or may reduce disposable income, thereby reducing the group's utility indirectly.

Thus, the best scenario for each interest group is that fiscal consolidation is attained by reducing the privileges of other interest groups. Then, a group may enjoy the benefit of fiscal consolidation without sacrificing its own fiscal privileges. Since nationwide public goods have positive externalities, any interest group may enjoy the benefit. This is a typical example of free riding because the government cannot enforce the willingness-to-pay principle. Without strong political leadership from the government, each interest group has an incentive for free riding; thus, fiscal consolidation attempts are easily delayed.

3.2 The Optimal Target of Fiscal Consolidation

If the government is politically strong enough to reduce fiscal privileges optimally, what time process for fiscal consolidation would be desirable? This issue is mainly related to intergenerational equity. The optimal time path of fiscal consolidation is determined by the discount rate, interest rate, and other economic conditions. For example, if the interest rate is high, the cost of debt issuance is also large; consequently, it becomes desirable to raise taxes as early as possible. The optimal debt/GDP ratio is small. In contrast, if the discount rate is high and it is desirable to consider the welfare of the present generation more than that of the future generation, it is good to attain fiscal consolidation slowly. In this instance, the speed at which taxes are raised is low. Then, the long-run target debt/GDP ratio is rather high.

3.3 Politically Weak Government

However, if the government is politically weak, each interest group achieves fiscal privileges. Thus, fiscal consolidation is attained only if each interest group agrees to accept a decrease in its own privileges. In this regard, it is important to consider how to set the fiscal consolidation schedule in advance. In particular, the crucial point is whether the pre-determined schedule can be revised in the future or not.

First, let us consider a commitment case whereby the predetermined fiscal consolidation schedule cannot be revised. Then, each interest group does not have much incentive for free riding. In the commitment case, it is impossible to revise the predetermined schedule of consolidation at a later stage. Since fiscal consolidation is attained only if each group agrees to cooperate from the beginning, the groups

have an incentive to cooperate to some extent in order to enjoy the benefit of consolidation. As a result, the long-run debt/GDP ratio is smaller than in the non-commitment case. Moreover, the government may attain desirable consolidation faster than in the non-commitment case. Nevertheless, the speed of consolidation is slower than in the first best case where the government freely reduces privileges.

However, in a non-commitment case where the predetermined schedule may be revised in the future, each interest group has a significant incentive for free riding. In this case, each interest group knows the history of fiscal consolidation and the degree of cooperation by other groups. Thus, it may think that fiscal consolidation can be attained by other groups' cooperation. Hence, it is not willing to accept a notable reduction in its own privileges. If so, predetermined cooperation may well be revised so that such groups have a greater free ride than in the commitment case.

3.4 The Legal Constraint of Fiscal Consolidation

As explained above, flexible fiscal consolidation attempts are likely to fail in a political economy. A desirable consolidation framework needs constraints imposed by legal institutions.

Since the 1990s, many developed countries have imposed some legal constraints on the reduction of fiscal deficits. The US enforced the Omnibus Budget Reconciliation Act (OBRA) to reduce medial spending and raise taxes. The US also introduced the pay-go system, which cannot raise new spending without raising associated taxes and/or reducing other spending.

In Japan, the Fiscal Structure Act was imposed in 1997 so as to reduce the fiscal deficit and government spending. Although such legal commitments are criticized in that they do not pay much attention to macroeconomic fluctuations and limit the freedom of discretionary fiscal policy, they have the benefit of making interest groups cooperate with fiscal consolidation in a political economy.

3.5 The EU and the Euro

Finally, let us explain fiscal consolidation in the EU. As explained in Sect. 2, the 28 member states of the EU have agreed to facilitate and maintain the stability of the economic and monetary union. However, following criticism regarding insufficient flexibility, the EU Council relaxed the rules in March 2005. It also made the pact more enforceable.

As a result, while the ceilings of 3 % for the budget deficit and 60 % for public debt remain, the decision to declare a country's deficit as excessive now relies on certain parameters. The 2013 fiscal compact defines a balanced budget as one with a general budget deficit of less than 3 % of GDP, and a structural deficit of less than 1 % of GDP if the debt/GDP ratio is significantly below 60 % and less than 0.5 % of GDP otherwise.

The reason why fiscal consolidation is a matter of concern for EU monetary union is that the fiscal deficit of one country has negative externalities on other countries. There are five effects of externalities.

1. If one country raises the public debt/GDP ratio to an unsustainable level, other countries have to support that country in order to alleviate the fiscal crisis. This gives each country a moral hazard incentive for deficit enlargement.
2. Because of the financial interdependence of the monetary union, any fiscal crises hurt the financial system across the EU.
3. If one country issues excessive public debt, this may cause an increase in the rate of interest, inducing an increase in the interest payments of other countries.
4. If investors are uncertain about the true fiscal financial information of each country, a good country has an incentive to send a signal to the market that it can impose the balanced-budget principle, a rule that may not be imposed by the deficient country.
5. Other than economic motives, countries that have strong preferences about stable prices may have an incentive to join the monetary union based on political reasons. By excluding deficient countries from the monetary union, satisfactory countries can conduct more restrictive monetary policies in order to stabilize the price levels.

Table 6.1 summarizes the current fiscal consolidation targets in major developed countries.

Table 6.1 The fiscal consolidation targets in developed countries

	The Fiscal Consolidation Targets, etc. (Fiscal Plan, etc.)
 Japan	<u>Medium-term Fiscal Plan (2013)</u> ● Primary balance (National and local governments) ⇒ ① To halve the primary deficit to GDP ratio by FY2015 from the ratio in FY2010 ② To achieve the primary surplus by FY2020 ● Public debt to GDP ratio (National and local governments) ⇒ Reducing steadily after FY2021
 U.S.	● There is no concrete target in "Budget of the United States Government FY2016". ※ In "Budget of the United States Government FY2014", a total of 4 trillion dollars of financial deficit (Federal government) shall be reduced in 10 years.
 U.K.	<u>Charter for Budget Responsibility (2014)</u> ● Cyclically-adjusted current balance (Public sector) as a percentage of GDP ⇒ To be balanced by the end of the third year of the rolling, 5-year forecast period ● Public sector net debt as a percentage of GDP ⇒ To be falling in 2016-17
 Germany	<u>German Stability Programme (2015)</u> ● Debt to GDP ratio (General government) ⇒ To reduce the portion of the debt ratio above 60% at an average rate of 1/20 of the debt over the previous three years ● Debt to GDP ratio (Federal government) ⇒ ① less than 70% by the end of 2016, ② less than 60% within ten years
 France	<u>Budget Law (2016)</u> ● Government deficit to GDP ⇒ Not exceed 3% by 2017
 Italy	<u>Update of the Italy's Stability Programme (2015)</u> ● To achieve the balanced budget in structural terms by 2018 (General government) ● Debt-to-GDP ratio (General government) ⇒ To reduce the portion of the debt ratio above 60% at an average rate of 1/20 of the debt over the previous three years

Source: Japanese public finance fact sheet. 2016 Ministry of Finance. <http://www.mof.go.jp/english/budget/budget/fy2016/03.pdf>

Appendix: Fiscal Deficits in a Growing Economy

A1 Introduction

Fiscal deficits are becoming a major source of concern for economic policy. Concern that present levels of budget deficits are abnormal and undesirable is reflected in the fact that a majority of OECD countries (including Japan) have been following budget strategies that aim to reduce, or eliminate, their deficits in the medium term. It is often said that fiscal deficits should be reduced in any way.

As explained in the main text of this chapter, balanced budgets are often advocated as a matter of virtue and prudence rather than as a result of an analysis of economic theory. It has also been emphasized that the principle of balanced budgets causes the political process to consider the costs and benefits of government spending more carefully. The rationale for these arguments is not so clear from the perspective of economic theory, as discussed in Sect. 1 of this chapter.

One plausible reason for the economic theory viewpoint is that fiscal deficits are not sustainable and may be out of control. However, in real economies long-run government expenditures and taxes could endogenously be determined so as to avoid a catastrophe. In a growing economy, the government deficit may be regarded as controlled effectively if the deficit grows at a rate slower than that of the size of the economy and/or the primary balance decreases with public debt. In such a situation, the deficit need not be zero in the long run.

The problem studied here is the normative aspect of sustainable equilibrium. Put another way, when a government seeks to stabilize its budget, to what level should it maintain deficits in the long run? This appendix considers the optimal size of government deficits in a way that is compatible with economic growth, under the assumption that government expenditures and taxes are somehow endogenously chosen. We will ignore unemployment issues in the current appendix in order to focus directly on the normative aspect of deficits from the viewpoint of macro balance.

The neoclassical growth literature examined the real effects of a temporary substitution of debt for distortionary income taxation in a perfect-foresight model. His approach is the closest in spirit to the present appendix, but his main concern is with the efficiency issues of distortionary capital income taxation. Our main concern here is with the role of deficit in realizing the long-run optimal macro 1-S balance. In this advanced study section, A2 presents an analytical framework of this appendix, based on Ihori (1988), and Sect. A3 discusses the policy implications of optimal deficits. Section A4 concludes this appendix.

A2 A Simple Growth Model

A2.1 Analytical Framework

The model developed here is a very simple neoclassical growth model. The production function in this economy is given by

$$y = f(k), \quad (6.A1)$$

where y is per capita real GDP, $k (= K/L)$ is the capital/labor ratio, and $f(\cdot)$ is the per capita production function. Labor supply is exogenous and increases at the rate of $n (>0)$. We implicitly introduce public investment. For simplicity, public capital and private capital are perfect substitutes. k may be regarded as total capital. Capital will not depreciate. The production function satisfies the usual neoclassical properties. Under perfect competition, the real yield on capital (r) is equal to the marginal product of capital.

$$r = f'(k). \quad (6.A2)$$

Let g denote per capita real government expenditures excluding interest payments to public debt, t denote per capita tax revenues, and b denote per capita outstanding public debt. Then, the government budget constraint is given, in per capita terms, by

$$D_b = g + r b - t - n b, \quad (6.A3)$$

where D means the derivative with respect to time. In addition, let $g_c = (1 - \alpha)g$ denote per capita government consumption and αg denote per capita government investment. The propensity to invest from government expenditures ($0 < \alpha < 1$) is assumed to be given.

The value of household assets is the sum of the value of government liabilities and the capital stock. For simplicity, we assume that public bonds and capital are perfect substitutes for saving.

All per capita private savings s must be absorbed in either private capital accumulation ($Dk - \alpha g + nk$) or additional public bonds in per capita terms. Thus,

$$s = Dk - \alpha g + D_b + nk + nb. \quad (6.A4)$$

For normative analysis, the method of formulating private saving is important. A natural assumption would be to allow the savings rate to vary as individuals maximize an intertemporal utility function. The framework of full optimization with an infinite horizon would lead to the neutrality proposition of alternative financing of government expenditures; that is, to a first approximation where the choice between current taxation and debt issuance in order to finance a given government expenditure stream is irrelevant to the determination of the level of aggregate demand. Thus, if the horizon is infinite, the concept of optimal deficit would lose its policy meaning (unless distortionary taxes are explicitly introduced).

This is because in such a circumstance private saving and government deficits are perfect substitutes. Whatever the level of government deficits, the private sector can always realize the optimal (first best) state by adjusting private savings. We examined this debt neutrality theorem in Chap. 4. Thus, in order to discuss the meaningful government deficit problem in terms of macro IS balance, from now on

we assume that private savings are determined rather myopically. The private saving rate out of real disposable income σ is fixed:

$$s = \sigma[f(k) + rb - t]. \quad (6.A5)$$

Thus, the dynamic system of this economy may be summarized by Eqs. (6.A2), (6.A3), (6.A4), and (6.A5), and the asset accumulation equation

$$Dk + Db = \sigma[f(k) + rb - t] + \alpha g - nk - nb. \quad (6.A6)$$

A2.2 The Government's Objective

The objective of the government is to maximize the discounted sum of lifetime utilities.

$$W = \int_0^{\infty} e^{-\rho t} U(c, g_c) dt \quad (6.A7)$$

where W is the discounted sum of utilities, ρ is the rate of discount, c is per capita real consumption, and $U(\cdot)$ is an instantaneous utility function. U depends upon private consumption and government consumption.

From Eqs. (6.A3) and (6.A6), considering the definition of disposable income, ($c = f(k) + rb - t - s$), we have

$$c = f(k) - nk - Dk - g_c. \quad (6.A8)$$

By choosing t and g appropriately, the government can choose time paths of k and b freely, which are given by Eqs. (6.A3) and (6.A6). Even if the propensity to save is fixed, the government can control indirectly overall capital accumulation by choosing fiscal policy variables. We may say that the asset accumulation equation (6.A6) determines the associated value of Db , and the government budget constraint (6.A3) determines the associated value of t once the optimal time paths of g_c and k are chosen, subject to the feasibility condition (6.A8).

Thus, the maximization problem in the competitive economy may be reduced to Maximize (6.A7) by choosing $[g_c, Dk]$ subject to (6.A8).

This maximization problem is essentially the same as the maximization problem in a centrally planned economy where the government can directly control resource allocation; hence, the first best can be realized in the competitive economy. At the same time, the corresponding optimal time path of government deficits is determined under the assumption that private saving behavior is not necessarily optimal.

It is well known that if taxes are distortionary, debt and deficits matter. If taxes are lump sum in nature, debt and deficits still matter as long as one makes reasonable assumptions concerning restrictions on market transactions and tastes. We now investigate the optimal size of deficits compatible with optimal economic

growth under the assumption that private saving behavior is not necessarily optimal.

A3 Optimal Deficits

A3.1 Phase Diagram

The maximization problem in the competitive economy is essentially reduced to the standard problem in the optimal growth literature (see Cass 1965; Judd 1987), apart from the optimization of government expenditures. The optimal conditions are

$$U_c = U_{gc} \quad \text{and} \quad (6.A9)$$

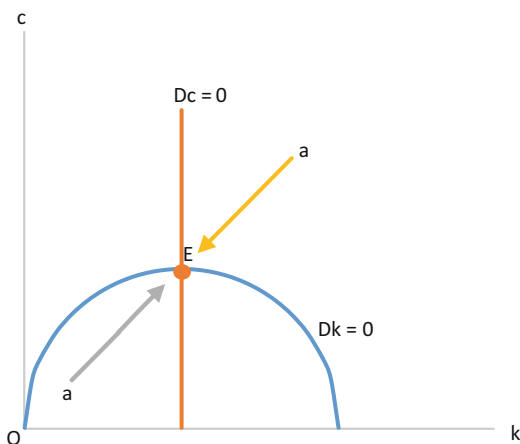
$$Dc = \frac{1}{\varepsilon(c)} [f'(k) - (n + \rho)]c, \quad (6.A10)$$

where U_i is the partial derivative of U with respect to variable i and $\varepsilon(c)$ is the elasticity of marginal utility with respect to private consumption ($-\varepsilon(c) = -cU_{cc}/U_c$).

From Eq. (6.A9), g_c may generally be regarded as a function of c . Thus, Eqs. (6.A8) and (6.A10) may be reduced to the system of differential equations with respect to c and k . In this context, it is useful to illustrate a phase diagram in the (c, k) plane.

In Fig. 6.A1, the $Dk=0$ curve means the combination of k and c that satisfies $Dk=0$ in (6.A8). Two curves, $Dk=0$ and $Dc=0$, divide the diagram into four regions, and the behavior of c and k in each region is indicated by a pair of arrows. As is well known, the long-run equilibrium point E of balanced growth is a saddle point. The path of optimal economic growth must lie along the stable branch aa , where given any initial level of capital k_0 , unique optimal consumption is the point on the stable branch aa . The government may choose g and t so as to realize c on aa during the transition.

Fig. 6.A1 Optimal growth



A3.2 Optimal Deficit During Transition

We now consider the optimal deficit during the transition process. Considering the definition of disposable income, the per capita real deficit is given by

$$g + ib - t = -f + \frac{c}{1 - \sigma} + g. \quad (6.A11)$$

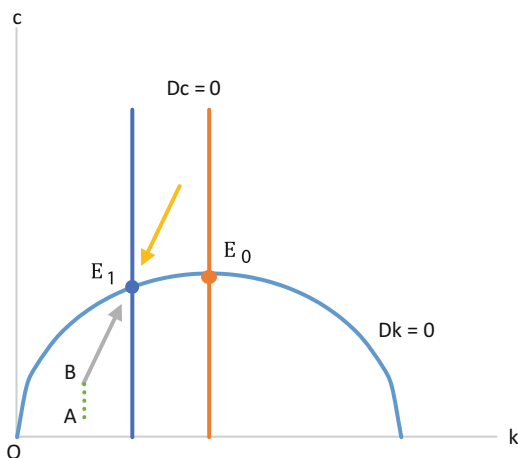
Hence, the deficit/GDP ratio (Φ) is given by

$$\Phi = -1 + \frac{\lambda}{1 - \sigma} + \gamma, \quad (6.A12)$$

where λ is the private consumption/GDP ratio (c/f) and γ is the government expenditure/GDP ratio (g/f). The time paths of λ and γ are determined so as to realize the optimal path aa . As σ does not appear in (6.A8) and (6.A10), these paths are independent of σ . However, Eq. (6.A12) means that the optimal time path of Φ depends upon σ and α . Put another way, the optimal deficit is meaningful only if the private propensity to save and the public propensity to invest are given. In a centrally planned economy, the concept of optimal deficit loses its policy implication because the government can control σ as well as Φ . The government can attain the first best by choosing the saving ratio optimally at any given level of government deficit.

From the optimality condition (6.A9), g normally increases with c . If $U_{cg} \geq 0$, g increases with c . From Eqs. (6.A8) and (6.A10), as shown in Fig. 6.A2, k increases with c . Thus, γ and λ do not necessarily change in the same direction. However, if c/g is constant, as in the Cobb-Douglas case, it is easy to see that γ and λ will change in the same direction. In such a circumstance, Eq. (6.A12) implies that the deficit/GDP ratio Φ will also change in the same direction. Equation (6.A12) implies that the tax/GDP ratio is negatively related to the consumption/GDP ratio λ . In other words, if it is desirable to decrease the government expenditure/GDP ratio, it may

Fig. 6.A2 Comparative dynamics



also be desirable to decrease the deficit/GDP ratio during the transition; hence, it may well be desirable to increase the tax/GDP ratio during the transition. Equation (6.A12) implies that the optimal deficit rate increases with the propensity to save.

A3.3 Macro IS Balance

Let us denote by Θ the private saving/GDP ratio (s/f). Then, Eq. (6.A12) is rewritten as

$$\Phi = \Theta - (1 - \lambda - \gamma), \quad (6.A13)$$

which is the so-called macro IS balance equation. $1 - \lambda - \gamma$ is the private investment/GDP ratio. In order to discuss the policy implications of optimal deficits, Eq. (6.A12) is more useful than Eq. (6.A13). When the propensity to save, σ , is given, Eq. (6.A12) can determine the optimal level of deficits.

A3.4 Comparative Dynamics

With these tools, we analyze the dynamic effects of exogenous changes in σ , α , and ρ . Note that the $Dk = 0$ and $Dc = 0$ loci are independent of α or σ . A change in σ does not affect the optimal time paths of λ and γ . Thus, from (6.A12) an increase in σ raises the optimal level of Φ during transition. If an exogenously given σ is increased, the government deficit should be increased. A change in α will affect γ so as to maintain the original optimal time path of g_c . Thus, an increase in α will raise γ , and hence the optimal level of Φ , during transition.

Figure 6.A2 illustrates the situation where ρ is increased. An increase in ρ moves the $Dc = 0$ curve to the left. At $t = 0$, consumption must jump from point A to B so as to move the economy toward a new long-run equilibrium point E_1 . λ and γ are increased so that the optimal level of Φ is increased during transition.

A3.5 Optimal Deficit in the Long Run

Let us now investigate the optimal size of government deficits in the long run. With regard to long-run equilibrium, substituting $Dk = Db = 0$ into Eqs. (6.A3) and (6.A6) gives us

$$g + rb - t = nb \text{ and} \quad (6.A3')$$

$$\sigma[f(k) + rb - t] = n(k + b) \quad (6.A6')$$

Further, Eq. (6.A10) is reduced to

$$f'(k) = n + \rho. \quad (6.A10')$$

If we use $*$ to denote optimal variables in long-run equilibrium, from Eq. (6.A10') the optimal long-run equilibrium capital/labor ratio k^* is determined. Then, from k^* , considering Eqs. (6.A8) and (6.A9), g^* and c^* are determined. The optimal values of b and t are determined by considering Eqs. (6.A3') and (6.A6'), and (6.A2) and (6.A4). The optimal deficit/GDP ratio in the long run (Φ^*) is given by

$$\Phi^* = -1 + \frac{\lambda^*}{1 - \sigma} + \gamma^*, \quad (6.A14)$$

where λ^* is the optimal consumption/GDP ratio and γ^* is the optimal government expenditure/GDP ratio for long-run equilibrium.

A3.6 Numerical Example

Our analysis suggests that the optimal deficit in a competitive economy generally depends on preferences and technology. In this subsection, we specify the utility function and the production function as a Cobb Douglas type and explicitly solve the optimal deficit for long-run equilibrium. Suppose preferences and technology are given by

$$u = c^a[(1 - \alpha)g]^{1-a} \quad 0 < a < 1 \quad \text{and} \quad (6.A15)$$

$$f = k^\beta \quad 0 < \beta < 1. \quad (6.A16)$$

The optimal conditions in the long run (6.A8) and (6.A10) may be reduced to

$$(1 - a)c = a(1 - \alpha)g \quad \text{and} \quad (6.A17)$$

$$\beta k^{\beta-1} = n + \rho. \quad (6.A18)$$

From (6.A17) and (6.A18), the optimal deficit/GDP ratio (Φ^*) is finally given by

$$\Phi^* = -1 + \frac{\lambda^*}{1 - \sigma} + \gamma^* = -1 + \left(1 - \frac{n\beta}{n + \rho}\right) \left(\frac{a}{1 - \sigma} + \frac{1 - a}{1 - \alpha}\right). \quad (6.A19)$$

Table 6.A1 calculates the optimal deficit/GDP ratio in the long run for given values of a , β , α , n , ρ , and σ . Table 6.A1 suggests that Φ^* varies greatly according to changes in parameters a , β , α , σ , ρ , and n . It would be very restrictive to have $\Phi^* = 0$. It is not plausible to say that a balanced budget is always desirable and hence that deficits should be reduced in any circumstance.

However, the results presented here also show that at least in certain circumstances the balanced-budget rule may be a very useful guide for fiscal policy. If $[n/(n + \rho)]\beta = \alpha = \sigma$, then we have $\Phi^* = 0$ irrespective of the value of a . In such an instance, the optimal private saving-investment difference, and hence the

Table 6.A1 Optimal deficit/GDP ratio in the long run

a	0.7	0.8	0.6	0.7	0.8	0.8	0.8	0.8	0.8	0.8
α	0.3	0.3	0.3	0.3	0.4	0.3	0.25	0.3	0.4	0.3
β	0.4	0.4	0.5	0.5	0.4	0.5	0.5	0.4	0.4	0.5
σ	0.2	0.2	0.25	0.25	0.15	0.25	0.25	0.15	0.1	0.2
Φ^*	4.3	2.9	2.9	2.1	2.0	1.4	0	-1.8	-2.2	-3.6

Notes: $n = 0.03$, $\rho = 0.03$, Φ^* is expressed as percentage

optimal deficit, is always zero. Because β means the share of capital income, $[n/(n + \rho)]\beta = \sigma$ may be relevant in a situation where capital income is saved, labor income is consumed, and the rate of time preference is arbitrarily close to zero. If, in addition, the propensity to invest from government expenditure (α) is equal to σ , the optimal deficit is reduced to zero.

In the Japanese economy, α is about 0.3–0.5, while σ is about 0.1–0.3. Thus, $\alpha > \sigma$ is likely. In such a situation, from (6.A19) we have $d\Phi^*/da < 0$. If parameter a increases, namely if preference changes from public consumption to private consumption, the optimal private investment rate is reduced; hence, the optimal deficit rate is reduced in the long run.

When actual γ is regarded as too high, parameter a is greater than $\bar{a}$, which is given by (6.A17) in the case of actual g and c . In such a situation, the balanced-budget rule may be a useful guide for fiscal policy. From the other comparative statics, we have the following results. If β increases, namely if the marginal product of capital is increased, say, because of technological progress, the optimal investment rate is raised and the optimal deficit rate is reduced. If α increases, namely if the propensity to invest from government expenditure is raised, the optimal private investment rate is reduced; hence, the optimal deficit rate is raised. If ρ increases, namely if the rate of time preference is raised, the optimal government expenditure/GDP ratio is raised; hence, the optimal deficit rate is raised.

If n increases, namely if the rate of population growth is raised, the optimal government expenditure/GDP ratio is reduced; hence, the optimal rate is lowered. ρ and n have the same effect on the long-run equilibrium capital/labor ratio k^* . Nonetheless, ρ and n have different effects on Φ^* . If σ increases, namely if the propensity to save is raised, the optimal deficit rate is raised so as to absorb the increased saving. These results are consistent with the comparative dynamics in the prior subsection.

A4 Conclusion

A4.1 Deficits and Growth

This appendix has explored the policy implications of government deficits from the viewpoint of long-run optimal growth. A deficit plays a role in adjusting the divergence between exogenous savings and optimal private investment. Because optimal private investment may not be compatible with the current saving rate, it is necessary to control a deficit so as to realize optimal growth. The results presented here suggest that at least in certain circumstances, the balanced-budget rule may be a very useful guide for fiscal policy.

It is shown that if it is desirable to decrease the government expenditure/GDP ratio, it may also be desirable to decrease the deficit/GDP ratio during the transition. Further, our analysis suggests that the optimal deficit/GDP ratio is increased if preference changes from private consumption to public consumption. The recent fiscal reconstruction movement in Japan may be justified from the viewpoint of

long-run macro IS balance. Finally, it should be stressed that our concern here is with the structure of normative arguments on government deficits rather than with the size of optimal deficits in the real economy.

A4.2 Deficit Ceilings and Fiscal Privilege

As explained in the main text of this chapter, fiscal consolidation efforts by private agents are beneficial because they improve the overall fiscal situation. Hence, as shown in Ithori and Itaya (2001, 2004) among others, the analytical framework of the private provision of public goods is useful in order to examine the outcome of fiscal reconstruction or consolidation (see also, among others, Cornes and Sandler 1996; Velasco 2000).

It is often argued that in order to attain successful outcomes of fiscal consolidation, a good macroeconomic situation is needed since we expect positive income effects on fiscal consolidation attempts. However, good economic circumstances do not necessarily enhance the reform of reorganizing fiscal expenditures, although they could enhance fiscal reconstruction. Ithori (2015) investigated how the deficit ceiling is determined in response to income fluctuations by explicitly incorporating the opposite side of fiscal consolidation; namely, political efforts to seek fiscal privileges, which harm the fiscal situation because of their detrimental effect of raising fiscal deficits.

Assume that the government is strong in the sense that it can impose a debt limit, but that it is weak in the sense that it cannot control fiscal privileges. All interest groups can seek fiscal privileges by making political efforts. When a ceiling on fiscal deficits is employed, an increase in fiscal privileges results in a decrease in useful public goods. Hence, the interest groups may recognize the cost of political efforts and have an incentive to improve the fiscal situation by giving up fiscal privileges to some extent. Paradoxically, the combination of a worse macroeconomic situation in the present and a better macroeconomic situation in the future does not necessarily justify an increase in the deficit limit in a recession. We could justify the need for the government to conduct restrictive fiscal policy in a recession.

A4.3 Hard Budget and Soft Budget Outcomes

The political efforts of interest groups are affected by political institutions and government's behavior. Thus, it is important to formulate how the government imposes a deficit limit. With regard to a hard budget, the government imposes the deficit limit before the interest groups make decisions on the quantity of privileges. With regard to a soft budget, the government imposes the deficit limit after the interest groups make decisions on fiscal privileges. In this way, we compare the hard budget with soft budget outcomes in a political economy where the government endogenously imposes the ceiling on the size of the deficit.

A weaker deficit ceiling results in a larger amount of political effort. A larger amount of disposal income or a smaller amount of tax results in a smaller amount of political effort by the interest groups. The optimal level of the deficit ceiling is based on the intergenerational allocation of public goods.

The government may depress the political efforts for fiscal privileges by lowering the deficit limit in the hard budget scenario. With regard to the soft budget scenario, the optimal deficit ceiling increases with fiscal privileges. This positive response of the deficit limit produces the soft budget outcome in the sense that the loose ceiling stimulates the political efforts of the interest groups to obtain more privileges. It is also useful to compare the hard budget and soft budget outcomes in order to explore the welfare implications.

When the deficit ceiling is determined after the interest groups conduct political efforts in the soft budget scenario, the government's loose response directly benefits the present generation and hurts the future generation. Ihori (2014) explored the paradoxical possibility that the increased privileges could harm even the interest groups of the present generation by harming the fiscal situation. In such a paradoxical situation, the commitment to a deficit ceiling could benefit even the present generation as well as the future generation.

Questions

- 6.1 Explain the benefit and cost of the balanced-budget fiscal policy.
- 6.2 Suppose the rate of interest is 3 % and the GDP growth rate is 1 %. If the target debt/GDP ratio is 150 %, how much primary surplus is needed to attain a sustainable fiscal policy?
- 6.3 Compare the Domar condition and the Bohn condition. Which condition is more useful for restoring sustainability?

References

- Barro, R. J. (1995). *Optimal debt management* (National Bureau of Economic Research Working Paper, No. 5327).
- Bohn, H. (1995). The sustainability of budget deficits in a stochastic economy. *Journal of Money, Credit, and Banking*, 27, 257–271.
- Cass, D. (1965). Optimum growth in an aggregate model of capital accumulation. *Review of Economic Studies*, 32, 233–240.
- Cornes, R., & Sandler, T. (1996). *The theory of externalities, public goods and club goods*. New York: Cambridge University Press.
- Domar, E. D. (1944). The “burden of the debt” and the national income. *American Economic Review*, 34(4), 798–827.
- Ihori, T. (1988). Optimal deficits in a growing economy. *Journal of the Japanese and International Economies*, 2, 526–542.
- Ihori, T. (2014). Commitment, deficit ceiling, and fiscal privilege. *FinanzArchiv: Public Finance Analysis*, 70, 511–526.
- Ihori, T. (2015). Fiscal consolidation in the political economy of Japan. In T. Ihori & K. Terai (Eds.), *The political economy of fiscal consolidation in Japan* (pp. 3–33). Tokyo: Springer.
- Ihori, T., & Itaya, J. (2001). A dynamic model of fiscal reconstruction. *European Journal of Political Economy*, 17(4), 1057–1097.

- Ihori, T., & Itaya, J. (2004). Fiscal reconstruction and local government financing. *International Tax and Public Finance*, 11(1), 1–13.
- Judd, K. (1987). Debt and distortionary taxation in a simple perfect foresight model. *Journal of Monetary Economics*, 20, 51–72.
- Velasco, A. (2000). Debts and deficits with fragmented fiscal policymaking. *Journal of Public Economics*, 76, 105–125.

1 Justification of the Public Pension

1.1 The Public Pension System

The public pension plays an important role in aging developed countries, including Japan. The government collects a significant amount of contributions from the working generation and pays a great deal of benefits to the elderly generation. This chapter investigates the economic effect of the public pension and discusses desirable reforms in an aging society.

The financing methods of the public pension are twofold: the pay-as-you-go system and the fully funded system. In the fully funded system, young people save by themselves; when they are old, they receive returns and savings in order to finance their living costs. If an individual dies at an earlier age than the average, the rest of her or his saving is distributed to other people of the same generation. In this sense, risk-sharing works among those who die early and those who live for a long time within the same generation; however, the balance of the overall pensions is closed within the same generation so that there are no intergenerational transfers.

With the pay-as-you-go system, the current working generation pays pension contributions. The government transfers these to the current elderly generation as pension benefits. There are no funding assets and no intergenerational transfers. In Japan, the public pension is called the modified funded (or modified pay-as-you-go) system. This is very similar to the pay-as-you-go system but still has some funding assets.

1.2 Justification

The main role of the public pension is to provide money for living costs in later life. This function is similar to that of private savings. Moreover, private pensions are now available in the private pension market. Nevertheless, why is a public pension

necessary and mandatory? There are four plausible reasons to justify the mandatory public pension system.

1.2.1 Income Redistribution

The argument here is that the public pension is necessary because it can redistribute income among generations and/or within generations. Intragenerational transfer means that pension contributions made by those who die earlier are transferred to those who live longer as pension benefits. This redistribution may be justified if life expectancy is uncertain and people are risk averse. However, such intragenerational redistribution can also be provided by private pensions. Thus, to some extent, this particular advantage is not unique to the public pension system.

It is true that a private pension is not perfect to deal with this problem because of asymmetric information. Life expectancy is hard to anticipate, but the consumer can understand her or his personal health condition more than the private pension company. Thus, those who are very healthy tend to purchase private pensions more than those who are not so healthy. Since a private pension company cannot identify who is more healthy or not, it could offer the same contract to all participants. Then, only very healthy people would join the program; consequently, the private pension company would not make a profit. In this context, the private market may not perform well with regard to the provision of a pension program. If asymmetric information causes a serious problem, a mandatory public pension is desirable in order to share the life expectancy risk among elderly people.

It is theoretically true that the asymmetric information problem exists and that the private market cannot handle this problem well. However, this difficulty may not be so serious quantitatively. Justifying the public pension simply because of the asymmetric information issue is a weak approach.

The unique role of the public pension is intergenerational redistribution, which has a function that private pensions do not have. Some argue that this function is desirable in order to provide help among generations. However, several problems should be noted.

First, how much should different generations help each other? Is it really possible to attain a desirable degree of redistribution in the pay-as-you-go system of an aging society?

As explained later, the rate of return on a public pension can differ significantly, depending upon the population size of each generation in the pay-as-you-go system. For example, in many developed countries, including Japan, the birth rate of each generation has changed considerably. After the Second World War, we experienced a rapid increase in population; then, the population began to decline. In this regard, the rate of return is volatile. It is not good to have volatile rates of return for a public pension. In particular, in an aging society that is experiencing depopulation, the rate of return may well be negative; hence, the pay-as-you-go system is inefficient.

The pay-as-you-go system involves the redistribution of money from the young to the old. If the old are poorer than the young, such redistribution between generations could be justified from the viewpoint of intergenerational equity.

However, in recent years it is not necessarily true that the old are poorer than the young.

For example, in Japan, during the high-growth era of the 1960s, the old were generally poor compared with the young because the workers experienced wage increases every year, while elderly people did not accumulate many assets. Consequently, at this time, age was a reliable indicator of people's economic situation. Indeed, we may presuppose that elderly people were poor. However, age no longer provides reliable information about economic situations. Among old people, there are many who are rich and have significant assets, while others are poor and cannot afford to meet ordinary living costs. Further, there are many young people who cannot find good jobs and who earn relatively low incomes. Since elderly people are very heterogeneous with respect to economic and other conditions, it seems questionable to redistribute income uniformly based on age.

1.2.2 The Failure of Private Pensions

Since private pensions do not necessarily work well in response to unanticipated shocks, it may be desirable to have a public pension in order to meet living costs when elderly. In particular, many people who support the concept of a public pension emphasize the importance of preparing for unanticipated inflation. Namely, private saving is not sufficient in an inflationary economy since the real value of a nominal private asset declines because of inflation. Because a public pension scheme may impose an indexation system on pension benefits, such a scheme is safer for elderly people than private pensions.

If the deregulation of the financial market is not enhanced and the nominal rate of interest is not adjusted with inflation, such as occurred in Japan until the 1970s, then this argument is plausible to some extent. However, even in Japan, deregulation in the financial market has been enhanced since the 1980s and the rate of interest is now freely determined in the market. In this regard, the nominal rate of interest should be perfectly adjusted with the anticipated rate of inflation; thus, the real return should not necessarily decline in response to inflation. Then, private pensions can provide necessary benefits to the elderly. If inflation is unanticipated, the real value of a nominal financial asset may decline. However, unanticipated inflation cannot continue for a long time. Since a pension covers a long time, unanticipated inflation would not cause a serious problem in the long run.

1.2.3 Paternalism

If agents are myopic, they do not consider the future seriously; thus, they do not necessarily prepare well with savings for later life. They may well save too little; if so, the government should provide a public pension scheme to compensate for the lack of private savings. When people are myopic, this argument is plausible.

Since people cannot save again when elderly, non-optimal saving behavior when young harms them significantly. In order to avoid this unwanted outcome, the government should impose compulsory saving as a form of public pension. Namely, when the agent cannot re-optimize later, it is desirable for the government

to intervene in private behavior. This is called the public provision of merit goods. Public pensions may be regarded as an example of merit goods.

This is a delicate issue because it relates to the extent to which private preferences are respected. Some may argue that even if resources in later life are low, such a person may have enjoyed significant consumption when young and in good health. If this is a matter of personal preference, the government should not intervene. Alternatively, others may argue that people should save as much as possible when young in order to prepare for serious risks when old.

In reality, some persons are very poor in their old age and cannot afford to make ends meet by themselves. In the welfare state, it is politically unavoidable for the government to help them *ex post*. As a result, the government develops welfare programs to support the poor. Consequently, some free-riding people anticipate public assistance when elderly and do not save much when young. They simply enjoy a significant amount of consumption when young and save little. Then, they still enjoy a certain amount of consumption when old because of public subsidies.

Honest people who save for their old age must pay taxes in order to support free-riding people. This is not fair. Hence, the government should impose a minimum level of compulsory saving alongside the public pension system in order to eliminate the free-riding incentive.

1.2.4 The Efficiency of a Compulsory Public Pension

Some argue that a public pension has the property of increasing returns to the extent that the returns are larger than with private pensions. If so, the public pension is competitive and efficient compared with private pensions and the compulsory scheme is unnecessary.

In reality, a public pension is mostly managed by a pay-as-you-go system. In an aging society such as Japan's, the population declines and wage income does not increase a great deal. This means that the return on the public pension is low or negative for the young generation. Thus, it is difficult to justify the public pension from the viewpoint of intergenerational equity.

With regard to a funded pension, the rate of return is almost the same as with a private pension. Which pension is desirable, public or private, depends upon handling and management costs. If bureaucratic management is inefficient, the public pension could be more expensive than private pensions.

2 Economic Effect of the Public Pension

2.1 The Funded System

The issue of most concern about the economic effect of a public pension is the effect on savings in a macroeconomy. First, let us explain the impact of a funded system.

Consider a simple two-period model. In the first period, the agent is young and earns labor income. She or he saves with private assets and public pension

contributions. In the second period, the agent is old and consumes all savings after retirement. The budget constraints are given as

$$c_1 = Y_1 - s - b \text{ and} \quad (7.1)$$

$$c_2 = (1 + r)(b + s), \quad (7.2)$$

where c_1 and c_2 denote first period consumption and second period consumption respectively; Y_1 denotes the first period labor income; s means private saving; b means pension contributions; and r is the rate of interest. In the funded system, pension contributions are invested in the market and the rate of return is the same as with private savings.

In Eqs. (7.1) and (7.2), by eliminating $s + b$, the present value budget constraint is given as

$$c_1 + \frac{1}{1+r}c_2 = Y_1. \quad (7.3)$$

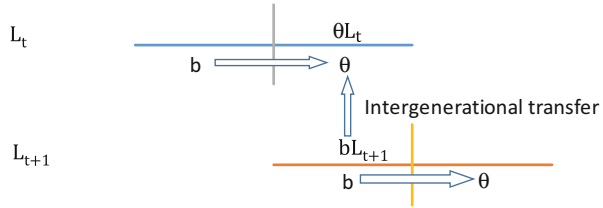
The agent maximizes its utility subject to this budget constraint, (7.3). Hence, the optimal levels of first-period consumption and second-period consumption are independent of b . In other words, the agent is only concerned with the total amount of “savings,” $b + s$. If b increases, s declines by the same amount, so that $s + b$ is fixed at the initial optimal level.

Since private saving and a funded public pension are perfect substitutes and thus indifferent for the agent, an increase in public pension contributions simply reduces private saving by the same amount. Note that the total amount of saving in a macroeconomy is given as $s + b$ because b is also invested in the capital market as a public fund. As long as $s + b$ remains constant, pension contributions do not affect aggregate saving; hence, capital accumulation does not change. Thus, in the funded system, a public pension does not reduce total savings in the economy.

2.2 The Pay-AS-You GO System

Next, we consider the pay-as-you-go system. Now we have to introduce two generations, the working generation and the retired generation, because the pay-as-you-go pension involves intergenerational transfer between young and old.

As shown in Fig. 7.1, generation t is born in period t and generation $t + 1$ is born in period $t + 1$. In period $t + 1$, generation $t + 1$ is young and generation t is old. The young generation pays a contribution and the old generation receives a benefit. The population grows at rate n . Let us use b to denote per capita pension contributions, θ for per capita pension benefits, and L_t and L_{t+1} for the population of each generation respectively. Then, the total benefit of the retired generation t in period $t + 1$ is θL_t , and the total pension contribution of the working generation $t + 1$ in period $t + 1$ is

Fig. 7.1 The pay-as-you-go system

bL_{t+1} . These two amounts must be equalized. This is the budget constraint of the pay-as-you-go system. Thus,

$$\theta L_t = bL_{t+1}. \quad (7.4)$$

From the definition of the population growth rate n , we have

$$L_t(1+n) = L_{t+1}. \quad (7.5)$$

From these two equations, we have

$$\theta = b(1+n). \quad (7.6)$$

The rate of return for the pay-as-you-go system is given by the population growth rate.

The second-period budget constraint now takes the place of Eq. (7.2).

$$c_2 = (1+r)s + (1+n)b. \quad (7.2')$$

Then, the present value budget constraint takes the place of Eq. (7.3) and is rewritten as

$$c_1 + \frac{1}{1+r}c_2 = Y_1 + \frac{n-r}{1+r}b. \quad (7.3')$$

Since public saving is zero in the pay-as-you-go system, private saving s is equal to macro saving.

Let us consider the impact of an increase in b on s . Figure 7.2 draws an indifference curve and budget line AB. The optimal point is E. The effect of a pay-as-you-go system on point E depends on how budget line AB moves in response to an increase in b .

It is useful to consider the following three cases.

(i) $n = r$

In this case, b does not appear in Eq. (7.3'). In Fig. 7.2a), when b increases, the budget line AB does not move, so the optimal point E remains fixed. Since the rate of return is the same between private saving and public saving, s and b are perfect substitutes. An increase in b would simply crowd out s by the same

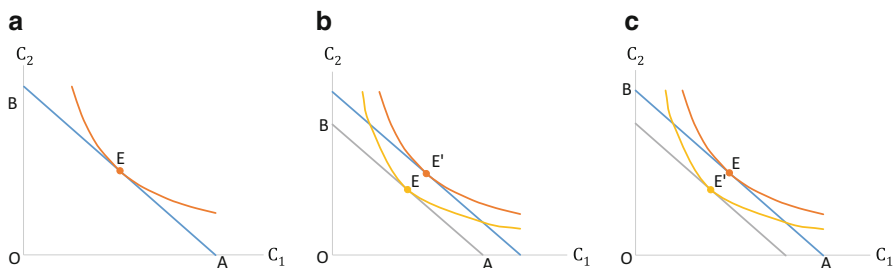


Fig. 7.2 Consumption decisions. In the case of (a) $n = r$, (b) $n > r$, (c) $n < r$

amount. At this point, the pay-as-you-go system is similar to the funded system. The important difference is that in the funded system, b is public saving used for capital accumulation, while in the pay-as-you-go system, b is simply a transfer. Since an increase in b reduces s , the saving in a macroeconomy declines here.

(ii) $n > r$

If the rate of return on a public pension (n) is greater than that of private saving (r), an increase in b enhances real effective income. The budget line AB moves upward, and the equilibrium point E moves upward and to the right at E' in Fig. 7.2b. As a result, consumption is stimulated. With regard to Eq. (7.1), c_1 increases and s declines more than an increase in b . Thus, total saving and capital accumulation are depressed by an increase in the public pension contribution, b . Although the direct impact of an increase in n benefits the present generation, its indirect impact through capital accumulation harms the future generation.

(iii) $n < r$

In this case, an increase in b reduces effective income on the right-hand side of Eq. (7.3'). The budget line AB moves downward, and the equilibrium point E moves downward and to the left at E' in Fig. 7.2c. c_1 declines, but the magnitude of reduction is smaller than the magnitude of an increase in b . This is because the second-period consumption also declines. Since $b + c_1$ increases, s declines less than an increase in b . Hence, total saving and capital accumulation are depressed by an increase in the public pension contribution, b .

To sum up, all three cases suggest that an increase in pension benefits reduces private savings, which are the same as aggregate savings. With regard to a pay-as-you-go system, the total saving in a macroeconomy also declines. In this sense, a pay-as-you-go pension harms capital accumulation and economic growth, thereby deteriorating any benefit for future generations.

However, if debt neutrality holds, public redistribution among generations is completely offset by private redistribution through bequests. Then, saving would

not be affected in a macroeconomy. Nonetheless, empirical studies have found that debt neutrality does not hold perfectly and an increase in public pension benefits depresses savings in a macroeconomy to some extent.

3 Public Debt and the Public Pension

3.1 The Funded System and Public Debt Issuance Within the Same Generation

The public pension and public debt have similar ways of conducting intergenerational redistribution. In this section, let us compare both policies. First, we assume public debt within the same generation, which has the same effect as a funded system. For simplicity, government spending is fixed throughout the analysis.

Public debt issuance implies Ricardian debt neutrality, as explained in Chap. 4. Similarly, a funded pension does not have the effect of intergenerational redistribution, as explained in Sect. 2 of this chapter. Changes in pension contributions b do not affect private consumption or welfare in either case. Thus, from the economic viewpoint, the two policies are equivalent.

Consider a two-period model of period t and period $t + 1$. With regard to a funded pension policy, the government budget is in surplus in period t , the first period, since pension contributions are invested. However, a deficit occurs in period $t + 1$, the second period, because of the payment of pension benefits.

With regard to public debt issuance, in period t the government budget is in deficit and in period $t + 1$ it is in surplus because of the raising of taxes for redemption.

Table 7.1 summarizes these outcomes. Although the two policies are economically the same, they are different with respect to the government budget balance. This suggests that information about a government deficit or surplus is not useful for judging the economic effect of public policy.

In the funded system, an increase in public contributions b reduces private saving s by the same amount, but the total macro saving does not change. With regard to public debt issuance within the same generation, the demand for public debt increases by the amount of tax reduction, but private saving s does not change. Since private saving s results in capital accumulation in the latter instance, the effect on capital accumulation is also the same between the two policies.

Table 7.1 The balance of the government budget (i)

	Period t	Period $t + 1$
Funded system	Surplus	Deficit
Bond issuance	Deficit	Surplus

3.2 Pay-AS-You-GO System and Public Debt Issuance Among Generations

Public debt issuance, which has the same effect as the pay-as-you-go system, issues debt that moves the fiscal burden to future generations. Both policies transfer income to generation t (the parents' generation) from generation $t + 1$ (the children's generation). Hence, if the sizes of the intergenerational transfers are the same, the two policies are identical.

As shown in Fig. 7.3, with regard to public debt policy, the government issues debt in period t and imposes a tax on generation $t + 1$ in period $t + 1$. Thus, the supply of debt increases. At the same time, a reduction of taxes in period t raises generation t 's disposable income and hence stimulates consumption in period t , raising the rate of interest in period t . With regard to a pay-as-you-go system, generation t anticipates a future transfer in period $t + 1$ when old and increases consumption in period t when young. Thus, the rate of interest again rises in period t .

Both policies affect the private sector and the macroeconomy in the same way because of changes in pension contributions b . However, as shown in Table 7.2, the government budget balance differs. Namely, in the pay-as-you-go system, the government budget is by definition balanced; however, with regard to public debt finance in period t , the budget is in deficit, and in period $t + 1$, the budget is in surplus. This is simply because in period t , debt is issued, and in period $t + 1$, it is redeemed. This suggests again that short-run fiscal balance does not provide any useful information on fiscal policy.

Public debt issuance among generations may be regarded as an intergenerational redistribution policy in period t from generation $t + 1$ to generation t . In other words, by using resources in period $t + 1$, the government reduces tax on generation t . Further, the fund in period t is borrowed from the bond market where generation t becomes a lender. Essentially, this debt policy has the same economic effect as the pay-as-you-go pension.

Fig. 7.3 Public debt policy

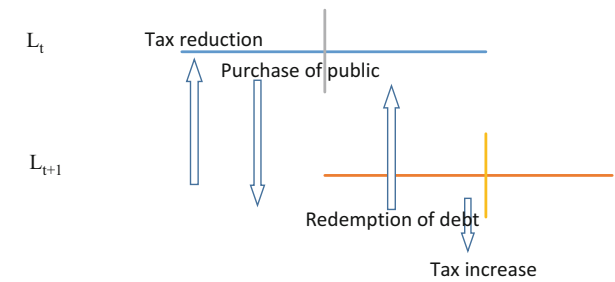


Table 7.2 The balance of the government budget (ii)

	Period t	Period $t + 1$
Pay-as-you-go system	Balanced	Balanced
Bond issuance	Deficit	Surplus

3.3 Generational Accounting

These arguments imply that information about the net life cycle burden for each generation is more important and useful than the government budget balance in each period for the purposes of investigating the economic impact of fiscal policy. From this viewpoint, Kotlikoff (1992) introduced the notion of “generational accounting,” which estimates the present value of a fiscal burden and the benefits caused by government policies for each generation.

According to generational accounting, the two policies in Sect. 3.1 are the same since there is no intergenerational transfer. In Sect. 3.2, generation t receives more than it pays, while generation $t + 1$ pays more than it receives. With respect to this intergenerational redistribution, both policies are the same. Hence, in both instances, generational accounting provides a useful indicator of fiscal policy.

Is generational accounting always effective as an indicator of fiscal policy? If public intergenerational redistribution may be offset by altruistic bequest motives, public redistribution does not have clear policy implications. Then, generational accounting also loses its policy implications. This notion is inconsistent with the extended Ricardian, namely Barro’s, debt neutrality. That is, if Barro’s neutrality is maintained, not only is a government’s budget balance meaningless as an indicator of fiscal policy, generational accounting is also useless.

If Barro’s neutrality is not maintained, we can compare notions of a government deficit and generational accounting. Generational accounting is defined in terms of stock variables, while a fiscal deficit is defined in terms of flow variables. If Ricardian debt neutrality is maintained within the same generation, generational accounting is more useful than fiscal deficit as an indicator of fiscal policy.

In order to have Ricardian neutrality, the agent behaves in a way that is subject to the present value budget constraint. The plausibility of this assumption depends upon the plausibility of a perfect capital market. In reality, because of liquidity constraint and an imperfect capital market, the agent cannot borrow easily; hence, the agent may behave in a way that is subject to the current budget constraint. In such a Keynesian situation, it is more plausible to assume that Ricardian debt neutrality is not maintained. If the Keynesian situation is more realistic, a flow indicator of fiscal deficit becomes an important fiscal indicator.

However, in the neoclassical situation, the original Ricardian neutrality is at least maintained by assumption. Liquidity constraint is not regarded as an important factor. If the agent behaves according to a long-term horizon and public intergenerational redistribution policy is important, then generational accounting gives us useful information about fiscal policy. Table 7.3 summarizes the above argument.

Table 7.3 Useful indicators of fiscal policy

Keynesian situation	Fiscal deficit
Original Ricardian	Generational accounting
Extended Ricardian (Barro’s neutrality)	Distortionary taxation

4 Public Pension Reform

4.1 The Aging Population in Japan

Japan now faces a serious problem because of longer life expectancy and lower fertility in an aging society. Using a simple theoretical framework of two-period overlapping generations, this section illustrates the potential conflicts among generations resulting from the 2004 pension reform in an aging Japan. The reform may be regarded as a gradual change from a defined-benefit (DB) system to a defined-contribution (DC) system. With regard to the pension system in Japan, see the case study of this chapter, Appendix A.

The budget constraint in the pay-as-you-go system is given as

$$L_t b_t = L_{t-1} \theta_t, \quad (7.7)$$

where L_t is the number of people in generation t , b_t is the per capita contribution when young in period t , and θ_t is the per capita benefit when old in period t . In the DC system, $b_t = \bar{b}$, while in the DB system $\theta_t = \bar{\theta}$. Here, $\bar{b}$ and $\bar{\theta}$ are exogenously given as fixed levels of contribution and benefit respectively.

The net benefit of generation t is defined as

$$\pi_t = \theta_{t+1} - b_t, \quad (7.8)$$

where, for simplicity, the discount rate is assumed to be zero.

Considering the above budget constraint, in the DB system the net benefit of generation t is written as

$$\pi_t = \left(1 - \frac{L_{t-1}}{L_t}\right) \bar{\theta}. \quad (7.9)$$

In the DC system, we have

$$\pi_t = \left(\frac{L_{t+1}}{L_t} - 1\right) \bar{b}. \quad (7.10)$$

As the time path of population size, let us assume that, from time 1 to time 6,

$$L_1 = 1, L_2 = 1, L_3 = 2, L_4 = 1, L_5 = 0.5, \text{ and } L_6 = 0.5. \quad (7.11)$$

Namely, $L = 1$ is the initial equilibrium level of population and $L = 0.5$ is the new equilibrium level of population. During the move from $L = 1$ to $L = 0.5$, the population temporarily rises. Generation 3 is a baby boom generation and, beginning with time period 5, population growth is negative. This may well reflect Japan's actual and future demographic changes after the Second World War.

4.2 The DB System

In the DB system, the pension benefit is fixed, while pension contributions are endogenously determined. Suppose $\bar{\theta} = 10$ without loss of generality. Further assume that a pay-as-you-go pension is introduced in time 2 when generation 1 is old. Then, the net benefit of each generation in the DB case is given as Table 7.4.

Alternatively, we have

$$\pi_1 = 10, \pi_2 = 0, \pi_3 = 5, \pi_4 = -10, \text{ and } \pi_5 = -10. \quad (7.12)$$

Generation 1 does not pay any contribution in time 1, but receives a benefit of 10 in time 2 when the pension is introduced. Thus, the net benefit is 10. Generation 2 pays 10 and receives 10, so that its net benefit is 0. Generation 3 baby boomers contribute 5, but receive 10 in benefits. Thus, their net benefit is 5. Generation 4 pays 20 but receives 10; consequently, its net benefit is -10 . The same applies to generation 5. Because the baby boomer population is larger than generation 2 (its parents), its contribution is the smallest among the six generations. This benefits the baby boomer generation. Generations 4 and 5 lose out because the population declines.

4.3 The Move from DB to DC

Now consider that in period 3, the system is changed from DB to DC, as happened in the 2004 reform in Japan. Then, from period 3, the pension benefit is endogenously determined, while the pension contribution is fixed. Each generation's net benefit is given in Table 7.5.

Alternatively, we have

$$\pi_1 = 10, \pi_2 = 10, \pi_3 = -5, \pi_4 = -5, \text{ and } \pi_5 = -0. \quad (7.13)$$

This situation changes the net benefits of all the generations except generation 1. Generation 2 gains because it now receives a benefit of 20 from generation 3 and pays 10. Generation 3 loses because it now receives only 5 when old and pays 10. Generation 4 pays 10 and receives 5. The net loss of generation 4 is now -5 , which

Table 7.4 Net payoff for each generation in relation to the pay-as-you-go (defined benefit) system

Generation	1	2	3	4	5
Net return	10	0	5	-10	-10

Table 7.5 The transition to a defined system in period 3

Generation	1	2	3	4	5
Net return	10	10	-5	-5	0

is smaller than in the DB system. This is because the size of the total contribution is smaller in the DC system since the population is declining and the per capita contribution is fixed.

This numerical example suggests that a change to the DC system is beneficial to the young and to future generations 4 and 5; however, they still suffer negative net benefits. As long as the pay-as-you-go system is maintained, the young and future generations lose out in an aging society with a declining population.

The 2004 pension reform in Japan has qualitatively the same policy implication because it may be regarded as a gradual change from the DB system to the DC system. Thus, it is beneficial to the young and future generations to some extent, but it cannot fully solve the problem of intergenerational inequity. See the advanced study of this chapter for a simulation analysis of pension reforms in Japan.

4.4 A Fully Funded System

Finally, let us investigate a fully funded system. Imagine that the pension is changed to a funded system in period 3. Then, we have Table 7.6.

Alternatively, we have

$$\pi_1 = 10, \pi_2 = 0, \pi_3 = -5, \pi_4 = 0, \text{ and } \pi_5 = 0. \quad (7.14)$$

In the fully funded system, changes in population do not affect the net benefit of each generation. Since the rate of interest is assumed to be zero, generation 4 pays 10 and receives 10. Thus, generation 4's net benefit becomes zero rather than being negative. Thus, it gains from the reform. So, too, does generation 5 compared with the pay-as-you-go scenario. Hence, this reform is beneficial to the young and future generations. For them, it could fully solve the problem of intergenerational inequity in an economy with a declining population.

With regard to generation 3, this generation has to take care of generation 2. Generation 3 pays 5 to generation 2 and pays 10 for its own fund accumulation. Thus, it pays 15 in total and receives 10. Its net benefit becomes -5 . This situation involves a per capita contribution of 5 because generation 2 does not accumulate assets for its old age.

Hence, this seemingly attractive reform has a serious problem in that it significantly impairs generation 3. When the public pension is moved to a funded system in period 3, generation 3 saves for its own old period and at the same time has to pay contributions to generation 2's benefits because generation 2 becomes old in period 3. This is because in period 2, when generation 2 is young, it does not save for its old age in the pay-as-you-go system. Generation 3 has to pay twice. This is called the double burden of transition from pay-as-you-go to funded systems.

Table 7.6 The transition to a funded system

Generation	1	2	3	4	5
Net return	10	0	-5	0	0

As long as generation 3 attends to generation 2's benefits, the net benefit of generation 3 is negative. With regard to generation 4, generation 3 is in the funded system from its young period; thus, generation 4 does not have to support generation 3. Consequently, an aging population does not affect the net benefit for generation 4. Future generations after generation 4 may enjoy a rate of return that is equal to the interest rate in the funded system.

From the viewpoint of generation 4, a transition to a funded system is desirable. However, from the viewpoint of generation 3, it is undesirable because generation 3's net benefit changes from positive to negative. In period 3, generation 4 does not exist. Generation 3 is young and can vote against the reform. Generation 2 is indifferent about the two systems. Thus, politically speaking, such a reform is unfeasible because generations 2 and 3 do not support it. This is a major problem of the transition. Namely, after the transition, future generations gain; however, during the transition, at least one generation loses to a significant extent.

4.5 Intergenerational Conflicts

To sum up, in an aging society, any reforms of a pay-as-you-go system produce intergenerational conflicts. With a move to a funded system, generation 3 loses simply because it suffers from "double burdens," which means that it saves both for itself and its parents in generation 2. If generation 3 does not save for its parents, its net benefit becomes zero through the transition to a funded system, which is better than a negative net benefit. But, in this situation, generation 2 loses out.

A plausible and realistic pension reform is that the pension benefit of generation 2 is partially cut. At the same time, the burden of caring for generation 2 is transferred in part to future generations and is not levied solely on generation 3. Namely, the government could issue public debt to finance part of the benefits of generation 2 and redeem the debt gradually over a long period. In order to achieve this, generations that follow generation 3 can also take care of generation 2 to some extent without feeling too great a burden. Alternatively, it is desirable to reduce the benefits of generation 2 in period 2 to a significant extent. By doing so, the burden on generation 3 is reduced. If generation 2 is relatively rich compared with generations 3, 4, and 5, this option is reasonable.

5 Privatization of the Pay-AS-You-GO System

5.1 A Simple Model

The move from a pay-as-you-go system to a funded system is equivalent to abolishing the pay-as-you-go system and moving to privatization of the public pension (see, among others, Kotlikoff 1995). Feldstein (1995) investigated the long-run effect of pension reform from this viewpoint. Although his analysis is based on a partial equilibrium model, it is useful because it incorporates the effect

of economic growth explicitly. In his model, the demographic structure is assumed to be fixed. Let us briefly explain the model.

First, consider the economic loss of introducing a pay-as-you-go system. In the two-period overlapping-generations model, a member of generation t earns wage income w_t and saves s_t in period t . When old, she or he obtains interest income and savings in period $t + 1$. r is the rate of interest, or the marginal product of capital.

Now, suppose that in period 0 the pay-as-you-go system is introduced and a pension contribution rate θ is imposed on labor income. This is transferred as a pension benefit to the elderly generation in period 0. Denote by n the population growth rate and by g the wage growth rate. Then, the pension contribution by the young generation in period 1 is given as $\theta w_0(1 + n)(1 + g) = \theta w_0(1 + \gamma)$. Hence, the rate of return on this pension γ for generation 0 is defined by $1 + \gamma = (1 + n)(1 + g)$.

Let us assume that with the introduction of the pay-as-you-go system, private saving declines at the same amount as the pension contribution. Then, generation 0's old period income at $t = 1$ reduces by the amount of $(r - \gamma)\theta w_0$. This value is discounted at $t = 0$ as $(1 + r)^{-1}(r - \gamma)\theta w_0$.

If the initial population is normalized to 1, the economic loss of generation t is given as

$$\begin{aligned} (1 + r)^{-1}(r - \gamma)\theta w_0(1 + g)^t(1 + n)^t &= (1 + r)^{-1}(r - \gamma)\theta w_0(1 + \gamma)^t \\ &= (1 + r)^{-1}(r - \gamma)T_0(1 + \gamma)^t, \end{aligned} \quad (7.15)$$

where $T_0 = w_0\theta$ means the size of pension benefit to the initial old generation in period 0. If the discount rate for the welfare of generations is δ , the present value of economic loss of all generations after generation 0 may be expressed as

$$\begin{aligned} \text{PVL} &= (1 + r)^{-1}(r - \gamma)T_0 \sum_0 [(1 + \gamma)^t / (1 + \delta)^t] \\ &= [(1 + \delta) / (1 + r)] [(r - \gamma) / (\delta - \gamma)] T_0. \end{aligned} \quad (7.16)$$

If the economy is on the golden rule growth path ($r = \gamma$), this value goes to zero. However, it is plausible to assume $r > \gamma$. If $\delta = r$, then we find $\text{PVL} = T_0$; hence, the loss of future generations equals the gain of the initial old generation. However, if $\delta < r$, then $\text{PVL} > T_0$. In such an instance, an introduction of a pay-as-you-go system harms future generations more than it benefits the initial old generation.

5.2 The Gain in Economic Welfare Through Privatization

The move from a pay-as-you-go system to a funded system is the same as the move to a private pension system in a macroeconomic sense. During the transition, public debt is issued. Then, the burden of debt is moved to future generations. If the burden of debt is greater than the benefit of privatization, future generations lose by the move. From now on, let us compare the burden of debt and the benefit of privatization.

Table 7.7 Costs and benefits of each generation

		t = 0	t = 1	t = 2
Pay-as-you-go system	Old generation (benefit)	$+T_0$	$+T_0(1+\gamma)$	$+T_0(1+\gamma)^2$
	Young generation (cost)	$-T_0$	$-T_0(1+\gamma)$	$-T_0(1+\gamma)^2$
	Net benefit	0	0	0
Privatization	Old generation (benefit)	$+T_0$	$+T_0(1+r)$	$+T_0(1+\gamma)(1+r)$
	Young generation (cost)	$-T_0$	$-T_0(1+\gamma)$	$-T_0(1+\gamma)^2$
	Interest payment		$-rT_0$	$-rT_0$
	Net benefit	0	$-\gamma T_0$	$[(1+\gamma)(r-\gamma)r]T_0$

We may assume that by privatizing the public pension, the government issues public debt by the amount of T_0 . Suppose, for simplicity, that the burden of debt is equally shared by future generations. Then, each generation pays rT_0 as the interest payment for the debt. This policy means that the outstanding public debt is fixed at the level of T_0 . In this situation, the costs and benefits of each generation are summarized as follows in Table 7.7.

With regard to a pay-as-you-go system, intergenerational transfer increases by the rate of γ . However, the costs and benefits are balanced in each period and a pension fund is not accumulated. With regard to privatization, old period income grows at the rate of r after period $t = 1$. By assumption, the private pension scheme (private saving) is the same as pension contributions in the pay-as-you-go system. Moreover, we have to consider the interest payment, $-rT_0$, in each period. The net benefit is calculated by subtracting this interest payment. If the present value of this balance is positive, privatization benefits future generations.

The present value of the net benefit of privatization is given as

$$\begin{aligned} \text{PVG} &= \sum_{t=1}^{\infty} (r - \gamma)T_0(1 + \gamma)^{t-1}(1 + \delta)^{-t} - \sum_{t=1}^{\infty} rT_0(1 + \delta)^{-t} \\ &= [(r - \gamma)/(\delta - \gamma) - r/\delta]T_0. \end{aligned} \quad (7.17)$$

Thus, PVG becomes positive if $r > \gamma$ (the rate of return on private capital is greater than the rate of return on the pay-as-you-go pension) and $\gamma > 0$ (economic growth rate is positive). In other words, the privatization of the public pension benefits future generations only if the economy grows. Feldstein (1995) pointed out that in reality these conditions are likely to hold; hence, privatization of the public pension benefits future generations to a significant extent.

However, as shown in Table 7.7, in period 1 of the transition, the net balance becomes negative. Even if privatization means an issuance of public debt in period 1, this move harms generation 1 to some extent. As long as labor supply is exogenously fixed, we may not obtain a Pareto-improved form of privatization whereby all generations gain.

Appendix A: Intergenerational Conflict in an Aging Japan

A1 Introduction

The benefits and burdens of social security continue to increase their roles in Japan’s economy because of the aging population, low birthrate, and the spread of nuclear families. We focus on the two major components of social security: pensions and medical care. The benefits are financed by social security premiums, taxes, and income from the investment of public pension reserves.

Benefits now total 120 trillion yen (23.5 % of GDP) in 2015 and are projected to rise to 149 trillion yen (24.4 % of GDP) in 2025. The government’s projections of social security expenditures are shown in Tables 7.A1 and 7.A2.

Japan has social security programs specifically for the “elderly” (also called the “aged”). In this case study, we first describe the social security system and then discuss reform of the current pay-as-you-go system.

A2 Medical Insurance

A2.1 Japan’s Health Care System

Medical care in Japan is provided through a universal health care system. By definition, the system includes all Japanese citizens and those working in Japan who are not citizens. Participation is compulsory. Universal coverage was established in 1961. The system covers sickness, injury, death (funeral benefit), pregnancy, and childbirth, but does not cover dental surgery, cosmetic surgery, hair removal, vaccinations, health examinations, and high-tech treatment (such as heart transplants).

The system is composed of a number of plans. At the most general level, working status or age determines which of the plans is applicable to an individual. Although the system is universal, the actual insurer (plan provider) can be either a government body or a private entity.

Table 7.A1 Trends and projections for social security benefits (percentage of GDP)

	2012	2015	2025
Pension (%)	11.2	11.0	9.9
Medical care (%)	7.3	7.8	8.8
Long-term care (%)	1.8	2.1	2.7
Others (%)	2.5	2.6	3.0
Total (%)	22.8	23.5	24.4

Notes: These figures include the benefits of unemployment insurance, workers’ compensation insurance, and public assistance (which is similar to Supplemental Security Income in the United States)

Source: http://www5.cao.go.jp/keizai-shimon/kaigi/special/future/0421/shiryou_03.pdf

Table 7.A2 Trends and projections for social security benefits (in trillion Yen)

	2012	2015	2020	2025
Pension	53.8	56.5	58.5	60.4
Medical care	35.1	39.5	46.9	54.0
Long-term care	8.4	10.5	14.9	19.8
Others	12.2	13.3	14.1	14.7
Total	109.5	119.8	134.4	148.9

Notes: As Table 7.A1

Source: As Table 7.A1

Note that the National Health Insurance (NHI) Plan is administered by municipal governments. So, also, are the plans covering retirees. NHI is financed by government subsidy and premiums.

Further, it is important to note that most care is provided by private practitioners in private facilities. In other words, the system is not like the National Health Service in the United Kingdom, where most doctors work directly for the government. In addition, the Japanese system provides free access to medical services for all patients. Namely, this is a system in which all patients can freely choose a hospital.

A2.2 The Retired and Elderly

Those covered by occupation-based insurance while working are included in the NHI scheme from when they retire until they become “elderly” (over 75). The benefits for such retirees are financed by premiums paid by the retirees themselves, funds from central government and local governments, and the transfer of contributions from the retirees’ former occupation-based programs.

Until fiscal 2007, benefits for the elderly were provided by plans operated by each municipality. Benefit payers (the municipalities) to medical service providers (hospitals, clinics, etc.) were separate from the insurers. Benefits were financed by payments from whichever of the programs an individual was in when younger, and funds from central government and local governments. In addition, the elderly paid premiums to the insurers with which they were enrolled.

Because most of the elderly were retirees, they were in the NHI Plan. Hence, some insurers within the NHI, especially those in rural areas where the elderly made up a relatively large percentage of the insurers’ enrollees, were forced to levy higher premiums. This disparity among insurers became wider with the aging of the population.

In order to address this issue, in fiscal 2008, the Medical Insurance System for the Elderly was introduced as an independent social insurance system for those aged 75 and over. In this system, earnings-related premiums are levied on the insured. In order to enroll, a participant has to withdraw from the NHI or any employee health insurance plan. Extended association with the Medical Insurance System for the Elderly is organized by municipalities and prefectures, which act as insurers (levying premiums) and benefit payers.

Insured persons in this system pay 10 % of the cost of medical treatment as a copayment. The remaining 90 % is divided into three parts: 50 % is paid by the government (financed by taxes or debt issuance), 40 % by the health insurance program the individual was in when younger, and 10 % by premiums paid by plan participants.

One of the aims of introducing the system is to shrink the geographic disparity in National Health Insurance premiums. The scheme is also intended to alleviate the financial burden that medical care can place on the elderly.

A2.3 Issues of Medical Insurance

Although Japan's expenditure on medical care is not high by international standards, there are further problems that need to be resolved. One major issue is the increasing medical expenses that come with an aging population. We examine the economic impact of increasing medical expenses using simulation studies later in the advanced study of this chapter. In addition, there is both a shortage and a severe misallocation of physicians. The misallocation applies to where doctors practice (their workplaces) and to their diagnostic and treatment specialties.

Hospital-employed physicians seem to be in short supply. In particular, there is a severe shortage of obstetricians and pediatricians. The number of births declined significantly from the 1973 echo peak of the late 1940s baby boom through the 1980s, and then settled at a low level. Thus, a decline in specialists working with babies and children is appropriate; however, the fall in numbers has been even greater than required.

However, a remedy is not simple. For example, Japan cannot easily accept foreign physicians because of the language barrier. Moreover, just increasing the number of physicians or the quota of medical school students would not solve the problem because of workplace misallocation, which relates to the division of physicians between hospitals and clinics.

In Japan, a hospital is defined as a medical facility that has an inpatient facility with 20 or more beds. A clinic has no inpatient facilities, or an inpatient facility with fewer than 20 beds. Most clinics are managed by self-employed physicians.

Under the fee structure set by central government, clinics receive more than hospitals for the same medical treatment. This reflects political pressure from the Japanese Medical Association, where self-employed physicians have a majority and are one of the most influential interest groups in Japan. In addition, the Ministry of Health, Labor, and Welfare (MHLW) looks to clinics as reliable providers of community-based health care, and in effect is intentionally subsidizing them for this purpose.

Clinics do not have enough first-aid facilities or sophisticated equipment to accept many patients. Moreover, because patients believe the quality of care is better, most patients prefer to go to hospitals. Further, seriously ill patients can be accepted only by hospitals. Thus, physicians in hospitals become very busy. Hospital-employed physicians have less control over their hours and working conditions than self-employed physicians, and earn less.

Because the fee structure favors clinics, the hourly income of hospital-based doctors is usually lower than that of self-employed (clinic-based) physicians. As a result, the number of clinics has been increasing and the number of hospitals decreasing since the 1990s. Currently, about one-third of all physicians and nurses work in clinics rather than in hospitals.

A3 The Pension System

A3.1 Japan’s Public Pension System

Japan’s public pension system is based on work status and age. There is a basic pension program covering essentially everyone, and an additional program for employees. The programs have survivor and disability benefits. Figure 7.A1 provides overviews. Each system has its own contribution and benefit structure, but both operate primarily as pay-as-you-go systems. Strictly speaking, the systems are not “pure” pay-as-you-go: the public pension system has reserves to pay future benefits to members of the postwar baby-boom generation.

The National Pension (NP: *kokumin nenkin*)—the basic national pension—is flat rate, which means that the monthly contribution is (generally) the same for all participants. The exceptions are adjustments for those with a low income and the

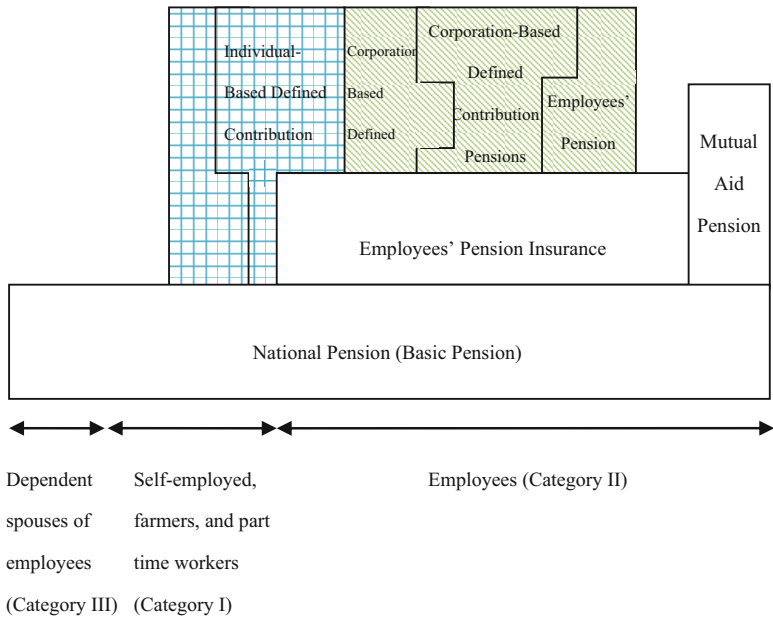


Fig. 7.A1 Structure of the pension system (*Notes: White areas are public pensions. Shaded areas are corporate pensions with preferential tax treatment. Cross-stripe areas are additional pensions with preferential tax treatment available to individuals. Personal pension plans provided by private insurance companies are not included.*)

disabled. Also, non-working students can postpone contributing. It is mandatory for all citizens to enroll in the basic national pension from age 20. Category II (employee) schemes, including Employees' Pension Insurance (EPI: *kosei nenkin hoken*), are earnings-related. In 2016, the Mutual Aid Pension of civil servants was integrated into the EPI.

Benefits under the NP begin at age 65. In order to receive any benefit, a person must have been in the system for at least 25 years. Someone who has been in the system for 40 years qualifies for full benefit. Those in the system for shorter periods, as well as those who postponed payments (contributions) or paid reduced rates, receive less than the full benefit.

EPI benefits are based on career-average monthly earnings, calculated over the employee's entire period of coverage, adjusted by a wage-index factor, and converted to a current-earnings level. This replaced 60 % of the average monthly earnings of previously active male workers. The percentage is called the replacement rate.

In addition to the public pension schemes, there are corporate pension plans. These are available to many Category II insured people. For example, there are Employees' Pension Funds with the private pension characteristic of accumulation, which provides a way to ensure better benefits for employees.

With a defined-contribution pension, the contributions are clearly specified for each employee and benefits are determined based on the sum of the contributions and investment income. Defined-benefit corporate pensions have not been adopted by many small and medium companies or self-employed persons.

The transfer of pension assets when changing jobs has not been assured, which has complicated measures in response to movements in labor demand. In order to cope with these problems, a Guaranteed Contribution-Based Pension rule was introduced in October 2001.

For the self-employed, farmers, and other Category I insured people, there is a National Pension Fund, which is a second-tier pension in Fig. 7.A1. The plan is voluntary. A participant pays an additional amount each month and, on retirement, receives a benefit in addition to her or his basic pension. The added benefit is a function of how many months a person paid into the fund.

The levels of public pension benefits are indexed to the Consumer Price Index in order to maintain the benefits' real values. In addition, the amounts are adjusted at least once every 5 years to reflect changes in actuarial factors.

The current arrangement is considered to have an unstable financial base. The system cannot ensure long-term stability because of its inability to cope with the changing employment and industry structures in an aging society. In addition, there are inequalities in benefits and the burden among and within the three categories of those who are insured.

A3.2 Pension Reform in an Aging Japan

Until the 1980s, Japan's population was relatively young and although the Japanese enjoyed significant longevity by world standards, public pension programs needed to cover relatively few people. However, demographic and economic factors have

imposed greater stress on the programs (see Takayama 1998; Hatta and Oguchi 1997, 1999; and Oshio 2002).

Substantial increases in the contribution rate of the EPI (and NP) are required to support currently legislated benefits, assuming that the normal retirement age (which was 60 and is being increased to 65) and benefits remain unchanged.

The existence of a reserve could mitigate future financial difficulties for the EPI. From the beginning, EPI contributions have been accumulated in a reserve that has been invested in government bonds issued for public works projects. However, these reserves have begun to diminish, and may disappear in the late twenty-first century, unless contributions are raised further. The current reserve no longer provides a substantial cushion for the EPI.

Japan has experienced progressive aging, a trend that is set to continue for a long time. Such aging reflects fertility rates that are below the replacement level and the trend of continually increasing longevity. Thus, if actual benefits are to be maintained, premiums must be raised.

A3.3 Outline of the 2004 Pension Plan Revision

Faced with these difficulties, Japan drastically reformed its pension system in 2004. The reform has three basic aspects.

First, the portion of the basic pension funded from the tax revenues of the general account of the central government was raised incrementally from one-third to one-half, beginning in fiscal 2004 and ending in fiscal 2009. Second, a freeze on increasing employee and national pension premiums was ended. Third, issues regarding women and pensions were addressed. Let us explain the reform in more detail.

At least once every 5 years, reviews of the system's finances with a 100-year horizon will be carried out. Before the 2004 revision, the "whole-future-balancing method" was adopted for pension finance. This meant that the reserve for public pensions was maintained at a level that looked at a continually updated 100-year period in order to balance benefits and contributions into the indefinite future. In the 2004 revision, it was decided that the pension reserve should reduce further in order to reduce the disparities in benefits and burdens among generations.

With reform, the whole-future-balancing method was replaced with the "closed-period-balancing method." With this method, the pension reserve is managed with a view to balancing it over a finite but long period of time. The target level of the reserve is set so as to maintain about one year's worth of benefit expenditures for 95 years ahead. The reserve is funded at a level that should allow the payment of benefits for 95 years into the future, given current benefit levels and various assumptions regarding future contributions and fund earnings.

Second, Employees' Pension contributions are being raised by 0.354 percentage points each year from October 2004 until fiscal 2017, when they will reach 18.3 % of employees' incomes. Their level will then be fixed at 18.3 %.

Third, the monthly benefit of the National Pension is being raised 280 yen each year, beginning in April 2005 and reaching 16,900 yen in fiscal 2017. Thereafter,

the benefit level will be automatically adjusted to keep benefits within the scheme's income.

The adjustment of benefits is to reflect the increased capability of society as a whole to contribute. This is called "macroeconomic indexation." Comparing the benchmark scenario with this revision, if the average growth in the number of total insured persons paying into the public pension scheme declines, and there is an increase in benefits as a result of longer-than-expected average life expectancy, benefits will decrease.

More precisely, demographically modified indexation is defined as the inflation rate minus an adjustment rate. The adjustment is expected by the government to be about 0.9 % per year. The actual level is based on the growth rate of total insured persons in the public pension scheme and the increase in benefits attributable to longer average life expectancy. Benefits will be adjusted using this demographically modified indexation. However, the formula will not be applied when demographically modified indexation is less than zero; for instance, when consumption prices and wages fall.

The nominal amount will be at the lower end of the possible adjustment. Basic support for a standard household will be approximately 50 % of the average income of the active generation. More specifically, income substitution will be 50.2 % in a standard model pension (including a couple's basic pension) from 2023 on.

A3.4 Is the 2004 Reform Effective?

Thus, the 2004 pension reform may be regarded as a gradual move from a defined benefit system to a defined contribution system. If this reform is perfectly conducted, it will certainly restrict the increasing trend of pension benefits. Indeed, the official projection confirms this, as shown in Table 7.A1. The pension benefit/GDP ratio will decline from 11.2 % in 2012 to 9.9 % in 2025. However, since this reform harms elderly people significantly, it is not necessarily certain that it will actually occur in the 2020s in a political economy. Elderly people will resist a decline in pension benefits in any circumstance. A more realistic scenario is that pension benefits will not decline as the 2004 reform projects. Namely, the government may use subsidies in order to avoid huge declines in pension benefits.

Based on this understanding, we investigate the situation whereby the 2004 reform is not effectively pursued in the 2020s in the simulation analysis given below.

Appendix B: Simulation Analysis in an Aging Japan

B1 Introduction

Japan is an aging society, so it is important to control the increasing level of social-welfare expenditures in order to attain and sustain long-term fiscal balance in the government's budget.

This advanced study examines the macroeconomic effects of fiscal and social security reforms on economic growth and intergenerational welfare in Japan, based on Ihori et al. (2005, 2011). The existing public health insurance and public pension schemes receive particular attention in the analysis. This is because payments from these programs, especially medical expenditures and the public pension, will increase rapidly in an aging Japan.

B2 The Model

The model employs multi-period overlapping-generations growth, developed by Auerbach and Kotlikoff (1983). The economy consists of household, firm, and government sectors. For simplicity, we assume that there is only one good.

Each household has a limited life expectancy, but its length is assumed to be uncertain. Namely, a household has a certain percentage chance of death in each period. A household earns a wage, obtains its utility from consumption, and is assumed to optimize its intertemporal consumption through its lifetime, taking the wage rate, the interest rate of savings, and its own survival rate as given. The tax system, the public pension scheme, and the public health insurance scheme are also assumed to be taken as given for the household sector. A household obtains its wage by supplying its labor inelastically until it retires; and once it retires, it never returns to the labor market. There are no altruistic bequest motives and Ricardian equivalence does not hold.

The firm is assumed to maximize profits, taking the wage rate and the interest rate as given. The wage rate and the interest rate are determined in each factor market with their equilibrium conditions.

Taxes, a public pension scheme, and a public health insurance scheme that reflect existing Japanese arrangements are incorporated in the model. The government sector collects taxes from the household. It also issues government bonds to finance its consumption and its transfers to a social security system. The government sector runs a pay-as-you-go public pension scheme and a public health insurance scheme. The government also accumulates a public pension fund from the contributions collected from working generations.

There is no private life insurance; thus, there is no mechanism for a household to hedge its risk of dying in any period. This risk means that a household has too few savings to consume goods sufficiently if it lives longer unexpectedly. Because a household does not have any bequest motives, a household leaves an accidental bequest in each period when it dies. There is certainty in the whole economy in terms of the population of each generation; thus, there is certainty about the total (aggregate) amount of bequests inherited in each period.

B3 Simulation Analysis in Ihori et al. (2005)

First, we explain the simulation results in Ihori et al. (2005). In order to make our simulation analysis as close to real circumstances as possible, obtainable and forecasted data have been used with estimated values of relevant parameters from empirical research. There are five key elements relevant to this simulation: demography, a government deficits policy, a public pension scheme, a medical health insurance scheme, and taxes.

B3.1 Demography

Actual data have been used from 1965 to 2000. Before 1965, population data was calculated backward from the 1965 population data under the assumption that the fertility rate and the mortality rate were the same as those of 1965. For the future population, the official estimation by the National Institute of Population and Social Security Research (NIPSSR) (2002) is used, and survival rates are taken from the NIPSSR life tables (kanzen seimeihyo). NIPSSR projects population only to 2100. For subsequent years, the number of births and deaths, and the survival rates, are fixed at the same levels as those in 2100. Figure 7.B1 shows aging rates based on three different scenarios in NIPSSR (2002). In our benchmark simulation, NIPSSR's medium variant estimation has been used.

B3.2 Government Deficits

Actual data from the System of National Accounts (SNA) are used through 2002, these being the latest data available at the time of writing. The actual growth rate of outstanding government debt was 6.57 % in 2002. From 2003, government debt has been calculated based on the following assumptions. Until 2013, the growth rate of outstanding government debt is maintained at 0.5 %, decreasing from 6.57 %. From 2014, the growth rate decreases at 0.1 % through 2023. From 2024, the ratio of outstanding government debt to GDP is assumed to be constant.

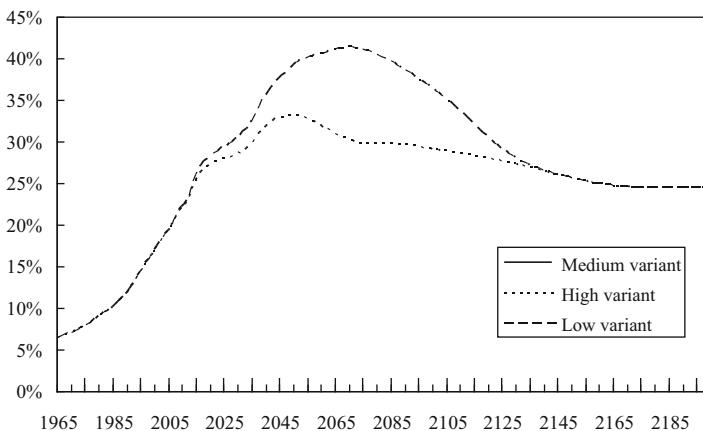


Fig. 7.B1 Aging rates (Source: NIPSSR 2002)

Under these assumptions, the ratio converges to a new steady-state level of 176 %, which is the benchmark case shown in Table 7.B1. The actual gross level of the GDP ratio in 2002 is 114.30 %.

B3.3 The Social Security System

Actual data have been used until 2002. From 2003, the total amount contributed to social security is assumed to be used to finance both schemes. In the actual system, the public pension contribution (the long-term contribution) and the public health insurance contribution (the short-term contribution) are typically collected together as the social insurance contribution. The contribution rate is assumed in order to satisfy the budget constraint, where the target level of the pension fund is exogenously given. The replacement rate was calculated from the SNA, and actual values are used until 2002. From 2003, the ratio is assumed to be fixed at the same rate of that in 2002, which is 54 %.

An aging population affects the endogenous determination of the contribution rate through two channels. One is the defined-benefit public pension scheme. If the current scheme does not change in the future, then an aging population will have to increase the contribution rate in order to maintain the same amount of per capita benefits in the future. The other channel is through public health insurance.

It is assumed that the public pension scheme is maintained at the same level as that of 2002 in the benchmark case in the sense that the scheme provides the same level of per capita benefits in the future. In terms of the amount of a public pension fund, actual data are used until 2002. From 2003, the amount of the fund is assumed to be fixed at the same level as in 2002 in the benchmark case. As explained in the case study of this chapter, it seems more plausible to assume that the 2004 reform will not occur in the 2020s. Thus, in the benchmark case we assume that the per capita benefits will be fixed in the defined-benefit system in the future. Additionally, the effect of the public pension reform in 2004 on the defined-contribution system is investigated below.

Through 2002, actual per capita benefits at each age were calculated. These show a U-shaped profile on age. From 2003, it is assumed that the U-shaped pattern does not change. However, because of an aging population, the ratio of public health insurance benefits to GDP increases gradually.

B3.4 Taxes

Except for a consumption tax, all other taxes (a labor income tax, an interest income tax, and an inheritance tax) are assumed fixed at the 2002 levels. A consumption tax is the only indirect tax in this simulation, but the actual tax system has a number of indirect taxes. In order to account for these other taxes, the consumption tax rate in this simulation is computed based on the total amount of all indirect tax revenues in the SNA. As a result, the consumption tax rate calculated here does not coincide with the actual consumption tax rate. It is higher because it includes the other indirect taxes.

Table 7.B1 Base simulation results

Year	GDP growth rate (<i>n</i>)	Interest rate (<i>r</i>)	<i>n</i> − <i>r</i>	Bond outstanding	Primary balance	Public pension benefit	Health insurance benefit	Tax burden	Social security burden	Social security contribution rate
				Percentage of GDP						
Actual	2002	0.05 %		114 %	−8.48 %	7.75 %	5.89 %	15.62 %	9.69 %	18.57 %
Simulation results	2003	0.73 %	−3.20 %	121 %	−3.30 %	10.16 %	5.06 %	21.14 %	9.65 %	15.12 %
	2005	0.40 %	−3.19 %	134 %	−2.43 %	10.73 %	5.21 %	22.21 %	10.18 %	15.94 %
	2010	0.04 %	−2.85 %	160 %	0.43 %	12.53 %	5.67 %	25.70 %	11.95 %	18.71 %
	2015	−0.60 %	−2.89 %	171 %	3.46 %	15.20 %	6.21 %	29.62 %	14.24 %	22.30 %
	2020	−0.57 %	−2.63 %	175 %	4.63 %	16.74 %	6.70 %	31.35 %	15.82 %	24.78 %
	2025	−0.73 %	−2.68 %	175 %	4.72 %	17.42 %	7.14 %	31.75 %	16.60 %	26.01 %
	2030	−1.11 %	−2.93 %	175 %	5.19 %	18.37 %	7.62 %	32.62 %	17.53 %	27.45 %
	2035	−1.42 %	−3.12 %	175 %	5.55 %	19.87 %	8.16 %	33.54 %	18.91 %	29.62 %
	2040	−1.59 %	−3.22 %	175 %	5.72 %	22.35 %	8.66 %	34.54 %	21.02 %	32.93 %
	2045	−1.49 %	−3.26 %	175 %	5.78 %	23.85 %	9.12 %	35.15 %	22.42 %	35.13 %
	2050	−1.46 %	−3.49 %	175 %	6.20 %	24.68 %	9.59 %	35.93 %	23.27 %	36.44 %

Note: The social security contribution rate is defined as the ratio of the total amount of social security contributions to the total amount of wage income

B3.5 Technological Progress

Technological progress in private production plays a very important role in economic growth. Thus, very careful attention should be paid to assumptions regarding technological progress. Technological progress here is calculated as the Solow residual. Average annual growth between 1983 and 1992 was 0.1%; between 1993 and 2002, it was -0.5%. In our benchmark simulations, technological progress from 2003 is assumed to be zero in order to reflect the reality of the two preceding decades.

B3.6 Simulation Results

The GDP growth rate in our simulation turns negative because of the decrease in the labor force and the zero rate of technological progress. This differs from Broda and Weinstein (2004), who assume positive GDP growth rates. With negative GDP growth, the rate gap can be bigger than 4%, as shown in the last column of Table 7.B1.

Tax burdens will increase to almost 36% in 2050 because of the large gap between the GDP growth rate and the interest rate. The gap results in high tax burdens to finance interest payments on outstanding government debts, even though the government tries to make the primary balance positive from 2010. In the benchmark case, it is assumed that the primary balance is positive by 2010.

The difference in the value of the tax burden between the actual burden and the simulated burden can be explained by the difficulty of achieving a positive primary balance by 2010 with the current tax level.

The trend for the ratio of public pension benefits to GDP, and the ratio of public health insurance benefits to GDP, to increase can be explained by an aging population. The social security burden increases to 23.27% in 2050 if the current system is maintained.

The simulation result of an increasing trend in public health insurance benefits is also consistent with empirical research. Such benefits are expected to increase their share of GDP by almost 1 percentage point every 10 years, so that the ratio of public health insurance benefits to GDP will be approximately 9.6% in 2050.

This simulation means that if the government wants to have a positive primary balance in the near future, the future burden will be high, implying that the current financial situation facing the Japanese government in terms of intergenerational conflicts is severe. If the government postpones the start of the reduction of its outstanding debt, the situation will be worse because of the greater interest payments needed to service the significant amount of outstanding debt.

Because of the large gap between the GDP growth rate and the interest rate, and because of an aging population, the national burden measured against GDP will increase to approximately 59% in 2050 in this benchmark case.

An increase in the contribution rate results in a decrease in disposal income. Thus, a rapid increase in the future contribution rate places a greater burden on future generations if the current modified pay-as-you-go public pension scheme

continues. Future generations will be less prosperous because of the increase in the contribution rate.

If an increase in the consumption tax rate induces an increase in private savings, the increase in the consumption tax to finance interest payments incurred by outstanding government debt results in higher GDP in the future; thus, future generations will be better off. Further, an increase in interest payments incurred by outstanding government debt implies an increase in interest income. In addition, an increase in the consumption tax necessarily results in a decrease in disposal income.

Two different scenarios in terms of future outstanding government debt have been studied in Ihori et al. (2005): “high-debt” and “low-debt” scenarios. The high-debt scenario corresponds to a weak consolidation scenario in the sense that the primary balance does not become positive until 2022, and outstanding government debt has a gross value of 450 % of GDP in the final steady state. In the low-debt (strong consolidation) scenario, outstanding government debt is paid back at a relatively early stage. As a result, the primary balance becomes positive in 2006 in this scenario and the steady-state level of outstanding government debt is 150 % of GDP (incidentally, the actual primary balance was negative in 2006). The final level of the outstanding government debt ratio in a steady state differs depending upon when the primary balance becomes positive.

With a weak consolidation policy, the future tax burden is higher than in the benchmark case and the tax burden increases to more than 50 %. Under a strong consolidation policy, the burden is higher than the benchmark case until around 2020, but the lowest burden is achieved eventually. A weak consolidation policy is not preferable for future generations because such a policy postpones the burden and places it on them. However, a strong consolidation policy is not preferable for the current generation because it has to carry the burden by paying relatively high taxes.

As explained before, in 2004 the public pension scheme was reformed. The main feature of the reform was to impose a ceiling on the contribution rate in the near future. Thus, instead of maintaining the per capita amount of future benefits, the per capita amount of future contributions is maintained after some further increases. The contribution rate is increased until 2017; however, after this, the rate is fixed at the 2017 level and the per capita amount of benefits is adjusted.

In our benchmark simulation, the amount of per capita benefits is assumed to be fixed at the 2002 level in the future; however, the total amount of benefits increases as the population ages.

Finally, in order to investigate the effect of the 2004 reform, the replacement rate is used as a control variable to maintain the future level of the contribution rate. According to our simulation, in 2050 the reform is shown to have successfully reduced the expected social security burden ratio from 23.27 to 15.02 %.

B4 Simulation Analysis in Ihori et al. (2011)

B4.1 Assumptions

Our second simulation (2011) uses more recent data. Since the *Projection of the Future Population in Japan* only gives estimates of the future population until 2105, it is assumed that the number of births and deaths, and the survival rates after 2105, are fixed at the same levels as those in 2105.

With regard to medical costs as a function of age, from 2008, the future sequence of government deficits is given based on the following assumptions. Since the average growth rate of the ratio of government debts to GDP (the debt/GDP ratio) between 1998 and 2007 was calculated to be 5 %, the growth rate of the debt/GDP ratio in 2008 is assumed to be 5 %. Further, the growth rate of the debt/GDP ratio from 2009 is assumed to decrease by 0.5 % every year.

This implies that the annual growth rate of the debt/GDP ratio from 2009 is given as 4.5 %, 4.0 %, 3.5 %, and so on. Then, it is assumed that the growth rate of the debt/GDP ratio continues to decrease until 2019 and also that the growth rate of the ratio becomes zero after 2019. This implies that the debt/GDP ratio remains constant after 2019 and that the constant debt/GDP ratio is 150 %.

From 2008, the U-shaped pattern of 2007 is assumed to continue. The growth rate of per capita national medical expenditure is assumed to be the same as that of technological progress in production. The copayment rate is assumed as 20 % for those aged 20–69, 10 % for those aged 70–74, and 5 % for those aged more than 75. Note that the actual copayment rate in recent years at the aggregate level is calculated to be approximately 14 % on average.

Except for a consumption tax, all taxes (a labor income tax, an interest income tax, and an inheritance tax) are assumed to be fixed at the 2007 rates. In contrast to the earlier simulation (2005), the value of technological progress from 2008 is assumed to be 1 % in this simulation.

B4.2 Simulation Results

With the assumptions indicated above, the benchmark result is shown in Table 7.B2, where actual values for 2005 are also presented. Note that the benchmark values for the ratio of public pension benefits to GDP and the ratio of public health insurance benefits to GDP are close to the actual values for 2007. The benchmark case forecasts that by 2050, the social security burden ratio will more than double compared with 2005. Our benchmark case shows that public health insurance benefits will increase by 1 % every 10 years.

Our simulation reports the following results. First, increasing the copayment rate, one of the most prominent changes in the reform, will improve economic growth and welfare by encouraging private saving. However, the magnitude of the effect on economic growth is not large: 0.0 % and 0.01 % in 2050 depending upon the change in the copayment rate, and 0.01–0.09 % in the short run. The positive effect on economic growth is relatively larger when the policy change is implemented, but the magnitude of the positive effect decreases over time. However, the positive effect of increasing the copayment rate on lifetime income or

Table 7.B2 Base simulation results

Year	GDP growth rate (<i>n</i>)	Interest rate (<i>r</i>)	$n-r$	Bond outstanding	Percentage of GDP				Health insurance benefit	National burden	Coypayment rate	Social security contribution rate
					Primary balance	Public pension benefit	Health insurance benefit	National burden				
Actual	2005	2.53 %		127.9 %	-7.45 %	8.44 %	6.42 %	27.05 %	14.4 %	19.55 %		
Simulation results	2005	1.75 %	-6.48 %	127.9 %	3.78 %	8.59 %	6.46 %	38.03 %	13.5 %	15.18 %		
	2010	1.38 %	-6.79 %	135.9 %	4.05 %	10.02 %	7.29 %	39.01 %	13.0 %	15.26 %		
	2015	0.78 %	-6.78 %	148.9 %	6.82 %	12.16 %	8.11 %	44.93 %	12.4 %	18.88 %		
	2020	0.93 %	-6.45 %	150.7 %	8.96 %	13.40 %	8.88 %	48.97 %	11.7 %	20.95 %		
	2025	0.78 %	-6.55 %	150.7 %	9.18 %	13.93 %	9.56 %	50.34 %	11.1 %	22.20 %		
	2030	0.46 %	-6.71 %	150.7 %	9.02 %	14.69 %	10.23 %	51.67 %	10.9 %	23.87 %		
	2035	0.16 %	-6.80 %	150.7 %	8.93 %	15.89 %	10.94 %	53.51 %	10.8 %	26.04 %		
	2040	-0.03 %	-6.82 %	150.7 %	9.17 %	17.88 %	11.61 %	56.33 %	10.8 %	28.89 %		
	2045	0.08 %	-6.89 %	150.7 %	9.81 %	19.08 %	12.25 %	58.64 %	10.5 %	30.67 %		
	2050	0.13 %	-7.18 %	150.7 %	10.51 %	19.75 %	12.92 %	60.48 %	10.1 %	31.85 %		

welfare is greater among relatively younger generations. Our simulation estimates that the increase in the copayment rate in the reform induces benefits that vary between 10,000 yen for the generation born in 1920 and 3.52 million yen for the generation born in 2000.

Second, potential ex post moral hazard behavior also results in a decrease in medical expenditures, although it weakens the benefits to economic growth of increasing copayment rates. The maximum short-run effect of the ex post moral hazard on economic growth is measured at 0.04 % when medical expenditures decrease by 10 % because of the behavior.

Third, the rise in future public health insurance benefits can mainly be explained by Japan's aging population. Increasing the copayment rate does little to reduce future public health insurance benefits, even when re-examined in a general equilibrium framework.

Fourth, reducing medical costs through efficiencies, preventive care, or technological progress has little effect on future economic burdens. A change in the national burden ratio in 2050 is merely 1.2 %, even if per capita medical costs change by 10 %.

Finally, if the government tries to hold public health insurance benefits as a percentage of GDP, it must continually reduce benefits, perhaps by up to 45 % by 2050. Such a policy also restrains economic growth until approximately 2035.

B5 Conclusion

We presented two simulation results based on Ihori et al. (2005, 2011). One of the main results is that the national burden to GDP, defined as the sum of the tax burden and the social security burden to GDP, will be approximately 60 % in 2050 in the benchmark case. If the current scheme is maintained, an aging population will result in an increase in the total amount of public pension benefits and the total amount of public health insurance benefits.

Public health insurance benefits are expected to increase by approximately 1 percentage point of GDP every 10 years, reaching 13 % in 2050. Had it not been for the 2004 pension reform, the tax burden would have increased to about 36 % of GDP and the social security burden would have risen to 23.3 % in 2050. Our simulation results indicate that the reform discussed in this appendix is not particularly effective at reducing future national medical expenditure. Further, greater efficiencies and emphasis on preventive care do not significantly influence the macroeconomy even if they reduce medical expenditures.

Our most notable result is that even if the government attains a positive primary balance in the near future, the future burden will be significantly high, implying that the current financial situation facing the Japanese government in terms of intergenerational conflicts is serious. If the government postpones the reduction of its deficits, the situation will be even worse because of the increased interest payments incurred by the significant amount of outstanding government debt.

Questions

- 7.1 What is the most important role of a public pension?
- 7.2 What is the benefit and cost of a move from a pay-as-you-go system to a funded system?
- 7.3 In the model of Sect. 4, with regard to the time path of population size, assume

$$L_1 = 1, L_2 = 1, L_3 = 1.5, L_4 = 2, L_5 = 2.5, \text{ and } L_6 = 2.5.$$

What is the net return for each generation in the following?

- (a) A DB system
- (b) A DC system
- (c) A move from a DB to a DC system in period 3
- (d) A move from a DB to a funded system in period 3

References

- Auerbach, A., & Kotlikoff, L. J. (1983). An examination of empirical test of social security and savings. In E. Helpman, A. Razin, & E. Sadka (Eds.), *Social policy evaluation: An economic perspective* (pp. 161–179). New York: Academic.
- Broda, C., & Weinstein, D. E. (2004). *Happy news from the dismal science: Reassessing Japanese fiscal policy and sustainability* (NBER Working Paper 10988). Cambridge, MA: National Bureau of Economic Research.
- Feldstein, M. (1995). *Would privatizing social security raise economic welfare?* (NBER working paper 5281). Cambridge, MA: National Bureau of Economic Research.
- Hatta, T., & Oguchi, N. (1997). The net pension debt of the Japanese government. In M. Hurd & N. Yashio (Eds.), *The economic effects of aging in the United States and Japan* (pp. 333–352). Chicago: University of Chicago Press.
- Hatta, T., & Oguchi, N. (1999). *Pension reforms*. Tokyo: Nikkei Publishing Inc. (in Japanese).
- Ihori, T., Kato, R. R., Kawade, M., & Bessho, S. (2005). Public debt and economic growth in an aging Japan. In K. Kaizuka & A. O. Krueger (Eds.), *Tackling Japan's fiscal challenges: Strategies to cope with high public debt and population aging* (pp. 30–68). Hampshire: Palgrave Macmillan.
- Ihori, T., Kato, R. R., Kawade, M., & Bessho, S. (2011). Health insurance reform and economic growth: Simulation analysis in Japan. *Japan and the World Economy*, 23, 227–239.
- Kotlikoff, L. J. (1992). *Generational accounting: Knowing who pays, and when, for what we spend*. New York: The Free Press.
- Kotlikoff, L. J. (1995). *Privatization of social security: How it works and why it matters* (NBER working paper 5330). Cambridge, MA: National Bureau of Economic Research.
- National Institute of Population and Social Security Research (NIPSSR). (2002). *Population projections for Japan: 2001–2050*. Tokyo: National Institute of Population and Social Security Research.
- Oshio, T. (2002). *Net pension liabilities, intergenerational equity, and pension reforms* (Project on intergenerational equity discussion paper, No.131). Institute of Economic Research, Hitotsubashi University.
- Takayama, N. (1998). *The morning after in Japan: Its declining population, too generous pensions and a weakened economy*. Tokyo: Maruzen.

Part II

Microeconomic Aspects of Public Finance

1 Taxation and Labor Supply

1.1 A Model of Labor Supply

The second half of this book considers the microeconomic aspects of public finance, which are standard topics of modern public finance. With regard to a useful textbook on microeconomics, see Varian (2014) among others. It is also useful to read standard textbooks on public finance such as Rosen (2014) and Stiglitz (2015).

In this chapter, we first investigate the microeconomic effects of tax on labor supply and other economic activities. In order to investigate this issue, it is necessary to formulate a way in which to determine labor supply in a simple microeconomic model. A household optimally allocates its available time Z between labor supply L and leisure x . Thus,

$$Z = L + x.$$

Z is exogenously given, say, as 24 h per day or 356 days per year. An increase in L means a decrease in x by the same amount.

Labor supply has the benefit of earning income, although it has the cost of sacrificing leisure. Optimal labor supply is determined at the point where the marginal benefit and marginal cost of labor supply are equal. Let us explain this point briefly.

The standard utility function is given as

$$U = U(c, L), \tag{8.1}$$

where c is consumption and L is labor. Utility U increases with c and decreases with L (increases with leisure x).

When a tax is imposed on labor income, the budget constraint is given as

$$c = (1 - t)wL, \quad (8.2)$$

where t is income tax rate and w is wage rate. The right-hand side of Eq. (8.2) means the disposable income. wL is before-tax labor income and tw is the payment of taxes on labor income. $(1 - t)w$ means the after-tax effective wage rate. For simplicity, we assume a proportional linear tax structure in this section.

The household optimally determines its labor supply to maximize its utility (1) subject to its budget constraint (2). In Fig. 8.1, the vertical axis is consumption and the horizontal axis is labor supply. The budget line before tax is line OA , the slope of which is the wage rate, w . As shown in Fig. 8.1, the point E_0 , where the budget line OA is tangent to an indifference curve, is initially optimum. At this point, the marginal benefit of raising labor supply, the slope of the budget line, is equal to the marginal cost, the slope of the indifference curve.

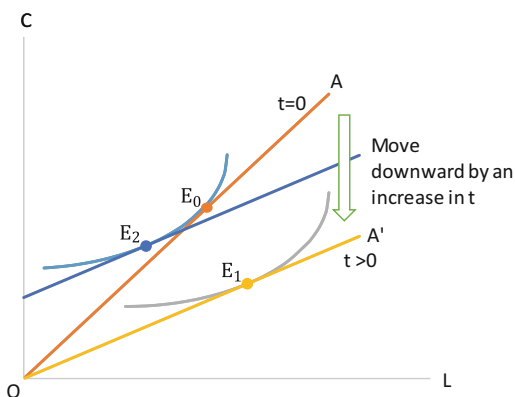
Alternatively, with $t > 0$ mathematically, we have as the first order condition

$$(1 - t)w = -\frac{U_L}{U_c}, \quad (8.3)$$

where U_L denotes the marginal disutility of labor and U_c denotes the marginal utility of consumption. The left-hand side of Eq. (8.3) is the marginal benefit of labor, which corresponds to the slope of the budget constraint. The right-hand side of Eq. (8.3) is the marginal cost of labor, which corresponds to the slope of the indifference curve.

How does income tax affect labor supply? Imagine that initially any labor income tax is not imposed. Then, a labor income tax is imposed. In Fig. 8.1, E_0 corresponds to the initial instance of $t = 0$. When $t > 0$ is imposed, budget line OA moves to OA' with a flatter slope. This means that the effective wage rate, $(1 - t)w$, declines by an increase in t . Thus, the equilibrium point moves from E_0 to E_1 . It is easy to see that E_1 is below E_0 , but could be to the left or right of E_1 . This is because the substitution and income effects offset each other to some extent.

Fig. 8.1 Tax and labor supply



1.2 Substitution Effect and Income Effect

In Fig. 8.1, E_2 is the point where the slope of the before-tax indifference curve associated with E_0 is equal to the slope of the after-tax budget line associated with E_1 . The movement from E_0 to E_1 may be divided into two movements, a move from E_0 to E_2 (the substitution effect) and a move from E_2 to E_1 (the income effect). These two effects are key concepts in microeconomics. See any standard textbooks on microeconomics such as Varian (2014) for more detailed explanations.

The substitution effect refers to a movement on the same indifference curve or the same utility level. This effect represents the direct effect of changes in relative price between consumption and labor supply. Thus, E_2 is always to the left of E_0 . Namely, the relative benefit of the labor supply reduces because of the income tax so that the labor supply is depressed.

However, the income effect refers to the effect of changes in effective income at the relative fixed price. Thus, E_1 is always to the right of E_2 . Since effective income declines because of income tax, both consumption and leisure decline. It is assumed that consumption and leisure are both normal goods, so that an increase in income stimulates demand for both goods. Note that leisure may be regarded as one component of consumption since it appears as an argument to raise utility in the utility function. By definition, a decline in leisure means an increase in labor supply. Hence, the negative income effect stimulates labor supply by depressing the consumption of leisure.

As long as the substitution effect dominates the income effect, E_1 is to the left of E_0 and labor supply is depressed by income tax. Then, we observe the disincentive effect of labor income tax on labor supply. However, we could have the opposite case as well if the income effect is strong enough.

1.3 The Cobb-Douglas Utility Function

Generally speaking, the substitution effect is not always greater than the income effect. For example, let us imagine the simple functional form of the Cobb-Douglas utility function:

$$U = c^\alpha (Z - L)^{1-\alpha}. \quad (8.1')$$

Here, leisure $Z - L = x$ is explicitly incorporated into the utility function since both c and x are relevant arguments in the Cobb-Douglas form. Similarly, the budget constraint (8.2) may be rewritten as

$$c + (1 - t)wx = (1 - t)wZ, \quad (8.2')$$

where x is also explicitly incorporated. The right-hand side of Eq. (8.2') means the economic value of available time. The left-hand side of Eq. (8.2') means the economic value of total consumption.

In this form of utility function, it is optimal to allocate the economic value of available time, $(1 - t)wZ$, into private consumption, c , and the economic value of leisure consumption, $(1 - t)wx$, in accordance with the weights of utility, α and $1 - \alpha$. Note that the price of consumption is normalized to unity. Namely, as the optimality conditions for c and x respectively, we have

$$c = \alpha(1 - t)wZ \quad \text{and}$$

$$(1 - t)wx = (1 - \alpha)(1 - t)wZ.$$

Hence, considering the definition of labor, the optimal labor supply is finally given as

$$L = \alpha Z. \quad (8.3')$$

This labor supply function is independent of tax rate t . In other words, in the Cobb-Douglas utility function, the substitution effect completely offsets the income effect so that labor supply is independent of the tax rate.

In empirical studies, the effect of the tax rate or after-tax wage rate on labor supply is generally ambiguous. In particular, with regard to full-time male workers, the substitution effect may not dominate the income effect. In contrast, with regard to part-time female workers, the substitution effect is generally significant.

Even if the substitution effect almost offsets the income effect, and hence income tax does not affect labor supply a great deal, this does not necessarily imply that the disincentive effect of tax on labor supply is without problems. Indeed, from the viewpoint of efficiency, only the substitution effect matters.

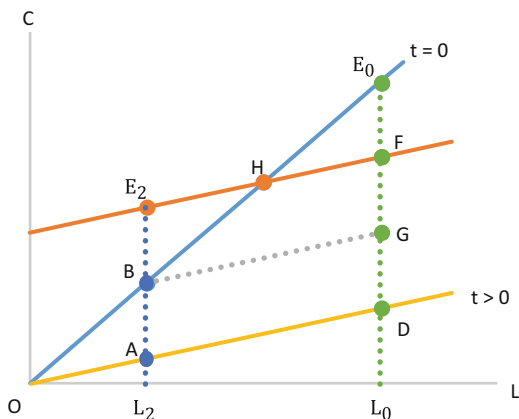
2 The Efficiency of Taxation

2.1 A Comparison with Lump Sum Tax

Taxation is used for financing necessary revenue. Since private agents pay taxes, their utility normally reduces because of the burden of taxes, apart from the benefit of government spending. Optimal tax literature investigates, from the viewpoint of efficiency, how to minimize the burden of tax or the decline of welfare subject to the required tax revenue.

From this viewpoint, the optimal tax is a lump sum tax. This tax is a per capita fixed amount tax $\bar{T}$, or poll tax, with a tax base that is independent of any economic activities. With regard to a labor income tax, its tax base is labor income or labor supply. In contrast, the tax base of a lump sum tax is an agent, independent of any economic activities. We have

$$T = \bar{T} \quad \text{for a lump sum tax and}$$

Fig. 8.2 Lump sum tax and labor income tax

$$T = twL \quad \text{for a labor income tax.}$$

Comparing both taxes, we investigate how income tax distorts economic activities and hence levies an extra burden, known as the excess burden, on the household.

Figure 8.2 is almost the same as Fig. 8.1. We have deleted the indifference curves for simplicity. Imagine that the government transfers tax revenue T to the same person as a lump sum transfer, TR . Thus,

$$T = TR.$$

Then, with regard to lump sum taxes, the tax and transfer offset each other; thus, the household is unaffected. The budget constraint in this case is given as

$$c = wL - T + TR = wL. \quad (8.4.1)$$

In Fig. 8.2, E_0 is still the equilibrium point in this policy.

With regard to labor income tax with a transfer, we have

$$twL = TR.$$

Further, the following budget constraint holds:

$$c = (1 - t)wL + TR. \quad (8.4.2)$$

These two budget constraints are not the same since the agent does not incorporate the government budget constraint,

$$twL = TR,$$

into her or his own budget constraint. The agent chooses labor supply L subject to the budget constraint (4-2) at given levels of $(1 - t)w$ and TR . Then, the associated optimal points differ between two taxes.

2.2 The Size of the Excess Burden

Now, with regard to the labor income tax $t > 0$, the government also returns the tax revenue twL as a lump sum transfer TR . Can the initial point E_0 be attained as before?

In Fig. 8.2, point E_2 denotes the same utility level when the government imposes the labor income tax as the initial utility level associated with point E_0 . Let us denote the labor supply associated with E_2 as L_2 . Then, a labor income tax at point E_2 is twL_2 , which corresponds to AB in Fig. 8.2. However, in order to attain E_2 , the government needs to transfer the amount of AE_2 , which is greater than the amount of AB .

In other words, E_2 can be realized only if the budget line moves to the line associated with point E_2 . Even if the government returns all the labor income tax revenue to the household, the government cannot attain the initial welfare for the household because of the divergence of the after-tax wage rate and the initial wage rate. In order to attain E_2 , the government needs a further transfer.

The extra transfer needed is E_2B in Fig. 8.2, which is called the excess burden, or dead weight loss, of labor income tax. In other words, because of insufficient tax revenue, twL_2 , the labor income tax imposes lower utility on the agent than the lump sum tax.

As shown in Fig. 8.2, the size of the excess burden corresponds to the size of the substitution effect. If the substitution effect is zero, namely if E_0 and E_2 coincide, the size of E_2B is zero. The larger the tax rate, the larger the excess burden.

In Fig. 8.2, $twL_2 = GD$ and $twL_0 = E_0D$. Since $E_2B = E_0F = FG$, we have

$$2E_2B + twL_2 = twL_0.$$

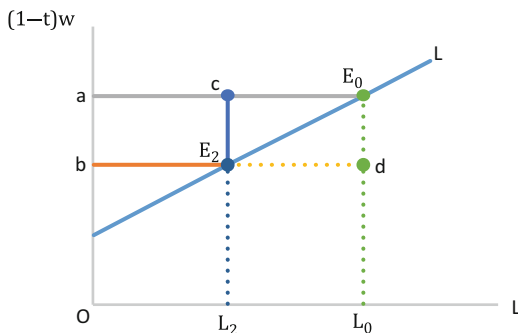
Thus, we obtain as the size of the excess burden,

$$E_2B = tw(L_0 - L_2)/2. \quad (8.5)$$

2.3 The Excess Burden and the Substitution Effect

Alternatively, Fig. 8.3 is useful for investigating the size of E_2B . In this figure, the vertical axis is the after-tax wage rate, $(1 - t)w$, and the horizontal axis is the labor supply. Line L is the compensated labor supply curve at the initial utility level associated with E_0 . This line corresponds to the size of the substitution effect associated with the before-tax initial utility. Note that the excess burden comes from the substitution effect.

Since the sign of the substitution effect is always positive, line L is always upward sloping. At point a , $t = 0$ and the labor supply is L_0 , which is associated with point E_0 . At point b , $t > 0$ and the labor supply is L_2 , which is associated with point E_2 . Tax revenue at E_2 is shown as acE_2b in Fig. 8.3. This corresponds to AB in Fig. 8.2.

Fig. 8.3 The excess burden

Let us consider the tax revenue when the tax rate is the same as at point b in Fig. 8.3 and compensated labor supply is L_0 . This size is given as area aE_0db . The revenue is given as E_0G , as in Fig. 8.2. In Fig. 8.2, this size corresponds to E_0F , the distance between the before-tax budget line and the after-tax budget line at L_0 . Note that in Fig. 8.2, point H is the middle point of E_0 and E_2 . Hence, the size of E_0G is twice that of E_2B . Considering that cE_0dE_2 is the same size as E_0G in Fig. 8.3, the size of E_2B is cE_0E_2 in Fig. 8.3. This shows the size of the excess burden in Fig. 8.3.

Let us calculate the area of cE_0E_2 . We know $cE_2 = tw$ and $cE_0 = twL_w$. Here, $L_w = \Delta L / \Delta w$ denotes how the labor supply increases with the effective wage rate, which is the size of the substitution effect. Thus, the size of the excess burden is calculated as

$$E_2B = \frac{1}{2}(tw)^2L_w = \frac{1}{2}\varepsilon t^2wL, \quad (8.6)$$

where $\varepsilon = wL_w/L$ denotes the (compensated) wage elasticity of labor supply.

This corresponds to the size of the substitution effect. From Eq. (8.6), we know that the excess burden is proportional to the substitution effect, ε , and is also proportional to the square of the tax rate. Because the other factors are fixed, when the tax rate doubles, the excess burden increases four times.

Since $\Delta L = L_0 - L_2$, $\Delta w = tw$, we have $L_w tw = L_0 - L_2$. Substituting this equation into Eq. (8.5), we again obtain Eq. (8.6). Thus, Figs. 8.2 and 8.3 are equivalent for defining the excess burden. In Chap. 9, we investigate the optimal tax rule using the concept of excess burden.

3 Interest Income Tax and Saving

3.1 The Life Cycle Saving Hypothesis

Next, we investigate the effect of interest income tax on saving. First, let us consider how interest income is produced from economic activities. Since interest income is a return on saving, we need to explain saving in the context of the optimizing behavior of households.

Saving is conducted in order to attain the optimal intertemporal allocation of consumption. A main reason why households save is that labor income in the future is not enough to prepare for future living needs. Saving means that a part of current consumption is transferred to future consumption. Optimal saving is determined so as to equate the marginal benefit of saving to the marginal cost of saving.

The standard saving hypothesis is the life cycle saving theory. We explain this theory with a simple two-period model, as in Chap. 3. Imagine that income occurs only in the first period. For example, when young the agent works and earns labor income, while she or he retires when old. The household optimally allocates consumption in two periods. If it consumes all the current income, it cannot have any income in the future period to consume. If it saves part of the current income, it earns interest income used for consumption in the future.

The budget constraint in each period is given respectively as

$$c_1 = Y_1 - s \text{ and} \quad (8.7)$$

$$c_2 = (1 + r)s, \quad (8.8)$$

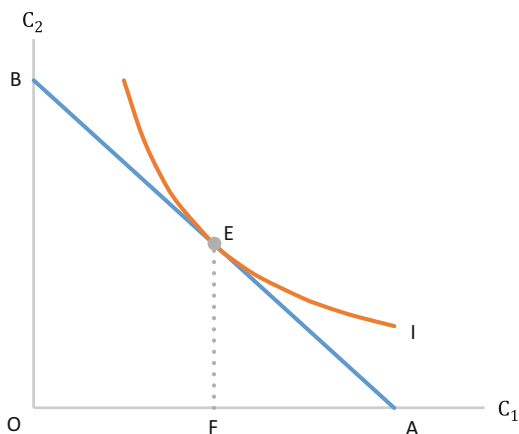
where c_1 is present consumption, c_2 is future consumption, Y_1 is present (labor) income, s is saving, and r is the rate of interest. From Eqs. (8.7) and (8.8), by eliminating s , we have the lifetime budget constraint,

$$c_1 + \frac{1}{1+r}c_2 = Y_1. \quad (8.9)$$

The household maximizes its lifetime utility $U = U(c_1, c_2)$ subject to the budget constraint (8.9) by choosing present and future consumption.

Figure 8.4 presents future consumption in its vertical axis and current consumption in its horizontal axis. The line AB shows the budget line (8.9) with the slope corresponding to the rate of interest. Since labor income occurs only in the present period, in the horizontal axis OA corresponds to the size of labor income. The indifference curve I refers to a combination of present and future consumption in order to maintain fixed lifetime utility and is concave toward point O.

Fig. 8.4 Optimal saving



The household chooses the highest utility point on the budget line. This point is at E, where the budget line and indifference curve are tangent. Alternatively, mathematically we have as the optimality condition

$$1 + r = \frac{U_{c1}}{U_{c2}}, \quad (8.10)$$

where U_{c1} means the marginal utility of c_1 and U_{c2} the marginal utility of c_2 .

If the utility function is specified to an additively separable type,

$$U(c_1, c_2) = V(c_1) + \frac{1}{1+\rho} V(c_2)$$

Equation (8.10) reduces to

$$1 + r = (1 + \rho) \frac{V_{c1}}{V_{c2}}, \quad (8.10')$$

where ρ denotes the time preference and V_{c1} means the marginal utility of c_1 . V_{c2} is the marginal utility of c_2 . The left-hand side of Eq. (8.10) or (8.10') is the slope of the budget line, while the right-hand side of Eq. (8.10) or (8.10') is the slope of the indifference curve. If $r = \rho$, the optimal condition means $c_1 = c_2$. Point E is on the 45-degree line and consumption smoothing is desirable. The size of saving, AF, denotes the optimal saving for the household.

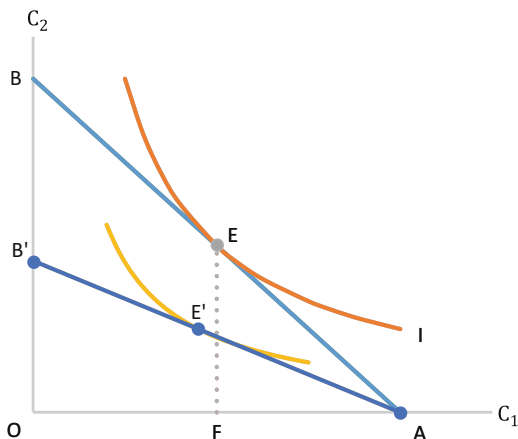
The slope of the indifference curve, $1 + \rho$, means the marginal cost of saving, while the slope of the budget line, $1 + r$, means the marginal benefit of saving. The marginal benefit of saving refers to the extent by which future consumption increases when current consumption is relinquished for saving. The marginal cost refers to how much a decline in current consumption for saving costs in monetary terms. The former depends on the rate of interest and the latter depends on the rate of time preference. The rate of interest is the rate of return on saving. If this rate is high, a decline of current consumption produces a large amount of future consumption.

The time preference rate refers to how much the household evaluates future consumption in terms of current consumption. A high time preference rate means that the household needs a large amount of future consumption at a given decline of current consumption. If this rate is high, it depresses saving.

3.2 The Effect of Interest Income Tax: The Substitution Effect and the Income Effect

Imagine that interest income tax t_s is imposed. This tax reduces the after-tax rate of return on saving. Namely, the after-tax interest rate reduces from r to $r(1 - t_s)$. Would this decline depress savings?

Fig. 8.5 The effect of interest income tax



In Fig. 8.5, the budget line moves from AB to AB' to the left and downward. The optimal point moves from E to E' . E' is below E , but it could be to the right or left of E . This is because the substitution effect and the income effect offset each other, as with labor supply in Sect. 1. Namely, the substitution effect reduces the relative attractiveness of saving, while the income effect raises saving by depressing current consumption because of a decline in effective income. Note that consumption is a normal good. Thus, the income effect is always positive. Figure 8.5 illustrates the effect of interest income tax.

3.3 The Cobb-Douglas Utility Function

For example, if we consider the Cobb-Douglas utility function, the substitution effect completely offsets the income effect; thus, saving becomes independent of interest income tax. This property is qualitatively the same as the impact of income tax on labor supply in Sect. 1.

Thus, the Cobb-Douglas utility function is specified as

$$U = c_1^\alpha c_2^{1-\alpha}. \quad (8.11)$$

The budget constraint with interest income tax is given as

$$c_1 + \frac{1}{1 + (1 - t_s)r} c_2 = Y_1. \quad (8.9')$$

Then, it is optimal to allocate income between c_1 and c_2 as follows:

$$c_1 = \alpha Y_1$$

$$\frac{1}{1 + (1 - t_s)r} c_2 = (1 - \alpha)Y_1.$$

Considering Eq. (8.7) or (8.8), we finally obtain

$$s = (1 - \alpha)Y_1, \quad (8.12)$$

which is independent of the income tax rate, t_s . In this instance, an increase in the interest income tax does not depress saving. We do not have the disincentive effect of interest income tax on saving. This property is qualitatively the same as with labor supply, which is explained in Sect. 1.

3.4 The Human Capital Effect

Imagine that labor income Y_2 is now available in the second period as well. Then, the impact of interest income tax on saving may be modified. The second period budget constraint is rewritten as

$$c_2 = (1 + r)s + Y_2. \quad (8.8')$$

With the interest income tax, the lifetime budget constraint is now rewritten as

$$c_1 + \frac{1}{1 + r(1 - t_s)} c_2 = Y_1 + \frac{1}{1 + r(1 - t_s)} Y_2. \quad (8.13)$$

Since interest income tax reduces the discount rate for future labor income, the present value of labor income increases; namely, through the presence of t_s , the present value of future labor income $Y_2/(1 + r)$ is modified to $Y_2/[1 + r(1 - t_s)]$, which increases with t_s .

This effect raises current consumption while reducing saving. This is called the human capital effect. Note that current labor income Y_1 is not affected by interest income tax. Considering the relation $s = Y_1 - c_1$, current consumption and saving move in the opposite direction.

3.5 The Cobb-Douglas Utility Function Revisited

For example, with regard to the Cobb-Douglas utility function, current consumption depends upon the present value of labor income. When labor income occurs only in period 1, this value is independent of the interest rate; thus, the interest rate does not affect labor supply. The substitution effect completely offsets the income effect. However, if labor income appears in the second period as well, the interest rate is included in the discount rate for future labor income. As a result, owing to interest income tax, the after-tax interest rate evaluates second-period labor income

more than before, raising the present value of labor income and hence stimulating current consumption. In other words, even if we assume the Cobb-Douglas utility function, or a separable utility function, interest income tax has a depressing effect on saving.

Mathematically, suppose that the Cobb-Douglas utility function is again given as

$$U = c_1^\alpha c_2^{1-\alpha}. \quad (8.11)$$

Then, considering Eq. (8.13), it is now optimal to allocate income between c_1 and c_2 as follows:

$$c_1 = \alpha \left[Y_1 + \frac{1}{1 + (1 - t_s)r} Y_2 \right]$$

$$\frac{1}{1 + (1 - t_s)r} c_2 = (1 - \alpha) \left[Y_1 + \frac{1}{1 + (1 - t_s)r} Y_2 \right].$$

Thus, the saving function is now given by

$$s = (1 - \alpha)Y_1 - \frac{\alpha}{1 + r(1 - t_s)} Y_2, \quad (8.14)$$

which is a decreasing function of interest income tax, t_s . If $Y_2 = 0$, the saving function is given as (8.12), which is independent of interest income tax, t_s . In contrast, if Y_2 is positive, an increase in t_s raises the present value of Y_2 , stimulating c_1 and depressing s .

Generally speaking, a reduction of interest income tax may promote capital accumulation. Since the substitution effect offsets the income effect to some extent, the overall effect is ambiguous.

Boskin (1978) pointed out that for the US economy, the substitution effect is likely to dominate the income effect; thus, a reduction of interest income tax could stimulate capital accumulation. Although empirical studies after Boskin's paper have not necessarily supported his conjecture, we can obtain a similar result if we incorporate the human capital effect into the analysis appropriately. See the advanced study of this chapter for a more detailed analysis.

4 Investment and Tax

4.1 The Classical View

We now investigate the effect of corporate tax on firms' behavior. According to the classical view of corporation tax, tax on firms does not affect their behavior in the short or long run. Namely, changes in corporate tax do not affect any economic activities including investment. Let us explain this classical view.

The objective of the representative firm is to maximize its profit. In order to maximize after-tax profit, a firm must maximize its before-tax profit. The aim of investment is to maximize before-tax profit, the level of which is independent of corporate tax. The crucial assumption here is that after-tax profit corresponds to before-tax profit on a one-to-one basis.

Imagine that the firm intends to maximize “pure” profit, which subtracts normal costs including payment for capital. The classical view assumes that after-tax profit exactly corresponds to before-tax profit because the normal user cost of capital, namely the rental cost of capital, is subtracted from the tax base. Let us explain this point using a simple model of the firm.

The firm may rent capital from the capital market at a given rental cost, which is normally equal to the rate of interest. Let us denote corporate tax by t_I , product price by p , the production function by $F(K, L)$, labor by L , capital by K , the wage rate by w , and the rental cost of capital by r . Then, after-tax profit R is given as

$$R = (1 - t_I)[pF(K, L) - wL - rK]. \quad (8.15)$$

The firm maximizes before-tax profit $pF - wL - rK$ in order to maximize after-tax profit R . The optimal conditions for K and L are given respectively as

$$pF_K = r \text{ and} \quad (8.16)$$

$$pF_L = w, \quad (8.17)$$

where F_K denotes the marginal product of capital and F_L denotes the marginal product of labor. Equations (8.16) and (8.17) are not affected by the tax rate, t_I . Thus, optimal output and investment are independent of t_I . Note that in Eq. (8.15), the rental cost of capital, rK , is subtracted from the tax base.

4.2 Corporate Tax and Borrowing Funds

In reality, only interest payments on borrowing funds are subtracted from the tax base. Thus, the rental cost of capital is not always subtracted. In this regard, corporate tax could affect investment.

The optimal condition of investment means that investment is conducted only if the after-tax marginal profit is greater than (or equal to) the rental cost of capital. The after-tax marginal profit is given as $(1 - t_I)pF_K$. Here, F_K is the marginal product of capital. Under normal corporate tax law, interest payments on bonds are not taxed. Thus, the rental cost in a bond-financed investment case is $(1 - t_I)r$. Since the term $(1 - t_I)$ appears in both sides of the condition, the optimal condition is the same as for $t_I = 0$.

In other words, with regard to borrowing funds, rK is subtracted from the tax base. Then, after-tax profit is given as Eq. (8.15) and the optimal conditions are still given as Eqs. (8.16) and (8.17).

4.3 Corporate Tax and Retained Earnings

With regard to investments financed by retained earnings, the interest payments on borrowing funds do not exist. Hence, investment does not affect the tax base and the rental cost of capital is not affected by the tax. Thus, we may compare $(1 - t_I)pF_K$ and r . It follows that t_I affects investment. For example, an increase in t_I reduces after-tax marginal profit, depressing investment. Alternatively, even with regard to bond finance, if interest payments are not tax-free, the rental cost of capital remains at r . Then, an increase in t_I depresses investment.

Namely, in the case of retained earnings, rK is not subtracted from the tax base. In place of Eq. (8.15), we now have as after-tax profit

$$R = (1 - t_I)[pF(K, L) - wL] - rK. \quad (8.15')$$

Hence, the optimal conditions are rewritten as

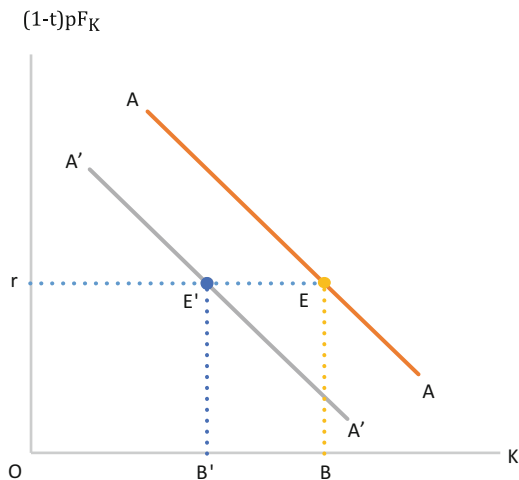
$$(1 - t_I)pF_K = r \text{ and} \quad (8.16')$$

$$pF_L = w. \quad (8.17)$$

t_I only appears in Eq. (8.16'). An increase in t_I depresses K , while it does not affect the demand for L .

Figure 8.6 explains the effect of corporate income tax on investment. The vertical axis denotes the interest rate r and the (after-tax) marginal product of capital $(1 - t_I)pF_K$. The horizontal axis denotes capital. The optimal point is given by the intersection of the (after-tax) marginal product curve and the interest rate line.

Fig. 8.6 The effect of corporate income tax



An increase in t_I moves the $(1 - t_I)pF_K$ curve downward from AA to $A'A'$. Thus, the optimal point moves from E to E' . The optimal capital stock declines from B to B' , depressing investment.

4.4 The Cost of Capital

Now, let us define the cost of capital by the marginal cost associated with the before-tax marginal return of capital, pF_K . In other words, this cost shows how much return is needed in terms of the before-tax return. This break-even rate of return is called the cost of capital. If the cost of capital increases, a higher before-tax return is needed; thus, investment is depressed. Without taxes, the cost of capital is equal to the rental cost of capital and the market rate of interest. With taxes, the cost of capital may well be higher than the rental cost of capital. For example, if tax depresses the benefit of investment, the cost of capital rises and investment declines. The cost of capital is a useful indicator of the relation between investment and taxes.

With regard to bond finance, we still have $pF_K = r$. The cost of capital is equal to r . With regard to retained earnings finance, the optimal condition is $(1 - t_I)pF_K = r$. Thus, the cost of capital becomes

$$pF_K = r/(1 - t_I), \quad (8.18)$$

which increases with t_I . In other words, tax raises the cost of capital more than the rental cost of capital and the rate of interest.

4.5 Depreciation

Moreover, capital depreciates physically and/or economically over time. How the tax system treats depreciation is a major factor in the cost of capital and investment behavior. Considering depreciation, the economic value of capital declines, so that it raises the rental cost of capital. Let us denote the true economic rate of depreciation by δ . Then, the rental cost of capital becomes $r + \delta$. If true economic depreciation is tax-free, the rental cost of capital declines to a level smaller than $r + \delta$, as explained in the instance of tax-free interest payments.

Thus, if true economic depreciation becomes tax-free, corporate tax does not affect investment. The cost of capital is the same as $r + \delta$. Moreover, if the tax system admits depreciation more than true economic depreciation as tax-free, it reduces the cost of capital and stimulates investment.

For example, investment tax credit means that the total amount of investment is treated as tax-free when investment is conducted. It reduces the cost of capital. It

admits depreciation more than true economic depreciation as tax-free. This investment tax credit is powerful at stimulating investment. Indeed, it works more effectively than reducing the corporate tax rate.

4.6 The Incidence of Corporate Income Tax in Japan

As explained below, the incidence of taxes depends upon how the tax base responds to taxes. If the tax base is very elastic to the tax rate, the burden is moved to others, and vice versa.

Doi (2016) analyzed the incidence of corporate income tax in Japan using a dynamic general equilibrium model. The dynamic macroeconomic model enables us to analyze both the instantaneous and the intertemporal incidence of corporate income tax. He included capital structure (i.e., choices of equity, debt, and retained earnings) in the proposed model in order to implement investment. The model also had a progressively increasing per unit agency cost on debt. Doi implemented a simulation based on the dynamic model and measured the incidence of corporate income tax on labor income when the (effective) corporate income tax rate decreased from 34.62 to 29.74 % in Japan.

In a neoclassical dynamic general equilibrium model, it is well known that the entire incidence moves to labor income in the long term since capital is perfectly mobile in the infinite horizon, while labor is not mobile. The main difference between Doi's (2016) results and the conventional neoclassical results is caused by the inclusion of the agency cost on debt. With the agency cost, capital is not perfectly mobile in the long run.

The benchmark case indicates that after a 4.88 % decrease in the (effective) corporate income tax rate, the percentage of the incidence on labor income is about 20–60 % and on capital income is about 40–80 %, in the short term (1 year). In the long term, about 90 % of the incidence is on labor income. Almost all the incidence moves to labor income in the long run. This is because capital is very mobile in the long run although it is not perfectly mobile.

A policy implication of his analysis is that a large share of the incidence of corporate income tax is still on labor income in Japan. Moreover, the percentage of the incidence on labor income increases in the long term. Thus, a reduction in the corporate income tax rate is more advantageous to labor income (more specifically, labor income after taxation changes), although general voters normally do not support a tax reform that involves reducing the corporate income tax rate.

Doi (2016) has adapted the tax capitalization view (the “new view”) of the shareholder return policy. However, firms can use a different type of shareholder return policy. Moreover, the above results are derived within a closed economy model, whereas firms face international competition in a real economy. These are important issues that need to be addressed in future research.

5 Consumption Tax

5.1 Shift of the Tax Burden and Price Determination

We now investigate the effect of tax on consumption goods. When the government imposes a tax on a consumption good, how is the price and burden on the consumer affected? This depends upon how much the consumer price increases in response to the tax. The degree of incidence of the tax burden to consumers depends on economic conditions.

Using a partial equilibrium framework, let us examine the impact of imposing a tax on a particular consumption good. The partial equilibrium approach assumes that the effect of a tax does not spill over the economy, so that we may only consider the impact on a specific goods market.

In Fig. 8.7, the vertical axis is the market price of good P and the horizontal axis is the demand D and supply S of the good. The downward sloping curve D is the demand curve and the upward sloping curve S is the supply curve. The intersection of both curves determines the equilibrium in the good's market. Without a consumption tax, the equilibrium point is E_0 and the equilibrium price is P_0 ,

The government now imposes a specific consumption tax. Namely, the firm has to pay a tax of T yen per quantity of product. This is called an ad valorem tax. Since the firm pays the tax to the tax authority, the firm is a legal taxpayer. Then, the supply cost of the product increases by T yen per unit and the supply curve moves upward by the amount of T yen. In this regard, the equilibrium point moves from E_0 to E_1 .

Let us compare equilibrium before and after the imposition of the tax. We denote by P_d the consumer price, which the consumer effectively pays, and by P_s the producer price, which the producer effectively receives. Before the imposition of the tax, the consumer price and the producer price are the same and equal to the equilibrium price, P_0 . After the tax, the consumer price rises to P_1 and the producer price declines to $P_1 - T$.

However, even if the producer is the legal taxpayer, the producer does not necessarily pay all the tax. Part of the tax is transferred to the consumer as an increase in the equilibrium price and a decrease in the producer price. As shown in

Fig. 8.7 The firm as the legal taxpayer

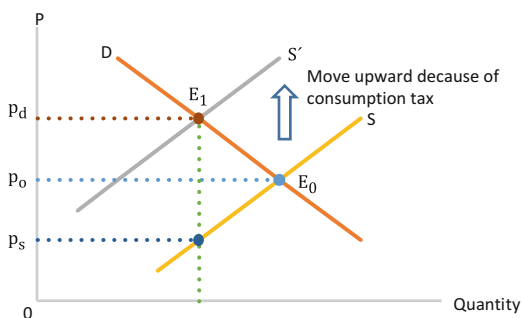


Fig. 8.7, it is rare that the market price increases by the same amount of the tax and the consumer pays all the tax. Such a 100 % incidence on the consumer is unlikely to occur. Later, we consider such extreme cases in Fig. 8.9. It is also rare that the market price does not increase at all. Such a 100 % incidence on the producer is unlikely to occur. The burden of tax is generally shared by the consumer and the producer, depending upon economic conditions.

5.2 The Consumer as the Legal Taxpayer

Next, let us consider a situation in which consumers are legal taxpayers. Namely, the government imposes a direct consumption tax whereby consumers pay T yen per unit of consumption of the good to the tax authority. This kind of tax payment seems unlikely to be observed in reality. However, theoretically it is interesting to consider this situation.

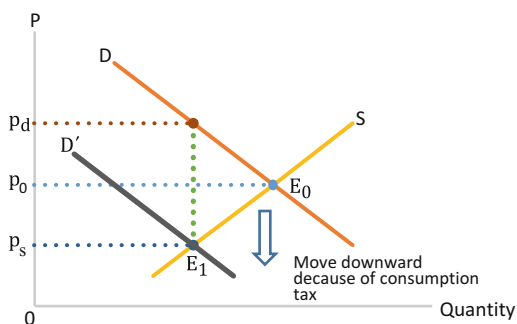
Since consumption of the good becomes more expensive by T yen per unit of consumption, in Fig. 8.8 the demand curve moves downward by T yen. The equilibrium point moves from E_0 to E_1 and the equilibrium (market) price declines from P_d to P_s .

How do the consumer and producer prices change? Since the producer does not pay the tax, the producer price is equal to the market price. The consumer price is the market price plus the tax. As a result of the imposition of the tax, the market price declines but the consumer price rises as shown in Fig. 8.8. Although the consumer pays the tax to the government, the economic incidence is different. Since the market price declines, a part of the tax burden is moved to the producer.

5.3 The Burden of Tax and Incidence

Let us compare Figs. 8.7 and 8.8. The market price after the imposition of the tax differs depending upon who is the legal taxpayer, the producer or the consumer. In the former instance, the market price rises, while in the latter, the market price declines.

Fig. 8.8 The consumer as the legal taxpayer



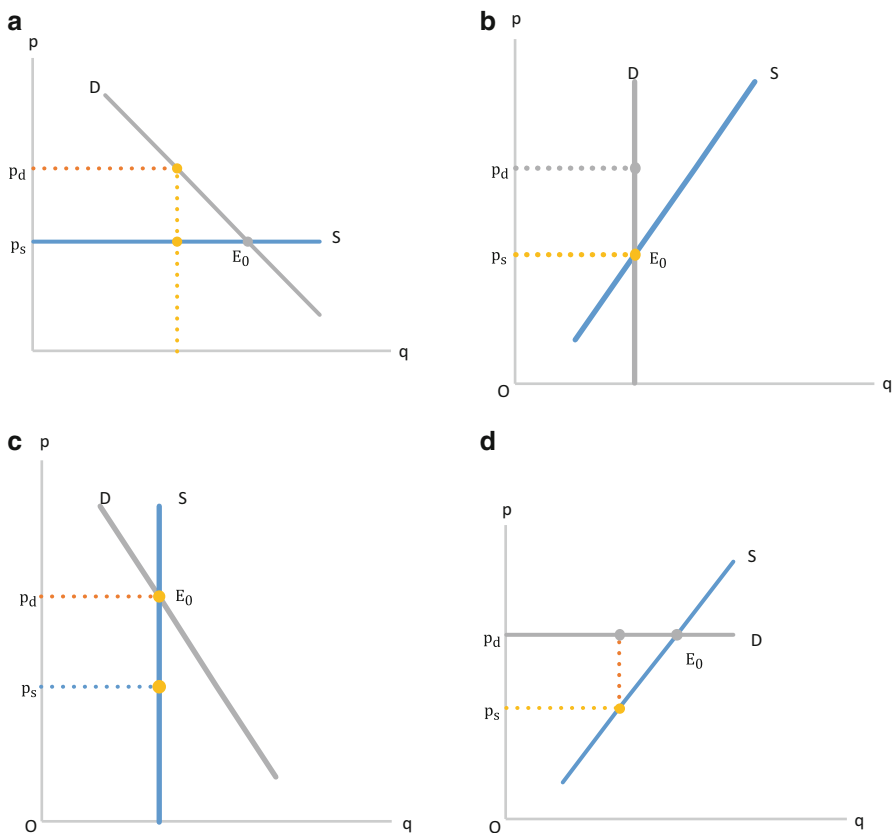


Fig. 8.9 Extreme cases of incidence. (a) Supply curve: infinite elasticity, (b) Demand curve: zero elasticity, (c) Supply curve: zero elasticity, (d) Demand curve: infinite elasticity, q denotes quantity

The consumer price rises in both instances (see Figs. 8.7 and 8.8). However, the producer price declines in both instances. As shown in these figures, the vertical gap between the demand and supply curves is equal to the tax, T yen. We always have

$$P_s(\text{producer price}) + T(\text{tax}) = P_d(\text{consumer price}). \quad (8.19)$$

In other words, how the consumer and producer prices change is irrelevant to who is the legal taxpayer. The economic burden of taxes is solely determined by how the consumer and producer prices change. In other words, the economic incidence of the tax burden is simply determined by the relative shape of the demand and supply curves, which are associated with purely economic conditions.

Specifically, economic incidence is dependent upon the ratio of demand and supply elasticities. Mathematically, we have

$$\frac{P_d - P_0}{P_0 - P_s} = \frac{\varepsilon_S}{\varepsilon_D}, \quad (8.20)$$

where $\varepsilon_D, \varepsilon_S$ denote demand and supply elasticities respectively.

The larger the demand elasticity of consumers compared with the supply elasticity of producers, the larger the portion of the tax burden that transfers to the consumer compared with the producer.

For example, consider some extreme cases. If supply elasticity is infinite in case (a) or demand elasticity is zero in case (b), the consumer bears the entire tax burden. If supply elasticity is zero in case (c) or demand elasticity is infinite in case (d), the producer bears the entire tax burden (see Fig. 8.9).

Necessity goods are generally inelastic. Thus, the consumer bears a significant portion of the taxes on such goods. However, luxury goods are much more elastic. In this regard, the producer cannot transfer a significant portion of the tax burden to the consumer.

Appendix: The Savings Elasticity Controversy

A1 Boskin (1978)

It is useful to overview the savings elasticity controversy after Boskin's (1978) paper. Early work tended to produce rather low estimates for the interest elasticity of saving, typically in the neighborhood of 0.10–0.20, meaning that a decrease in the interest rate from 10 to 5 % would reduce savings by approximately 13 % if the elasticity were 0.20. However, there were some estimates of the elasticity of saving that were insignificantly different from zero. It follows that the income effect and the substitution effect are almost the same in terms of magnitude.

Boskin, however, estimated an elasticity nearly twice the magnitude of earlier estimates. His estimated range for the elasticity of saving was between 0.30 and 0.60, with the preferred estimate being 0.40, which was twice the magnitude anyone else had found using similar data. Further, his preferred estimate of the elasticity of saving implied that the taxation of capital income causes an annual excess burden of approximately US \$60 billion, which was an astonishing result, to say the least. As explained in the main text, if the substitution effect is large, the size of the excess burden is also large.

Boskin's result was quite controversial and started a debate over the magnitude of the elasticity of saving. He estimated an ad hoc consumption function and used an instrumental variables technique to control for the possible endogeneity of some of the regressors; for example, income. The data used were annual time series observations for the United States for the period 1929–1969, omitting the war years.

The key to Boskin's large estimate is the interest rate variable used in the estimated regression equation. The theoretically preferred variable is the expected, real interest rate, net of tax. Unfortunately, this variable is not directly observed; it

must be constructed, which means that a number of thorny measurement issues arise.

First, which interest rate should be used? Second, the interest rate must be adjusted for taxes. Again, it is not immediately obvious how to deal with this when there is more than one tax rate and more than one government, for example, central government and local governments, imposing taxes on capital income. Third, the interest rate must be adjusted for inflation because it is the real rate that is important for intertemporal decision-making. Thus, which price index should be used to calculate the inflation rate? Fourth, it should be the expected, real interest rate net of tax that belongs in the consumption or savings function equation. Calculating the expectations of the taxpayer and aggregating to the economy level is a difficult task. Clearly, any technique used will be somewhat arbitrary and difficult to defend.

Finally, the consumption function estimated is somewhat ad hoc; it was not derived from the optimizing behavior of consumers. This makes it difficult to interpret the specific results because it is unclear what the parameters mean. This is an application of the so-called Lucas critique.

A2 Summers (1981)

In an important paper, Summers (1981) argued that human wealth is related to the interest rate; the higher the interest rate, the lower the present value of future labor earnings and the lower the level of wealth. Using a two-period model, whereby the agent works in the first period alone to study the capital income tax issue, does not fully capture the influence of the interest rate on wealth. Further, including wealth in a consumption function along with an interest rate variable, as Boskin did, would also tend to confound the different effects.

The interest elasticity of saving that takes into account the effect of the interest rate on human wealth could be much higher than previously thought. Using a calibrated computer simulation model, Summers simulated the model and calculated an interest elasticity with an order of magnitude larger than Boskin's empirical estimates.

Consider the two-period life cycle model studied earlier, but suppose that the consumer also receives labor income in the second period. Her or his two budget constraints are

$$Y_1 - c_1 - s = 0 \quad \text{and} \quad (8.A1)$$

$$Y_2 + (1 + r)s - c_2 = 0, \quad (8.A2)$$

where Y_j is labor earnings in period j ($j = 1, 2$). If the utility function is given as

$$U = \log(c_1) + \beta \log(c_2),$$

where $\beta = 1/(1 + \rho)$ and ρ is the rate of time preference, it is straightforward to show that the consumption function is given by

$$c_1 = (1/(1 + \beta))W, \quad (8.A3)$$

where $W = (Y_1 + RY_2)$ is the present value of labor income, or human wealth, and $R = 1/(1 + r)$.

Then, saving is given by

$$s = Y_1 - W/(1 + \beta). \quad (8.A4)$$

Saving responds to the interest rate when human wealth is not held constant in accordance with

$$ds/dr = (ds/dW)(dW/dr) = Y_2 R^2 / (1 + \beta) > 0, \text{ if } Y_2 > 0 \quad (8.A5)$$

Not only would the elasticity of saving be positive in this case, it is also possible for it to be greater than one in magnitude. It will also vary with income.

In this example, the elasticity of saving is given as

$$\varepsilon = rR^2 Y_2 / (\beta Y_1 - RY_2). \quad (8.A6)$$

The denominator must be positive for saving to be positive. If the following condition (8.A7) holds, the elasticity is greater than one in magnitude.

$$Y_2/Y_1 > (1 + r)(1 + rR)/(1 + \rho). \quad (8.A7)$$

For example, interpreting the formula on an annual basis, suppose $r = 0.02$ and $\rho = 0.01$. This requires that $Y_2/Y_1 > 1.029$. However, if $r = 0.025$ and $\rho = 0.01$, then $Y_2/Y_1 > 1.039$. This requires the wage profile to increase by at least 3.9 %, which may be empirically unlikely if we interpret the inequality as involving an annual comparison.

However, if we interpret the two-period example with each period being 25–30 years long (a generation), an annual interest rate of 2.5 % would have a doubling time of about one generation, 28 years. Thus, if we set $r = 1$ in the two-period example and $\rho = 0.5$, then $Y_2/Y_1 > 2$. Wages would have to at least double over a single generation in order for the condition to be satisfied. This seems empirically reasonable. See Batina and Ihori (2000) for further discussions on this topic.

Questions

8.1 Assume the Cobb-Douglas utility function

$$U = c^{0.8}(10 - L)^{0.2},$$

where U is utility, c is consumption, and L is labor supply. Suppose wage is 60 and consumption tax is 0.2. What is the optimal value of L ?

8.2 Suppose the initial tax rate is 0.1 and the corresponding excess burden is 10. If the tax rate rises to 0.3, how much is the excess burden at the new equilibrium?

8.3 Say whether the following statements are true or false and explain the reasons.

- (a) The excess burden increases with the income effect.
- (b) Changes in the consumption tax rate and labor income tax for the same amount of tax revenue have no effect on the real economy.

References

- Batina, R., & Iori, T. (2000). *Consumption tax policy and the taxation of capital income*. New York: Oxford University Press.
- Boskin, M. (1978). Taxation, saving and the rate of interest. *Journal of Political Economy*, 86, S3–S27.
- Doi, T. (2016). *Incidence of corporate income tax and optimal capital structure: A dynamic analysis*. RIETI DP 16-E-022.
- Rosen, H. S. (2014). *Public finance*. New York: MacGraw-Hill.
- Stiglitz, J. E. (2015). *Economics of the public sector*. New York: W. W. Norton & Company.
- Summers, L. H. (1981). Capital taxation and accumulation in a life cycle growth model. *American Economic Review*, 71, 553–544.
- Varian, H. R. (2014). *Intermediate microeconomics: A modern approach*. New York: Norton.

1 Labor Income Tax and Interest Income Tax

1.1 Exogenous Labor Supply

The theoretical literature on tax reform discusses a desirable tax system that assures the required revenue when multiple taxes are available. First, let us compare labor income tax and interest income tax with the equal revenue requirement.

Consider a simple two-period model. Let us denote the labor income tax rate by t_w and the interest income tax rate by t_r . The budget constraints of a representative consumer for each tax are written as

$$c_1 = Y(1 - t_w) - s \text{ and} \quad (9.1)$$

$$c_2 = (1 + r)s, \quad (9.2)$$

and

$$c_1 = Y - s \text{ and} \quad (9.3)$$

$$c_2 = [1 + (1 - t_r)r]s, \quad (9.4)$$

where c_1 and c_2 denote consumption in each period, Y is labor income, s is saving, and r is the rate of interest. Equations (9.1) and (9.2) include labor income tax, while Eqs. (9.3) and (9.4) include interest income tax. In this section, we assume that labor income Y is exogenously given. This is an important and crucial assumption. We also assume that the agent earns labor income only in period 1.

The present value budget constraint for each case is given as

$$c_1 + \frac{1}{1+r}c_2 = Y(1-t_w) \text{ and} \quad (9.5)$$

$$c_1 + \frac{1}{1+r(1-t_r)}c_2 = Y, \quad (9.6)$$

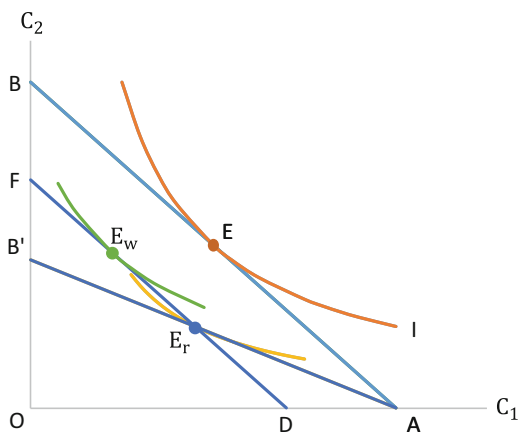
where Eq. (9.5) represents the labor income tax case and Eq. (9.6) the interest income tax case. In both equations, the left-hand side is the present value of consumption and the right-hand side is the present value of labor income. Labor income tax reduces disposable labor income, while interest income tax raises the relative price of future consumption.

In order to collect the same amount of tax revenue, which tax is relatively desirable for a household? Figure 9.1 explains this problem. The vertical axis is future consumption and the horizontal axis is present consumption. Point E is the initial equilibrium point before tax where the before-tax budget line is tangent to an indifference curve. E_w is the equilibrium point under labor income tax and E_r is the equilibrium point under interest income tax. As shown in this figure, under the constraint of the same tax revenue, utility at E_w is always higher than utility at E_r .

Let us explain this result in Fig. 9.1. The vertical (or horizontal) gap between line AB and line DF corresponds to tax revenue in terms of second (or first) period consumption. If the equilibrium point is on line DF, the government may collect the same amount of tax revenue in either case. Thus, we have to compare two points associated with labor income tax and interest income tax on line DF. With regard to t_w , the relative price between c_1 and c_2 is not affected by tax; hence, the DF line is tangent to an indifference curve at E_w . In contrast, with regard to t_r , the relative price between c_1 and c_2 is affected by tax; hence, line AB' , not AB, is tangent to an indifference curve at E_r on line DF.

Thus, utility at E_r is lower than utility at E_w . The optimal choice between c_1 and c_2 is distorted by interest income tax and creates an extra burden. This analysis suggests that labor income tax is better than interest income tax.

Fig. 9.1 Labor income tax and interest income tax



1.2 Comprehensive Income Tax

What tax base is desirable? This question is important in relation to actual tax reform as well as the theoretical literature. There are two plausible arguments about a desirable tax base. One is that comprehensive income is ideal; another is that expenditure or consumption is best.

First, we explain the notion of comprehensive income tax. Many tax experts have focused attention on what has become known as “comprehensive” income in order to define an ideal base for taxation. A number of different definitions have been suggested for this concept. These definitions have eventually coalesced to one similar in spirit to that given by Simons (1938): comprehensive income may be defined as the algebraic sum of the market value of rights exercised in consumption and the change in the value of the store of property rights between the beginning and end of the period in question. This is known as the Haig-Simons definition of comprehensive income. Bradford (1986) refers to this concept of income as “accrual income.”

Let C represent consumption, E represent current earned income plus any transfers received, W represent wealth, and r represent the return on wealth (e.g., the interest rate on a savings account). Under the Haig-Simons definition, comprehensive income is equal to $C + \Delta W$. However, as a simple matter of accounting, this is also equal to $E + rW$. Thus, $E + rW = C + \Delta W$ is taken as the tax base under an income tax.

It is useful to think of ΔW as saving that can be negative if the individual is borrowing. Thus, the base under a comprehensive income tax could also be described as consumption plus saving in accordance with a user’s definition of income.

However, the tax base under a consumption tax would simply be C or $E + rW - \Delta W$ instead. Thus, the consumption base is lower (higher) than the income base for a net saver (borrower). The consumption base in the aggregate is smaller than the income base if society is accumulating capital ($\Delta W > 0$).

The basic notion behind the definition of comprehensive or accrual income is that it measures an individual’s command over resources. A change in accrual income signals a change in the individual’s command over resources. If, for example, an individual experiences an unexpected capital gain on an investment, her or his power to consume has increased and presumably she or he should pay more in income tax as a result. Note that this is true even if the gain has not actually been realized but has only accrued, as in the case of an increase in the value of one’s home.

Then, the government should calculate comprehensive income, which is the sum of all income in a given year, and apply a progressive tax rate on it. Hence, the same tax rate is applied both to labor income and interest income.

The prevailing view among conventional tax theorists is that individuals should pay tax on the basis of their comprehensive income. Further, the driving force in tax policy should be to define and measure comprehensive income carefully. Unfortunately, measuring comprehensive or accrual income can be difficult, if not

impossible, to accomplish for several reasons, as pointed out by Bradford (1986) and Kay and King (1986), among others.

1.3 Expenditure Tax

However, our argument in Sect. 1.1 means that the ideal tax base is expenditure or consumption only; thus, interest income should not be taxed. As shown in Eq. (9.5), with regard to present value budget constraint, consumption is equal to labor income. Hence, taxing expenditure or consumption is the same as taxing labor income (see also Sect. 4). Expenditure tax may be regarded as taxing labor income, only without taxing interest income.

Thus, the foregoing analysis in Sect 1.1 suggests that from the viewpoint of efficiency, expenditure (or consumption) tax is more desirable than comprehensive income tax. Moreover, since consumption is more stable than income, consumption is a better indicator of economic ability than income. Consequently, expenditure tax is desirable from the viewpoint of horizontal equity, which is the criterion that persons with the same economic ability should pay the same burden of tax. If present value budget constraint in terms of stock variables is more meaningful than budget constraint in terms of flow variables, expenditure tax is more desirable than comprehensive income tax.

1.4 Endogenous Labor Supply

So far, we have assumed that labor income Y is exogenous and hence independent of labor income tax, t_w . If we relax this assumption, as in Chap. 8, labor income tax is not necessarily more desirable than interest income tax. Then, expenditure tax is not desirable either from the viewpoint of efficiency.

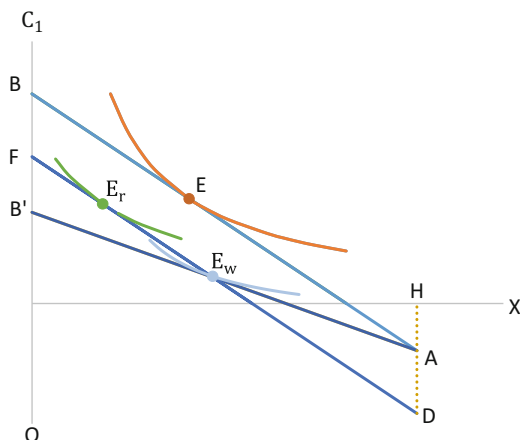
In order to explore this point in an extreme fashion, we now assume that labor income is endogenous but that second-period consumption is somehow exogenously fixed. Namely, we assume that because of some social or institutional constraints, optimal second-period consumption is exogenously fixed, independent of the tax rate, but that labor supply is endogenously determined.

Let us denote first-period leisure by x , first-period available labor supply time by Z , and actual labor supply by $L (= Z - x)$. Then, Eqs. (9.5) and (9.6) are rewritten as

$$c_1 + (1 - t_w)wx = (1 - t_w)wZ - \frac{1}{1+r}c_2 \text{ and} \quad (9.5')$$

$$c_1 + wx = wZ - \frac{1}{1+r(1-t_r)}c_2. \quad (9.6')$$

Fig. 9.2 The optimizing behavior of a household



Equation (9.5') corresponds to the labor income case and Eq. (9.6') the interest income tax case.

The optimizing behavior of a household with respect to c_1 and x is described in Fig. 9.2. In this diagram, the vertical axis denotes c_1 and the horizontal axis denotes x since the agent chooses c_1 and x subject to her or his budget constraint. AH corresponds to the exogenously given optimal level of second-period consumption. Here the problem is to choose c_1 and x .

With regard to $t_r > 0$, from Eq. (9.6') the relative price between c_1 and x is independent of t_r . By imposing t_r , the budget line moves from AB to DF . However, with regard to $t_w > 0$, from Eq. (9.5') the slope of the budget line becomes flatter in accordance with the tax. The budget line moves from AB to AB' . Hence, as shown in Fig. 9.2, utility at E_r is higher than utility at E_w . This means that interest income tax is more desirable than labor income tax in order to raise the same tax revenue. This is because the interest income tax is now a lump sum tax on the exogenously given second-period consumption.

In reality, labor supply and second-period consumption are both endogenously determined to some extent. Thus, the issue of which tax is more desirable is generally ambiguous from the efficiency viewpoint. The optimal tax rule that minimizes the excess burden, explained in Sect. 2, suggests that if labor supply is less elastic than second-period consumption, labor income tax becomes more desirable, and vice versa.

1.5 The Negative Incentive Effect and Optimal Taxation

Some argue that it is optimal not to tax interest income or asset income, and that expenditure tax is desirable. However, as explained above, the argument is generally invalid. If saving is less elastic than labor supply, it may be desirable to tax interest income heavier than labor income.

In the real world, labor supply is often institutionally fixed. In this regard, we may justify expenditure tax to some extent. However, labor supply can be volatile in the long run. The negative incentive effect of tax is not generally ignored, even in the case of labor income tax. Thus, it is important to compare various tax bases from the viewpoint of efficiency. The relation between the negative incentive effect or the substitution effect and the tax rate is the main concern of optimal taxation from the viewpoint of efficiency.

2 The Theory of Optimal Taxation

2.1 Theoretical Framework

In this section, we briefly explain the theory of optimal taxation. The optimal taxation problem of the so-called Ramsey model has the following assumptions.

- (i) The tax schedule available for the government involves multiple consumption taxes on several consumption goods. Labor income tax is not available.
- (ii) Consumers are identical; thus, we may use the concept of a representative agent. Income inequality among consumers is not considered.
- (iii) The representative consumer maximizes her or his utility at given consumer prices by allocating her or his income among consumption goods.
- (iv) The consumer price is equal to the producer price plus a tax on the good.
- (v) The government determines multiple tax rates on consumption goods so as to maximize the utility of the representative agent subject to the required tax revenue. In doing so, the government incorporates the utility maximizing behavior of the representative consumer into the optimization problem.

In other words, the government intends to minimize the total excess burden subject to the revenue requirement. Consider a two good economy with good 1 and good 2. Figure 9.3 draws the compensated demand curve and the supply curve for each good. The demand curve is downward sloping and the supply curve is a horizontal line since we assume the constant producer price. As shown in Fig. 9.3, the government collects tax revenues of $T_1 + T_2$ by imposing taxes t_1 and t_2 on good 1 and good 2 respectively. Imposing taxes produces excess burdens of E_1 and E_2 on good 1 and good 2 respectively. Thus, the government intends to minimize the sum of the excess burdens, $E_1 + E_2$, subject to the same revenue requirement of $T_1 + T_2$ by choosing t_1 and t_2 .

2.2 The Ramsey Rule

The solution of this optimal tax problem is called the Ramsey rule. See Ramsey (1927). In general terms, the Ramsey rule adopts a complicated formula, as shown

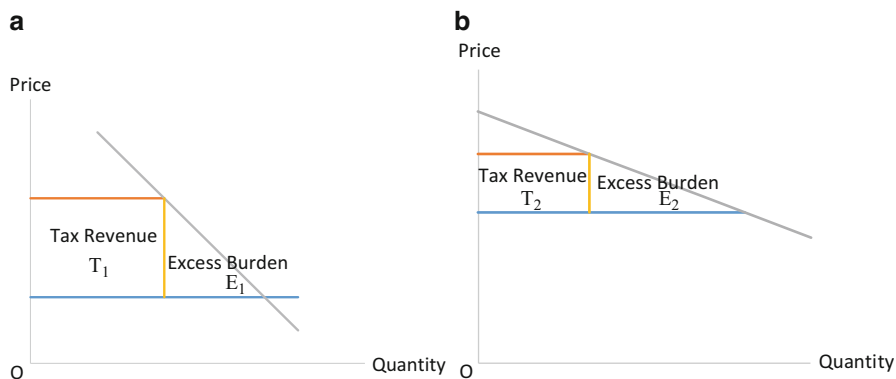


Fig. 9.3 (a) An inelastic good, (b) An elastic good

in Sect. 2.3; however, under some restrictive assumptions, we may derive the following two results.

2.2.1 The Inverse Elasticity Proposition

If compensated demand is independent, namely if the cross-substitution effect is zero, the optimal tax rate for each good is inversely proportional to its price elasticity.

Compensated demand is the demand when income is adjusted to make utility fixed. The effect of a price on compensated demand, or the derivative of compensated demand with respect to its own price, corresponds to the substitution effect. If the cross-substitution effect is zero, the compensated demand curve does not move in accordance with changes in taxes on the other good.

Then, intuitively, the area below the compensated demand curve shows the size of the consumer surplus. The area between the compensated demand curve and the constant producer price curve shows the excess burden. This proposition implicitly means that the ratio of the excess burden to tax revenue should be equalized for all goods. Namely, if the tax rate changes marginally, the change of the excess burden and of tax revenue should be equal for all goods at the optimum. The inverse elasticity proposition implies that if the cross-substitution effect is zero for all goods, it is optimal to impose a higher tax rate on a less elastic good with respect to its price.

In Fig. 9.3, the ratio of E_1 to T_1 should be the same as the ratio of E_2 to T_2 . Thus,

$$\frac{E_1}{T_1} = \frac{E_2}{T_2}.$$

As shown in Fig. 9.3, suppose good 1 is an inelastic good and good 2 is an elastic good. The less the elasticity of a good, the smaller the size of the excess burden.

Thus, a higher tax rate does not produce a larger distortionary cost. It follows that it is desirable to impose a higher tax rate on such a good.

The implication behind the inverse elasticity rule is straightforward. Efficient taxes distort decisions as little as possible. The potential for distortion is greater the more elastic the demand for a commodity. Thus, efficient taxation requires that relatively high rates of taxation are levied on relatively inelastic goods.

If the cross-substitution effect is not zero, the compensated demand curve moves in accordance with changes in taxes on the other good. Then, the excess burden depends upon the cross-substitution effect as well as the good's own substitution effect. Consequently, we have the Ramsey rule as explained in Sect. 2.3.

2.2.2 The Uniform Tax Rate Proposition

If the compensated price elasticity of leisure with respect to each good is equal, it is optimal to impose a labor income tax only or a uniform tax on each good except those related to leisure.

This proposition implies that if other conditions are equal, it is not beneficial to impose divergent tax rates on many consumer goods. If tax rates change significantly among a range of goods, the excess burden changes more than the tax rates. In particular, the tax rate, which is already high, is raised further and the excess burden increases significantly, raising the overall excess burden to a notable extent. Thus, if other conditions are equal, it is desirable to impose a uniform tax rate on all consumer goods or the labor income tax only. Note that uniform consumption tax is equivalent to labor income tax, as explained in Sect. 4.

An application of this proposition is known as the Corlett-Hague (1953) proposition in the form of a three-goods model with two consumption goods and leisure. This proposition (the Corlett-Hague rule) states:

It is optimal to impose a higher tax rate on the good that is more complementary to leisure.

In effect, high taxes on complements to leisure provide an indirect way to gain access to leisure in taxation terms and hence move closer to the perfectly efficient outcome that would be possible if leisure is taxable.

2.3 Mathematical Formulation

The Ramsey rule is a basic criterion for any optimal taxation problem. See Diamond and Mirrlees (1971). We derive this rule using a dual approach. Suppose in the economy that there is only one consumer. This individual consumes leisure and two goods. Producers produce two consumption goods and a public good, g , by applying leisure (labor). The variable indexed by 3 is associated with leisure and the variables indexed by 1 and 2 are associated with the consumption goods. The prices

that the consumer faces are called the consumer's prices and are denoted by the vector $\mathbf{q} = (q_1, q_2, q_3)$. The consumer's net demand vector is $\mathbf{x} = (x_1, x_2, x_3)$. The consumer's utility function is given by $u = u(x_1, x_2, x_3)$.

Then, the consumer's budget equation is given as

$$q_1x_1 + q_2x_2 + q_3x_3 = 0. \quad (9.7)$$

Note that the consumer's net demand for leisure, x_3 , is negative and her or his demand for other goods is positive on the relevant domain of the prices. Namely, net leisure is the difference between leisure $Z - L$, and available time, Z . Thus, $x_3 = (Z - L) - Z$. Alternatively, it is minus labor supply, $-L$. Equation (9.7) is the same as the standard expression of budget constraint:

$$q_1x_1 + q_2x_2 = q_3L, \quad (9.7')$$

where the left-hand side denotes consumption spending and the right-hand side denotes after-tax wage income.

The production possibility frontier is the constant cost type. The production possibility frontier is given as

$$p_1x_1 + p_2x_2 + p_3x_3 + g = 0, \quad (9.8)$$

where producer's prices, $\mathbf{p} = (p_1, p_2, p_3)$, are constants. This constraint is also the same as

$$p_1x_1 + p_2x_2 + g = p_3L, \quad (9.8')$$

where the left-hand side corresponds to total output and the right-hand side corresponds to labor input.

Specific excise taxes and a wage tax are imposed. Thus, we have

$$q_i = t_i + p_i, \quad i = 1, 2, 3. \quad (9.9)$$

When a positive wage tax is imposed, the consumer's after-tax pay is less than the amount that her or his employer pays. This implies $q_3 < p_3$ and $t_3 < 0$. An increase in t_3 implies a decrease in the wage tax. For example, $p_3 = w$ and $q_3 = (1 - t_w)w$. Then, $t_3 = -t_w w$. Thus, we have $t_3x_3 = t_w wL > 0$.

The tax revenue collected is spent on the public good. The government budget constraint is given as

$$t_1x_1 + t_2x_2 + t_3x_3 = g. \quad (9.10)$$

Equation (9.10) may be derived from Eqs. (9.7), (9.8), and (9.9). Thus, this equation will not explicitly be considered below as a constraint.

Using the dual approach, the consumer's optimizing behavior may be summarized in terms of the expenditure function:

$$E(q, u) = 0. \quad (9.11)$$

Equation (9.11) summarizes the optimizing behavior of the consumer and the budget constraint. The production possibility frontier, Eq. (9.8), may be rewritten as

$$p_1 E_1(q, u) + p_2 E_2(q, u) + p_3 E_3(q, u) + g = 0, \quad (9.12)$$

where $E_i = \frac{\partial E}{\partial q_i} = x_i(q, u)$ ($i = 1, 2, 3$), is the compensated demand function for good i .

The maximization problem is to maximize utility, u , subject to Eqs. (9.11) and (9.12). The associated Lagrange function is given as

$$V = u - \lambda_1 E(q, u) - \lambda_2 [p_1 E_1(q, u) + p_2 E_2(q, u) + p_3 E_3(q, u) + g], \quad (9.13)$$

where λ_i ($i = 1, 2$) is a Lagrange multiplier.

The first-order conditions are given as

$$\frac{\partial V}{\partial q_i} = -\lambda_1 E_i - \lambda_2 [p_1 E_{1i} + p_2 E_{2i} + p_3 E_{3i}] = 0, \quad (i = 1, 2, 3), \quad (9.14)$$

where $E_{ij} = \frac{\partial^2 E}{\partial q_i \partial q_j}$ denotes the substitution effect. Considering Eq. (9.9), Eq. (9.14) may be rewritten as

$$\frac{(q_1 - t_1)E_{1i} + (q_2 - t_2)E_{2i} + (q_3 - t_3)E_{3i}}{E_i} = -\frac{\lambda_1}{\lambda_2}.$$

Considering the homogeneity condition, $\sum q_i E_{ij} = 0$, and the symmetrical cross effects, $E_{ij} = E_{ji}$, we obtain the Ramsey rule as

$$\frac{t_1 E_{i1} + t_2 E_{i2} + t_3 E_{i3}}{E_i} = \frac{\lambda_1}{\lambda_2}. \quad (9.15)$$

Alternatively, in the elasticity term, we have

$$e_1 \sigma_{i1} + e_2 \sigma_{i2} + e_3 \sigma_{i3} = \frac{\lambda_1}{\lambda_2} \quad (i = 1, 2, 3), \quad (9.15')$$

where $e_i = t_i/q_i$ is the effective tax rate and $\sigma_{ij} = q_j E_{ij}/E_i$ is the compensated elasticity. The Ramsey rule means that under an optimal tax structure, the marginal deadweight burden of a unit increase in each tax rate is proportional to the demand for that good. Alternatively, the marginal excess burden is proportional to the marginal tax revenue for that good.

From the Ramsey rule (9.15) or (9.15'), we may derive some special propositions, as explained in Sect. 2.2.

The Inverse Elasticity Proposition Assume that the cross-substitution terms among the commodities are all zero ($E_{ij} = 0$ for $i \neq j$). Then, the intrinsic tax rate of a commodity is inversely related to its demand elasticity. Thus,

$$e_i = \frac{\lambda}{\sigma_{ii}} \quad (i = 1, 2, 3), \quad (9.16)$$

where $\lambda = \lambda_1/\lambda_2$ takes a common value for $i = 1, 2, 3$.

The Uniform Tax Rate Proposition A uniform tax structure is optimal if and only if wage elasticities of demand are equal for all commodities; namely, $\sigma_{13} = \sigma_{23}$. Thus,

$$e_1 = e_2 = e_3 \quad (9.17)$$

2.4 Heterogeneous Households

Imagine that households are heterogeneous with respect to income. Then, the optimal tax rule should include efficiency and equity factors. If a progressive income tax is available, the government may use it to deal with the equity issue, as explained in Chap. 11. However, if a progressive income tax is not available, the consumption tax has to deal with efficiency and equity issues.

From the viewpoint of efficiency, it is desirable to impose a higher tax on a less elastic good. However, from the viewpoint of equity, it is desirable to impose a lower tax on a good with a higher distributional indicator, which is the weighted average of the social marginal utility of each consumer's income using his or her demand properties as weights.

Generally, the good with a high distributional indicator is normally a necessity, which is less elastic. Poor people consume necessity goods a great deal. Thus, from the equity viewpoint, a less elastic necessity good should not be taxed more heavily. This rule is inconsistent with the famous inverse elasticity proposition because such a necessity is less elastic and should be taxed more heavily. In other words, there is a trade-off between the objectives of efficiency and equity. In contrast, a luxury good is very elastic and should not be taxed more heavily from the viewpoint of efficiency. However, since rich people consume luxury goods more than poor people, such goods should be levied more heavily than necessity goods from the viewpoint of equity.

In general, optimal departure from the Ramsey rule depends upon the following considerations. The first is how much society cares about equality. The second is the extent to which the consumption patterns of the rich and poor differ. If the rich and the poor consume the same goods in the same proportion, taxing the goods at different rates cannot affect the distribution of income. The third consideration is the extent of inequality in the economy. If income inequality is large, the equity consideration becomes more important than the efficiency consideration, and vice versa.

3 The Theory of Tax Reform

3.1 Optimal Taxation and the Theory of Tax Reform

The optimal tax approach has been criticized in several respects. In this section, we explain the tax reform approach as an alternative method of tax policy. One could argue that the Ramsey-type optimal tax formula is not useful from the viewpoint of realistic applicability. Namely, the government may not have precise information about the utility function and market equilibrium conditions. Moreover, it may be difficult for the government to change the tax system drastically because of various constraints such as political privileges on existing tax rates and conflicts among interest groups. Thus, the government can only change tax rates gradually and partially. It may also be difficult to find a social welfare function that is acceptable for most people in a democratic society.

Feldstein (1976) criticized the optimal taxation approach based on these difficulties. He proposed an alternative tax reform approach that gradually reforms the existing tax system toward the desirable target,

In other words, the optimal tax approach investigates the optimal tax system freely from the beginning, while the tax reform approach is concerned with the gradual change of the actual tax system.

3.2 The Fundamental Rule of Tax Reform

Let us explain the fundamental rule of tax reform, using a similar framework as the optimal taxation approach. Imagine that specific consumption taxes are initially imposed on most goods before tax reform and that a given amount of revenue is collected. By conducting a tax reform, a new set of tax rates is imposed on goods. The government has to collect the same amount of tax revenue as before. The problem is how to raise the utility of the representative agent after the tax reform.

Let us denote a vector of goods by $\mathbf{x}$, their consumer prices by $\mathbf{q}$, their tax rates by $\mathbf{t}$, and their producer prices by $\mathbf{p}$. For example, in the two-goods model, we have $\mathbf{x} = (x_1, x_2)$, $\mathbf{q} = (q_1, q_2)$, $\mathbf{t} = (t_1, t_2)$, and $\mathbf{p} = (p_1, p_2)$.

We have the following identity equation with respect to the relation among $\mathbf{q}$, $\mathbf{t}$, and $\mathbf{p}$:

$$\mathbf{q} = \mathbf{p} + \mathbf{t}. \quad (9.18)$$

We assume for simplicity that producer prices are fixed, independent of the tax reform.

The budget constraint of a household is applicable before the reform and after the reform, given respectively as

$$\mathbf{q}_A \mathbf{x}_A = M \text{ and } \mathbf{q}_B \mathbf{x}_B = M, \quad (9.19)$$

where M is the exogenously given income, subscript A means before the reform, and subscript B after the reform. The government budget constraint is given as

$$t_A x_A = t_B x_B. \quad (9.20)$$

The government collects the same tax revenue before and after the reform.

A sufficient condition that the utility of a household increases in accordance with the tax reform is given as

$$q_B x_A \leq q_B x_B \quad (9.21)$$

As shown in Fig. 9.4, this condition implies that the consumption vector before the reform evaluated at after-reform consumer prices, point X_A , is interior to the budget line that corresponds to the consumer vector after the reform, point X_B . In this regard, if, inversely, utility declines in accordance with the reform, the household could have chosen x_A rather than x_B at q_B . Indeed, the household chooses x_B . Thus, its utility certainly increases.

From Eqs. (9.18), (9.19), and (9.20), we have

$$p x_A = p x_B. \quad (9.22)$$

Using this equation, Eq. (9.22) may be rewritten as

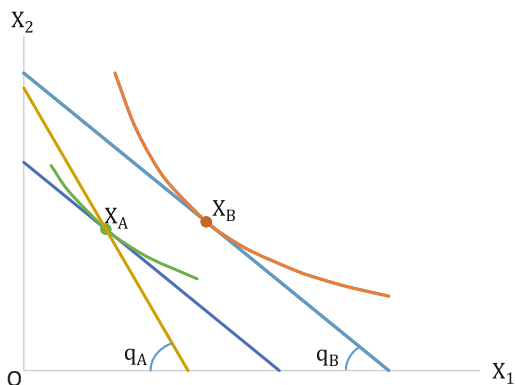
$$t_B x_A \leq t_B x_B$$

or

$$t_B (x_B - x_A) \geq 0. \quad (9.23)$$

In other words, the sufficient condition for the desirability of the reform is that the change in the amount of consumption evaluated at the after-reform tax rates becomes non-negative. Alternatively, inequality (9.22) means that if it is evaluated at the new tax rates, tax revenue does not decline.

Fig. 9.4 The theory of tax reform



3.3 Application to Some Examples

3.3.1 Enlarging the Tax Base

Consider a tax reform aimed at enlarging the tax base for all consumption goods except those related to leisure. The desirability of this reform is judged according to whether it depresses labor supply, which is not included as a tax base after the reform.

As explained in Chap. 8, with regard to the Cobb-Douglas utility function, labor supply is independent of consumption good prices; hence, this tax reform does not affect labor supply. It follows that it is desirable to enlarge the tax base. As a result, it is optimal to tax uniformly all consumption goods with a uniform consumption tax or, with regard to the Cobb-Douglas utility function, to tax labor income only with a labor income tax.

3.3.2 Unifying Tax Rates

Next, consider a tax reform aimed at imposing a uniform tax rate on goods that are initially taxed at different rates. This reform is the same as the foregoing reform that enlarges the uniform tax base.

This similarity arises because enlarging the tax base may be regarded as integrating tax rates from initially different rates, which include a zero rate, with a uniform rate. Thus, if the value added of taxable goods does not decline or the value added of a non-taxable good, leisure, does not increase, unifying tax rates is desirable. With regard to the Cobb-Douglas utility function, uniform tax structure is always desirable.

We have shown how the fundamental reform rule may be applied to the reform of an enlarged tax base or the integration of tax rates. This criterion may be useful because information on changes in consumption goods is readily available.

4 General Consumption Tax and Labor Income Tax

4.1 The Equivalence Theorem

The general consumption (or expenditure) tax or value added tax is widely imposed in many countries. We now compare a general consumption tax and a labor income tax with regard to raising the same tax requirement. Let us denote the consumption tax rate by t_c . This tax is imposed on consumption in general. In a two-period model, the budget constraint in each period is written as

$$c_1 = Y - s - t_c c_1 \quad \text{and} \quad (9.24)$$

$$c_2 = (1 + r)s - t_c c_2. \quad (9.25)$$

Y is labor income in period 1. $t_c c_1$ and $t_c c_2$ are tax payments on consumption. The present value budget constraint is now given as

$$c_1 + \frac{1}{1+r}c_2 = \frac{1}{1+t_c}Y. \quad (9.26)$$

This equation is similar to the present value budget constraint, Eq. (9.5), of the labor income tax:

$$c_1 + \frac{1}{1+r}c_2 = Y(1-t_w). \quad (9.5)$$

In particular, if the following condition is maintained,

$$\frac{1}{1+t_c} = 1-t_w, \quad (9.27)$$

both equations are equivalent. In other words, if Eq. (9.27) is maintained, labor income tax and consumption tax have the same effect on economic variables. Namely, the government may collect the same amount of tax revenue, and the economic impacts on labor supply and consumption are the same. This is the equivalence theorem between consumption and labor income tax.

For example, if $t_w = 0.2$ and $t_c = 0.25$, equivalence is maintained. In other words, changes in the consumption tax rate and labor income tax for the same amount of tax revenue have no effect on the real economy. Note that this equivalence holds even if we also consider labor income in period 2. Moreover, this theorem holds in the endogenous labor supply model.

Intuitively, this is because the tax base is the same for the two taxes. Namely, the present value of consumption is equal to the present value of labor income. As long as the tax base is the same, taxing at the stage of receiving income and taxing at the stage of spending on consumption should have the same economic effect.

4.2 A One-Period Model

We may explain this theorem in a one-period model intuitively. In the one-period model, the before-tax budget constraint is given as

$$c = wL. \quad (9.28)$$

Consumption c is equal to labor income, wL . Thus, the tax bases of consumption tax and labor income tax are the same. The after-tax budget constraint is

$$(1+t_c)c = wL \quad \text{for the consumption tax case and} \quad (9.29)$$

$$c = (1-t_w)wL \quad \text{for the labor income tax case.} \quad (9.30)$$

As long as Eq. (9.27) holds, both constraints, Eqs. (9.29) and (9.30), are the same. Hence, the economic effect of taxation is the same between t_c and t_w .

From Eqs. (9.29) and (9.30), it is easy to derive

$$t_w wL = t_c c \quad (9.31)$$

The government collects the same tax revenue as long as condition (9.27) is satisfied.

Note that this equivalence result holds even if labor supply is endogenously determined. The disincentive effect of labor income tax on labor supply is the same as the disincentive effect of consumption on labor supply since the budget constraint is affected in the same way. Similarly, the disincentive effect of consumption tax on consumption is the same as the disincentive effect of labor income tax on consumption. Labor income tax does not have a stronger disincentive effect on labor than consumption tax. Similarly, consumption tax does not have a stronger effect on consumption than labor income tax. Both taxes are the same from the viewpoint of efficiency costs.

4.3 Some Remarks

This equivalence theorem corresponds to Ricardian debt neutrality as described in Chap. 4 since the agent is supposed to behave in terms of the present value budget constraint. However, if the household does not behave in terms of present values, Ricardian neutrality is not necessarily maintained. In this regard, the equivalence theorem between consumption and labor income taxes is not maintained either.

For example, if a consumer is subject to liquidity constraint, then she or he cannot borrow at the same rate of interest as the saving rate. Thus, she or he cannot behave in terms of present values. In such a case, the equivalence theorem is invalid unless saving is zero. However, if the agent does not save at all, the one-period model would apply. Section 4.2 shows that the equivalence result still holds in such a circumstance.

Alternatively, progressive labor income tax and proportional consumption tax are not equivalent. With regard to progressive tax, the tax burden depends on the time path of income; hence, present value budget constraint cannot describe the constraint of the optimizing behavior of the household.

Moreover, if we consider bequests in the model, consumption and labor income do not necessarily coincide. Unless bequests are taxed at the consumption tax rate, the equivalence theorem does not hold. With bequests, e , the budget constraint, Eq. (9.26), is rewritten as

$$c_1 + \frac{1}{1+r}c_2 + e_1 = \frac{1}{1+t_c}Y + (1+r)e_0 \quad (9.26')$$

where e_0 is the bequest that the agent receives from her or his parent, and e_1 is the bequest that the agent leaves for her or his child. If the following condition occurs,

$$e_1 = (1 + r)e_0,$$

the equivalence result still holds. This condition means that the agent does not consume the bequest that she or he receives from the parent and just leaves the bequest to her or his child.

Even if the equivalence theorem is maintained, two important differences exist between a consumption tax and a labor income tax. One is the effect on macroeconomic saving; the other is the conflict among generations during transition. Both effects originate from the timing effect of taxation, although these effects are irrelevant to microeconomic incentive effects. If the equivalence theorem is maintained, the budget constraint of a household is the same; thus, microeconomic effects are equivalent. Nevertheless, the timing of tax payments differs between the two taxes. The timing effect may have an important implication for the macroeconomic effect, as explained in Sect. 5.

5 The Timing Effect of Taxation

5.1 The Overlapping-Generations Model

First, we explain the conflict among generations during the transition of a tax reform. An increase in consumption tax affects the tax burden among generations differently because of the timing effect of taxation. For simplicity, we consider the incidence of lump sum taxes using a simple two-period overlapping-generations model because the timing effect can be analyzed by investigating income effects. Each generation lives for two periods: the young and old periods. Let us call generation t the generation that is born at the beginning of $t - 1$ and dies at the end of t .

The government has to collect a given amount of tax, say 10, in each period. The government can impose different taxes on the young generation and the old generation. The population of each generation is normalized as 1 and stationary. An increase in consumption tax effectively changes the timing of taxation and hence affects the different incidence on each generation. The timing effect of taxation concerns the income effect only; thus, it may be analyzed by changes in lump sum taxes.

Table 9.1 shows the situation whereby the government initially collects taxes from the young generation in the amount of 5 and from the old generation in the amount of 5. In Table 9.1a, in period 3 a tax reform is conducted so that after period 3 the young generation pays 0 and the old generation pays 10. The timing of taxation is moved to the later period of life. However, in Table 9.1b, because of tax reform in period 3, the young generation pays 10 and the old generation pays 0. The timing of taxation is moved toward the earlier period. In either instance, the government still collects 10 in each period as before.

Table 9.1 Tax collection from young and old generations

a	Period						
	Generation	1	2	3	4	5	
	1	5					
	2	5	5				
	3		5	10			
	4			0	10		
	5				0	10	

b	Period						
	Generation	1	2	3	4	5	
	1	5					
	2	5	5				
	3		5	0			
	4			10	0		
	5				10	0	

5.2 The Incidence of Tax Reform

Let us investigate the incidence of tax reform for each generation. The lifetime tax burden of each generation may be calculated by adding up the taxes for the two periods. For simplicity, we assume that the rate of interest is zero.

In Table 9.1a, the burden of generation 3 rises to 15 while the burden for other generations remains 10 as before. In Table 9.1b, the burden of generation 3 declines to 5 while the other generations pay 10 as before. Comparing 1(i) and 1(ii), tax reform affects the incidence of the transitional generation, generation 3, only.

Comparing these two cases, all generations except generation 3 pay the same amount of lifetime taxes, 10, as before. From this viewpoint, tax reform is indifferent for them. If so, reform 1(ii) is better than reform 1(i) because generation 3 is more prosperous. The suggestion is that with regard to the timing effect of taxation, if this transfers the tax burden toward the earlier period of life, a tax reform is always desirable.

Generation 3 represents the interest of transitional generations. For these generations, tax payments before the reform are not affected by the reform. Their welfare may be affected only by tax payments after the reform. Thus, the timing of taxation toward the earlier period of life reduces their tax burden in the old period, which benefits the transitional generation.

5.3 Transitional Generations

The tax reform whereby labor income tax is reduced and consumption tax is raised may be regarded as transferring the burden from the young period to the old period. The timing of taxation is moved to the later period of life. Thus, the old generation during the transition is less prosperous.

This tax reform is equivalent to taxing consumption in the old period only for the transitional generation because this generation's choice of consumption and saving in the young period cannot be revised any more. In this sense, an increase in the

consumption tax rate affects the transitional generation in the same way as a lump sum tax. This tax is efficient in the sense that it does not produce distortionary disincentive effects. However, it harms the old generation.

In contrast, the tax reform whereby timing is transferred toward the earlier period of life, such as by reducing consumption taxes and raising labor income taxes, benefits the transitional generation. The other generations are not directly affected. This tax reform is essentially the same as issuing public debt.

5.4 The Effect on Saving and Economic Growth

The effect of a move from labor income tax to consumption tax on the incidence of each generation has another implication: The tax reform also affects future generations in a general equilibrium framework. This is because the timing of taxation affects the size of saving in a macroeconomy. If the timing of taxation transfers the fiscal burden from the old to the young period, the saving of the young declines. Since the future tax burden reduces, a household need not save more when young. This effect is theoretically the same as the pay-as-you-go pension system described in Chap. 7.

In other words, the reverse tax reform of postponing the fiscal burden to the later period of life stimulates saving. The tax reform of substituting labor income tax with consumption tax means postponing the tax burden until the future; hence, such a reform has the impact of stimulating saving. This stimulates capital accumulation, thereby benefiting future generations by raising their wage income when young. Namely, the tax reform in Table 9.1a benefits future generations although it harms the transitional generation.

The advanced study of this chapter explains the tax timing effect more fully.

6 Simulation Analysis of Tax Reform

6.1 Multi-Period Overlapping-Generations Growth Model

The tax reform whereby consumption tax is raised and labor income tax is reduced has been intensively investigated by using simulation analysis.

The first classical study is a paper by Summers (1981). In this paper, the author used an overlapping-generations growth model whereby each generation lives for 55 years and works for 40 years. Then, each generation retires for the last 15 years. In this regard, Summers investigated the quantitative effect of tax reform.

A household chooses its optimal consumption and saving for 55 years based on present value budget constraint. The population grows exogenously, technological growth is included, and labor supply is exogenous. GDP is produced by two inputs, labor supply and capital in the aggregate production function. Output is distributed to labor and capital owners according to marginal productivity. The government

collects a given amount of taxes by imposing a labor income tax, a capital income tax, and a consumption tax.

According to Summers's analysis, the most desirable tax to maximize long-run welfare is a consumption tax. The second is a labor income tax, and the last is a capital income tax. The difference between a consumption tax and labor income tax originates from the timing effect. As explained previously, a consumption tax stimulates saving and capital accumulation, enhancing long-run welfare. The difference between a labor income tax and a capital income tax is with respect to the interest elasticity of saving. If the elasticity of saving is large, capital income tax reduces capital accumulation to a significant extent.

The reason why elasticity is large is because of the human capital effect, as explained in Chap. 8; namely, an increase in the after-tax interest rate reduces the present value of future labor income, reducing the effective income. This depresses present consumption and hence stimulates saving. Considering this effect, even if the conventional substitution effect is not large, the interest elasticity of saving could be significantly large. If so, a reduction of the capital income tax rate stimulates saving and capital accumulation to a significant extent by reducing the after-tax rate of return on saving.

To sum up, there are two reasons why the consumption tax prevails over the labor income tax in improving welfare under the simulated reform in Summers's model. First, the capital intensity of production is higher under the consumption tax reform. This raises the wage level and hence consumption above the increase due to the labor income tax reform. This is because the economy moves closer to the golden rule level of capital under the consumption tax reform than under the labor income tax reform.

This situation mainly occurs because under a labor income tax, the taxpayer pays the bulk of her or his taxes when she or he is working; whereas under a consumption tax, the tax liability is more evenly spread over the life cycle. Thus, under a consumption tax, the taxpayer has to save more when working in order to pay her or his future tax than she or he does under the wage tax; thus, saving and the capital intensity of production are higher, as explained above.

Second, the present value of the taxpayer's tax liability is lower under the consumption tax reform than under the labor income tax reform. This occurs because those who are alive at the time of the transition experience a heavier tax burden than those who are living in the new, post-reform steady state. However, steady-state welfare calculations may be a poor indicator of the true costs and benefits of a tax reform, as noted by Summers. Further, the transition may be rapid; hence, only a few generations may be less prosperous under the proposed reform.

6.2 Comments by Evans (1983)

Evans (1983) criticized Summers's work on several grounds. Evans argued that simulation models are useful tools for providing guidance but are not the same as doing careful empirical work. A key parameter such as the interest elasticity of

saving can only be uncovered through careful empirical analysis. Further, Evans demonstrated that the large interest elasticity that Summers calculated is not robust to small changes in the assumed parameters of the simulation model.

Evans showed that the larger the rate of time preference, the lower the interest elasticity of saving. In addition, the lower the population growth rate and the growth rate of the economy, which were both empirically relevant for the 1970s and 1980s, the smaller the interest elasticity.

For example, if both growth rates are 1 % rather than 1.5 % and 2 %, respectively, and the intertemporal elasticity of substitution is one-third, the interest elasticity of saving calculated by Evans is only 0.35 when the time preference rate is zero. This cannot be ruled out given the range of empirical estimates cited by Evans. These saving elasticities are much closer to the empirical literature on the subject and also slightly lower than Boskin's (1978) preferred estimate of 0.40; however, they are an order of magnitude lower than Summers's result.

Third, Summers's calculation of interest elasticity is partial equilibrium in nature; it does not include the feedback effect of greater savings on the interest rate. In a partial equilibrium, the capital stock, and hence the wage rate and the gross interest rate, may be taken as exogenous. This may be justified under a small country assumption where capital flows are beyond the local government's control; thus, it makes sense to calculate the interest elasticity of saving since the interest rate is exogenous.

In contrast, in a general equilibrium model, an exogenous increase in the net interest rate, say, which is caused because the presumed exogenous interest income tax rate has fallen, induces more saving. However, a greater flow of saving in this period raises the capital stock in the next period; thus, the interest rate in the next period reduces. This tends to reduce saving in the next period and thus moderates the total increase in saving in response to the initial increase in the net interest rate. Consequently, general equilibrium elasticity is smaller than partial equilibrium elasticity. In defense of Summers, however, whether the general equilibrium calculation of Evans is more appropriate depends entirely upon whether the economy is open to capital flows, which is an empirical issue.

Fourth, Evans connected generations with altruistic cash bequests, thus making the consumer's horizon infinite. It is well known that the partial equilibrium elasticity of saving is infinite in this situation. However, Evans showed that the general equilibrium elasticity for the parameters used by Summers yields an interest elasticity of only 1.33 when generations are connected by bequests. Since this is an upper bound, Summers's assertion that the elasticity is greater than 2.00 is "out of the question." Indeed, in general, Evans shows that the larger the bequest, the larger the saving rate and the wealth-income ratio, but the smaller the interest elasticity of saving. Under one plausible circumstance, interest elasticity is only 0.2 and in some instances is even negative, for example, -0.01 .

Of course, these extensions substantially alter the calculation of the welfare gain to be had from the tax reforms considered by Summers. Qualitatively, although a consumption tax stimulates capital accumulation, thereby benefiting future generations, it harms the old generation during the transition. Following Summers's

paper, many simulation studies have investigated the size of the long-run benefit and the short-run loss. This is a quantitative matter. Many simulation results suggest that the long-run benefit is larger than the short-run loss. Nevertheless, there are many complicated factors, such as heterogeneous households, that must be investigated further. See Batina and Ihori (2000) for more discussions on this topic.

Appendix A: Optimal Taxation in an Overlapping-Generations Economy

A1 The Optimal Tax Rule

A1.1 Overlapping-Generations Growth Model

The theory of optimal taxation is one of the oldest topics of public finance. Originally, the studies centered on the theory of optimal consumption taxation. Ramsey (1927) published the first theoretical result, which proved to be the starting point of a great many studies on the subject and is well known today as the Ramsey tax rule, as explained in the main text of this chapter. This appendix examines the optimal combination of consumption taxes, labor income taxes, and capital income taxes in an overlapping-generations growth model, based on Diamond (1965). In the context of economic growth, we must also consider dynamic efficiency; namely, the golden rule. After investigating the first best solution, this appendix intends to clarify the relationship between the Ramsey rule and the golden rule when lump sum taxes are not available.

We apply the overlapping-generations model of the advanced study from Chap. 5, in which every individual lives for two periods. We extend this basic model by incorporating several distortionary taxes and by allowing for endogenous labor supply; otherwise, a labor income tax becomes a lump sum tax.

An individual living in generation t has the following utility function:

$$u_t = u(c_t^1, c_{t+1}^2, x_t), \quad (9.A1)$$

where c^1 is the individual's first-period consumption, c^2 is second period consumption, and $x = (Z - l) - Z = -l$ is first-period net leisure. Z is the initial endowment of labor supply.

The individual's consumption, saving, and labor supply programs are restricted by the following first- and second-period budget constraints:

$$(1 + \tau_t)c_t^1 = (1 - \gamma_t)w_t l_t - s_t - T_t^1 \quad \text{and} \quad (9.A2)$$

$$(1 + \tau_{t+1})c_{t+1}^2 = [1 + r_{t+1}(1 - \theta_{t+1})]s_t - T_{t+1}^2, \quad (9.A3)$$

where τ is the consumption tax rate, γ is the tax rate on labor income, w is the real wage rate, s is the individual's real saving, r is the real rate of interest, and θ is the

tax rate on capital income. T_t^1 is the lump sum tax levied on the young in period t and T_t^2 is the lump sum tax levied on the old in period t .

From Eqs. (9.A2) and (9.A3), the individual's lifetime budget constraint reduces to

$$q_{1t}c_t^1 + q_{2t+1}c_{t+1}^2 + q_{3t}x_t + T_t = 0, \quad (9.A4)$$

where $\mathbf{q}_t = (q_{1t}, q_{2t+1}, q_{3t})$ is the consumer price vector for generation t . Thus, we have the following relationships between consumer prices and tax rates:

$$q_{1t} = 1 + \tau_t, \quad (9.A5.1)$$

$$q_{2t+1} = \frac{1 + \tau_{t+1}}{1 + r_{t+1}(1 - \theta_{t+1})}, \text{ and} \quad (9.A5.2)$$

$$q_{3t} = (1 - \gamma_t)w_t. \quad (9.A5.3)$$

The present value of a lifetime lump sum tax payment on the individual of generation t (T_t) is given as

$$T_t = T_t^1 + \frac{T_{t+1}^2}{1 + r_{t+1}(1 - \theta_{t+1})}. \quad (9.A5.4)$$

Equilibrium in the capital market is simply

$$s_t = (1 + n)k_{t+1}l_{t+1}, \quad (9.A6)$$

where n is the rate of population growth and k is the capital/labor ratio.

The feasibility condition is in period t :

$$c_t^1 + \frac{c_t^2}{1 + n} + g + (1 + n)k_{t+1}l_{t+1} = w_t l_t + r_t k_t l_t + k_t l_t, \quad (9.A7)$$

where g is the government's expenditure per individual of the younger generation.

The government budget constraint in period t is given as

$$\tau_t c_t^1 + \frac{\tau_t c_t^2}{1 + n} + \theta_t r_t k_t l_t + \gamma_t w_t l_t + T_t^1 + \frac{T_t^2}{1 + n} = g. \quad (9.A8)$$

Equation (9.A8) may be rewritten in terms of tax wedge:

$$t_{1t}c_t^1 + t_{2t}c_t^2 + t_{3t}x_t + T_t^1 + \frac{T_t^2}{1 + n} = g, \quad (9.A8')$$

where t_i is a tax wedge and is given as

$$t_{1t} = \tau_t = q_{1t} - 1, \quad (9.A9.1)$$

$$t_{2t} = \frac{\tau_t}{1+n} + \frac{\theta_t r_t k_t l_t}{c_t^2} = \frac{q_{2t}(1+r_t) - 1}{1+n} + \frac{\theta_t r_t T_t^2}{(1+n)[1+r_t(1-\theta_t)]}, \text{ and } (9.A9.2)$$

$$t_{3t} = -\gamma_t w_t = q_{3t} - w_t. \quad (9.A9.3)$$

The tax wedge t_i is the difference between the consumer price q_i and the producer price. Note that labor income taxation means $t_3 < 0$ since $x < 0$. Capital income taxation ($q_2 > 1/(1+r)$) means that the consumer price of c^2 is greater than the producer price ($t_2 > 0$). $1/q_2 - 1$ is the after-tax net rate of the return on saving. Thus, for $T^2 = 0$, t_2 is given as

$$(1+n)t_2 = \frac{\left[(1+r) - \frac{1}{q_2}\right]s}{c^2} = q_2(1+r) - 1.$$

On the left-hand side, we multiply $(1+n)$ because t_2 is an effective tax rate on second-period consumption; hence, it is relevant for the older generation.

Observe that the government budget constraint, Eq. (9.A8), is consistent with the production feasibility condition, Eq. (9.A7). Namely, one of the three equations, Eqs. (9.A4), (9.A7), and (9.A8), is not an independent equation that can be derived by the other two equations.

A1.2 Dual Approach

It is useful to formulate the optimal tax problem by using the dual approach. Let us write $E(\mathbf{q}_t, u_t)$ for the minimum expenditure necessary to attain utility level u_t when prices are $\mathbf{q}_t = (q_{1t}, q_{2t+1}, q_{3t})$. Then, we have

$$E(q_t, u_t) + T_t = 0, \quad (9.A10)$$

which implicitly defines the utility level of generation t as a function of consumer prices: $\mathbf{q}_t$ and lump sum taxes T_t . Eq. (9.A10) incorporates the lifetime budget constraint, Eq. (9.A4).

However, as in the advanced study of Chap. 5, Appendix, the factor price frontier is written as

$$w_t = w(r_t), \quad (9.A11)$$

where

$$w'(r_t) = -k_t < 0 \text{ and } w'' > 0.$$

From Eqs. (9.A3), (9.A5.4), (9.A6), (9.A10) and (9.A11), we can express the second-period budget constraint in terms of compensated demands as

$$q_{2t+1}E_2(q_t, u_t) + T_t - T_t^1 = (1+n)w'(r_{t+1})E_3(q_{t+1}, u_{t+1}). \quad (9.A12)$$

E_i denotes the partial derivatives for the expenditure function with respect to price q_i ($i = 1, 2, 3$). Note that $E_3 = x = -l < 0$. We call Eq. (9.A12) the compensated capital accumulation equation.

The production feasibility condition, Eq. (9.A7), is also rewritten in terms of compensated demands as

$$E_1(q_t, u_t) + \frac{E_2(q_{t-1}, u_{t-1})}{1+n} + (1+n)w'(r_{t+1})E_3(q_{t+1}, u_{t+1}) + [w(r_t) - (1+r_t)w'(r_t)]E_3(q_t, u_t) + g = 0. \quad (9.A13)$$

A2 The First Best Solution

First of all, let us investigate the first best solution where two types of lump sum tax, T^1 and T^2 , are available. Then, the government does not have to impose any distortionary taxes: $\tau = \theta = \gamma = 0$. The government's objective at time 0 is to choose taxes to maximize an intertemporal social welfare function, W , expressed as the sum of generational utilities discounted by the factor of social time preference, β .

The associated Lagrange function is given as

$$W = \sum_{t=0}^{\infty} \beta^t \left\{ u_t - \lambda_{1t} [E(q_t, u_t) + T_t] - \lambda_{2t} \left[E_1(q_t, u_t) + \frac{E_2(q_{t-1}, u_{t-1})}{1+n} + g + (1+n)w'(r_{t+1})E_3(q_{t+1}, u_{t+1}) + (w(r_t) - (1+r_t)w'(r_t))E_3(q_t, u_t) \right] - \lambda_{3t} [q_{2t+1}E_2(q_t, u_t) + T_t - T_t^1 - (1+n)w'(r_{t+1})E_3(q_{t+1}, u_{t+1})] \right\}, \quad (9.A14)$$

where λ_{1t} , λ_{2t} , and λ_{3t} are Lagrange multipliers for the private budget constraint (9.A10), the resource constraint (9.A13), and the capital accumulation equation (9.A12) respectively.

Differentiating the Lagrangian function, Eq. (9.A14), with respect to T_t , T_t^1 , and r_{t+1} respectively, we have

$$\frac{\partial W}{\partial T_t} = -\beta^t (\lambda_{1t} + \lambda_{3t}) = 0, \quad (9.A15.1)$$

$$\frac{\partial W}{\partial T_t^1} = \beta^t \lambda_{3t} = 0, \text{ and} \quad (9.A15.2)$$

$$\frac{\partial W}{\partial r_{t+1}} = 0 \quad (9.A15.3)$$

Considering the homogeneity condition, $(\sum_{j=1}^3 q_j E_{ij} = 0)$ and $\tau = \theta = \gamma = 0$, in the steady state, Eq. (9.A15.3) reduces to

$$1 + n = \beta(1 + r) \quad (9.A16)$$

This is the modified golden rule, which is the standard optimality condition of capital accumulation. The optimal levels of T^1 and T^2 are solved to satisfy the government budget constraint, Eq. (9.A8), and the modified golden rule, Eq. (9.A16). When two types of lump sum tax, T^1 and T^2 , are available, the government can attain the modified golden rule, Eq. (9.A16), at the first best solution.

A3 Second Best Solution

We are now ready to investigate normative aspects of distortionary tax policy. From this point on, we do not impose lump sum taxes: $T_t^1 = T_t^2 = 0$. First, let us investigate the situation where all the consumer prices, q_1 , q_2 , and q_3 , are optimally chosen. In other words, we assume that the government can choose consumption taxes, wage income taxes, and capital income taxes optimally although lump sum taxes are not available.

The maximization problem may be solved in two stages. In the first stage, one can choose $\{r_{t+1}\}$ and $\{q_t = (q_{1t}, q_{2t+1}, q_{3t})\}$ ($t = 0, 1, \dots$) so as to maximize W . In the second stage, one can choose (τ, γ, θ) to satisfy Eqs. (9.A5.1), (9.A5.2), and (9.A5.3). Thus, our main concern here is with the first stage problem. The optimization problem is solved in terms of the consumer price vector. The actual tax rates affect the problem only through the consumer price vector.

In other words, the problem is to maximize

$$\begin{aligned} W = \sum_{t=0}^{\infty} \beta^t \{ & u_t - \lambda_{1t} E(q_t, u_t) - \lambda_{2t} [E_1(q_t, u_t) + \frac{E_2(q_{t-1}, u_{t-1})}{1+n} + g \\ & + (1+n)w'(r_{t+1})E_3(q_{t+1}, u_{t+1}) + (w(r_t) - (1+r_t)w'(r_t))E_3(q_t, u_t)] - \\ & \lambda_{3t} [q_{2t+1}E_2(q_t, u_t) - (1+n)w'(r_{t+1})E_3(q_{t+1}, u_{t+1})] \}. \end{aligned} \quad (9.A17)$$

Equations (9.A10) and (9.A13) both have zero degree with respect to the q vector, but Eq. (9.A12) does not. We consider the problem as follows. The maximum W is subject to Eqs. (9.A10) and (9.A13), and q_t is uniquely determined

to a proportionality. Then, Eq. (9.A12) gives the level of q_{2t+1} , which is consistent with the solution of our main problem. Thus, we obtain

$$\lambda_{3t} = 0. \quad (9.A18)$$

Differentiating the Lagrangian function, (9.A17), with respect to q_{1t} , q_{2t+1} , and q_{3t} , we have

$$\begin{aligned} \frac{\partial W}{\partial q_j} = \beta^t \{ & -\lambda_{1t} E_j(q_t, u_t) - \lambda_{2t} E_{1j}(q_t, u_t) - \lambda_{2t+1} \frac{E_{2j}(q_t, u_t) \beta}{1+n} - \\ & \lambda_{2t-1} \frac{E_{3j}(q_t, u_t)(1+n)w'(r_t)}{\beta} - \lambda_{2t} [w(r_t) - (1+r_t)w'(r_t)] E_{3j}(q_t, u_t) \} = 0 \\ & (j = 1, 2, 3). \end{aligned} \quad (9.A19)$$

Differentiating with respect to r_{t+1} , we obtain

$$\begin{aligned} \frac{\partial W}{\partial r_{t+1}} = & -\beta^t \{ \lambda_{2t} (1+n)w''(r_{t+1}) E_3(q_{t+1}, u_{t+1}) - \\ & \lambda_{2t+1} \beta (1+r_{t+1})w''(r_{t+1}) E_3(q_{t+1}, u_{t+1}) \} = 0. \end{aligned} \quad (9.A20)$$

In a steady state, Eq. (9.A20) means

$$1+n = \beta(1+r) \quad (9.A16)$$

Considering Eq. (9.A20) and the homogeneity condition ($\sum_{j=1}^3 q_j E_{ij} = 0$), Eq. (9.A19) in the steady state reduces to

$$\begin{aligned} \lambda_1 E_j - \lambda_2 \{ & (q_{1j} - 1) E_{1j} + \left(q_{2j} - \frac{\beta}{1+n} \right) E_{2j} + \left[-\frac{(1+n)w'}{\beta} + q_{3j} - w + \right. \\ & \left. (1+r_t)w' \right] E_{3j} \} = 0 \end{aligned}$$

or

$$\frac{t_1 E_{1i} + \beta t_2 E_{2i} + t_3 E_{3i}}{E_i} = \frac{\lambda_1}{\lambda_2} \quad (i = 1, 2, 3). \quad (9.A21)$$

Equation (9.A21) is the modified Ramsey rule, an extension of the standard Ramsey rule for the intertemporal setting with β . Note that β appears in the second-period excess burden in Eq. (9.A21). Hence, when all consumer prices are available, the optimality condition is given by the modified golden rule, Eq. (9.A16), and the modified Ramsey rule, Eq. (9.A21) (see Ihori 1981).

A4 Optimal Taxation in the Second Best Case

A4.1 The Modified Ramsey Rule

If $\beta = 1$, Eq. (9.A21) will be reduced to the standard Ramsey rule. In other words, if the government is concerned with steady state utility only, we have the standard Ramsey rule as well as the golden rule. The standard Ramsey rule describes the static efficiency point.

There is an important difference between our modified Ramsey rule and the standard static Ramsey rule even if we are only concerned with long-run welfare, ignoring transition ($\beta = 1$). Our rule is derived under the assumption that all effective taxes are available in the sense that the government can choose all consumer prices (q_1, q_2, q_3). This is because one cannot normalize $\mathbf{q}$ in a dynamic system (unless lump sum taxes are available).

Atkinson and Sandmo (1980) derived the standard Ramsey rule in the circumstance where debt policy is employed to achieve a desired intertemporal allocation. This rule (and hence the golden rule) is, however, also relevant to the second best solution where neither lump sum taxation nor debt policy is available. This is because changes in consumption taxes and labor income taxes have lump sum timing effects. Namely, an increase in consumption taxes with a reduction in labor income taxes is equivalent to an increase in lump sum taxes in the second period of life with a reduction in lump sum taxes in the first period of life. This tax timing effect is explained in the main text of the current chapter.

A4.2 The Elasticity Term

Assume for simplicity of interpretation that the cross-substitution effects are zero ($E_{ij} = 0$ for $i \neq j$). Then, from Eq. (9.A21), we have in the elasticity form

$$e_1 \sigma_{11} = \beta e_2 \sigma_{22} = e_3 \sigma_{33}, \quad (9.A22)$$

where e_i is the effective tax rate (t_i/q_i) and σ_{ij} is compensated elasticity ($q_j E_{ij}/E_i$).

If labor supply is completely inelastic (along the compensated supply curve), the optimal tax on second-period consumption is zero, while the tax on labor income is equivalent to a lump sum tax and could be set arbitrarily high. If, however, the demand for future consumption is inelastic, the argument is reversed, and future income is the ideal tax base from an efficient view.

In general, the optimal rate of effective tax, e_i , depends upon the relative magnitudes of the elasticities. There is no particular reason to believe that the optimal rate should be the same for the three sources of the tax base. This interpretation carries over, with appropriate modifications, to the situation of non-zero cross-elasticities.

A4.3 The Implicit Separability Condition

Considering the homogeneity condition in elasticity terms, $\sum_{j=1}^3 \sigma_{ij} = 0$ ($i = 1, 2, 3$), Eq. (9.A21) may be reduced to

$$-e_1(\sigma_{12} + \sigma_{13} + \sigma_{21}) + \beta e_2(\sigma_{21} + \sigma_{23} + \sigma_{12}) = e_3(\sigma_{23} - \sigma_{13}). \quad (9.A23)$$

If $\sigma_{13} = \sigma_{23}$, Eq. (9.A23) is reduced to

$$(\sigma_{12} + \sigma_{13} + \sigma_{21})(\beta e_2 - e_1) = 0, \quad (9.A24)$$

which implies $\beta e_2 = e_1$. Considering Eqs. (9.A9.1), (9.A9.2), and (9.A16), we obtain $q_1 = (1+r)q_2$. Substituting Eqs. (9.A5.1) and (9.A5.2) into the above equation, we finally have $\theta = 0$. Thus, the optimal tax on interest income is zero. $\sigma_{13} = \sigma_{23}$ is called the implicit separability condition. If this condition is satisfied, the government should not impose interest income tax.

A4.4 Two Objectives and Intertemporal Efficiency

In this economy, the government intends to realize two objectives: intertemporal efficiency and financing the public good, g . When two types of lump sum tax on the young, T^1 , and the old, T^2 , are available, the government can attain these two objectives at the same time. We call this the first best solution.

However, if the government cannot control the total amount of lump sum taxes, T , but can control the combination of T^1 and T^2 , it can realize intertemporal efficiency with the modified golden rule, but cannot finance the public good without imposing static efficiency costs. This situation is an example of the second best solution. Such an example is essentially the same as distortionary taxes with an ideal debt policy. The modified Ramsey rule is relevant as in the situation where all consumer prices are optimally chosen.

A4.5 The Lagrange Multiplier

From Eq. (9.A14), an increase in T^1 at given T^2 means $\frac{\partial W}{\partial T^1} + \frac{\partial W}{\partial T} = \lambda_3 - (\lambda_1 + \lambda_3) = -\lambda_1$. Thus, λ_1 corresponds to the marginal benefit of lump sum transfer for each individual of the younger generation financed by distortionary taxes. λ_1 is normally negative in the static model but may be positive in the present dynamic model. This is because an increase in disposable income in the first period of an individual's life stimulates saving and capital accumulation, which may improve the dynamic efficiency of the economy.

λ_2 corresponds to the positive marginal benefit of a decrease in government revenues: $\sigma_{22} < 0$ and $\sigma_{33} > 0$. $\sigma_{23} > (<) 0$ and $\sigma_{32} < (>) 0$ if c^2 and x are substitutes (complements). If γ and θ are positive, $e_2 > 0$ and $e_3 < 0$. Hence, $\sigma_{33} - \sigma_{23} > 0$ implies that $e_2 > 0$. $\sigma_{22} - \sigma_{32} < 0$ implies that $e_3 < 0$ if λ_1 is negative. This is exactly what one would expect from the static optimal efficiency point.

A5 Heterogeneous Individuals and Distributional Objectives

We have been concerned with the generality of the (modified) golden rule and the (modified) Ramsey rule in a growing economy. It has been shown that even with the second best solution, the golden rule and the Ramsey rule hold if all effective non-lump sum taxes are available. We have then shown that when consumption taxes are not available, the mixed Ramsey-golden rule holds. Here, the optimal formulae include divergence from the golden rule at the third best solution.

A few studies have considered the optimal tax mix for an economy with heterogeneous individuals and distributional objectives. As pointed out before, if debt policy is chosen optimally, the intuition of the static results provides the correct guidance for tax policy in a dynamic economy. The standard separability result suggests that labor income taxes may be more efficient than capital income taxes, at least in some circumstances. Atkinson and Stiglitz (1976) and Stiglitz (1985) showed that if, with an optimal nonlinear income tax, the utility function is weakly separable between labor and all combined goods, there is no need to employ differential indirect taxation to achieve an optimum.

Further, Deaton (1981) has shown that where there are many consumers, and only a linear income tax and proportional commodity taxes are allowed, weak separability between goods and leisure, together with linear Engel curves for goods, remove the need for differential commodity taxation. When applied directly to the taxation of saving, the optimal capital income tax rate may be reduced to zero. Atkinson and Stiglitz (1976) suggested that the reason for the asymmetry between labor income and capital income is not because labor income is taxed in a nonlinear fashion, but because the difference between people is based on their wages and not the rates of return on saving.

Appendix B: Tax Reform Within Lump Sum Taxes

B1 Introduction

Appendix A of this chapter characterized tax structures that maximize the sum of generational utilities discounted by the social time preference in an overlapping-generations growth model. Because the incentive effects are complicated and sensitive to parametric structure, theory alone cannot provide clear-cut guidance to efficient dynamic tax structures. With the general model, the rates of tax are highly sensitive to the compensated elasticities and covariances. Unfortunately, we have little empirical data on some of these parameters.

At this stage, we have two alternatives. One is to address the quantitative issues of the incentive effects, using numerical simulation models in which agents live for many periods, as explained in the main text of this chapter. The other is to eliminate the incentive effects. It should be stressed that the impact on intergenerational incidence of converting an income tax to either a consumption or wage tax does not depend solely on the difference in such incentive effects on a representative person.

Consumption taxes and labor income taxes are equivalent from the viewpoint of household budget constraint. Both taxes affect the relative price of consumption over time in the same way, as also explained in the main text of this chapter.

The present appendix thus employs the second approach that eliminates the incentive effects. Namely, within the framework of lump sum taxation, this advanced study, Appendix B intends to analyze theoretically the effect of the timing of tax payments on the welfare of earlier generations during the transition process.

The rationale for this approach is not that we believe that such incentive effects of distortionary taxes are unimportant. Rather, the aim of this approach is to demonstrate that even if there are no incentive effects, different taxes generate different intergenerational incidence because consumers differ in their timing of payments of taxes. This is called the tax timing effect. The difference between consumption and labor income taxation is not the incentive effect. The tax reform concerning consumption and labor income taxation may well be evaluated within the framework of lump sum tax reform. It is useful to analyze the implications of lump sum tax reform for intergenerational incidence more fully.

Essentially, if the rate of interest is greater than the rate of population growth, the effect of consumption tax is to reduce the lifetime present value of taxation by postponing tax payments to later in life. This is called the tax postponement effect. Based on Ihori (1987), we theoretically investigate under what circumstances the tax postponement effect is relevant and how the timing of tax payments affects intergenerational incidence.

B2 Analytical Framework

The model is almost the same as in Appendix A. For simplicity, it is assumed that labor supply is exogenous. We now incorporate lump sum taxes instead of distortionary taxes into the overlapping-generations model of Appendix A. Thus, a person born in period t has the following saving function:

$$s_t = s(w_t, r_{t+1}, T_t^1, T_t). \quad (9.B1)$$

Assuming consumption to be normal, $0 < s_w < 1$, $0 > s_{T^1} = \partial s / \partial T^1 > -1$, and $0 < s_T = \partial s / \partial T < 1$. However, the sign of s_r depends on the relative magnitude of income and substitution effects. For simplicity, s_t is assumed to be independent of r_{t+1} .

Hence, the economy may be summarized by the following equation, where T_t^1 and T_t are policy variables:

$$s[w(r_t), T_t^1, T_t] = -(1+n)w'(r_{t+1}). \quad (9.B2)$$

In order to analyze the welfare aspect of tax reform on each generation, it is useful to explore the dynamic properties of the economy. Under the stability

condition, r will monotonously converge to the long-run equilibrium level, r_L . This implies

$$0 < \frac{-s_w w'}{(1+n)w''} < 1 \quad (9.B3)$$

at the steady state equilibrium.

The government budget constraint for period t is simply

$$T_t^1 + \frac{T_t^2}{1+n} = g. \quad (9.B4)$$

The present value of lifetime lump sum tax payment on an individual of generation t (T_t) is given as

$$T_t = T_t^1 + \frac{T_{t+1}^2}{1+r_{t+1}}. \quad (9.B5)$$

From Eqs. (9.B4) and (9.B5), we have

$$T_t = \frac{(r_{t+1} - n)T_t^1}{1+r_{t+1}} + \frac{(1+n)g}{1+r_{t+1}} + \frac{T_{t+1}^2 - T_t^2}{1+r_{t+1}}. \quad (9.B5')$$

Obviously, $T_t^1 = T_{t+1}^1 = T^1$ and $T_t^2 = T_{t+1}^2 = T^2$ when the tax structure is time invariant. T_t^2 , T_{t+1}^2 , and the third term appear only when the tax structure is time variant.

B3 Lump Sum Tax Reform

B3.1 The Tax Postponement Effect

Suppose that the government changes the combination of lump sum taxes (T^1 , T^2) in period $j+1$. T^2 is raised and T^1 is reduced. This yields:

$$T_j^2 < T_{j+1}^2 = T_{j+2}^2 = T^2 \text{ and } T_j^1 > T_{j+1}^1 = T_{j+2}^1 = T^1$$

First, let us investigate the partial equilibrium effect of tax reform on the present value of the lifetime tax payment T . If $r > n$, postponing tax payments to later in life ($T^1 \rightarrow T^2$) means a reduction of the lifetime present value of taxation. This is the so-called the tax postponement effect.

For future generations, $j+1+i$ ($i=1, 2, \dots$) for Eq. (9.B5') means that the present value of tax payments, T , decreases if and only if $r > n$. If $r > n$, this gives an extra benefit to the future generation. If $r < n$, the tax postponement effect is unfavorable for the future generation.

For the existing younger generation $j+1$, the tax postponement effect works in the same way as with the future generation. The tax postponement effect is relevant to the steady state and the transition process. For the existing older generation j , T_{j+1}^2 is increased, while T_j^1 is not reduced. Thus, the lifetime present value of taxation T_j is raised. This corresponds to the third term of Eq. (9.B5') and gives an extra burden to generation j . The result may be called the direct tax reform effect or the time horizon effect.

During the transition, the earlier generation may suffer significant reductions in welfare because of the tax reform. Note that this effect works irrespective of whether r is greater than n or not. In this sense, the effect should be distinguished from the tax postponement effect.

B3.2 The Effect on Savings

Let us investigate the impact of tax reform on savings. A reduction of T^1 directly increases an individual's saving. However, if $r > n$, the decrease in T^1 reduces T and hence indirectly reduces her or his saving. However, considering (9.B5'), we have

$$\frac{\partial s}{\partial T^1} = s_{T^1} + \frac{(r-n)s_T}{1+r} < -1 + \frac{r-n}{1+r} = -\frac{1+n}{1+r} < 0. \quad (9.B6)$$

Hence, the direct effect of T^1 is always greater than the indirect effect of T^1 : An individual's saving is raised irrespective of the sign of $r-n$. The lump sum tax reform ($T^1 \rightarrow T^2$) increases the saving of the existing younger generation $j+1$ and the future generation.

This may be called the (permanent) tax timing effect. This tax reform imposes a tax liability later in the life cycle. As a result, taxpayers tend to increase their saving early in the life cycle in order to meet the additional tax liability later in the life cycle.

The impact of this tax reform on generation j 's saving depends upon whether a member of generation j anticipates this tax reform in period j or not. If an individual of generation j does not anticipate the reform, her or his saving is unaffected by the tax reform. If she or he anticipates the reform, an increase in T_{j+1}^2 raises T_j and hence increases s_j . This may be called the (temporary) tax timing effect.

Because of the tax reform, the saving function of future generations moves upward. Hence, the tax reform stimulates capital accumulation during the transition path. The new long-run equilibrium capital/labor ratio, k_{L1} , is greater than the initial long-run equilibrium ratio, k_{L0} . Thus, the tax reform ($T^1 \rightarrow T^2$) stimulates capital accumulation in the long run.

If a member of generation j anticipates the tax reform, generation j 's saving is greater than the level indicated by the initial saving function. This leads to an extra initial capital endowment to generation $j+1$. Thus, generation j 's extra saving stimulates capital accumulation during the earlier transition process. Note that this temporary tax timing effect disappears in the long run.

B3.3 The Welfare Effect of Tax Reform

We now explore the welfare aspect of tax reform during the growth process. Let us examine the effect of tax reform on the utility of each generation $j+i$, u_{j+i} ($i=0, 1, 2, \dots$). If the tax reform is to increase T^2 and reduce T^1 from period $j+1$ on, u_j definitely decreases. This is because of the direct tax reform effect.

Moreover, if a member of generation j does not anticipate the tax reform, u_j reduces further. The effect on the future generation $j+i$ ($i=1, 2, \dots$) depends upon the tax postponement effect and the temporary and permanent tax timing effects. If $r > n$, the tax postponement effect is favorable for the future generation.

B4 The Tax Timing Effect

B4.1 The Welfare Implication of the Tax Timing Effect

Let us investigate the welfare aspect of the tax timing effect. In order to analyze the welfare of each generation explicitly, it is useful to employ the expenditure function approach as in Appendix A. The system is summarized by

$$E\left[\frac{1}{1+r_{t+1}}, u_t\right] = w(r_t) - T_t \quad \text{and} \quad (9.B7)$$

$$E_2\left[\frac{1}{1+r_{t+1}}, u_t\right] = -(1+n)(1+r_{t+1})w'(r_{t+1}) - T_{t+1}^2, \quad (9.B8)$$

where $E[\cdot]$ denotes the expenditure function and $E_2[\cdot]$ denotes the compensated demand function for second-period consumption. Differentiating Eqs. (9.B7) and (9.B8) comprehensively, we have

$$\begin{aligned} & \begin{bmatrix} E_u, & E_2 \frac{-1}{(1+r_{t+1})^2} \\ E_{2u}, & E_{22} \left[\frac{-1}{(1+r_{t+1})^2} \right] + (1+n)(w' + (1+r_{t+1})w'') \end{bmatrix} \begin{bmatrix} du_t \\ dr_{t+1} \end{bmatrix} \\ &= \begin{bmatrix} w' \\ 0 \end{bmatrix} dr_t, \end{aligned} \quad (9.B9)$$

where $E_u = \partial E / \partial u_t$, $E_{2u} = \partial E_2 / \partial u_t$ and $E_{22} = \partial E_2 / \partial \left(\frac{1}{1+r_{t+1}} \right)$. Hence,

$$\frac{du_t}{dr_t} = \frac{1}{\Delta} w' \left\{ E_{22} \left[\frac{-1}{(1+r_{t+1})^2} \right] + (1+n)[w' + (1+r_{t+1})w''] \right\}, \quad (9.B10)$$

where Δ is the determinant of the matrix of the left-hand side of Eq. (9.B9). In addition, we have

$$\frac{dr_{t+1}}{dr_t} = -\frac{E_{2u}w'}{\Delta}. \quad (9.B11)$$

Under the global stability condition, $0 < dr_{t+1}/dr_t < 1$ at the steady state solution. Hence, $\Delta > 0$. The sign of $[.]$ in Eq. (9.B10) is positive if the elasticity of substitution between labor and capital is large, which is consistent with the stability condition, Eq. (9.B3). In such an instance, a higher capital endowment given to an individual's generation makes her or his lifetime utility higher. An increase in k_t raises w_t and lowers r_{t+1} . The former effect increases u_t , while the latter effect decreases u_t . If the elasticity of substitution is large, a decrease in r_t raises w_t significantly. The net effect is likely to increase u_t under the stability condition.

Thus, on the transitional growth process where capital accumulation is monotonously increased, each generation's lifetime utility is monotonously increased. Note that this favorable tax timing effect works, irrespective of the sign of $r - n$. Consequently, generation j 's extra saving is favorable for those future generations that are close to generation j . For distant future generations, generation j 's extra saving is unimportant. In this sense, the temporary tax timing effect is relevant only to future generations that are close to the present. The utility of distant generations depends upon whether long-run equilibrium is closer to the golden rule because of the tax reform than before. Hence, if $r > n$, the tax reform ($T^1 \rightarrow T^2$) is favorable for distant future generations from the viewpoint of the tax postponement effect and the permanent tax timing effect.

B4.2 Summary

Our analysis of tax reform and intergenerational incidence may be summarized in Table 9.B1, which shows that if $r > n$, tax reform has different impacts on the current older generation and the current younger and future generations. Namely, the tax reform ($T^1 \rightarrow T^2$) harms the current older generation and benefits the future generation. However, the reverse tax reform ($T^1 \leftarrow T^2$) benefits the existing older

Table 9.B1 Tax reform and intergenerational incidence

Tax Reform		Current older generation	Near future generation	Distant future generation
$T^1 \rightarrow T^2$	$r > n$	DTR(−)	TPP(+)	TPP(+)
			TTT(+)	PTT(+)
	$r < n$	DTR(−)	TPP(−)	TPP(−)
			TTT(+)	PTT(−)
$T^1 \leftarrow T^2$	$r > n$	DTR(+)	TPP(−)	TPP(−)
			TTT(−)	PTT(−)
	$r < n$	DTR(+)	TPP(+)	TPP(+)
			TTT(−)	PTT(+)

Notes: (i) (+) means a favorable effect, and (−) means an unfavorable effect

(ii) *DTR* denotes the direct tax reform effect, *TPP* denotes the tax postponement effect, *TTT* denotes the temporary tax timing effect, and *PTT* denotes the permanent tax timing effect

generation and harms the future generation. This is a trade-off relationship between the current older generation's welfare and the future generation's welfare.

As is well known, if $r > n$, the growth path is efficient in the sense that no generation is better off unless some generations are worse off. In contrast, suppose the growth path is inefficient: $r < n$. Then, tax reform affects the welfare of the current older generation and the distant future generation in the same direction. However, even in this situation, if a member of the current older generation anticipates the tax reform, the temporary capital accumulation effect produces a trade-off relationship between the current older generation and the future generation that is close to the present.

B5 Some Remarks

So far, we have considered the circumstance whereby taxes are lump sum. Our analysis suggests that the direct tax reform, the tax postponement, the temporal tax timing, and the permanent tax timing effects are important for the evaluation of tax reform. However, when taxes are distortionary, how would the results of this study be affected? With regard to the timing of tax payments, a wage tax corresponds to T^1 and a capital income tax corresponds to T^2 .

A consumption tax may be regarded as a combination of T^1 and T^2 . Among the three taxes, an individual pays wage taxes early in life. In this sense, converting a wage tax to a consumption tax is associated with the tax reform ($T^1 \rightarrow T^2$). It should be stressed that the difference between consumption and labor income taxation is not the exemption from taxation of capital income or the incentive effect, but the different timing of tax payments. Thus, a tax reform concerning consumption and labor income taxation may well be evaluated within the framework of lump sum tax reform.

With regard to the income effect, the implications of distortionary tax reform are the same as in this study. For example, if the tax reform ($T^1 \rightarrow T^2$) is desirable, then a capital income tax is better than a wage or consumption tax. However, a change in the tax rate on capital income also has an incentive effect. If the interest elasticity of saving is large, a reduction of the capital tax is desirable during the efficient growth process.

The lump sum tax reform model developed here should be regarded as a complement to the incentive analysis that has been used to compare income, wage, and consumption taxes. The standard incentive and simulation analyses are better suited to capturing the differing incentive effects of each tax.

The lump sum tax approach is better suited to exploring qualitatively the consequences of the differing timing of tax payments, an aspect of reality that has not been systematically analyzed in most of the literature that compares consumption, wages, and income tax. Even with the incentive effects ignored, the differing timing of tax payments causes consumption, wages, and income tax to achieve

different intergenerational incidence during the transition process when tax rates are set to achieve identical tax revenue per worker.

Questions

9.1 Say whether the following is true or false and explain the reason.

A smaller tax rate is always more desirable than a larger tax rate in order to collect the same revenue.

9.2 In a two-period model, assume that the agent earns labor income in both periods. Show that the equivalence hypothesis between general consumption tax and labor income tax still holds.

9.3 Explain why the timing effect of taxation concerns only the income effect.

References

- Atkinson, A., & Sandmo, A. (1980). Welfare implications of the taxation of savings. *Economic Journal*, 90, 529–49.
- Atkinson, A. B., & Stiglitz, J. E. (1976). The design of tax structure: Direct versus indirect taxation. *Journal of Public Economics*, 6, 55–75.
- Batina, R., & Iori, T. (2000). *Consumption tax policy and the taxation of capital income*. Oxford: Oxford University Press.
- Boskin, M. (1978). Taxation, saving and the rate of interest. *Journal of Political Economy*, 86, S3–S27.
- Bradford, D. (1986). *Untangling the income tax*. Cambridge, MA: Harvard University Press.
- Corlett, W. J., & Hague, D. C. (1953). Complementarity and the excess burden of taxation. *Review of Economic Studies*, 21, 21–30.
- Deaton, A. (1981). Optimal taxes and the structure of preferences. *Econometrica*, 49, 1245–1260.
- Diamond, P. A. (1965). National debt in a neoclassical growth model. *American Economic Review*, 55, 1126–1150.
- Diamond, P. A., & Mirrlees, J. (1971). Optimal taxation and public production I and II. *American Economic Review*, 61, 273–291.
- Evans, O. J. (1983). Tax policy, the interest elasticity of saving, and capital accumulation: Numerical analysis of theoretical models. *American Economic Review*, 73, 398–410.
- Feldstein, M. (1976). On the theory of tax reform. *Journal of Public Economics*, 6, 77–104.
- Iori, T. (1981). The golden rule and the Ramsey rule at a second best solution. *Economics Letters*, 8, 89–93.
- Iori, T. (1987). Tax reform and intergeneration incidence. *Journal of Public Economics*, 33, 377–387.
- Kay, J. A., & King, M. (1986). *The British tax system*. Oxford: Oxford Press.
- Ramsey, F. P. (1927). A contribution to the theory of taxation. *Economic Journal*, 37, 47–61.
- Simons, H. (1938). *Personal income taxation*. Chicago: University of Chicago Press.
- Stiglitz, J. E. (1985). *Inequality and capital taxation* (Technical report No. 457). Stanford: Stanford University.
- Summers, L. H. (1981). Capital taxation and accumulation in a life cycle growth model. *American Economic Review*, 71, 553–544.

1 Progressive Income Tax

1.1 Income Redistribution Policy

Chapter 9 examined optimal taxation from the viewpoint of efficiency. Although this efficiency issue is an important topic of optimal taxation, the optimal tax literature also investigates the equity issue. This chapter examines income redistribution policy among heterogeneous individuals within the same generation.

Needless to say, income inequality is a serious problem in the real economy. As explained in Chap. 1, one of the fundamental functions of public finance is to redistribute income among individuals. The government conducts several measures to cope with this issue by using progressive income taxes and social welfare programs. When there is inequality among individuals, how should a redistribution policy be imposed? Further, what factors are crucial to determine an optimal redistribution policy?

A progressive income tax is the most popular and powerful way to conduct a redistribution policy. However, it may also cause the disincentive effect on labor supply and other economic activities. The optimal degree of redistribution depends upon various economic and social factors, such as value judgments on social inequality, disincentive effects on economic variables, revenue requirement, and the degree of income inequality.

1.2 A Two-Person Model with Income Inequality

First, we explain the classical argument for extreme income redistribution. The purpose of this argument is to justify an extremely progressive income tax. Imagine a simple two-person model with income inequality. There are two different persons with respect to income, H and L. Let us denote each person's income by Y_H , Y_L , and $Y_H > Y_L$ respectively. H is a rich person and L is a poor person.

Utility from income may be represented by the common utility function,

$$U = U(Y). \quad (10.1)$$

Utility increases with income and marginal utility decreases with income. Without any redistribution, we have

$$U_H = U(Y_H) > U_L = U(Y_L).$$

The utility of person H is higher than the utility of person L. If this outcome is regarded as inequitable, redistribution is needed to some extent.

1.3 The Social Welfare Function

The government conducts a redistribution policy so that it imposes a tax on person H and transfers it to person L. How much should the government redistribute between them? This may depend on various factors including a value judgment on inequality. First, we formulate this social judgment by using the social welfare function:

$$W = W(U_H, U_L), \quad (10.2)$$

where W is social welfare and U_H and U_L are the utility levels for H and L respectively. Normally, W increases with U_H and U_L .

There are two special functional forms of the social welfare function:

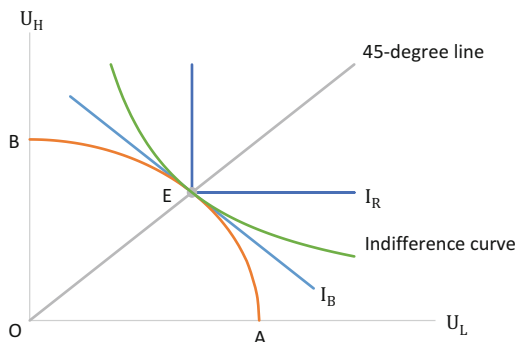
$$W = U_H + U_L \text{ and} \quad (10.3.1)$$

$$W = \text{Min}[U_H, U_L]. \quad (10.3.2)$$

Equation (10.3.1) refers to the Bentham judgment in the sense that social welfare is given as the sum of utilities. This judgment is also called the utilitarian criterion since it concerns the utilities of all agents. Equation (10.3.2) refers to the Rawls judgment in the sense that social welfare is given as the worst person's utility. This judgment is also called the maximin criterion since it intends to maximize the minimum utility.

In Fig. 10.1, the vertical and horizontal axes denote utility for person H and person L respectively. Let us draw the social indifference curve, the combination of U_H and U_L , in order to maintain the same social welfare. The social indifference curve associated with the Bentham judgment, Eq. (10.3.1), is curve I_B , which is the line with the slope of 45 degree. The social indifference curve associated with the Rawls judgment, Eq. (10.3.2), is curve I_R , the line for which is at right angles on the 45-degree line.

Let us explain the property of social indifference curves intuitively. For the Bentham judgment, Eq. (10.3.1), we have as an indifference curve

Fig. 10.1 Socially optimal point

$$U_H = W_0 - U_L,$$

where W_0 means a fixed level of welfare. The slope of this curve is given by -1 , as shown in Fig. 10.1. When W_0 is high, the associated indifference curve is located in the upward region in Fig. 10.1.

For the Rawls judgment, Eq. (10.3.2), we have as an indifference curve

$$U_L = W_0 \text{ if } U_L < U_H \text{ and}$$

$$U_H = W_0 \text{ if } U_H < U_L.$$

Thus, the indifference curve is a vertical line if $U_L < U_H$, and is a horizontal line if $U_H < U_L$ in Fig. 10.1.

These two formulations are rather extreme. Generally, normal formulations on social welfare imply that the associated indifference curve lies between I_B and I_R . If the judgment is more concerned with inequality, the slope of the associated indifference curve is steeper and approaches I_R .

1.4 The Socially Optimal Point

The utility frontier, which is the combination of utilities associated with different redistributions between Y_H and Y_L , may be drawn as curve AB in Fig. 10.1. Curve AB is convex toward the origin. Since the marginal utility of income decreases with income, social welfare increases when redistribution is more equitable and approaches the 45-degree line. The socially optimal point maximizes social welfare on the utility frontier.

The socially optimal point is given by the point where the indifference curve is tangent to the utility frontier. With regard to the Bentham judgment, it is easy to see that the optimal point E is on the 45-degree line since at this point the slope of the indifference curve is equal to -1 . With regard to the Rawls judgment, the slope of the indifference curve at point E is kinked; however, it is also easy to see that E is on the 45-degree line.

Thus, as shown in Fig. 10.1, the optimal point E is on the 45-degree line, irrespective of the social value judgment. In other words, in either the Bentham judgment or the Rawls judgment, it is optimal to redistribute income so as to attain perfect equality. It follows that point E is also optimal at a wide range of reasonable judgments on equity. At point E, the after-tax income of each person is equal to the average income, $(Y_H + Y_L)/2$.

1.5 The Optimal Income Tax Schedule

The income tax schedule to realize perfect equality is easily given as

$$T = Y - \frac{1}{2}(Y_H + Y_L) \quad (10.4)$$

The government has to collect all income above the average income as taxes and distribute these to people with income below the average in the form of a transfer. Equation (10.4) is shown in Fig. 10.2. The optimal marginal tax rate $(\Delta T/\Delta Y)$ (= the optimal increase in tax when income increases by 1 yen) is 100 %. This is an extremely progressive income tax rate; in other words, an extremely progressive income tax schedule is justified in this theoretical framework.

1.6 Perfect Equality When Income Is Uncertain

As explained later, the 100 % marginal tax rate is too high, causing largely negative incentive effects. We do not normally observe such extreme redistribution in reality. However, such an extremely progressive income tax may be justified in a situation of uncertainty.

Suppose the representative agent earns Y_H or Y_L at the even probability rate of 50 %. If she or he does not pay any income tax or receive any transfer, her or his expected utility, W , is given as

$$W = \frac{1}{2}[U(Y_H) + U(Y_L)] \quad (10.5)$$

Fig. 10.2 Extremely progressive income tax

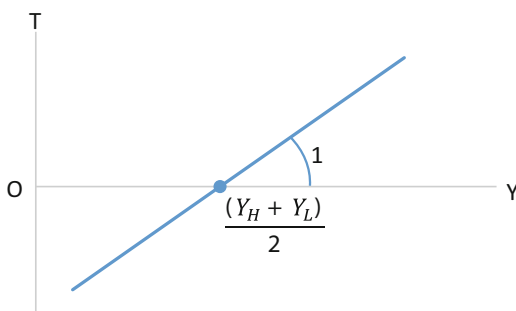
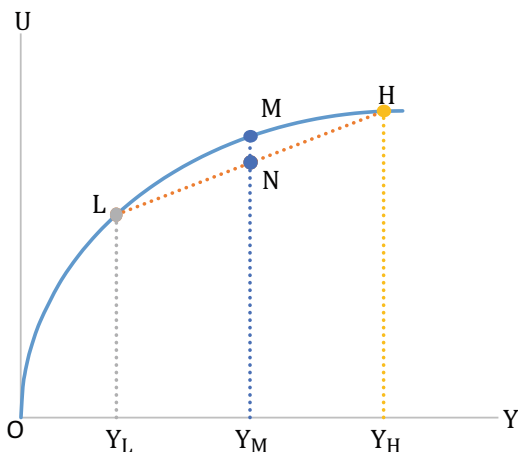


Fig. 10.3 Perfect equality when income is uncertain



In contrast, if the agent is under an extremely progressive income tax scheme, Eq. (10.4), she or he receives a transfer when her or his income is low and pays a tax when income is high. Her or his expected utility, W , is now given as

$$W = U\left(\frac{Y_H + Y_L}{2}\right) \quad (10.6)$$

Namely, the agent now receives the average income, $Y_M = (Y_H + Y_L)/2$, whether Y_H or Y_L is realized ex post. Since the marginal utility of income decreases with income, ex ante expected welfare, W , given by Eq. (10.5) is lower than ex ante expected welfare, W , given by Eq. (10.6). Hence, the agent always gains by having the extremely progressive income tax.

Figure 10.3 explains this outcome. Point M corresponds to W given by Eq. (10.6), while point N corresponds to W given by Eq. (10.5). Since the marginal utility of income decreases with income, utility at M is higher than utility at N. It follows that the perfect equality policy is always desirable in order to avoid ex post income fluctuations. This is because the marginal utility decreases with income. This property is called the risk-averse preference.

2 Endogenous Labor Supply

2.1 The Detrimental Outcome of Perfect Equality

With regard to bequests, there are many uncertain factors that determine the value and timing of bequests since life expectancy is uncertain and cannot be anticipated ex ante. Thus, an extremely progressive bequest tax may be justified. Alternatively,

if income is purely determined by good or bad luck, income randomly fluctuates; hence, a similar argument would apply, as explained in subsection 1.6. However, with regard to labor income, it seems plausible to assume that labor income is largely endogenously determined.

A serious difficulty with the extreme redistribution policy described in Sect. 1 is the question of who will still work when faced with a 100 % marginal tax rate. Person H would not have an incentive to earn more than the average income because all income above the average is taxed. If H does not earn more than the average, the government cannot find taxes to transfer to person L. Further, because H's income declines, the average income also declines. In order to tax H's income, the government has to reduce the average income following Eq. (10.4).

Then, if the after-tax income is always given as the average income, independently of the before-tax income, nobody would wish to earn labor income. They would rather stop working and enjoy their leisure by receiving the transfer from government. Everyone has an incentive to act in this way. As a result, the before-tax income of all individuals reduces to zero. This outcome is the worst possible without income inequality.

The poor performance of communist countries after the Second World War may have been caused by this negative incentive effect. Since the governments pursued extreme ex post equality, people did not have an incentive to work hard and relied on subsidies from the government.

2.2 Endogenous Labor Supply

The above discussion suggests that it is important to consider the effect of income tax on before-tax income or labor supply. The standard model of endogenous labor supply is the leisure-labor choice model in Chap. 8. This section investigates optimal income redistribution using this model.

The utility function (10.1) may be rewritten as

$$U = U(c, L), \quad (10.1')$$

where c is consumption and L is labor supply. The consumer optimally chooses c and L subject to the budget constraint. The budget constraint is affected by how the government imposes a progressive income tax schedule.

We have the following two budget constraints:

$$c = wL - T \text{ and} \quad (10.5')$$

$$T = twL - A, \quad (10.6')$$

where w is a wage rate, $wL = Y$ is before-tax income, T is a tax payment, t is a tax rate, and A is a constant. Equation (10.5') is the private budget constraint and Eq. (10.6') specifies the linear income tax schedule with A .

Now imagine that person H and person L have different wage rates, so that $w_H > w_L$ is maintained. This means that $Y_H > Y_L$ before taxation; namely, even if both persons work for the same length of time, the wage income is different depending upon the ability and quality of labor supply. This is a simple explanation as to why income inequality exists among agents. H earns more income than L simply because H's skill, or wage rate, is higher than L's skill, or wage rate, $w_H > w_L$. This assumption is straightforward and easily explains income inequality.

Then, we have

$$Y_H = w_H L_H > Y_L = w_L L_L. \quad (10.7)$$

2.3 A Linear Income Tax Schedule

Equation (10.6') is a linear income tax schedule with a positive transfer, A. As shown in Fig. 10.4, $M = A/t$ is the minimum level of taxable income. Income above M is taxed at rate t. In contrast, a person with income below M receives the subsidy. A higher t means a more progressive income tax schedule.

By definition, a progressive tax implies that the average tax rate increases with the tax base or income. With regard to Eq. (10.6'), $A > 0$ refers to a progressive tax, $A = 0$ refers to a proportional tax, and $A < 0$ refers to a regressive tax, as shown in Fig. 10.5. The sign and size of A would be a key factor for redistribution. Note that even if we have a linear income tax and the marginal tax rate is constant, a uniform

Fig. 10.4 A linear progressive income tax

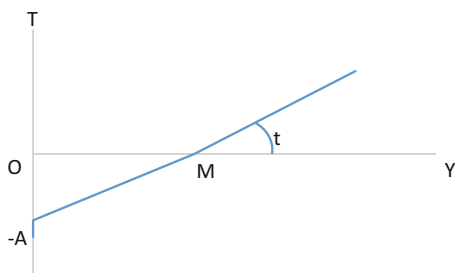
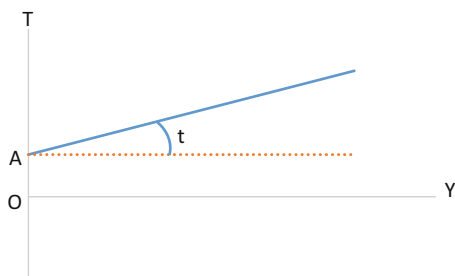


Fig. 10.5 A linear regressive income tax



transfer makes the tax schedule progressive. The government can redistribute income among individuals only if it uses a progressive income tax of $A > 0$.

Alternatively, we may define a progressive tax by increasing marginal tax rates with income. In reality, many countries, including Japan, adopt this type of progressive income tax schedule. We investigate the implications of a nonlinear income tax schedule later.

In this section, we assume that the government does not provide any public goods and conducts redistribution only. Thus, the government budget constraint is given as

$$T_H + T_L = 0$$

or

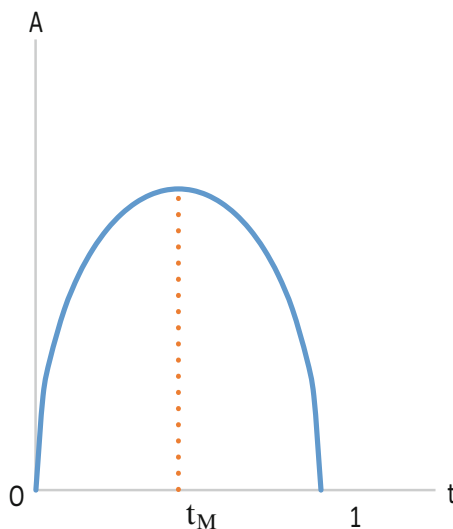
$$t(w_H L_H + w_L L_L) = 2A. \quad (10.8)$$

Linear progressive income tax means that the government collects taxes using a proportional income tax and transfers it as a lump sum subsidy. The left-hand side of Eq. (10.8) is the tax revenue collected by the proportional income tax and the right-hand side is a lump sum subsidy of $A > 0$.

2.4 The Tax Possibility Curve

In Fig. 10.6, we draw a curve of the relationship between A and t that satisfies Eq. (10.8). This curve is called the tax possibility curve because it shows how the tax revenue from a proportional income tax used for A varies with the tax rate, t .

Fig. 10.6 The tax possibility curve



As shown in this figure, the tax possibility curve means that if $t = 0$ and $t = 1$, then $A = 0$; and if $0 < t < 1$, then $A > 0$. Namely, if $t = 0$, the government does not collect taxes. Further, if $t = 1$, nobody wishes to work; thus, the tax base is zero. $L_H = L_L = 0$ means that $A = 0$. When the tax rate rises from $t = 0$, tax revenue first increases. However, when the tax rate is high enough to discourage work incentives, a further increase in the tax rate may reduce the tax base and then tax revenue. This is a paradoxical case. Let us denote the revenue maximizing tax rate by t_M . Then, if $t > t_M$, we have a paradoxical case with a tax rate that is too high.

The government must choose A and t in order to maximize social welfare, subject to Eq. (10.8). In other words, it chooses the optimal point on the tax possibility curve. What is the optimal point? It can be determined by considering the social welfare function; namely, optimal income tax is given as the maximization of social welfare on the tax possibility curve.

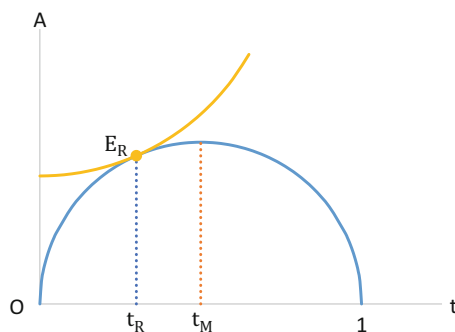
3 The Optimal Income Tax

3.1 The Rawls Judgment

First, we investigate this problem based on the Rawls or maximin judgment. In order to find the optimal point on the tax possibility curve, it is useful to draw a social indifference curve associated with Eq. (10.3.2). When the indifference curve is tangent to the tax possibility curve, it corresponds to the optimum. Thus, we investigate the curvature of the indifference curve.

Since the Rawls or maximin criterion is only concerned with the lowest utility person, in the model of Sect. 2 the government only considers the U_L of person L. Namely, the relevant indifference curve is a combination of A and t that makes U_L constant. An increase in t moves the budget line of L downward, reducing her or his utility. In contrast, an increase in subsidy A enlarges L's effective income, raising her or his utility. Thus, as shown in Fig. 10.7, the indifference curve is

Fig. 10.7 Optimal income tax: the Rawls criterion



upward sloping. If t and A move in opposite directions, U_L does not remain constant.

Thus, the optimum is located at E_R , on the upward-sloping region of the tax possibility curve. It follows that the optimal tax rate, t_R , is always smaller than the revenue-maximizing tax rate, t_M . Obviously, it is less than unity. In an endogenous labor supply model, the optimal marginal tax rate is smaller than 100 %, which is the optimal tax rate in the exogenous labor supply model of Sect. 1. Further, it is smaller than the revenue-maximizing tax rate. Thus, we have the following inequality:

$$0 < t_R < t_M < 1. \quad (10.9)$$

Since the Rawls criterion is significantly concerned with inequality, it requires significant redistribution. Nevertheless, it is not desirable to raise the marginal tax rate too high. If this happens, the labor incentive of person H falls significantly, thereby reducing the total tax revenue, which could have been used for redistribution to person L. The reason why we have $t_R < t_M$ is that even with regard to L, a high t reduces her or his incentive to work.

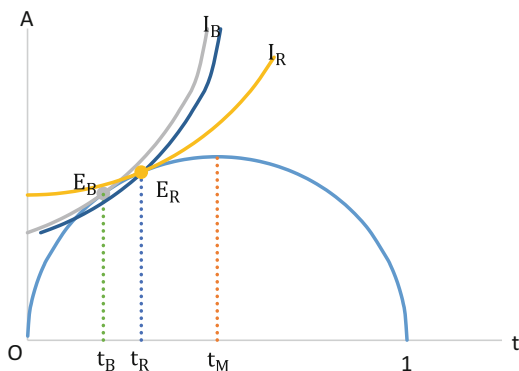
The tax possibility curve shows that two different tax rates constitute the same tax revenue. From the viewpoint of equity, tax revenue matters. From the viewpoint of efficiency, a smaller tax rate is desirable in order to produce a smaller excess burden. Thus, a smaller tax rate is always more desirable than a larger tax rate to achieve the same revenue. This explains intuitively why the optimal point does not exist in the paradoxical region.

3.2 The Bentham Criterion

We now consider the Bentham or utilitarian criterion. The optimal tax rate t_B is given by maximizing $U_L + U_H$. Since the indifference curve for fixed U_H is upward sloping as in the indifference curve for fixed U_L , the social indifference curve for Bentham or utilitarian social welfare is also upward sloping, as shown in Fig. 10.8. Thus, the optimal point is left of the revenue maximizing point. Consequently, we have $t_B < t_M$; however, what is the relation between t_B and t_R ?

Intuitively, since the Rawls criterion is more concerned with inequality than the Bentham criterion, the optimal tax rate, t_R , is likely to be larger than t_B . Thus, the natural conjecture is that $t_B < t_R$. In order to justify this conjecture, let us compare the social indifference curves for both criteria at the same point. As shown in Fig. 10.6, the slope of the indifference curve for the Rawls criterion, I_R , is steeper than the slope of the indifference curve for the Bentham criterion, I_B . It follows that E_B is left of E_R . Further, we can verify the foregoing conjecture. See the advanced study of this chapter, Appendix, for a more detailed analysis on this point.

Fig. 10.8 Optimal income tax: the Bentham criterion



In sum,

$$0 < t_R < t_B < t_M < 1. \quad (10.10)$$

Intuitively, the following applies. An increase in t reduces disposable income, thereby impairing the utility. In order to maintain the same utility level, an increase in A is necessary. This is why an indifference curve is upward sloping. With regard to Rawls criterion, social welfare only depends upon person L ; hence, the effect of t on Y_L is mostly involved. Since Y_L is low, the required increase in A is relatively small. However, with regard to the Bentham criterion, social welfare also depends on person H 's utility and L 's utility. An increase in t reduces both Y_L and Y_H . Since Y_H is large, the negative effect of t on Y_H is larger than that of Y_L . Hence, the required increase in A is larger. As a result, the slope of indifference curve I_B is steeper than that of curve I_R .

3.3 Optimal Redistribution

As explained before, the degree of optimal redistribution depends on the social judgment about inequality. As society's concern with inequality increases, society's desire for redistribution becomes greater. For a more detailed analysis, see the advanced study of this chapter.

With a given social judgment, the degree of income inequality is important in order to determine the size of redistribution. As the inequality of before-tax income increases, income tax becomes more progressive. It is obvious to see that if $w_H = w_L$, and hence $Y_H = Y_L$, the government does not have to conduct any income redistribution. The optimal tax rate should be zero since we do not consider the public good provision here. The larger the gap between w_H and w_L , the larger the optimal tax rate.

In a many-persons economy, the shape of income distribution becomes a key factor. Suppose the distribution of ability or wage rate may be described by the normal distribution. Then, the variance of distribution may indicate the degree of

inequality among agents. The more the degree of variance, the larger the optimal tax rate.

Moreover, if the substitution effect of labor supply is large, and hence a reduction of the after-tax wage rate significantly depresses labor supply, the efficiency cost of redistribution is large. In this regard, it is not desirable to impose a large amount of redistribution. Thus, the optimal tax rate may also depend upon the efficiency cost.

4 Nonlinear Income Tax

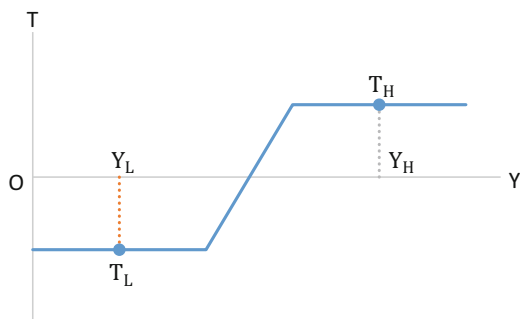
4.1 The First Best

So far, we have considered the linear income tax schedule. The marginal tax rate is constant there. This tax schedule is called a flat tax. In the real economy, tax reforms that reduce the degree of progressivity have been enacted in several developed countries such as the US and the UK. Further, some East European countries have recently adopted a flat tax rate. However, most countries, including Japan, adopt a nonlinear progressive tax whereby the marginal tax rate increases with income. Theoretically, if the government can impose nonlinear tax rates freely, what is the optimal tax schedule?

Imagine that a step-wise nonlinear tax schedule with flat tax rates is available, as shown in Fig. 10.9. This schedule could be optimal in some instances. In this figure, person L faces a flat tax schedule around point T_L and person H faces a flat tax schedule around point T_H . At these points, the marginal tax rates for L and H are both zero; namely, the slope of the tax schedule at T_H and T_L is zero; hence, the tax burden does not rise marginally with income.

Note that the marginal tax rate corresponds to the size of efficiency cost. If the marginal tax rate is zero, the excess burden disappears; hence, the issue of an excess burden in terms of efficiency does not arise. Moreover, as shown in Fig. 10.9, person L receives a subsidy while person H pays tax. Since income is actually

Fig. 10.9 The optimal tax schedule



redistributed from the rich to the poor, this is also desirable from the viewpoint of equity.

If the government redistributes income at zero marginal tax rates, it must impose a nonlinear tax, not a linear income tax. This type of nonlinear, step-wise optimal tax may be regarded as the imposition of a lump sum tax on person H and the transference of a lump sum subsidy to person L. This could be called an ability-specific lump sum tax and is the first best tax schedule to attain the first best without sacrificing efficiency costs.

Such a schedule imposes a lump sum tax, T_H , on person H and transfers a lump sum subsidy, T_L , to person L. Thus, we have

$$\begin{aligned} T &= T_H \text{ if } Y = Y_H \text{ for person H and} \\ T &= -T_L \text{ if } Y = Y_L \text{ for person L.} \end{aligned} \quad (10.11)$$

4.2 Self-Selection Constraint

This ability-specific tax schedule, Eq. (10.11), is not adopted in the real economy. The main reason is that the government does not have precise information about true ability. Person H has an incentive to earn income according to Y_H if T_H is determined, independent of his or her income. However, if the government does not have precise information about ability, H prefers to earn in accordance with Y_L and not Y_H . This is behavior that mimics L. By so doing, H receives a subsidy, T_L , because the government now regards H as L. If all persons mimic L, the government cannot collect tax revenue for redistribution. In other words, an ability-specific tax schedule may not be feasible.

With regard to a linear income tax, the subjective equilibrium point for each person exists only at one point, so that person H cannot raise his or her utility by mimicking person L. In contrast, with regard to nonlinear income tax, multiple points can be the subjective equilibrium points because the indifference curve could be tangent to the tax schedules more than once. Then, person H could be more prosperous by mimicking person L. In order to eliminate this possibility, self-selection constraint is imposed so that person H is more prosperous at his or her original equilibrium point rather than by mimicking person L. Thus, we have

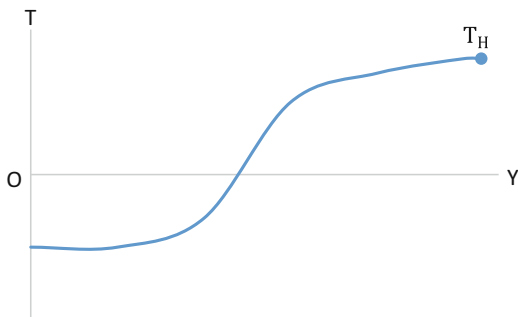
$$U^H(Y_L) < U^H(Y_H). \quad (10.12)$$

This inequality means that H cannot raise her or his utility by mimicking L.

4.3 The Optimal Marginal Tax Rate

With self-selection constraint, an extremely nonlinear tax schedule, such as a step-wise ability-specific schedule, cannot be justified. A desirable tax schedule is

Fig. 10.10 Optimal nonlinear income tax



progressive at the low-income level but regressive at the high-income level, as shown in Fig. 10.10. Note that progressive schedules for all income levels are not optimal. This is a well-known proposition (Mirrlees (1971); Seade (1977)). Moreover, it can be shown that the optimal marginal tax rate at the highest ability income level, Y_H , should be zero:

$$dT/dY_{\text{at } Y=Y_H} = 0. \quad (10.13)$$

Intuitively, the following applies. Imagine that the marginal tax rate for person H is positive. In Fig. 10.10, the slope of the income tax schedule is positive at T_H . Then, imagine that the schedule is changed so that the marginal tax rate becomes zero for income higher than T_H . This reform benefits H. However, other people whose income is smaller than T_H face the same tax schedule as before. Thus, their welfare does not change. The government also collects the same revenue as before.

This is because a tax reduction for income greater than T_H affects person H only. Her or his income does not reduce because of the reform; thus, the tax revenue does not decline either. Indeed, H's income increases because she or he moves from point T_H to the right. In other words, subject to the same revenue constraint, H is more prosperous. As long as the conventional social welfare function (10.2) is assumed, this reform is desirable and enhances social welfare.

We then consider the Rawls or maximin criterion (10.3.2). The government is only concerned with person L. Can the above reform also be justified? If a large number of people pay taxes and the distribution of ability is continuous, we can justify the above argument.

Imagine that an individual is contiguous to person H. This individual earns income at a point close to T_H . The tax reform benefits her or him; hence, she or he earns more. Then, this individual moves to the right. Until she or he moves to T_H , the marginal tax rate is still positive. This means that she or he pays more than before. Thus, total tax revenue also increases. Since an increase in tax revenue is used as a subsidy for person L, L's welfare increases. In other words, the tax reform is desirable even in relation to the Rawls criterion.

The result that the optimal marginal tax rate for the highest ability person is zero suggests that a progressive tax schedule for all people is undesirable. However, in

reality, marginal tax rates normally increase with income. This gap raises the problem of having precise information about ability.

The government cannot know the amount of the highest person's, H 's, income. It is also difficult to change marginal tax rates continuously. Marginal tax rates can only be changed several times, as with a step-wise function. If a nonlinear tax schedule is limited to a step-wise function and imposes the same tax rate on a large fraction of people, it may be desirable to raise the marginal tax rate for income at the end.

4.4 A Differentiated Linear Tax Schedule

If the government could perfectly tell who has what ability, it could impose lump sum redistributive taxes. Obviously, the government cannot tell, so the more able individuals have no incentive to reveal their greater ability. The government, in its choice of tax structure, must recognize these limitations on its information. These constraints are called self-selection constraints. A self-selection constraint has an important role to determine optimal progression. Differences in the progressivity of the tax rates are driven by differences in the source of income inequality among agents and the degree of inequality.

The assumption of fully nonlinear taxation may be unrealistic. In most developed countries, income tax schedules are progressive and take, undoubtedly for simplicity, the form of continuous piecewise linear functions. Following the seminal analysis of general income tax structure by Mirrlees (1971), most work has focused on optimal undifferentiated linear income tax.

Ordoover and Phelps (1979) discussed the optimal mix of linear taxes of wealth and wages that maximize a Rawls, or, maximin social welfare function. Park (1991) analyzed steady-state solutions of optimal tax mixes in an overlapping-generations model of heterogeneous individuals with a utilitarian social welfare function. He showed that an uneven distribution of innate abilities leads to high rates of consumption and wage-income taxes, and a high level of lump sum transfers.

A few papers analyze the normative aspects of differentiated linear income taxation. Bennett (1982) examined optimal linear labor income taxation when the government has the ability to differentiate marginal tax rates across individuals. Alesina and Weil (1992) demonstrated that any fiscal system with a continuous linear tax schedule can be Pareto-improved by the introduction of a second tax schedule, and by letting taxpayers select their preferred tax function from the menu of the linear schedule presented to them. In a two-type, two-period optimal linear income taxation model, Dillen and Lundholm (1996) investigated the situation whereby the second-period tax system can be differentiated in accordance with the observations from the first period.

Using a two-type, two-period framework, Ihori (1992) showed that if differentiated lump sum taxes are available, the optimal marginal tax rates on the efficient household are zero. The government can impose redistributive lump sum taxes on the household; however, it is necessary to use marginal taxes on the labor

and capital income of the less efficient household if the self-selection constraint is binding. When differentiated lump sum taxes are unavailable, it is desirable to use differentiated labor and capital income taxation. In such an instance, if the source of inequality is in labor income, optimal labor income taxation will normally be more progressive. However, when the source of inequality is in capital income, optimal capital income taxation may or may not be more progressive.

The greater the degree of inequality, the more progressive the optimal capital income tax structure will be. The intuition is as follows. When the self-selection constraint is binding, the government can use the information about the source of inequality to discriminate among individuals. Thus, the optimal tax structure of the income that is the source of inequality may be more progressive than the optimal tax structure of the other income.

4.5 The Recent Approach to the Optimal Marginal Tax Rate

So far, we have assumed that the highest ability exists in a finite region, w_H . Alternatively, if the distribution of ability has a distribution from 0 to ∞ , how would the result be altered? Assuming Pareto distribution with the highest ability in the infinite region, Saez (2001) and Gruber and Saez (2002) showed that the marginal tax rate for labor income must be between 50 and 80 % in order to be at an optimal level. Their papers derive optimal income tax formulas using compensated and uncompensated elasticities of earnings with respect to tax rates. A simple formula for a high-income optimal tax rate is obtained as a function of these elasticities and the thickness of the top tail of income distribution. This is a very important and useful contribution (see also Diamond 1998).

In reality, we have to apply the same marginal tax rate to the highest bracket of income where many rich are covered, even if we use a non-linear tax schedule. In such a realistic case, the highest marginal tax rate could be relatively large, depending on elasticities of income and the shape of income distribution.

5 Economic Constraint and Redistribution

Generally, income redistribution is conducted in several ways such as through progressive taxes, social welfare programs, social security systems including public pensions, and medical services. The efficacy of a redistribution policy depends upon economic constraints. In particular, the following points are important in order to determine the effectiveness of redistribution.

5.1 Credibility

How serious does the government conduct redistribution policy? In order to attain successful redistribution, the credibility of the policy is important. However, in some paradoxical cases, an improbable policy is effective.

For example, if a private agent believes that she or he may enjoy a good quality of life thanks to a beneficial social welfare program, she or he may not have an incentive to make any effort on her or his behalf. However, if such a person worries about the uncertainty of a future welfare program and is unlikely to receive beneficial measures from the government in the near future, these issues may stimulate her or his effort to earn. In this regard, an improbable policy could be more effective.

5.2 The Crowding-Out Effect

A redistribution policy may have negative effects on the earning efforts of recipients. Namely, an increase in subsidy from the government may crowd out the recipients' own efforts. If the recipients do not work hard as the result of the redistribution policy, their income does not increase a great deal: it simply crowds out the before-redistribution income.

The argument for redistribution often ignores this crowding-out effect. Moreover, the redistribution policy itself may induce income inequality. If the potential recipients do not work hard because of the anticipation of a subsidy from the government, their before-tax income is low. Then, income inequality before redistribution increases. It is important to recognize that before-tax inequality among individuals is endogenously determined to some extent, which may be affected by redistribution policy. If people are rational and forward looking, an extreme progressive policy *ex post* may result in a large degree of inequality *ex ante*.

In contrast, if public subsidy promotes human capital accumulation among the poor, the crowding-in effect may occur. Since the poor face liquidity constraint, they cannot conduct necessary educational investment. Income redistribution is effective at supporting the potentially able poor to develop their skills.

5.3 Expectation

Private agents may behave rationally or myopically. It is important to know the degree to which people consider the future. If people are myopic and do not pay much attention to the future, they consume a great deal in the present and save little. By so doing, they may become poor in the future. Then, they may become recipients of social welfare programs.

If they are rational and have perfect foresight and expectations, they save for the future; hence, they do not become recipients of social welfare programs.

5.4 Asymmetric Information

The government cannot know who is really poor and needs a subsidy from them. If a social welfare program is too generous, it may benefit those who should not be eligible. However, if it is too strict, it may not help the poor who really need the subsidy. It is often said that reported income does not necessarily reflect true income.

Income is defined by revenue minus cost. For employees it is easy to distinguish revenue from income since the earning cost is clear for them. However, for self-employed people, earning costs are closely related to living costs, so that tax authorities have difficulties identifying true earning costs. If earning costs are over-reported, reported income is underestimated. In such a situation, the government cannot identify true income and hence the true poor.

5.5 Stigma

When society has a culture of shame attached to becoming a subsidy recipient, the poor do not like to receive the subsidy. Then, redistribution tends to be too small. However, if society has a culture that promotes the right to become a subsidy recipient, many people are content to receive the subsidy. Thus, redistribution becomes too great.

5.6 Commitment

It is important to terminate the period of benefits in order to avoid a moral hazard problem. A typical example is unemployment insurance. When an agent is unemployed and does not find a new job for a long period, it may be hard to terminate the benefit simply because the payment period is due to end. Politically, the government may extend the period of termination. If so, people may not have an incentive to seek a new job.

Without commitment, those who could have found a job may not do so and may continue to receive unemployment benefit in the long run.

Appendix: Optimal Linear Income Tax

A1 Introduction

There are four main ingredients for a model of standard optimum linear income taxation: a social welfare function, a preference relation or labor supply function for individuals, an ability structure and distribution, and a revenue requirement for the government. As discussed by Atkinson and Stiglitz (1980), the standard conjectures may be summarized as follows.

- (i) The optimal marginal tax rate increases with the government's inequality aversion.
- (ii) The optimal marginal tax rate decreases with the elasticity of labor supply.
- (iii) The optimal marginal tax rate increases with the spread in abilities.
- (iv) The optimal marginal tax rate increases with the government's needs.

In this appendix, we intend to reexamine conjectures (i)–(iv) using a diagram of the tax possibility frontier and the social indifference curve as explained in Sect. 3 of this chapter, based on Ihori (1987). All the conjectures, (i)–(iv), are not always analytically valid.

Section 3 of the main text has shown that the marginal tax rate is higher under Rawls's criterion than under Bentham's (see also, among others, Ihori (1981, 1987); Hellwig (1986)). The optimal marginal tax rate is bounded above by the Rawlsian rate, which in turn is bounded by the revenue-maximizing rate. Helpman and Sadka (1978) have reported that the effect of a mean-preserving spread in abilities cannot be determined in general.

The purpose of this appendix is to contribute to the understanding of the structure of the optimal linear income tax model. The appendix achieves this through diagrammatic examination of some comparative statics, using a diagram of the tax possibility frontier and the social indifference curve, as in the main text of the chapter.

The appendix is organized as follows. Section A2 recapitulates Sheshinski's (1972) formulation of the linear income tax problem and presents a diagram of the tax possibility frontier and the social indifference curve. Section A3 analyzes the response of the parameters of optimal linear income tax to changes in the social objective function from Bentham's sum-of-utilities to Rawls's max-min. It is shown that conjecture (i) is analytically established. Section A4 analyzes the response of the parameters to changes in government budgetary needs, using Sheshinski's (1971) educational – investment model. It is shown that conjecture (iv) cannot be valid in general. Finally, Sect. A5 concludes this appendix.

Section A3 corresponds to the comparative statics of the social welfare function (movement of the social indifference curve), and Sect. A4 corresponds to the comparative statics of the tax requirement (movement of the tax possibility frontier). It is shown that once the tax possibility frontier moves, the analytical results become ambiguous in general. Note that conjectures (ii) and (iii) correspond to the situation where both the tax possibility frontier and the social welfare function move.

A2 The Model

The model is essentially the same as in Sects. 2 and 3 of the main text of this chapter and is in accordance with Mirrlees (1971) and Sheshinski (1972). For simplicity, suppose two individuals have the same preferences but different skills. Let $u(c, L)$ be the common utility function, where $c > 0$ is consumption and $0 \leq L \leq 1$ is labor.

It is assumed that $u_1 > 0$ and $u_2 < 0$, where u is strictly concave. We also assume normality of consumption and leisure. The skill of an individual is denoted by w . Namely, for the rich individual $w = w_H$, and for the poor individual, $w = w_L$. From now on, subscript H refers to the rich individual and L the poor individual.

The wage rate earned by a w -person is assumed to be w . Hence, her or his gross income Y is wL . Each consumer chooses c , z , and L so as to solve the following:

$$\begin{aligned} \max u(c, L) \\ \text{s.t. } c = Z - T(Z), Z = wL, \end{aligned} \quad (10.A1)$$

where T is the tax function. We consider a linear tax function as follows:

$$T(Y) = -A + (1 - \beta)Y \quad (10.A2)$$

where A is the minimum guaranteed income and $1 - \beta = t$ is the marginal tax rate.

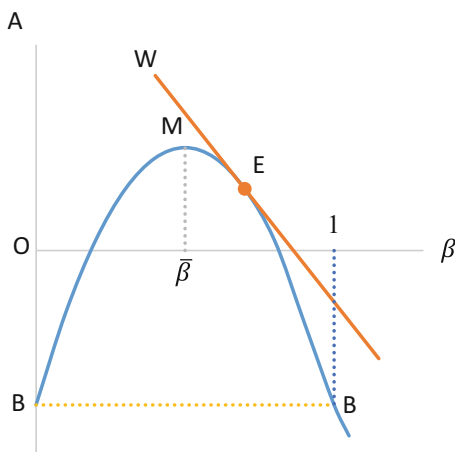
We denote by $c(\beta w; A)$ and $L(\beta w; A)$ respectively w -person's demand for consumption and her or his supply of labor. βw is the after-tax real wage rate and A is non-wage income. We also define an indirect utility function: $v(\beta w; A) = u[c(\beta w; A)L(\beta w; A)]$.

Let R be a predetermined level of per capita government spending, so that the government's budget constraint is $T_H + T_L = R$. Employing Eq. (10.A2), this constraint reduces to:

$$R + 2A = (1 - \beta)[w_H L(\beta w_H; A) + w_L L(\beta w_L; A)] \quad (10.A3)$$

Let us draw a diagram of the tax possibility frontier. In Fig. 10.A1, curve BB shows the government budget constraint for given R . When $\beta = 0$, L is zero. From Eq. (10.A3), $A = -R/2$ ($OA = R/2$). When $\beta = 1$, A is also given by $-R/2$. For small values of β , L increases with β and A also increases. However, because a rise of β means a reduction of tax rate, the feasible guarantee eventually declines. M is

Fig. 10.A1 The tax possibility frontier



the highest point of curve BB, and $\bar{\beta}$ is the associated β . For $\bar{\beta} < \beta$, the negative effect on revenue of a decrease in the marginal tax rate $(1 - \beta)$ dominates the positive effect on revenue of an increase in work effort. We call curve BB the tax possibility frontier (TPF).

Mathematically, we have

$$\frac{dA}{d\beta_{AB}} = \frac{(1 - \beta)(w_L L_{L\beta} + w_H L_{H\beta}) - (w_L L_L + w_H L_H)}{2 - (1 - \beta)(w_L L_{LA} + w_H L_{HA})} \quad (10.A4)$$

where $L_{ij} = \partial L_i / \partial j$ ($i = L, H$ and $j = A, \beta$).

Let us draw an indifference curve of an individual, curve I. Curve I is downward sloping. An increase in A raises utility and must be offset by a decrease in β so as to maintain the same utility. Considering the first order condition of utility maximization, we have

$$dA/d\beta_I = -Y < 0 \quad (10.A5)$$

It is interesting to note that curve I is not necessarily strictly convex.

The linear income tax problem may be written as

$$\begin{aligned} \max & W(A, \beta) \\ \text{s.t.} & + (10.A3), \end{aligned} \quad (10.A6)$$

where $W(A, \beta)$ is the social welfare function. The social welfare function is given by

$$W(A, \beta) = \frac{1}{1 - \nu} \left[\nu(A, \beta w_L)^{1-\nu} + \nu(A, \beta w_H)^{1-\nu} - 2 \right] \quad (10.A7)$$

where $\nu \geq 0$. With $\nu = 0$, we have the Bentham (utilitarian) objective. With $\nu = \infty$, we have the Rawls (maximin) case. For higher values of ν the function is more concave. We now illustrate a social indifference curve in the (A, β) plane. The slope of the social indifference curve is given by

$$\frac{dA}{d\beta_w} = - \frac{\nu_L^{-\nu} \nu_{L\beta} + \nu_H^{-\nu} \nu_{H\beta}}{\nu_L^{-\nu} \nu_{LA} + \nu_H^{-\nu} \nu_{HA}} \quad (10.A8)$$

where $\nu_{ij} = \partial \nu_i / \partial j$ ($i = L, H$ and $j = A, \beta$). The social indifference curve is not necessarily convex. Figure 10.A1 illustrates the social optimal point E where curve W is tangent to curve BB. Once we know the tax possibility frontier and the social indifference curve, we can attain the optimal point.

A3 Shift of the Social Welfare Function

In this section, we investigate the comparative statics of the weight of the social welfare function. When ν changes, the social indifference curve moves, but the tax possibility frontier does not. The optimal point moves on the initial tax possibility frontier. As shown by the movement from W to W' in Fig. 10.A2, if the absolute slope of the social indifference curve increases with the same values of A and β , the optimal point moves to the right: the optimal level of A decreases and the optimal level of β increases. Thus, it is useful to differentiate $dA/d\beta$ with respect to ν .

$$\begin{aligned} \frac{d^2 A}{d\beta d\nu} &= \frac{1}{(\nu_L^{-\nu} \nu_{LA} + \nu_H^{-\nu} \nu_{HA})^2} [(\nu_L^{-\nu} \nu_{LA} + \nu_H^{-\nu} \nu_{HA})(\nu_L^{-\nu} \nu_{L\beta} \log \nu_L - \nu_H^{-\nu} \nu_{H\beta} \log \nu_H) \\ &\quad + (\nu_L^{-\nu} \nu_{L\beta} + \nu_H^{-\nu} \nu_{H\beta})(\nu_L^{-\nu} \nu_{LA} \log \nu_L - \nu_H^{-\nu} \nu_{HA} \log \nu_H)] \\ &= \frac{1}{(\nu_L^{-\nu} \nu_{LA} + \nu_H^{-\nu} \nu_{HA})^2} \nu_L^{-\nu} \nu_H^{-\nu} (\nu_{HA} \nu_{L\beta} - \nu_{H\beta} \nu_{LA}) (\log \nu_H - \log \nu_L) \end{aligned} \quad (10.A9)$$

We know that $w_L < w_H$ and $\nu_H > \nu_L$. We show that

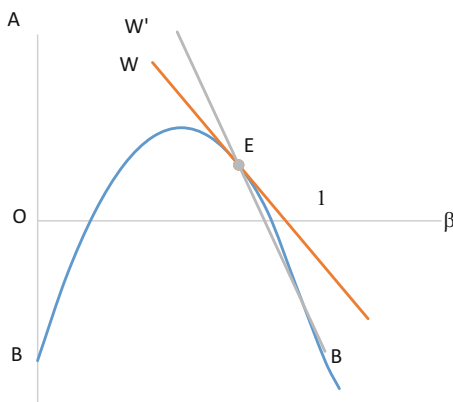
$$\nu_{L\beta} \nu_{HA} - \nu_{H\beta} \nu_{LA} < 0$$

or

$$\frac{\nu_{L\beta}}{\nu_{LA}} < \frac{\nu_{H\beta}}{\nu_{HA}}$$

Using the envelope theorem, it is straightforward to see that

Fig. 10.A2 Shift of the social welfare function



$$\frac{\nu_\beta}{\nu_A} = c$$

Since c is an increasing function of w , it follows that the above inequality holds.

Hence, it is easy to see that the sign of Eq. (10.A9) is negative. The absolute value of the slope of the social indifference curve decreases with ν . Thus, the optimal value of β decreases with ν , and the optimal value of A increases with ν . When the social function approaches the Rawls criterion as $\nu \rightarrow \infty$, the optimal tax parameters converge to the Rawls optimal tax parameters. When the social welfare function approaches the Bentham criterion as $\nu \rightarrow 0$, the optimal tax parameters converge to the Bentham optimal tax parameters. We confirm analytically the conjecture that the optimal marginal tax rate increases with the government's inequality aversion.

A4 Shift of the Tax Possibility Frontier

Let us examine how the optimal point changes when R is increased. In this situation, the tax possibility frontier moves but the social indifference curve does not. From now on, we concentrate on the case of the educational investment model in accordance with Sheshinski (1971). Remember that the educational investment model is a special instance of the labor incentive model. We have

$$u(c, L) = u[c - g(L)]$$

and first order conditions that are

$$\nu_A = u' \text{ and} \quad (10.A10a)$$

$$\nu_\beta = u' c \quad (10.A10b)$$

$g(L)$ is the cost of education where $g(\cdot)$ is convex (i.e., there are increasing marginal costs). It is unnecessary to assume that u is strictly concave here.

In the educational investment model, the income effect on labor supply is assumed as $y_A = 0$. Substituting $y_A = 0$ into Eq. (10.A4), the slope of the tax possibility frontier is given by

$$\frac{dA}{d\beta_B} = \frac{(1 - \beta)(w_L L_{L\beta} + w_H L_{H\beta}) - (w_L L_L + w_H L_H)}{2} \quad (10.A11)$$

Because L depends only upon β , the slope of curve BB is determined solely by the level of β .

A celebrated property of the educational investment model is that the slope of curve BB is independent of A ; thus, we can explore intuitive implications of an increase in R . An increase in R moves curve BB downwards. It is easy to see that the combination of $dA/dR > 0$ and $d\beta/dR > 0$ is not feasible. The marginal tax rate should be moderate in the sense that a decrease in $1 - \beta = t$ does not induce people

to work in such a way that it increases the tax revenue. An extra resource left to the government is unavailable as the result of increases in A and β . Thus, we have the following three possibilities:

- (a) $\frac{dA}{dR} < 0$ and $\frac{d\beta}{dR} \geq 0$
- (b) $\frac{dA}{dR} < 0$ and $\frac{d\beta}{dR} < 0$, and
- (c) $\frac{dA}{dR} \geq 0$ and $\frac{d\beta}{dR} < 0$

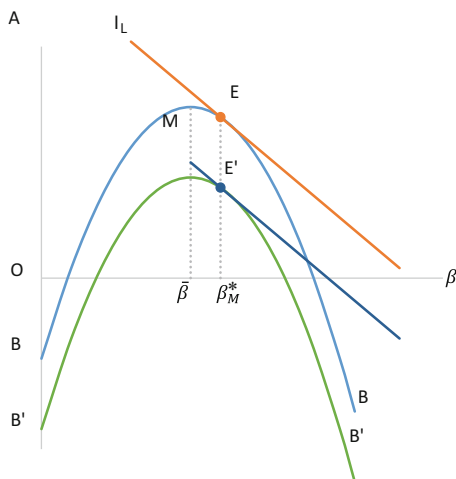
We consider the special instances of $\nu = \infty$ (the maximin case) and $\nu = 0$ (the utilitarian case) with regard to the social welfare function. Note that the analysis conducted for the case of $\nu = 0$ is also valid for all $\nu \geq 0$.

A4.1 The Maximin Case

When the social welfare function is given by the maximin criterion, the relevant social indifference curve is given by the least prosperous person's indifference curve I_L , which is strictly concave. Considering $y_A = 0$, the curve's slope depends only on β . Because the slope of curve BB also depends only on β , the new optimal point E' in Fig. 10.A3 is just below the initial optimal point E . The optimal marginal tax rate in the maximin criterion, $1 - \beta_M^*$, is independent of R . Thus, we have case (a).

According to the maximin criterion, an increase in the tax revenue requirement should be financed by a decrease in the income guarantee, while the marginal rate should be kept constant. Observe that this policy implication is valid as long as social welfare is given by the representative individual of some given target ability $\hat{w}$. As shown in the prior section, it is true that the optimal marginal tax rate is higher in the maximin case than in any other. The optimal level of β increases with target ability $\hat{w}$. However, a less progressive tax structure is desirable when R is increased.

Fig. 10.A3 The maximin case



A4.2 The Utilitarian Case

Let us now consider the utilitarian case. Substituting $\nu = 0$ and Eq. (10.A10a,b) into Eq. (10.A8), the slope of the social indifference curve is reduced to

$$\frac{dA}{d\beta_U} = -\frac{u'_L Y_L + u'_H Y_H}{u'_L + u'_H} \quad (10.A12)$$

Social indifference curve U is downward-sloping. However, curve U is not necessarily concave.

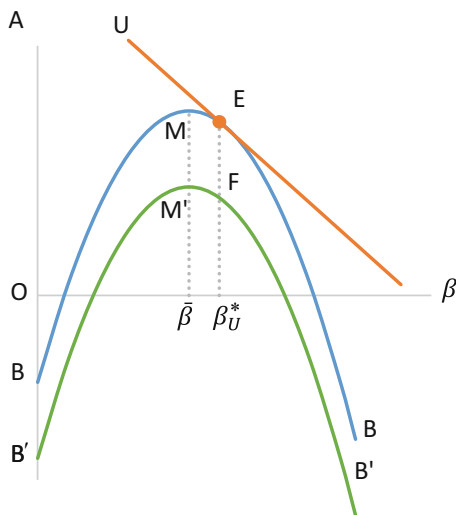
Let us now examine the comparative statics of an increase in R . If $dA/d\beta_U$ is independent of A as in the maximin case, the new optimum E' is just below E in Fig. 10.A4, given by a point such as F . If $dA/d\beta_U$ is an increasing function of A at point F , the slope of curve U is steeper than that of curve BB ; thus, the new optimal point is to the southeast of E . Consequently, if $d^2A/d\beta dA_U \geq 0$, we have case (a), and a less progressive tax structure is desirable.

We have

$$\begin{aligned} \frac{d^2A}{d\beta dA} &= \frac{1}{(u'_L + u'_H)^2} [(u''_L Y_L + u''_H Y_H)(u'_L + u'_H) - (u'_L Y_L + u'_H Y_H)(u''_L + u''_H)] \\ &= \frac{1}{(u'_L + u'_H)^2} (r_L - r_H)(Y_L - Y_H)u'_L u'_H \end{aligned} \quad (10.A13)$$

where $r \equiv -u''/u'$ is absolute risk aversion.

Fig. 10.A4 The utilitarian case



If absolute risk aversion is constant, Eq. (10.A13) is zero; hence, we have $d\beta/dR = 0$ and $dA/dR < 0$, as in the maximin case. If absolute risk aversion is non-decreasing, Eq. (10.A13) is positive and we have case (a).

If the utility function is such that the marginal utility of higher ability persons is relatively more weighted as the result of a decrease in A (an increase in R), the slope of the social indifference curve U becomes steeper; hence, case (a) is more likely, and a less progressive tax structure is optimal. It should be stressed that if the new optimal point is between M' and F , it is still possible to have a less progressive tax structure: case (b). Even when r is increasing (but not so rapidly), a less progressive tax structure could be optimal.

A5 Conclusion

As an extension of Sect. 3 of the main text of the chapter, this appendix has considered the role of the tax possibility frontier and the social indifference curve in a comparative statics analysis. It is shown that when the social indifference curve moves, the comparative statics result is analytically well investigated. We confirm the conventional conjecture that the optimal marginal tax rate increases with a government's inequality aversion.

However, if the tax possibility frontier moves, the comparative statics result is rather ambiguous. Even if we employ an extreme case of the educational investment model, we cannot always confirm analytically the conventional conjecture that the optimal marginal tax rate increases with a government's budgetary needs.

Questions

- 10.1 Consider the three-person economy. Each person's income is given by 10, 30, and 50 respectively. What is the income tax schedule to realize the perfect equality of after-tax income?
- 10.2 Consider the following Cobb Douglas utility function:

$$U = c^\alpha (Z - L)^{1-\alpha},$$

where Z is available time endowment, L is labor supply, and c is consumption. Suppose the government imposes a linear income tax and a lump sum transfer:

$$c = (1 - t)wL + A,$$

where t is the tax rate and A is transfer. What is the optimal labor supply function? Draw the tax possibility curve.

References

- Alesina, A., & Weil, P. (1992). *Menus of linear income tax schedules* (NBER working paper no. 3968). Cambridge, MA: National Bureau of Economic Research.
- Atkinson, A. B., & Stiglitz, J. E. (1980). *Lectures on public economics*. New York: McGraw-Hill.
- Bennet, J. (1982). The individually differentiated taxation of income. *Public Finance*, 37, 299–317.
- Diamond, P. (1998). Optimal income taxation: An example with U-shaped pattern of optimal marginal income tax rates. *American Economics Review*, 88, 83–95.
- Dillen, M., & Lundholm, M. (1996). Dynamic income taxation, redistribution, and the Ratchet effect. *Journal of Public Economics*, 59, 69–93.
- Gruber, J., & Saez, E. (2002). The elasticity of taxable income: Evidence and implications. *Journal of Public Economics*, 84, 1–32.
- Hellwig, M. F. (1986). The optimal linear income tax revisited. *Journal of Public Economics*, 31, 163–179.
- Helpman, E., & Sadka, E. (1978). The optimal income tax: Some comparative statics results. *Journal of Public Economics*, 9, 383–393.
- Ihori, T. (1981). Sufficient conditions for the optimal degree of progression to decrease with the government revenue requirement. *Economics Letters*, 6(3), 95–100.
- Ihori, T. (1987). The optimal linear income tax: A diagrammatic analysis. *Journal of Public Economics*, 34, 379–390.
- Ihori, T. (1992). The optimal type-specific tax system: Source of inequality and optimal progression. *Public Finance*, 47, 430–445.
- Mirrlees, J. (1971). An exploration in the theory of optimum income taxation. *Review of Economic Studies*, 38, 175–208.
- Ordovery, J. A., & Phelps, E. S. (1979). The concept of optimal taxation in the overlapping generations model of capital and wealth. *Journal of Public Economics*, 5, 1–26.
- Park, N.-H. (1991). Steady state solutions of optimal tax mixes in an overlapping -generations model. *Journal of Public Economics*, 46, 227–246.
- Saez, E. (2001). Using elasticities to derive optimal income tax rates. *Review of Economic Studies*, 68, 205–229.
- Seade, J. K. (1977). On the shape of optimal tax schedules. *Journal of Public Economics*, 7, 203–236.
- Sheshinski, E. (1971). On the theory of income taxation (HIER discussion paper no. 172). Cambridge, MA: Harvard Institute for Economic Research, Harvard University.
- Sheshinski, E. (1972). The optimal linear income tax. *Review of Economic Studies*, 49, 637–643.

1 Public Goods

1.1 Public Goods and Private Goods

In Chap. 8, we investigated taxation from the viewpoint of efficiency. In this chapter, we investigate government spending from the viewpoint of efficiency. Here, the notion of public goods is important. As explained in Chap. 1, public goods have properties of non-rivalness and non-excludability. Non-rivalness in consumption means that an increase in someone's consumption does not reduce the availability of consumption for others. Non-excludability means that someone cannot be excluded from consuming a good because of technical or other reasons simply because she or he does not pay the price.

Goods that are not perfectly excludable or rival are called impure public goods. Non-excludable and non-rival public goods may have different spillover effects among people. Impure public goods may be classified according to the degree of spillover.

For example, consider a streetlight. Imagine that a community has many people who need the benefit of streetlights. A streetlight could be set in front of a house in this community. The benefit of the streetlight may be indicated by the degree of brightness of its light. Let us denote by 1 the brightness in front of the house. The brightness for the houses of others may represent the degree of spillover. If this is zero, the streetlight does not provide spillover and is a private good. However, if it is unity, namely the spillover effect is the same as the original light and everyone can enjoy the benefit equally, it becomes a pure public good. If the brightness is between 0 and 1, namely the spillover effect is positive but smaller than the original effect, it becomes an impure public good. Both pure public goods and impure public goods are sometimes simply called public goods.

The government does not necessarily have to provide public goods. On the contrary, the private sector can provide certain types of public good. For example, education may be regarded as an impure public good with excludability but without

Table 11.1 Public goods and private goods

	Excludable	Non-excludable
Rival	Private good	Commons
Non-rival	Club good	Public good

rivalness that can be provided by the government or the private sector. In this context, non-excludability does not apply to education and non-rivalness applies to some extent. A school may determine who is allowed to attend it based on ability or other standards; however, many students can nonetheless enjoy education services. Further, defense is a typical example of a pure public good that benefits all people in a country. Even so, the provision of defense depends significantly on private defense firms. Indeed, the government is a buyer of this particular good.

Although it seems rare to satisfy the foregoing two definitions of non-rivalness and non-excludability perfectly, a wide range of goods approximately satisfy at least some aspects of the two definitions as impure public goods. Namely, if a good provides some externalities to others, it may be called a public good in accordance with a wider definition. In this regard, the positive externality of consumption is an important feature that can differentiate a public good from a private good.

Excludable but non-rival goods are called club goods. Private sports facilities may charge a membership fee and those who pay the fee are allowed to use the facility. Such a good is excludable but non-rival because someone's use does not have a negative spillover effect on others. Many members may use the same facility without serious congestion as long as the number of students is appropriate. As explained in Chap. 13, some public services provided by local governments are called local public goods and can be regarded as examples of club goods.

Non-excludable but rival goods are called commons. For example, with regard to fishing in an ocean, it may be difficult to exclude someone from fishing in a particular area. Further, if someone fishes a great deal, this affects the amount of fish available for others. Some other natural resources also have a property of rivalness (see Table 11.1).

1.2 Formulation of Public Goods

Analytically, public goods may be formulated as follows. Let us denote agent i 's consumption of good y by y_i and the total supply of good y as Y . ($i = 1, \dots, n$). n is the number of agents. With regard to a pure public good, we have

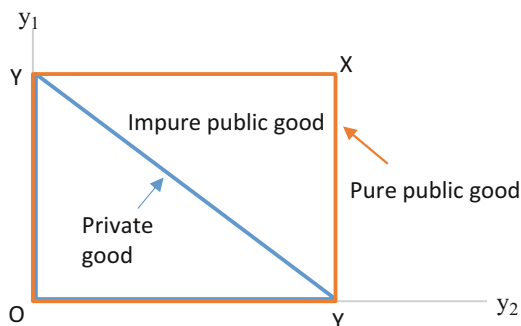
$$y_i = Y. \quad (11.1)$$

With regard to a private good, we have

$$\sum_i y_i = Y. \quad (11.2)$$

In other words, agents may consume the same amount in relation to a pure public good in Eq. (11.1), while the total consumption of agents is equal to the total supply

Fig. 11.1 The consumption possibility curve



for a private good in Eq. (11.2). In this sense, a pure public good is a good with equal consumption for everyone. Note that equal consumption does not imply equal benefit. Preferences for pure public goods may diverge among agents.

Imagine that there are two people in Fig. 11.1. With regard to private goods, the consumption possibility curve is given by YY , the slope of which is -1 . With regard to pure public goods, the consumption possibility curve is given by YXY . Both people can consume the total supply equally. The region between the two curves corresponds to impure public goods.

1.3 Public Goods and Actual Government Spending

Here we compare the notion of public goods with actual government spending. Government spending, except transfers, may be regarded as a provision of public goods from the microeconomic viewpoint. Examples of pure public goods are fundamental social institutions, necessary legal facilities, general administrative services such as the police and fire departments, and nationwide public goods such as diplomacy, national security, and the overall public infrastructure. Other spending, including education, insurance, parks, and regional developments, can be regarded as impure public goods.

If we classify government spending in this way, it transpires that most developed countries have recently increased their share of spending on impure public goods rather than pure public goods. This is because voters' perceptions about the role of government may have changed. Further, heterogeneity among voters has increased lately.

Moreover, in the global economy, international economic activities have developed significantly, raising new issues about global environmental fluctuations. This also raises the role of international organizations in coping with worldwide problems which may be regarded as global public goods, or international public goods. In order to promote such international activities, governments must contribute significant funds. When developed countries have attained high economic growth and enjoy a high quality of life, they must support these global public goods.

2 Optimal Provision of Public Goods: The Samuelson Rule

2.1 The Samuelson Rule: Diagramed Derivation

We now investigate the optimal provision of public goods. In the first best scenario, the government can control resource allocation freely and determine the optimal level of public goods. The necessary condition is called the Samuelson rule.

The Samuelson rule:

The marginal social benefit of public goods, which is given by the sum of each agent's marginal benefit, should be equal to the marginal cost of public goods.

We can explain this rule with a two-person model. Each person has preferences for private goods x and public goods Y .

$$U^i = u_i(x_i, Y), \quad (i = 1, 2). \quad (11.3)$$

Each person's utility U^i increases with the consumption of private goods x_i and public goods Y . Production possibilities are given as the production frontier function,

$$F(X, Y) = 0. \quad (11.4)$$

In addition,

$$x_1 + x_2 = X \quad (11.5)$$

denotes the feasibility condition of the private goods.

In Fig. 11.2a, the vertical axis denotes private goods x and the horizontal axis denotes public goods Y . We draw person 1's indifference curve and production constraint AB . A movement from point B to the right means an expansion of public goods sacrifices private goods. Hence, the production frontier AB is downward sloping and convex to the origin. The slope of this production constraint curve corresponds to the marginal cost of public goods in terms of private goods. The slope of Person 1's indifference curve means the marginal benefit of public goods of person 1 in terms of private goods.

Then, we fix person 1's utility as U_I and consider the associated indifference curve. With this constraint, the consumption possibility of person 2 may be drawn as curve CD , which is the vertical difference between AB and U_I , as shown in Fig. 11.2b. Note that at a given level of public goods F , we have $FI = x_1$ and $HI = x_2$. When F changes, we may obtain curve CD as the locus of HI .

The Pareto optimum point, which is the condition of efficient allocation, maximizes person 2's utility subject to person 1's fixed utility. The utility maximizing point of person 2 on curve CD is given by point E , where curve CD and person 2's indifference curve U_{II} are tangent. At this point, the slope of person

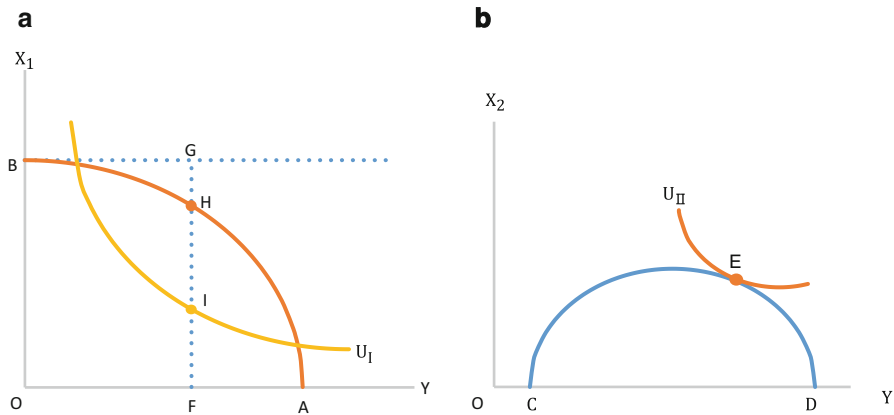


Fig. 11.2 Optimal provision of public goods. (a) person 1, (b) person 2

2's indifference curve or person 2's marginal rate of substitution, $MRS_2 (= U_Y/U_{X_2})$, is equal to the gap between the slope of the production curve or the marginal rate of transformation, $MRT (= F_Y/F_X)$, and the slope of person 1's indifference curve, MRS_1 . Note that U_Y means the marginal utility of a public good, U_{X_i} means the marginal utility of a private good for person i , F_Y means the marginal cost of the public good, and F_X means the marginal cost of the private good. Namely, we have

$$MRS_2 = MRT - MRS_1$$

or

$$MRS_1 + MRS_2 = MRT. \quad (11.6)$$

This is the Samuelson rule (See Samuelson (1954)).

So far, we have assumed that the government can control resource allocation freely. In a competitive economy, if lump sum taxes are available, the government can attain the first best by realizing the Samuelson condition.

2.2 The Samuelson Rule: Mathematical Derivation

The Samuelson rule is a basic criterion of the optimal public good problem. We may derive this rule mathematically. There are two agents in the economy. Each agent i ($i = 1, 2$) consumes the private good x_i ($X = x_1 + x_2$) and the public good Y . Agent i 's utility function is given as

$$U^i = u_i(x_i, Y) \quad (i = 1, 2). \quad (11.3)$$

From Eqs. (11.4) and (11.5), the production possibility frontier is rewritten as

$$F(x_1 + x_2, Y) = 0 \quad (11.4')$$

A Pareto optimal allocation is given as the solution for maximizing the utility of agent 1, while holding agent 2's utility fixed at some given level of $\bar{u}$. The associated Lagrangian is

$$L = u_1(x_1, Y) - \mu_1[\bar{u} - u_2(x_2, Y)] - \mu_2 F(x_1 + x_2, Y) \quad (11.7)$$

The first order conditions are given as

$$\frac{\partial L}{\partial x_1} = u_{11} - \mu_2 F_x = 0 \quad (11.8.1)$$

$$\frac{\partial L}{\partial x_2} = \mu_1 u_{21} - \mu_2 F_x = 0, \text{ and} \quad (11.8.2)$$

$$\frac{\partial L}{\partial Y} = u_{12} + \mu_1 u_{22} - \mu_2 F_Y = 0 \quad (11.8.3)$$

where μ_i is a Lagrange multiplier ($i = 1, 2$), $u_{ij} = \frac{\partial u_i}{\partial j}$ ($i = 1, 2, j = x, Y$), and $F_i = \frac{\partial F}{\partial i}$ ($i = x, Y$). From Eqs. (11.8.1, 11.8.2, and 11.8.3) we finally obtain

$$\frac{u_{12}}{u_{11}} + \frac{u_{22}}{u_{21}} = \frac{F_Y}{F_x} \quad (11.9)$$

Equation (11.9) is nothing but the Samuelson rule. The left-hand side of Eq. (11.9) is the sum of the marginal rates of substitution between the public good and the private good for all individuals ($MRS_1 + MRS_2$). The right-hand side of Eq. (11.9) is the marginal rate of transformation between the public good and the private good (MRT). The public good is efficiently supplied when the sum of the marginal rates of substitution of the public good is equal to the marginal rate of transformation of the public good.

2.3 The Samuelson Rule: Simple Derivation

We may also derive the Samuelson rule in a simpler model. Suppose that the utility function is specified as

$$u_i = x_i + V(Y) \quad (i = 1, 2). \quad (11.3')$$

The production technology function is specified as

$$x_1 + x_2 + pY = M \quad (11.10)$$

The social welfare is given by the sum of the utilities since the two agents are identical. Thus, the government intends to maximize

$$W = u_1 + u_2 = (M - pY) + 2V(Y) \quad (11.11)$$

by choosing Y . The optimal condition is given as

$$p = 2V'(Y) \quad (11.12)$$

The left-hand side of Eq. (11.12) denotes the marginal cost of public goods and the right-hand side denotes the sum of the marginal benefit of public goods. Thus, Eq. (11.12) denotes the Samuelson rule.

2.4 Numerical Example: A Two-Person Model of Public Goods

Example 1

Suppose each person's utility function is given as

$$U^1 = x_1 + \log Y$$

and

$$U^2 = x_2 + 2\log Y$$

In addition, the production frontier is simply given as

$$x_1 + x_2 + Y = M$$

Then, $V_Y^1 = 1/Y$ and $V_Y^2 = 2/Y$. Hence, the Samuelson rule means that $1/Y + 2/Y = 1$. The answer is $Y = 3$. Figure 11.3 explains this case. $MB^1 = 1/Y$ and $MB^2 = 2/Y$; hence, $MB^1 + MB^2 = 3/Y$.

Note that we implicitly assume the Bentham criterion as social welfare. Generally, the Samuelson rule alone cannot determine the optimal level of public goods. This rule is a necessary condition of the optimal provision. We need, in addition, the value judgment on social welfare in order to determine the optimal level of public goods.

Example 2

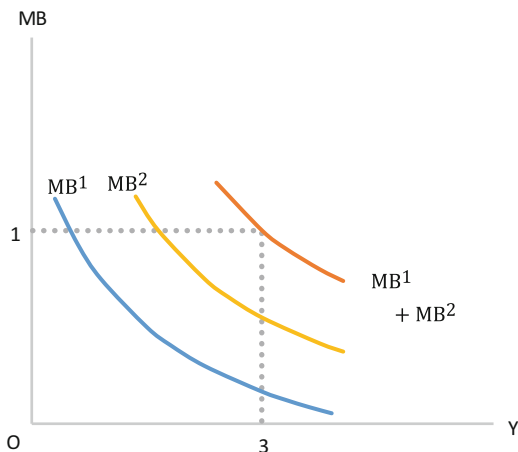
Suppose the utility function is given as

$$U^1 = x_1 Y, \quad U^2 = x_2 Y$$

and the production frontier is simply given as

$$x_1 + x_2 + Y = M$$

Fig. 11.3 The Samuelson rule



Then, $MB^1 = \frac{U_Y}{U_{x1}} = \frac{x_1}{Y}$ and $MB^2 = \frac{U_Y}{U_{x2}} = \frac{x_2}{Y}$. Hence, the Samuelson rule means

$$\frac{x_1}{Y} + \frac{x_2}{Y} = 1$$

Considering the feasibility condition, we have $2Y = M$. Thus, the answer is $Y = M/2$. If agents are identical, social welfare is represented by each agent's utility. Hence, we can determine the optimal level of public goods explicitly.

3 The Theory of Public Good Provision: The Nash Equilibrium Approach

3.1 The Nash Equilibrium Approach of Private Provision

The prior section investigated the normative analysis of the provision of public goods. This section investigates the positive theoretical analysis of the private provision of public goods. When the government does not provide public goods optimally, how do private agents behave? They may have an incentive to provide the public goods privately. The standard approach with the private provision of public goods is called the Nash equilibrium approach, whereby each agent optimizes the provision of public goods at a given level of public goods provided by other agents.

A public good can be provided by the private sector. Households may contribute to the provision of public goods if the initial level of public goods is too low. For example, we have already considered the provision of streetlights in front of houses. Suppose the government does not provide streetlights at all. Then, each agent may decide how many streetlights, which are pure public goods, she or he would like to have in front of her or his house.

Alternatively, if we consider the provision of an international public good, each country may be regarded as a private contributor since it determines its provision of the international public good based on its own interest. For example, the total emissions of CO₂ could be reduced by the abatement activities of countries; thus, the provision of abatement spending by each country may be regarded as a private provision of public goods. Then, the Nash equilibrium approach becomes relevant since each country behaves non-cooperatively to maximize its own welfare. [Appendix](#) of this Chapter deals with this case.

Alternatively, one could consider intergovernmental finance. Suppose local governments can provide nationwide public goods, the benefit of which spills over the country. If central government does not provide these goods, each local government has an incentive to provide them.

3.2 A Two-Person Model

Consider the two-person economy. In this context, we formulate person 1's optimization problem. Person 1's utility function is given as

$$U^1 = u_1(x_1, Y), \quad (11.13)$$

where U^1 is her or his utility, x_1 is her or his consumption of private goods, and Y is her or his consumption of public goods, which is equal to the total supply of public goods. For simplicity, preferences are identical between agents.

Person 1's budget constraint is given as

$$x_1 + py_1 = M, \quad (11.14)$$

where p is the price of public goods in terms of private goods and M is her or his income. For simplicity, two persons have the same income, and the marginal cost of public goods is fixed as p . y_1 and y_2 denote the private provision of public goods for each person respectively. Then, we have

$$y_1 + y_2 = Y. \quad (11.15)$$

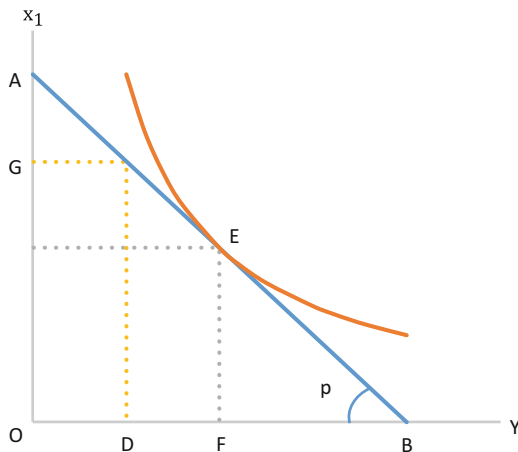
From Eqs. (11.14) and (11.15), the budget constraint of person 1 is rewritten as

$$x_1 + pY = M + py_2. \quad (11.16)$$

The right-hand side of Eq. (11.16) is called the effective income of person 1, which includes the benefit of the spillover effect of public goods provided by person 2. Person 1 effectively chooses x_1 and Y so as to maximize welfare, Eq. (11.13), subject to budget constraint, Eq. (11.16), at given levels of M , p , and y_2 .

This formulation assumes that person 1 regards others' provision of public goods y_2 as fixed when she or he chooses her or his own decision variables, x_1 and Y . This

Fig. 11.4 The Nash reaction function



is called the Nash equilibrium approach, which is consistent with the definition of non-cooperative Nash equilibrium.

In Fig. 11.4, the vertical axis is private goods x and the horizontal axis is public goods Y . Line AB corresponds to the budget constraint, Eq. (11.16). AG corresponds to py_2 and GO corresponds to M . The slope of the budget line is p . Person 1 may choose any point on line AB . Figure 11.4 draws her or his indifference curve. The indifference curve is a combination of private goods and public goods in order to fix person 1's utility, which is concave toward the origin.

The optimal point, the highest utility point, on line AB is given by point E , where line AB is tangent to the indifference curve. Person 1 consumes public goods of OF . In other words, at the given level of $OD = y_2$, person 1's optimal public provision is given as $DF = y_1$.

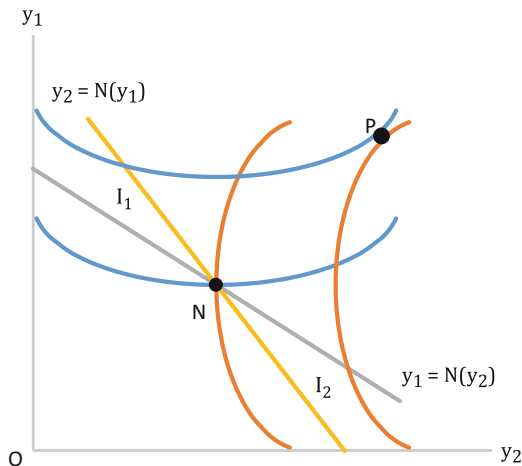
As shown in Fig. 11.4, the optimal levels of Y and y_1 for person 1 are a function of y_2 . This is the Nash reaction function of person 1. Thus,

$$y_1 = N(y_2). \quad (11.17)$$

If person 2 provides more in the way of a contribution to public goods, person 1 reduces her or his own contribution and raises her or his consumption of private goods ($N' < 0$); however, she or he does not reduce her or his contribution of public goods to a greater extent than a reduction in the total supply ($-1 < N'$). In other words, if y_2 increases, person 1's effective income $M + py_2$ increases. Because of the positive income effect, person 1 raises the consumption of private goods and public goods. Because her or his consumption of private goods increases, y_1 declines but the consumption of public goods, Y , increases.

Person 2's optimizing behavior is similarly formulated. Her or his Nash response function is similarly given as

$$y_2 = N(y_1). \quad (11.18)$$

Fig. 11.5 The Nash equilibrium

The combination of y_1 and y_2 , which satisfies Eqs. (11.17) and (11.18) at the same time, gives the Nash equilibrium.

Figure 11.5 explains the Nash equilibrium. The vertical axis is person 1's provision, y_1 , and the horizontal axis is person 2's provision, y_2 . Curve $N(y_2)$ denotes person 1's reaction curve and curve $N(y_1)$ denotes person 2's reaction curve. Since $0 > N' > -1$, the slope of curve $N(y_2)$ is negative and flatter than curve $N(y_1)$. The intersection of both curves gives the Nash equilibrium point N.

3.3 Efficiency of the Nash Equilibrium

Let us compare the Nash equilibrium and the Pareto optimum. The provision of public goods at the Nash equilibrium is smaller than at the Pareto optimum. At the Nash equilibrium, public goods are provided to a smaller extent than at the Pareto optimum. This is because each person chooses her or his provision by considering her or his own welfare.

At the Nash equilibrium point, the marginal benefit of each person, which is given as the marginal rate of substitution, is equal to the marginal cost of public goods, p . Thus,

$$MRS^1 = MRS^2 = p.$$

If the benefit is limited to each person as with private goods, this is the socially optimal condition. Thus, the private market may attain the Pareto optimum allocation, as the fundamental theory of welfare economics implies.

However, with regard to public goods, it is necessary to include the spillover effect on other agents. The social marginal benefit is larger than the personal marginal benefit in a multiple person economy. The Samuelson rule implies that the sum of the personal marginal rate of substitution, which is given as the social

marginal benefit of public goods, is equal to the marginal cost of the public goods. Thus,

$$MRS^1 + MRS^2 = p.$$

In other words, at point N we have

$$MRS^1 = MRS^2 < MRS^1 + MRS^2.$$

Hence, public good Y is undersupplied at the Nash equilibrium point N.

In Fig. 11.5, we draw the Pareto optimal point P, where the indifference curves of both persons are tangent at point P. However, at point N, the indifference curves of both persons intersect, which means that point N is not Pareto efficient. I_1 denotes an indifference curve of person 1, while I_2 denotes an indifference curve of person 2 at N.

Note that indifference curve I_1 becomes tangent to the horizontal line on curve N (y_2), while indifference curve I_2 becomes tangent to the vertical line on curve N (y_1). For person 1, the horizontal line is the budget line in Fig. 11.5 since she or he may choose any level of y_1 at a given level of y_2 . The optimal point is the point where the budget line is tangent to her or his indifference curve, which corresponds to the reaction curve.

3.4 Examples: Comparison

We compare equilibria between the Nash game and the Samuelson rule.

Example 1

Suppose each person's utility function is given as

$$U^1 = x_1 + \log Y \text{ and}$$

$$U^2 = x_2 + 2\log Y$$

In addition, the production frontier is simply given as

$$x_1 + x_2 + Y = M$$

Then, $V_Y^1 = 1/Y$ and $V_Y^2 = 2/Y$. Hence, the Nash solution means $1/Y > 1, 2/Y = 1$. The answer is $Y = 2$. In this situation, only person 2, whose evaluation of public goods is greater than that of person 1, provides the public good at $Y = 2$, which is smaller than $Y = 3$ with the Samuelson rule. Person 1 does not provide public goods at all.

Example 2

Suppose the utility function is given as

$$U^1 = x_1 Y, \quad U^2 = x_2 Y$$

and the production frontier is simply given as

$$x_1 + x_2 + Y = M$$

Then, $MB^1 = \frac{U_Y}{U_{x1}} = \frac{x_1}{Y}$ and $MB^2 = \frac{U_Y}{U_{x2}} = \frac{x_2}{Y}$. Hence, the Nash solution means that

$$\frac{x_1}{Y} = \frac{x_2}{Y} = 1$$

Considering the feasibility condition, we have $3Y = M$. Thus, the answer is $Y = M/3$, which is again smaller than $Y = M/2$ with the Samuelson rule.

3.5 Criticism of the Nash Equilibrium Approach

In reality, the private provision of public goods is often observed. Charity is a notable example. With regard to charity, the total amount that is contributed may be considered a public good since the total amount is used for worthwhile public services and benefits the contributor. In this regard, the Nash equilibrium approach is useful to explain why people are charitable.

However, there are arguments against the use of the Nash equilibrium approach to explain the mechanism of the private provision of public goods. For example, Andreoni (1990, 1993) criticized the Nash approach.

In this regard, the model that presents the conventional private provision of public goods does not necessarily offer an effective explanation of the outcome of charitable giving. In the US, charitable giving has three properties. First, many people give to charity. Some empirical studies suggest that 85 % of US citizens donate to churches. Second, the total amount of charity is significantly large. Some estimate that the amount is about 2 % of GDP. Third, if the government is involved with charitable giving, an increase in public funds would not reduce private funds by much. For example, US\$1 of government funding would crowd out private charitable giving by less than 5–28 cents.

Andreoni pointed out that the foregoing facts are not explained effectively by the Nash approach. As the size of agents increases, the portion of contributors converges to zero in the Nash equilibrium, a situation that is inconsistent with the actual data on charitable giving.

For example, consider the Cobb-Douglas utility function with a plausible value of the marginal propensity to consume public goods, which is 0.5. Here, the Nash equilibrium model predicts that the portion of contributors becomes 3 % when the size of agents is 200 with a plausible distribution of income. This theoretical

conjecture may not explain precisely the actual data on charitable giving. Thus, Andreoni suggested that warm-glow motives should be incorporated into the utility function. Consequently, agents obtain utility from giving to charity as well as from the total amount of charity. Extending the conventional model to warm-glow motives may accurately explain the actual outcome of charitable giving.

4 The Theoretical Analysis of Public Goods: The Lindahl Equilibrium

4.1 The Lindahl Equilibrium

We now investigate the Lindahl equilibrium whereby the government plays an important role in the provision of public goods. See Lindahl (1919). This equilibrium can attain the efficiency of allocation. Thus, many studies have considered the plausibility of this mechanism. The mechanism has three stages.

- (i) The government determines each agent's burden ratio of the provision of public goods.
- (ii) Each agent declares her or his desirable provision of public goods at a person-specific burden ratio.
- (iii) The government adjusts burden ratios so as to equate all agents' desirable levels in public goods. Then, it determines the optimal provision of public goods whereby all agents demand the same level of public goods.

First, let us formulate person 1's optimizing behavior. She or he maximizes her or his utility, Eq. (11.13), subject to the following budget constraint:

$$x_1 + phY = M, \quad (11.19)$$

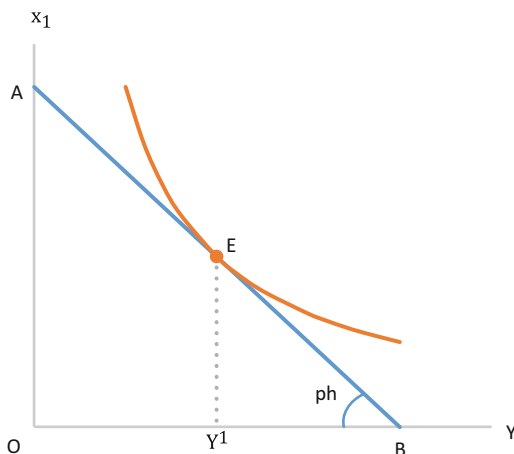
where $h = y_1/Y$ is the person-specific burden ratio for person 1. h is given for person 1 and ph may be regarded as the effective price or personalized price of a public good.

As shown in Fig. 11.6, the slope of the budget line AB is ph and $OA = M$. The optimal point is given as point E, where the budget line and indifference curve are tangent. The associated Y is person 1's most desirable level of public goods.

The relation between h and person 1's optimal Y^1 may be written as

$$Y^1 = \lambda(h). \quad (11.20)$$

This is called the Lindahl reaction function. Y^1 decreases with h . If the personalized price of a public good, h , increases, person 1's demand for Y^1 declines because of substitution and income effects.

Fig. 11.6 The optimizing behavior

Person 2's optimizing behavior may be formulated in a similar way:

$$Y^2 = \lambda(1 - h). \quad (11.21)$$

Note that person 2's burden ratio is given as $1 - h$. The government presents a person-specific burden ratio to each agent. Usually, two persons' optimal levels of public goods are not the same. Then, the government adjusts the burden ratios so that the sum of the burden ratios becomes 1 at the same optimal level of Y , $Y^1 = Y^2$.

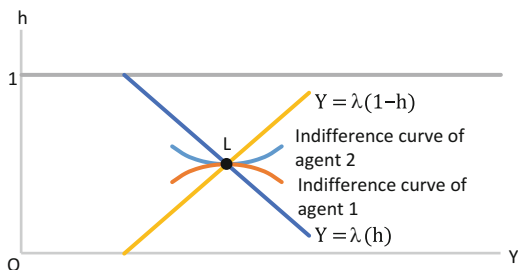
4.2 Efficiency of the Lindahl Equilibrium

The Lindahl equilibrium is determined by two Lindahl reaction functions. Figure 11.7 presents person 1's burden ratio with h in the vertical axis and the level of public goods, Y , in the horizontal axis. Each person's reaction curve is drawn. Person 1's reaction curve is downward sloping, while person 2's reaction curve is upward sloping. Note that person 2's burden ratio, $1 - h$, has its origin at $(0, 1)$. The Lindahl equilibrium is determined by the intersection of two Lindahl reaction functions at point L.

Figure 11.7 also draws each person's indifference curve. Person 1's indifference curve crosses her or his Lindahl reaction curve at a point where the slope of the indifference curve becomes flat. The indifference curve is concave at this point. Further, utility increases when the indifference curve goes downward. This is because person 1's utility increases if she or he consumes the same amount of public goods at a lower burden. Person 2's indifference curve is the reverse of person 1's curve because the burden ratio for the two agents is opposite.

As shown in Fig. 11.7, the indifference curves are tangent to each other at the Lindahl equilibrium point L, which is the Pareto optimum. Thus, the provision of

Fig. 11.7 The Lindahl equilibrium



public goods is efficient. In other words, the Lindahl equilibrium L is the Pareto optimum and the sum of personal marginal substitution is equal to the marginal transformation of production. This refers to the Samuelson rule of the optimal provision of public goods whereby each person chooses a burden of public goods at personalized prices; thus, the prices are equal to the personal benefit of the public goods. Hence, the sum of the personalized prices is equal to the marginal cost of the public goods.

In other words, the marginal benefit of the public good of person 1, MRS^1 , is equal to the personalized price, ph . In addition, the marginal benefit of person 2, MRS^2 , is equal to the personalized price, $p(1 - h)$. Hence, we have

$$MRS^1 + MRS^2 = ph + p(1 - h) = p = MC,$$

which is the Samuelson rule.

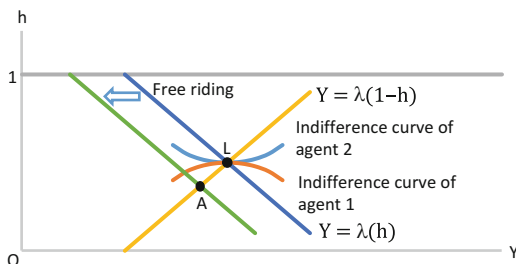
5 The Free Rider Problem

5.1 Public Goods and the Free Rider Problem

The Lindahl equilibrium has the desirable property of attaining the Pareto optimum. The government can find the Lindahl equilibrium by raising the burden ratio of agents who want to demand more public goods than others. By so doing, the government can always attain the Pareto optimum at the Lindahl equilibrium. This is true as long as agents honestly report their true preferences to the government. If not, then the government has to deal with the free rider problem.

“Free riding” means that agents enjoy the benefit of public goods without paying the burden. First, we explain the free rider outcome when agents reveal their true preferences. With regard to the Nash equilibrium, if an agent does not pay anything at the equilibrium, she or he free rides on others’ provisions. Since public goods are non-excludable, even if she or he does not contribute at all, she or he can still enjoy the benefit. The corner solution of the Nash equilibrium is likely to occur if preferences on public goods diverge and/or income inequality is significant among agents.

Fig. 11.8 The Lindahl equilibrium and free riding



The free rider problem can occur even in the Lindahl mechanism when agents do not reveal their true preferences. Agents may have an incentive not to reveal their true preferences because by underreporting their preferences, they can avoid the burden of public goods and still enjoy the benefit of public goods. By reducing their demand for public goods intentionally so that it is less than true demand, such agents can reduce their burden. This type of free riding behavior can occur in the Lindahl equilibrium.

As shown in Fig. 11.8, if person 1 does not reveal her or his true preference and intends to avoid her or his burden, she or he is likely to reveal a smaller level of public goods than her or his optimal level $\lambda(h)$ at a given h . Then, her or his revealed reaction curve moves to the left in this figure. Thus, the Lindahl equilibrium point moves from L to A . At the new point, A , person 1's burden ratio declines; thus, her or his utility may increase because she or he may enjoy public goods at a lower burden ratio.

The foregoing argument means that even in the Lindahl mechanism, we cannot exclude the possibility of free ride incentives, as in the Nash equilibrium approach. Consequently, the provision of public goods is smaller than in the true Lindahl case, and person 2 faces a larger burden ratio. In other words, the free rider makes others less prosperous by moving her or his burden to others.

So far, person 2 is assumed to behave honestly. Of course, person 2 also has an incentive to free ride. If both persons wish to free ride, both revealed reaction curves move to the left. Hence, the resulting burden ratio for both persons does not change much. However, the provision of public goods declines. This outcome harms both persons. Considering the possibility of free riding, the Lindahl mechanism cannot attain the Pareto optimum.

5.2 Possibility of the Free Ride Problem

When benefit and burden are separated, a conflict among agents occurs. In this regard, it is difficult to handle the free rider problem. With regard to pure public goods, equalizing the burden makes the benefit burden ratio equal for agents. If the benefit of pure public goods is the same among agents, equal sharing of the burden is fair and desirable. For example, expenditure to maintain the fundamental

institutions of society is a pure public good. Thus, the government should collect the same amount from all agents.

However, benefits can diverge among agents. For example, regional public goods may offer different consumption possibilities among agents. In this regard, an equal burden is not effective. Those who do not receive many benefits are eager to avoid the burden. Hence, the free rider problem is serious.

The alternative burden principle is that a burden increases with benefits. This is called the benefit-to-pay principle. However, because the government may not know the true benefit for each agent, this principle is not necessarily feasible. In some cases, benefits may depend on the size of income, although this does not always work. For example, it may not be true that benefits from defense, education, and public capital increase with income.

Thus, the seriousness of the free rider problem depends on the divergence of benefits among agents. In reality, the content of government spending varies from pure public goods to impure public goods. Thus, the equal burden scheme cannot equate the benefit burden ratio for agents; consequently, the free rider problem is serious in the real economy.

How should the problem be handled? The benefit-to-pay principle may avoid too much demand. However, it may induce an incentive for free riding. If the cost of too much demand is serious, it may be desirable to impose the benefit-to-pay principle. Then, the provision of public goods is not too great.

An alternative approach is to reduce the incentive to free ride. If a public good project attains the Pareto optimum, all agents can gain with appropriate redistribution. Thus, if a redistribution policy is reliable, agents do not have an incentive to demand too much or too little. When past public projects are conducted with appropriate redistribution policies, agents believe that a new project will also be fair with redistribution. Thus, they do not have to free ride a great deal. In this sense, the reliability of government policy on equity is important in order to handle the free rider problem.

5.3 Game Theory Approach to the Free Rider Problem

As explained, the main problem with any simple pricing mechanism is that people may have a strong incentive to misrepresent their preferences and thus “free ride” by not contributing to the public good. This is easily seen in the following simple game. Suppose there are two persons, 1 and 2, who live at the end of a dead-end street.

The two persons meet and agree that both would benefit from the provision of a streetlight. They agree to split the cost evenly. Assume that if the streetlight company receives a check from only one person, it sends that person a bill for the remaining cost. Let B denote the benefit that an individual receives from the light and C the cost. In order to make the problem interesting, suppose $C/2 < B < C$.

The payoff matrix is depicted in Table 11.2. The private individuals know the payoffs and everyone knows that everyone else knows this. Thus, neither person

Table 11.2 The streetlight game

	Contribute	Do not contribute
Contribute	$B - C/2, B - C/2$	$B - C, B$
Do not contribute	$B, B - C$	$0, 0$

alone has an incentive to provide the streetlight; both have an incentive to free ride completely. The one-shot game has a unique Nash equilibrium where neither person contributes to the streetlight. This is because not contributing to the public good is a dominant strategy since $B > B - C/2$ and $0 > B - C$ for both players in the game, by assumption.

There may be an economic incentive to cooperate if the interaction occurs more than once. In order to capture the notion that agents may undertake actions that support a public good for economic reasons, we can imagine a repeated game. Consider the streetlight game and suppose that the two persons interact once each period simultaneously for an infinite number of periods. Let β be the discount factor, where $0 < \beta < 1$, and assume $C > B > C/2$, as before.

Suppose both persons employ the strategy “never cooperate.” This constitutes a Nash equilibrium in the infinitely repeated game. The payoff to such a strategy is zero. Unilaterally deviating from this strategy by cooperating only lowers the payoff during the period in which the deviation takes place since $B < C$, and does not raise it in other periods if the other person is playing the strategy “never cooperate.” Thus, the strategic pair (never cooperate, never cooperate) is a Nash equilibrium.

Next, suppose both persons play the strategy “always cooperate.” The payoff is $(B - C/2) + \beta(B - C/2) + \beta^2(B - C/2) + \dots = (B - C/2)/(1 - \beta)$. Consider a unilateral deviation from this strategy. The payoff increases during the period in which a person unilaterally deviates by not cooperating since $B > B - C/2$, and does not fall in the other periods. The person thus benefits from unilaterally deviating. It follows that the strategic pair (always cooperate, always cooperate) is not an equilibrium.

This tends to suggest that cooperation may be unlikely to occur in such a “prisoner’s dilemma” environment. However, there are more complicated strategies that can support the cooperative outcome in this arrangement. Consider the so-called trigger strategy. A simple trigger strategy has two parts. First, person 1 begins by cooperating and continues to cooperate if person 2 cooperated in the prior period. Second, if person 2 unilaterally deviated from cooperation in the prior period, person 1 punishes person 2 by playing non-cooperatively for a number of periods.

With regard to the streetlight, if both persons play the trigger strategy and cooperate in each period, the payoff is $(B - C/2)/(1 - \beta)$ for each person. Then suppose that person 2 “cheats” in the first period of the game. Person 2’s payoff is B in this period instead of $B - C/2$; thus, person 2 is better off in the period in which she or he deviates. However, in the second period, person 1 finds out about 2’s “cheating” and “punishes” person 2 by choosing not to cooperate. Person 2’s payoff after the first period is 0. Thus, in deciding whether to deviate or not, person

2 compares her or his payoff in terms of cooperation, $(B - C/2)/(1 - \beta)$, with the payoff when she or he deviates and is punished, B . If the former is greater than the latter, $(B - C/2)/(1 - \beta) > B$, or, after simplifying, if $\beta > C/2B$, then person 2 cooperates and contributes to the streetlight for each period. If this is also true of person 1, she or he cooperates as well, and the trigger strategy can support cooperation.

The intuition is that the person who “cheats” receives a larger benefit than she or he receives by cooperating before the other person finds out. Once punishment begins, however, the “cheater’s” payoff falls below the payoff that she or he would have received by cooperating. This is the cost of cheating. Since the cost occurs in the future, it seems reasonable to discount it. The larger the discount factor, β , the more weight the “cheater” places on the cost associated with cheating. If the discount factor is high enough, the cost is large enough to induce cooperative behavior.

For example, if the cheater does not care about the future at all, $\beta = 0$ and the cost of cheating has no effect on her or his behavior. In addition, the longer it takes for the other player in the game to discover that cheating has occurred, the greater the benefit of cheating and the less likely cooperation will be.

In the streetlight game, we assumed that the private agents knew the payoffs of the game. If this were literally true, the government could hire one of the agents to explain everyone’s payoff for the public good and then charge the appropriate Lindahl prices. In a more complex setting, private agents may not know the payoffs, B^j , precisely but may know that $C/2 < B^j < C$ for each agent, j . A more interesting case to consider is where the discount factor differs among agents.

Suppose that the payoff and the discount factor differ among agents and there is equal cost sharing. Then, with a trigger strategy, agent j contributes if $\beta^j > C/nB^j$ when there are n agents, given that the other $n - 1$ agents are contributing. The lower the unit cost, the greater the number of agents; and the larger the individual payoff, the more likely it is that a trigger strategy is successful. Individuals with a low benefit, or a low discount factor, may fail to contribute. See Batina and Ihori (2005) for more discussions on this topic.

5.4 The Clarke Tax

We now explain the mechanism that makes agents reveal their true preferences on a given size of project. The issue is whether the government conducts the given public project or not. Here, the size of project is exogenously fixed. The government conducts the project if and only if the total benefit exceeds the cost. Since the government does not know the true benefit of agents, the government regards the reported benefits as the true benefits. The problem is how to make agents report their true benefit using a tax-transfer mechanism.

This mechanism is the Clarke tax (Clarke 1971). If a decision depends upon an agent’s reported benefits, she or he is called a pivotal agent. Then, according to this tax, the pivotal agent has to pay the amount that others would lose through the

Table 11.3 The Clarke tax

Agent	A	B	C
True benefit	100	70	-80
Clarke tax (true report)	10	0	0
Clarke tax (C reports too little: -180)	0	0	170

decision. Under the Clarke tax mechanism, each agent has an incentive to report her or his true preferences to the government. Let us explain this mechanism intuitively in Table 11.3.

Suppose that persons A, B, and C are asked to report their net benefits from a given public project. Their net benefits, benefits minus tax burdens, are given as 100, 70, and -80 respectively. In other words, their benefits are 200, 170, and 20 respectively, while the total cost of 300 is equally levied among the three agents. Thus, agents A and B are made more prosperous by the project, while agent C is less prosperous.

If three agents report their true benefits, agent A is the pivotal agent who effectively determines the decision of the project. This is because the sum of B and C's benefit is $70 + (-80) = -10$, which is negative. Then, adding A's benefit, the sign of the total benefit becomes positive. Thus, A is the pivotal agent. With regard to person B, the sum of A and C's benefit is already positive, $100 + (-80) = 20$; thus, adding B's benefit does not change the sign. Similarly, with regard to agent C, the sum of A and B's benefit is $100 + 70 = 170$. Adding C's benefit, -80, cannot change the sign. Since agent A is the only pivotal agent, she or he has to pay the Clarke tax, which is given by the net loss of B and C, $-70 + 80 = 10$.

Let us investigate if each person has an incentive to demand too much or too little. By reporting their true benefits, agents A and B can always choose the optimal decision to accept the project. They do not have an incentive to report false benefits. Since the Clarke tax is independent of their reports about benefits, the tax burden cannot be reduced by demanding too much or too little.

However, person C can change the sign by demanding too little. By so doing, she or he can reject the project. For example, if she or he reports the net benefit of -180, the sum is negative, $100 + 70 + (-180) = -10$. Then, this project is rejected. However, now agent C becomes the pivotal person; thus, she or he must pay the Clarke tax. The amount is the total loss to agents A and B, which is $100 + 70 = 170$. In other words, although agent C can avoid her or his own loss of 80 by rejecting the project, she or he also has to pay a Clarke tax of 170. In sum, agent C loses by 90. By demanding too little, she or he pays the Clarke tax and loses. Thus, it is not desirable for agent C to demand too little. She or he has an incentive to report her or his true net benefit.

5.5 The Clarke Tax and a Balanced Budget

Unfortunately, the Clarke tax mechanism is not generally Pareto optimal since the budget does not balance identically for all possible strategies. In some

circumstances, a surplus of revenue is collected under the mechanism because of the incentive tax. The additional tax revenue cannot be spent without disrupting the incentives of the mechanism in a finite population.

If the revenue is used in a systematic way that agents can predict, they will respond to the use of the revenue at the margin in a strategic manner. This may severely limit the ability of the mechanism to provide agents with the correct incentive. The wasted revenue could be negligibly small in a large economy and be ignored for all practical purposes. This may be true for some strategies; however, it is not true for all strategies.

Alternatively, one can imagine a lump sum rebate of the excess revenue that would only cause a small distortion to incentives, which would become zero asymptotically with the size of the economy. However, even if the tax revenue falls as the economy increases in size, another problem emerges, as pointed out by Green and Laffont (1979): the agent has less of an incentive to tell the truth if the individual agent's incentive tax falls with the size of the economy. In this instance, the mechanism may fail to provide the appropriate incentive in large economies. Thus, truth telling as a dominant strategy, budget balance, and Pareto optimality appear to be incompatible.

6 The Neutrality Theorem of Public Goods

6.1 The Neutrality Theorem

Consider the Nash mechanism of public goods provision. This approach assumes that the private sector voluntarily provides public goods instead of the government. As explained in Sect. 3, the Pareto optimum level of public goods cannot be attained and the market fails. In this section, we do not discuss the normative aspect of the Nash mechanism; rather, we explore an interesting outcome of redistribution policy in this formulation.

Warr (1983) showed that in the formulation of the Nash provision of public goods, redistribution policy cannot have any real effect. This policy is perfectly offset by the private reaction to the provision of public goods. This is called the neutrality theorem of public goods. The outcome is consistent irrespective of preferences and the distribution of income.

6.2 The Model of Neutrality Result

We consider a two-person economy as in Sect. 3. Both people provide public goods voluntarily. The government conducts the redistribution policy; namely, the government may tax person 1's income and give a subsidy to person 2. The redistribution is conducted from person 1 to person 2. Because person 1's disposable income declines, her or his provision of public goods also declines. However, since person 2's disposable income rises, her or his provision of public goods also rises.

The neutrality theorem means that at the new equilibrium, a reduction of person 1's provision is the same as a reduction of her or his disposable income, and an increase in person 2's provision is the same as an increase in her or his disposable income. As a result, the total provision of public goods does not change. Moreover, the redistribution policy does not change each person's consumption or welfare.

Consider a two-person economy in which each person's utility function is given as

$$U^i = U^i(x_i, Y) \quad i = 1, 2, \quad (11.22)$$

where U^i is utility, x_i is the private good consumption of person i , and Y is a pure public good.

Each person's budget constraint is given as

$$M_i = x_i + y_i, \quad (11.23)$$

where M_i is income and y_i is the private provision of a public good by person i . The public good is privately provided:

$$y_1 + y_2 = Y. \quad (11.24)$$

From the optimizing behavior of each person, we have

$$x_i = x_i(U^i) \quad (11.25)$$

and

$$Y = Y^i(U^i) \quad (i = 1, 2). \quad (11.26)$$

These two equations give the optimal combination of private consumption and public good as a function of each person's utility. Namely, optimal levels of private good consumption and public good are an increasing function of each person's utility.

Then, from the above equations as the feasibility condition, we have

$$M_1 + M_2 = x_1(U^1) + x_2(U^2) + Y^1(U^1) \quad (11.27)$$

and

$$Y^1(U^1) = Y^2(U^2). \quad (11.28)$$

The two Eqs. (11.27) and (11.28), determine the equilibrium values of U^1 and U^2 . Since the total income, $M_1 + M_2$, appears in the first equation, the total income in the economy determines welfare and other economic variables. Since the distribution of income does not affect $M_1 + M_2$, redistribution does not matter either. In

other words, income redistribution does not affect real economic variables. This is the neutrality theorem of public goods.

6.3 Perfect Crowding Out

Another formulation of the neutrality result is to incorporate publicly provided public good G in addition to privately provided public good Y . Then, the utility function, Eq. (11.22), is rewritten as

$$U^i = U^i(x_i, Y + G), \quad (11.22')$$

where Y and G are perfect substitutes. The government levies a lump sum tax T_i in order to provide the public good G . Then, the private budget constraint, Eq. (11.23), is rewritten as

$$M_i = x_i + y_i + T_i. \quad (11.23')$$

The government budget constraint is given as

$$T_1 + T_2 = G. \quad (11.29)$$

In this formulation, the feasibility condition, Eq. (11.27), may be rewritten as

$$M_1 + M_2 = x_1(U^1) + x_2(U^2) + Z^1(U^1), \quad (11.27')$$

where $Z = Y + G$ denotes the overall supply of public good, which is an increasing function of each individual's utility. Then, in place of Eq. (11.28), we have

$$Z^1(U^1) = Z^2(U^2). \quad (11.30)$$

Equations (11.27') and (11.30) determine U^1, U^2 as a function of $M_1 + M_2$. Thus, we have another version of the neutrality result here. It is easy to see that an increase in G by raising T_i does not affect the equilibrium level of Z . It would crowd out private provision of public good, Y , by one to one. The government cannot affect the equilibrium level of Z by changing G . This means the perfect crowding out of public spending.

6.4 Plausibility of the Neutrality Theorem

The neutrality theorem applies to various instances of the private provision of public goods. For example, local governments may provide nationwide public goods voluntarily and central government may conduct regional redistribution policies. Alternatively, national governments provide international public goods

and some international organizations redistribute income among countries. In such instances, redistribution may not have any real effect on the Nash solution. If we consider the public provision as well as the private provision of public goods, public provision financed by taxes can crowd out private provision by 100 %.

Analytically, we can consider other formulations of the voluntary provision of public goods. In relation to the Nash equilibrium approach, each agent regards others' provision of public goods as fixed. An alternative approach is that an agent becomes the leader and chooses her or his optimal provision by incorporating others' reaction functions. Others follow the leader's provision. This is the Stackelberg equilibrium approach. Even in this leader-follower approach, the neutrality theorem can be maintained.

In a realistic situation, however, this proposition may not be maintained. First, the neutrality theorem is not preserved in relation to non-negative constraint. The private provision of public goods by each agent cannot be negative. If income is low and/or the evaluation of public goods is low, the optimal level of public goods may well be smaller than the sum of others' provision. In this regard, the optimal level of an agent's provision can be negative. However, because of the non-negativity constraint, she or he spends her or his income on private consumption in accordance with the corner solution.

Then, public redistribution has a real effect. This is because the agent cannot adjust to the redistribution policy in accordance with the corner solution. It has been shown that the larger the size of agent and the larger the inequality of income, so the likelihood of this situation occurring increases.

6.5 Concluding Remarks

In this section, we studied the famous neutrality propositions whereby private agents are able to offset certain government policies on a one-for-one basis. The two policies studied at length are a pure redistribution of income across agents and government provision of a public good financed by a tax imposed on all agents. These issues have generated great controversy and much useful research. In particular, we presented and discussed the conditions under which the propositions hold.

There are two new reasons for neutrality to fail. First, if there are unsophisticated agents who do not see through the government's budget constraint, certain policies that affect these agents may affect the equilibrium, even though there may be sophisticated agents who do see through the government's constraint and behave accordingly. Second, if contributors believe they can affect local conditions but cannot affect federal policies, then federal policies have an impact on the equilibrium.

It is useful to point out the important situation of donated labor. If a public good is produced using donated labor alone, neutrality generally fails as long as the opportunity cost of donating labor differs across agents. However, if contributors also make cash contributions, these contributions can be adjusted to offset the government's policy and neutrality may still hold.

Our conclusion is that neutrality is a very fragile result theoretically. It will break down under a variety of realistic circumstances. This strongly suggests that the neutrality result will not generally hold in a real economy. Policymakers need to recognize that private agents may take actions that offset the impact of the government's intended policy.

Appendix: Public Bads, Growth, and Welfare

A1 Introduction

It is well recognized that because of the disexternalities of public bads such as pollutants, economic growth does not necessarily enhance welfare; however, the abatement behavior may offset such disexternalities. Indeed, abatement behavior may be so beneficial that it can raise overall welfare. In contrast, if the agent faces a corner solution and does not see a need for conducting abatement, this means that the agent significantly evaluates growth and hence notably gains from growth. Thus, a natural conjecture is that growth normally enhances welfare, especially for the poor agent, although the paradoxical possibility of immiserizing growth because of pollutants is not excluded.

In the real world, many poor countries are willing to have high growth even if it may raise the quantity of pollutants. Some economists, many of whom are associated with international organizations, advocate an international lump sum income transfer to developing countries in order to help introduce pollution abatement activities that improve the global environment. It is thus important to investigate the welfare implications of growth with pollutant emissions, which may deteriorate environmental quality, by explicitly incorporating offsetting abatement behavior.

Some papers have explored the offsetting effect of abatement behavior analytically using a framework of private provision of public goods (see, among others, Cornes and Sandler (1996); Sandler (1992); Shibata (2003); Cornes and Rubbelke (2012)). Shibata (2003) claimed that once we explicitly incorporate a public bad of damaging welfare, the optimizing abatement behavior results in a paradoxical result that economic growth cannot always enhance welfare. Using an extended version of Shibata's analytical framework, we shall also show that the foregoing conjecture is not necessarily valid.

A2 Analytical Framework

Many public goods are types of service that reduce the amounts or magnitudes of the effects of undesirable public outcomes or phenomena (namely, public bads). With respect to this public-bad-reducing-type of public good, agents' real concern is not the quantity of the public goods provided (such as the size of the police force, the number of fire stations, and the amount of health services) but the net magnitude

of the public bad that remains in the community after public-bad-reducing activities are undertaken. In other words, agents are really concerned with the magnitude of the undesirable conditions that remain in the community, such as the net quantity of environmental pollution, the amount of crime statistics, the frequency of fires, the number of afflicted patients, etc.

As a concrete example, we consider pollution abatement activities. In such an instance, it is important to formulate how the quantity of pollutants is accumulated and how the abatement behavior is determined in order to identify the quantity of pollutants remaining in the environment. If the initial quantity is exogenously given and fixed, the conventional analytical framework could be fine. However, if it is endogenously accumulated within the community and affected by economic and abatement activities, the conventional framework is no longer appropriate. In this appendix, we incorporate a public bad of damaging welfare and a public good of improving welfare. Thus, we analyze the agents' optimization problem with respect to a public-bad-reducing-type abatement behavior by explicitly considering how the quantity of pollutants is accumulated.

Under these circumstances, it is important to recall that laws of thermodynamics normally imply that there can be no such thing as non-polluting production. Hence, it is plausible to assume, for simplicity, that agent i 's production of income w_i necessarily emits a quantity of pollutants, denoted by $\bar{z}_i$. The (initial) quantity of pollutants $\bar{z}_i$ increases with the production of income, w_i . We assume that the quantity of pollutants emitted non-linearly increases with production of the private good. Thus, the (inverse) pollution emission function is given as

$$w_i = M_i(\bar{z}_i) \quad (11.A1)$$

where $M_i(\bar{z}_i)$ is the exogenously given agent-specific (inverse) pollutant emission function and the marginal change $m_i \equiv dM_i/d\bar{z}_i (> 0)$ reflects the degree of efficiency of production activities that may minimize the amount of pollutants. Here, m_i is an endogenous variable. The lower the m_i , the larger the pollution emission from the given amount of good production, and the less efficient the production technology. When the agent produces no good, her or his emission is zero. Agent i may not recognize the disexternalities of her or his income-earning activity on the environment given by Eq. (11.A1) regarding her or his optimizing behavior. Note that m_i is not necessarily constant or the same among agents: $m_i \neq m_j$ for some i, j .

Suppose that there are $n+1$ agents. Let $\bar{Z} \equiv \sum_{i=1}^{n+1} \bar{z}_i$. The utility depends upon private consumption and (net) environmental quality. Agent i 's optimization problem with respect to abatement is thus formulated as

$$\begin{aligned} \text{Max}_{y_i, a_i} \quad & U_i = U_i(y_i, a_i + a_{-i} - \bar{Z}) \\ \text{s.t.} \quad & y_i = w_i - K_i(a_i), \end{aligned} \quad (11.A2)$$

where $K_i(a_i)$ is the person-specific cost function of the abatement for agent i , and y_i is private consumption. a_i and a_{-i} are the quantity of pollutants abated by agent i and by agents other than i respectively. The marginal change $k_i \equiv dK_i/da_i (> 0)$ reflects the degree of efficiency of abatement activities that may reduce the amount of pollutants. The lower the amount of k_i , the larger the pollution reduction from the given amount of income spent on abatement, and the more efficient the abatement technology. It is unnecessary to assume that a fall in production has the same reducing effect on pollutants as an increase in abatement. We assume $k_i \neq m_i$. We consider the general situation where k_i is not necessarily constant or the same among agents: $k_i \neq k_j$ for some i, j .

Hence, the agent's effective (nonlinear) budget constraint is rewritten as

$$y_i + K_i(A + \bar{Z} - a_{-i}) = w_i \quad (11.A3)$$

where net environmental quality A is given as

$$a_i + a_{-i} - \bar{Z} \equiv A \quad (11.A4)$$

Net environmental quality A is negatively related with the quantity of pollutants remaining in the environment, which is the public bad denoted by B . Thus, $A = -B$. Note that in the foregoing optimization, the quantity of aggregate pollutants emitted by the agents other than i works as if it reduces agent i 's income.

The agent chooses y_i and A to maximize $U_i(y_i, A)$ subject to Eq. (11.A3) at given levels of $\bar{Z} - a_{-i}$ and w_i . If we assume an interior solution, the optimizing behavior on vector (A, y_i) may be formulated in terms of the compensated demand functions,

$$A = \Phi_i(U_i) \text{ and} \quad (11.A5)$$

$$y_i = \Gamma_i(U_i) \quad (i = 1, 2, \dots, n+1) \quad (11.A6)$$

A, y_i is an increasing function of U_i since we assume that both private consumption and environmental quality are normal goods. Thus, environmental quality generally increases with welfare.

A3 Wealth Differentials

A3.1 The Neutrality Result

Pollution due to growth may harm the environment. Thus, abatement activities are important in order to attain welfare-enhancing growth. A natural conjecture is that growth normally enhances welfare, especially for the poor agent since she or he significantly evaluates growth. As already suggested, some economists, many of whom are associated with international organizations, advocate an international lump sum income transfer to developing countries in order to help them stimulate pollution abatement activities that improve the global environment.

However, as implied by the neutrality theorem of public goods (see Sect. 6 of the main text of this chapter), the effect of lump sum inter-agent income transfers on aggregate emissions is zero at best when optimizing abatement behavior is determined as an interior solution. This is because a reallocation of the agents' aggregate income has a neutral effect in determining the Nash equilibrium pollution level when all countries are rich enough to emit the equilibrium level of pollution. If we assume that all agents attain their respective internal solutions at the Nash equilibrium and, consequently, the set of contributors to the abatement activities is fixed, wealth differentials with the same aggregate wealth do not matter at all. This is a well-known neutrality theorem, as explained in Sect. 6 of this chapter.

Some countries with a small amount of wealth, though, choose not to contribute to the abatement because the Nash equilibrium quantity of pollutants remaining in the environment achieved by others (a_{-i}) is larger than their individually desirable level of total abatement (A), particularly with regard to poor agents. Such agents do not contribute to the abatement at all since the marginal utility of private consumption is strictly greater than the marginal utility of abatement in terms of consumption. In such an instance, changes in wealth differentials due to economic growth or redistribution have real effects; namely, a plausible conjecture is that a transfer from the rich to the poor is desirable since the poor significantly evaluate an increase in income. However, we now show that this conjecture is not necessarily valid.

Suppose the world consists of two types of $n+1$ country: n identical poor countries 1, 2, ..., n , and one rich country $n+1$. Thus, $w_1 = \dots = w_n = w_L < w_{n+1} = w_H$. Subscripts L and H denote the poor and rich respectively. Country L does not abate at the corner solution: $a_L = 0$. Suppose income is redistributed from country H to country L, so that w_H declines and w_L rises but total income $nw_L + w_H$ does not change. Since the redistribution occurs after production activities are over, the initial pollutant $\bar{Z}$ does not change either.

Because the income of country H, w_H , decreases from the income effect, y_H and A decrease; hence, U_H and a_H also decrease. After receiving an income transfer, if country L still faces the corner solution, an increase in w_L results in the same increase in y_L without raising a_L . From this direct effect of redistribution, U_L increases. Thus, a decrease in wealth differentials normally benefits the poor country and harms the rich country. At the same time, a decrease in a_H means a deterioration of environmental quality, A ; namely, overall environmental quality deteriorates. This harms country L to some extent. If the abatement activity of country H is very efficient or the number of poor countries (n) is large, the negative spillovers of a reduction of country H's abatement are large; thus, the poor country could also lose.

A3.2 Analytical Result

Analytically, considering $dy_L = dw_L$ and $da_L = 0$, from the utility function, Eq. (11.A2), with regard to the poor country,

$$dU_L = U_y dw_L + U_A dA \quad (11.A7)$$

Since $da = da_H = d(w_H - y_H)/k_H$, where $k_H \equiv dK_H/da_H$ and $ndw_L = -dw_H$, Eq. (11.A7) may be rewritten as

$$dU_L = -\left(\frac{U_y}{n} - \frac{U_A}{k_H}\right)dw_H - \frac{U_A}{k_H}dy_H \quad (11.A7')$$

Here, $dw_H < 0$ and $dy_H < 0$. Thus, the second term is positive ($-\frac{U_A}{k_H}dy_H > 0$). With regard to the corner solution, we know $U_y - \frac{U_A}{k_L} > 0$ for the poor country where $k_L \equiv dK_L/da_L$. However, this does not necessarily imply $\frac{U_y}{n} - \frac{U_A}{k_H} > 0$ for the poor country. If k_H is low or n is high, $\frac{U_y}{n} - \frac{U_A}{k_H}$ (and the first term) could be negative. If the first term is negative and large, this term may dominate the sign of Eq. (11.A7').

In other words, $dU_L < 0$ if and only if

$$\frac{k_H}{n} < \frac{U_A}{U_y} \frac{dw_H - dy_H}{dw_H} \quad (11.A8)$$

The condition in accordance with Eq. (11.A8) could hold if $k_H \leq nk_L$. When the number of poor countries is large and/or the rich countries have more efficient technology for abatement than the poor countries, a transfer from the rich to the poor may harm the poor, who faces a corner solution. In such an instance, a redistribution policy that intends to reduce wealth differentials between the rich and poor countries deteriorates the environment and may reduce the welfare of the poor country and that of the rich country. Thus, we have explored the possibility that a decrease in wealth differentials may be undesirable for improving environmental quality.

In the standard framework of an interior solution, as shown in Ihuri (1996), an agent with high productivity does not necessarily enjoy high welfare. Namely, if $k_L > k_H$ and agent L has less efficient abatement technology than agent H, both agents can gain by transferring income from agent L to agent H. The foregoing analytical result has shown that we may derive a similar policy implication even in the circumstance of a corner solution under the condition in accordance with Eq. (11.A8).

Itaya et al. (1997) showed that social welfare could be raised by creating sufficient income inequality so that only the rich may provide public goods. Under identical technology of providing public goods, they considered the situation where the poor are simply indifferent about contributing or not contributing to public goods; hence, the utilities are initially equal before the transfer. However, we have considered the situation where the poor choose not to contribute and the utilities initially diverge between the two choices. Then, we have shown that even the poor could gain if the condition in accordance with Eq. (11.A8) is satisfied by redistribution from the poor to the rich.

Cornes and Sandler (2000) showed a similar paradoxical possibility where the technology of abatement is the same among agents. They showed that the greater the number of non-contributors, the more likely it is that there is a local

Pareto-improving redistribution. This finding is consistent with our result. We have shown that the relative size of poor countries has qualitatively the same effect as the relative efficiency of abatement technology in the condition in accordance with Eq. (11.A8). Namely, even if there is only one non-contributor, redistribution from the poor to the rich can be Pareto-improving when the technology of abatement differs among agents. In such an instance, the larger the wealth differentials, the smaller the gap between the level of the Nash equilibrium abatement with corner solutions and the level with a Pareto optimum abatement that is Pareto-preferred to the Nash equilibrium.

A4 Immiserizing Growth

We now consider the possibility of immiserizing growth when the production technology is inefficient. A plausible conjecture is that if the poor significantly evaluate an increase in income with a corner solution, economic growth enhances their welfare. We show that even if the poor were previously not achieving interior solutions, we could have an interesting result of immiserizing growth due to the emission of pollutants. Worldwide economic growth may reduce welfare by increasing the overall level of the emission of pollutants when economic growth makes some poor countries become richer.

Suppose as in Sect. A3 of this appendix that the world consists of two types of country, the rich and the poor. The number of poor countries L is n , and the number of rich countries H is 1. Economic growth occurs for the rich and poor countries.

First, let us consider the situation where w_H only increases. This increases $\bar{Z}$. Then, if this negative welfare effect is smaller (larger) than the positive welfare effect of an increase in abatement, both y_H and A increase (decrease); hence, U_H increases (decreases). However, if this negative welfare effect is equal to the positive welfare effect of an increase in abatement, either y_H or A does not change; hence, U_H remains the same as before. In such a special circumstance, an increase in wealth results in an increase in abatement by the same amount; thus, welfare does not change. If A increases (decreases), it benefits (harms) country L .

Next, let us consider the situation where w_L only increases. For the poor country with the corner solution, whereby the poor do not abate at all, a marginal increase in wealth does not induce an increase in abatement. Thus, y_L increases by the same amount as w_L and always benefits country L . When country L faces a corner solution and significantly evaluates the marginal utility of private consumption, it is likely to gain notably from economic growth. However, the overall level of pollutants increases, thereby harming the rich country H .

Since worldwide economic growth means that both w_L and w_H increase, in accordance with the foregoing conjecture we may say that the rich country normally loses from such growth unless the environment-damaging effect of growth is very low and/or the abatement technology is very efficient. Growth benefits the poor to some extent since the poor can enjoy more private consumption with the corner solution. This is a plausible conjecture.

It is, however, interesting to note that, if growth itself increases the quantity of pollutants emitted and thereby reduces environmental quality significantly, and the number of poor countries is large, the damaging effect of economic growth on the environment may outweigh the positive income effect for the poor country. In such an instance, the poor country may also lose from worldwide economic growth even if it faces a corner solution.

As Bhagwati (1958) showed, the paradoxical possibility of immiserizing growth in the field of international trade requires that either growth is ultra-biased against production of the importable or the foreign offer curve is inelastic. Ihori (1994) showed that immiserizing growth may occur because of non-cooperative private funding of impure public goods. Cornes and Sandler (1985, 1996) pointed out that technical progress in the production of private goods may not be beneficial. They explored one possibility of immiserizing growth in the presence of pure public goods. Immiserizing growth may also occur even with regard to pure public goods once we allow for pollutants caused by production and inefficient technology in the world of poor and rich countries.

A5 Conclusion

It is well recognized that although the disexternalities of public bads such as pollutants emitted because of economic growth do not necessarily enhance welfare, the abatement behavior may offset such disexternalities. However, if the agent faces a corner solution of not conducting abatement and significantly evaluates growth, she or he gains notably from growth. Thus, a natural conjecture is that growth normally enhances welfare especially for the poor agent. By explicitly incorporating optimizing abatement behavior, we have shown that the conjecture is not necessarily valid. Further, although the conjecture normally holds, we may still obtain some instances of paradoxical results.

Questions

- 11.1 Consider the two-person model of a public good. Each person's marginal benefit, MB^i , of the public good, Y , is given as

$$MB^1 = 10 - 2Y \text{ for person 1}$$

$$MB^2 = 5 - Y \text{ for person 2}$$

The marginal cost of the public good is 3. What is the optimal level of Y ?

- 11.2 Consider a three-person economy, A, B, and C. Suppose A's net benefit of a public good project is 140, B's net benefit is -70 , and C's net benefit is -80 . What is the outcome of the Clarke tax mechanism?
- 11.3 Suppose individuals are all identical with respect to income and preferences. How do you deal with the free rider problem?

References

- Andreoni, J. (1990). Impure altruism and donations to public goods: A theory of warm-glow giving. *Economic Journal*, 100, 464–477.
- Andreoni, J. (1993). An experimental test of the public-goods crowding-out hypothesis. *American Economic Review*, 83, 1317–1327.
- Batina, R. G., & Iori, T. (2005). *Public goods: Theories and evidence*. Berlin/New York: Springer.
- Bhagwati, T. L. (1958). Immiserizing growth: A geometrical note. *Review of Economic Studies*, 25, 201–205.
- Clarke, E. H. (1971). Multipart pricing of public goods. *Public Choice*, 11, 17–33.
- Cornes, R., & Rubbelke, D. (2012). *On the private provision of contentious public characteristics* (ANU working papers in economics and econometrics 577). München: CESifo.
- Cornes, R., & Sandler, T. (1985). Easy riders, joint production and public goods. *Economic Journal*, 94, 580–598.
- Cornes, R., & Sandler, T. (1996). *The theory of externalities, public goods, and club goods*. New York: Cambridge University Press.
- Cornes, R., & Sandler, T. (2000). Pareto-improving redistribution and pure public goods. *German Economic Review*, 1, 169–186.
- Green, J., & Laffont, J.-J. (1979). *Incentives in public decision-making*. Amsterdam: North Holland.
- Ihori, T. (1994). Immiserizing growth with interregional externalities of public goods. *Regional Science and Urban Economics*, 24, 485–496.
- Ihori, T. (1996). International public goods and contribution productivity differentials. *Journal of Public Economics*, 61, 567–585.
- Itaya, J., de Meza, D., & Myles, G. D. (1997). In praise of inequality: Public good provision and income distribution. *Economics Letters*, 57, 289–296.
- Lindahl, E. (1919). Just taxation – A positive solution. In R. A. Musgrave & A. T. Peacock (Eds.), *Classics in the theory of public finance*. London: Macmillan.
- Samuelson, P. A. (1954). The pure theory of public expenditure. *Review of Economics and Statistics*, 36, 387–389.
- Sandler, T. (1992). *Collective action: The theory and application*. Ann Arbor: University of Michigan Press.
- Shibata, H. (2003). Voluntary control of public bad is independent of the aggregate wealth: The second neutrality theorem. *Public Finance/Finances Publiques*, 53, 269–284.
- Warr, P. (1983). The private provision of a public good is independent of the distribution of income. *Economics Letters*, 13, 207–211.

1 The Failure of Government

1.1 Government Intervention

In the discussion about public goods, the rationale for public provision is the failure of the market. However, even if the market fails, it does not necessarily mean that the government must provide the goods. For example, if market failure is due to externality, the government may impose a Pigouvian tax and/or subsidy policy to ameliorate the failure. Namely, the government may intervene by using taxes and/or subsidies. The government does not have to provide the public goods; these may be provided by the private sector with appropriate tax and subsidy policies. It is difficult to judge whether the government or the private sector with some indirect intervention should provide impure public goods.

If the market fails, the standard public finance approach suggests that the government should intervene to correct the market failure. Alternatively, we could say that the government should not intervene even if the market fails. This is because government intervention may produce another cost, the failure of government. In this regard, which cost is more serious, the failure of government or that of the market? This raises the fundamental issue of government behavior in the theory of public finance.

1.2 The Theory of Public Choice

Although the market sometimes fails, the government is not perfect either. Since public economic activities are complicated, even an idealistic government cannot attain the best solution. For example, in Chap. 2 we discussed the possibility of policy lags. Thus, the benevolent government cannot necessarily behave optimally. Moreover, because of bureaucratic problems and so on, the government does not

necessarily maximize social welfare in a political economy. Thus, we may not assume the idealistic government in reality.

Many people agree with the conjecture that governments fail to some extent. Indeed, many examples exist of the bad behavior of governments. Such behavior involves corruption, bribes, and rent seeking. Based on this background, it seems plausible to assume that the objective of governments is not idealistic or benevolent but realistic and biased in the sense that they simply adjust the conflicts of various interest groups such as politicians, bureaucrats, and voters.

The theory of public choice examines government behavior from the viewpoint of such a realistic understanding. According to this theory, government policy is not perfect. Further, a government fails even if the market is not perfect; hence, the governmental role is needed. The objective of government itself is biased. Thus, we need to consider the inefficiency of government behavior.

J. M. Buchanan, a founder of public choice theory, first emphasized the failure of government in a public finance context in his book, *Public Finance in Democratic Process: Fiscal Institutions and Individual Choice* (1967). Standard public economics normally investigates idealistic policies. However, the public choice approach focuses on the actual political process of fiscal management based on the biased objective of government. It should also be stressed that the public choice approach is not the only one to investigate the political aspect of public finance. Actually, many researchers have recently investigated the economic implications of public finance in a political economy. A typical topic is a voting model, as explained in Sect. 2 below.

1.3 Small Government

As explained in Chap. 1, since the 1970s the size of public spending has increased in developed countries including Japan. At the same time, a particular idea to reduce the size of public spending has been popular among business people. The idea is called the move to small government. This subsection investigates this movement analytically.

Public spending may be analyzed in two aspects: the demand- and supply-side factors. From the demand side, government spending is affected by private agents' behavior that seeks to spend more and pay fewer taxes. From the supply side, politicians and bureaucrats may determine public spending in order to pursue their interests.

In the democratic political process, voters are ultimately supposed to determine government spending. It is plausible to explain the size of government from the viewpoint of each voter's optimizing behavior. If agents are identical, it is hard to explain why government spending is high. When agents have common interests, redistribution cannot be too great. Further, even if a small conflict about preferences exists among voters with respect to the optimal size of government, a move to small government is likely to occur as part of a political process.

When preferences and income diverge, and voters evaluate public spending differently, the share of impure public goods increases. Then, the government has two choices. First, it can reduce the size of spending and provide only pure public goods, which is a move toward small government. Second, it can provide various impure public goods such as welfare spending measures, which is a move toward big government. We investigate how political factors affect government spending in the following section.

2 The Voting Model

2.1 Inequality and the Demand for Public Goods

First, we consider the impact of demand factors on public spending. If agents are identical, there are no conflicts with respect to the provision of public goods. In reality, because of differences with respect to income and preferences, the optimal size of public goods differs among voters. Thus, who finally determines the actual size of public goods?

With regard to private goods, differences with respect to income and preferences do not cause serious problems because quantity may be adjusted according to preferences and income. At the market price, if an agent wants to consume a large amount, she or he simply buys a great deal. This is the benefit-to-pay principle.

With regard to pure public goods, because of the property of equal consumption without excludability, all agents must consume the same amount. Thus, conflicts arise and the government has to adjust these. A plausible adjustment process is to use the majority voting system.

2.2 Analytical Framework

Suppose there are three individuals, person 1, person 2, and person 3, with income inequality. Each person's identical, additively separable utility function is given as

$$U^i = U(c_i, Y) = c_i + V(Y) \quad i = 1, 2, 3, \quad (12.1)$$

where c_i is the private consumption of person i , Y is the public good, and $V(Y)$ is utility from consuming the public good. For simplicity, we assume that the income effect of private consumption is zero.

The private budget constraint is given as

$$M_i = c_i + tM_i, \quad (12.2)$$

where M_i denotes the income of person i and t is the tax rate. We assume that

$$M_1 < M_2 < M_3. \quad (12.3)$$

Person 1 is poor, person 2 is in the middle-income bracket, and person 3 is rich.

The government budget constraint is

$$t(M_1 + M_2 + M_3) = Y. \quad (12.4)$$

The left-hand side of Eq. (12.4) denotes total tax revenue and the right-hand side denotes government spending on public goods.

Let us investigate each person's desirable tax rate (or the size of public goods). Substituting the private and government budget constraints into the utility function, we have

$$U^i = (1 - t)M_i + V(tM), \quad (12.1')$$

where $M = M_1 + M_2 + M_3$ is the total income in this economy.

Then, differentiating this function, Eq. (12.1'), with respect to the tax rate, t , and setting it as zero, we have as the optimality condition,

$$dU^i/dt = -M_i + MV_Y = 0. \quad (12.5)$$

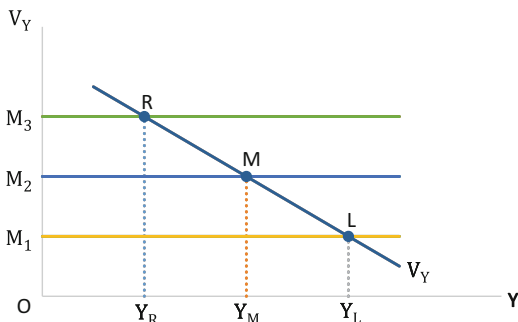
Thus, the optimal tax rate or optimal public goods of person i is given as

$$M_i/M = V_Y(Y), \quad (12.6)$$

where V_Y denotes the marginal utility of public goods, dV/dY .

As shown in Fig. 12.1, the income share of person i , M_i/M , is a horizontal line, depending upon each person's income. The vertical axis denotes the marginal utility of public goods and each person's income share, and the horizontal axis denotes the level of public goods. Person 1's income share line is the lowest, while person 3's line is the highest. The V_Y curve is the marginal utility of public goods, which is assumed to be the same among the three persons. Thus, the optimal point for person 1 is given as point L, the intersection of her or his income share line and the V_Y curve. The optimal point for person 2 is point M. Finally, the optimal point for person 3 is point R.

Fig. 12.1 Preferences for small or big government



As can be easily seen, person 1's optimal Y , Y_L , is the largest among the three; person 2's optimal Y , Y_M , is in the middle; and person 3's optimal Y , Y_R , is the smallest. This simple model explains why rich people like small government with low tax and small spending, while poor people like big government with high tax and large spending. This is because the cost of public spending increases with income, while the benefit of public spending is independent of income.

2.3 The Median Voter Theorem

Imagine that the income tax schedule is linear and exogenously given. The tax rate is endogenously determined by voting. Note that the tax rate and the size of government spending is a one-to-one relationship since income is exogenously given. We may use both variables for the same meaning. If the demand for public goods differs among voters, how is the size of spending determined? A plausible mechanism is majority rule by voting.

Consider the typical majority voting system where each voter has one vote. Voters behave honestly with respect to their preferences. In this regard, the outcome of majority voting may reflect the interests of the median voter. Let us explain this.

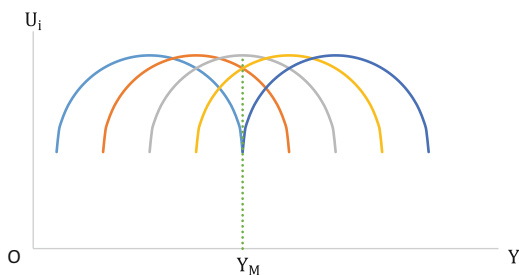
Compare Y and an increase in Y , $\Delta Y + Y$. Which would each voter choose? As shown in Fig. 12.2, the relationship between welfare and Y is normally concave and has a unimodal shape. If voters pay significant attention to Y and think that Y is too small, they vote for an increase in Y , $\Delta Y + Y$. When $Y = 0$, all voters choose $\Delta Y + Y$. Then, as Y increases, some voters turn against $\Delta Y + Y$. Namely, if the income effect of public goods is zero and tax increases with income, richer voters begin to vote against an increase in Y , $\Delta Y + Y$, as Y increases. If we arrange voters according to income, the median voter with median income attains her or his optimal public goods, Y_M , with majority voting. If Y increases more than Y_M , most voters are against it.

The above argument implies the median voter theorem:

Public spending is determined by the median income voter.

In the foregoing three-person model, person 2 is the median voter and Y_M is the outcome of majority voting. If we compare Y_M and Y_L , persons 2 and 3 vote for Y_M

Fig. 12.2 The median voter theorem



and person 1 votes for Y_L . Y_M wins. If we compare Y_M and Y_R , persons 1 and 2 vote for Y_M and person 3 votes for Y_R . Again Y_M wins. If voters are identical with respect to income but different with respect to preferences, a similar argument applies. In such an instance, public spending is determined by the median preference voter.

This is the median voter theorem, which has an important policy meaning. The size of government is determined by the median voter; hence, the size is not too large or small. Many empirical studies have examined whether spending is determined by the median income voter. For example, a simple test is to regress government spending on the after-tax income of the median voter. However, it is hard to estimate this proposition directly. Empirical results so far seem ambiguous.

3 The Voting Model and Reality

3.1 The Paradox of Voting

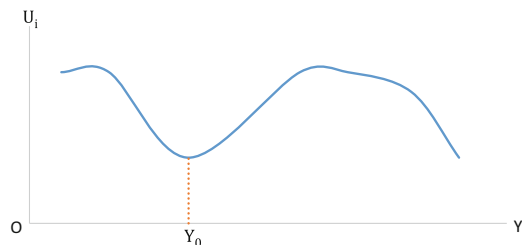
The median voter model is a standard theoretical model that is used to determine public spending in a political process. However, there are several problems. An important one is concerned with the existence of stable unique equilibrium. This depends upon the shape of preference for public goods. As shown in Fig. 12.2, if a preference produces a peak and has a unimodal shape, we have stable unique equilibrium; if not, we may not attain stable equilibrium by majority voting.

Let us consider the following example. In Fig. 12.3, preferences for public goods show both peaks and troughs. Namely, until Y_0 , utility decreases with public goods. Then, utility increases with public spending to a certain level. Finally, utility decreases with public spending.

For example, consider public education spending. If public education is less than Y_0 , agents may prefer private education to public education. In this instance, they must pay taxes to support public education even if they choose private education. Thus, their utility decreases with regard to public education. If Y is greater than Y_0 , they now choose public education. Then, so long as the benefit is greater than the cost of public education, their utility increases with regard to public education.

Imagine that there are three agents: rich (R), middle income (A), and poor (P). The levels of public education are high (H), middle (M), and low (L). It is plausible

Fig. 12.3 Preference for public education



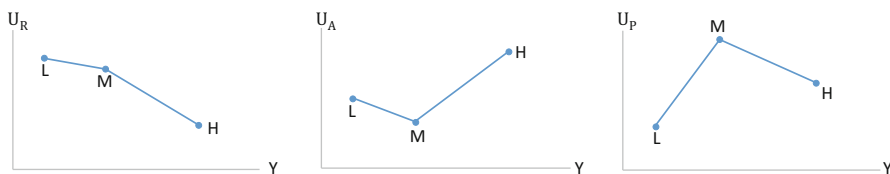


Fig. 12.4 The paradox of voting

to assume that the rich agent always prefers private education and is against an increase in public education.

Thus, as shown in Fig. 12.4, her or his utility decreases with regard to public education. However, the poor agent always prefers public education. Her or his utility is highest at M, and H is better than L. The middle-income agent prefers private education if public education is less than M, and prefers public education if it is higher than M. Thus, her or his utility is highest at H, and L is better than M.

In this example, majority voting does not produce stable equilibrium. The outcome depends upon how voting occurs. Consider the choice between L and M. L has the most votes. In the choice between L and H, H wins. However, in the choice between H and M, M wins. It follows that majority voting that wins with regard to any choice does not exist. This is called the paradox of voting.

3.2 Problems with the Median Voter Hypothesis

The existence problem is exacerbated if there is more than one issue in the election. In Fig. 12.5, we have depicted three voters' preferences for two issues, G and H, in the left-hand panel and ideal points for voters A, B, and C in the right-hand panel. Each agent has single-peaked preferences. Segment AB is the set of common tangency points for voters A and B, segment BC is the set of common tangency points for voters B and C, and so on.

There is no point that intersects all three segments AB, BC, and AC; thus, there is no majority rule equilibrium even though each voter has single-peaked preferences. Consider a point on segment AC, say e , and suppose it is an equilibrium. Voter B can propose point f to voter A and voter A will support it over point e since it is closer to her or his bliss point. However, voter C can respond by offering voter B a point that she or he prefers to point f , and so on.

However, Plott (1967) showed that a "median voter" hypothesis may be salvaged if there is an ideal point for at least one voter and all the other voters come in pairs that are diametrically opposed to one another. In Fig. 12.6, we have depicted the ideal points for a number of voters.

First, consider the left-hand panel. The set of points on the line segment AB is a set of common tangency points between voters A and B, the set AC is a set of tangency points between voters A and C, and so on. Notice that point C, voter C's ideal point, is a majority voting equilibrium for the three voters. A point strictly in

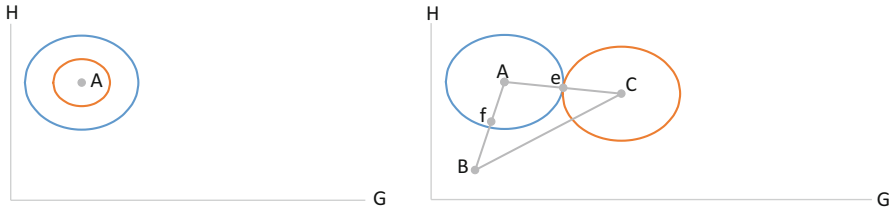


Fig. 12.5 Multi-dimensional voting

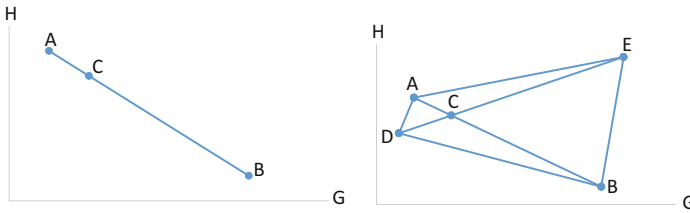


Fig. 12.6 Generalizing the median voter hypothesis

between points A and C makes voter A better off but makes B and C worse off and would be voted against by B and C. The same applies for points strictly between B and C. Point C is the only point in the intersection of the sets AB, AC, and CB.

Now suppose we add a pair of voters, D and E, whose preferences are diametrically opposed to one another relative to voter C. Point C is still a majority voting equilibrium. Consider a point on the segment CE. Voter E is better off; however, A, B, C, and D are worse off and vote against it. The same applies for any other move away from point C. Voter C is a median voter in all directions. This assumption is quite restrictive and Plott concluded that it was unlikely to occur. Other analysts also provided necessary and sufficient conditions for existence. However, the required conditions tend to be highly restrictive.

The question then becomes: How prevalent is the problem of cycles? The conditions supporting the existence of a majority rule equilibrium are very restrictive and probably do not hold in the real world. If so, why is there so much apparent stability in the politics of the real world? If we seek more realistic information about voter preferences, the existence of a cycle may not be a serious problem. See Batina and Ihori (2005) for more discussions on this topic.

3.3 Interest Groups

An alternative formulation of the demand-side model of the political process is the bargaining model of interest groups. Let us explain the standard bargaining model in accordance with Becker (1985). Various interest groups such as labor unions,

consumer groups, and groups of firms aim to affect taxes and subsidies by applying political pressure on the government.

For example, taxpayers seek tax reductions while subsidy recipients seek subsidy increases. If the total expenditure of interest groups increases, the political pressure also increases. However, this may induce each member within a group to engage in free riding behavior. We can also consider non-cooperative games within a group as well as between groups. For simplicity, assume cooperative behavior within the group. Then, each group determines its optimal expenditure in order to maximize its members' welfare subject to the balanced budget constraint.

In the Nash non-cooperative game approach between groups, the outcome depends upon the excess burden of taxes and subsidies and the benefits of policies. Namely, an increase in the excess burden of taxes stimulates political pressure from taxpayers to reduce taxes. Similarly, an increase in the excess burden of subsidies depresses recipients' political activities to seek subsidies. If taxpayers are politically stronger than recipients, the size of government becomes smaller. Moreover, if the tax and subsidy systems are efficient and the excess burden is relatively small in accordance with the size of government, political activities by interest groups do not cause serious distortionary costs. Thus, taxes and subsidies increase, resulting in large government, and vice versa. The efficiency of the tax structure may be positively related to the size of government.

The majority-voting model is useful for investigating the direct democratic system, while the bargaining model of interest groups is useful for analyzing the indirect democratic situation. In the voting model, the median voter has strong political power. In the bargaining model, minority groups could have some bargaining power.

4 Political Parties and Fiscal Policy

4.1 The Objective of Parties

In reality, we do not expect perfect governments or representative consumers. In a more realistic approach, we may consider imperfect governments or heterogeneous agents. In particular, bargaining among politicians, policymakers, and private agents determines policy. In such a political process, political parties have an important role. Their behavior is also affected by political institutions. This section investigates the behavior of political parties.

Generally, the political party has two objectives. One is to stay as the ruling party as long as possible; thus, any party wishes to obtain support from voters as much as possible. The party's objective becomes the same as that of the majority of voters. Another objective is to pursue the party's own preferences. In this regard, different parties have different objectives and may represent the different interests of various groups of economic agents; consequently, each party has a partisan objective.

If a politician is only concerned with maintaining the status quo, her or his objective is to win the election. If the politician has a partisan preference or reflects

the interests of various interest groups, she or he regards winning the election as a means of realizing her or his own objective. Generally, these two objectives coexist. Even a partisan politician is happy if she or he is likely to win: any policies are imposed only by the ruling party. The difference between the two objectives originates from differences among politicians' objective functions. If politicians purely seek the ruling position, they have the same objective, which is the interest of the majority of voters. However, partisan politicians have different objectives.

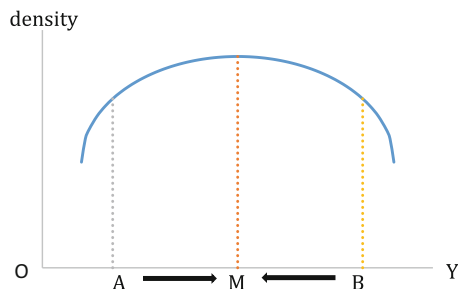
4.2 The Convergence Theorem

In Hotelling's (1929) famous model of a spatial market, two firms sell the same product to buyers, who are uniformly distributed on a line. The firms choose the price and location. There is also a linear transport cost that depends upon the distance of the buyer from the seller. Hotelling argued that an equilibrium occurs when the two sellers locate in the middle of the market and charge the same price.

Applying this idea, Downs (1957) argued that two political parties move to the center of a distribution of voters on a one-dimensional issue if they only care about winning an election. This hypothesis is widely used and implies the median voter theorem. Namely, two parties intend to obtain support from the median voter. To do so, their policies become the same. Whichever party actually wins, the realized policy is the same. This is called the convergence of policies.

In Fig. 12.7, the horizontal axis denotes the size of government, Y , and the vertical axis denotes the density of voters who have the desired level of Y . Suppose party A's ideal point is given by point A, and party B's ideal point is given by point B. M is the desired point of the median voter. If either party A or B changes its position toward M, it obtains more votes than at its original position. Hence, both parties have an incentive to set their position to point M, the ideal position of the median voter. It follows that the parties' policies become the same at point M.

Fig. 12.7 The convergence of policies



4.3 Further Analysis of the Convergence Theorem

In the field of location economics, d'Aspremont et al. (1979) provided a counterexample to Hotelling's result. They assumed there is a quadratic transport cost and showed that firms locate as far apart as possible. Prescott and Visscher (1977) examined a sequential version of the Hotelling model whereby firms first choose their locations and then choose their prices. They showed that locating as far apart as possible in the first stage is optimal. Thus, if the quadratic transport cost is interpreted as a cost of campaigning, or if political parties must choose an ideology first and then choose a position on an issue, political parties may not converge to the median of the distribution.

Recently, a number of researchers have begun exploring models in which political parties are ideologically motivated. It has been shown, for example, that partisan politics may keep policies from converging completely. Political parties may wish to win an election in order to impose their own preferred policy based on their ideological preferences, which is the opposite of Downs's view.

Suppose that there is one issue and that there are two political parties, L and R, with ideal points, G_L and G_R , respectively. In this scenario, $0 < G_L < G^{\text{med}} < G_R < G_{\text{max}}$ where G^{med} is the median voter's ideal level for G and G_{max} is the largest feasible level for G . Each party's preferences are single-peaked at their ideal point, and all voters also have single-peaked preferences. In addition, assume that a party's utility falls the further away it is from its ideal point, and that each party gains utility from winning the election. This creates an interesting trade-off for the party. Each party would like to win the election and must move closer to the median to do so. However, each party would also like to impose its own ideal policy.

Alesina and Rosenthal (1995) showed that if both political parties know the distribution of voters, policy convergence occurs so that ideology does not matter. This follows because if one party chooses a policy proposal that is identical to its ideal point, the other party can win the election with perfect certainty by making a proposal slightly closer to the median position. Thus, both parties are driven to the median position and policy convergence occurs. However, if there is enough uncertainty about the distribution of voters, Alesina and Rosenthal showed that convergence is incomplete: $G_L < g_L < g_R < G_R$ is the equilibrium, where g_k is party k 's policy proposal in the election.

Once a party has won the election, it has a strong incentive to impose its most preferred policy G_k instead of its promised policy g_k . This is an example of the time consistency problem. The party should promise to pursue g_k but once elected imposes G_k . As Alesina and Rosenthal pointed out, there may be mechanisms that impose a constraint on this sort of behavior.

For example, a government in which other political agents must be dealt with in order to pass a policy, for example the legislature, and the possibility of running for re-election, impose constraints on a politician. However, one cannot overlook the examples where a politician has publicly reneged on a promise. We conclude that voting is an imperfect method for determining the demand for a public good.

4.4 Extensions and Voting

A variety of problems with the hypothesis have been mentioned in the literature. As the two parties converge, voters have little incentive to vote for one party rather than another and may become indifferent as a result. Voters in the extreme tails of the distribution may become alienated and drop out as parties converge. In fact, a voter who observes a party alter its position away from her or his ideal point may also become alienated, even if the voter is not in one of the distribution tails.

Moreover, many issues have a strong ideological following; yet voting on a yes-no basis hardly suffices to register the intensity of many voters' preferences. Some voters may drop out of the process as a result of indifference, alienation, the inability to register the intensity of their preferences, or some other reason. If enough voters drop out, the distribution may change, and this is reflected in the final outcome.

There are also costs associated with voting, and yet there appear to be few direct benefits. Why would anyone vote in a large election? Surely, a single vote does not matter in determining the outcome when thousands, if not millions, are casting a vote. Of course, one could appeal to patriotic duty, or a desire to express one's ideology. However, including such a motive introduces an additional element into the model that may alter its predictions. For example, if voters vote to express their ideological beliefs, they may not vote for a party that opportunistically alters its policy simply to win.

Uncertainty may also affect the outcome. A politician will sometimes state an ambiguous position on an issue in order to appeal to the largest number of voters. This can make it difficult for a voter to tell exactly what the candidate's true position is. Further, the median position on an issue may change over time as new voters enter the process and older voters leave. Thus, there may be difficulty ascertaining where the median position lies. This also seems realistic and may affect the model in a substantive way.

The country-specific nature of the institutional structure of elections may affect the outcome of the process. For example, in US politics, presidential candidates must first survive a grueling series of primary elections to become the nominee of a party. If the candidate must choose a set of positions to appeal to the median voter in the party, it may be difficult for the candidate to alter her or his position in order to win the vote of the median voter in the general election. Thus, the positions of the two parties may not converge because of institutional restrictions.

4.5 The Political Business Cycle

Several works investigate the political implications of fiscal deficits and public debt from the viewpoint of political economy. The most famous argument uses the political business cycle model, which stresses the political aspect of fiscal deficits (see Nordhaus (1975)).

This model assumes the following.

- (i) The policymaker is only concerned with maintaining power.
- (ii) The policymaker utilizes the Phillips curve, which shows the negative relationship between unemployment and inflation. Namely, an excessive fiscal policy can reduce unemployment in the short run even if it raises the cost of inflation.
- (iii) Voters are naive or myopic in the sense that they evaluate politicians' performance only at the time of an election.

The ruling party wishes to impose excessive fiscal measures in order to stimulate the aggregate economy before an election. By enlarging the fiscal deficit, it can attain economic expansion at election time. Then, it is likely to win the election. After the election, the ruling party imposes restrictive measures to reduce the deficit and restore the sustainability of fiscal management over time. When the next election comes, the ruling party again engages in excessive fiscal measures in order to stimulate the economy. The voters vote for the ruling party simply because the economy is prosperous at the time of the election. As a result, the election period corresponds to the period of the business cycle. Indeed, the political factor can cause the business cycle.

This theory has some relevancy with regard to the business cycle in the US where prosperity may well have corresponded to the year of the presidential election until the mid-1970s. However, since the 1970s, we have not observed stable Phillips curves. Thus, recent arguments are rather skeptical about this theory.

In Japan's case, unlike the presidential system in the US, the timing of an election can be endogenously determined by the ruling party. Namely, the prime minister can choose the date for the election of the Lower House. Thus, in Japan the timing of an election is usually adjusted to a time of prosperity, rather than the macroeconomy being adjusted to the timing of an election.

4.6 The Partisan Business Cycle

We also tend to observe political parties that want to win an election in order to impose a particular policy or ideology, rather than simply compete to win the election. The parties may thus establish positions for ideological reasons and be less willing to sacrifice principle for a favorable outcome in the election. In this instance, the parties may not converge to the median position.

Thus, an alternative approach considers multiple parties with partisan preferences. In this regard, the median voter theorem is not maintained and different parties pursue different policies. Let us apply this formulation to fiscal management. It is plausible to assume that many democratic socialist parties in the EU and the Democratic Party in the US are likely to prefer excessive fiscal measures than conservative parties in the EU and the Republican Party in the US. Such democratic socialist parties do not pay a great deal of attention to the cost of inflation. They aim to redistribute income to the poor and obtain support from minority voters.

As a result, a change of government means a change in excessive and restrictive measures. Such changes of government may cause the business cycle. In this regard, the cause is not the political business cycle but the partisan business cycle.

5 Theoretical Model of the Partisan Business Cycle

5.1 The Macroeconomic Model

Following Alesina et al. (1993), let us explain a theoretical model of the partisan business cycle. First, we formulate a simple macroeconomic model of inflation rate and economic growth. Since we focus on the business cycle, economic growth here is almost the same as an increase in GDP in a boom.

Suppose that the economic growth rate y_t is given as

$$y_t = \lambda(\Pi_t - w_t) + y_F \quad (12.7)$$

where Π_t is the rate of inflation, w_t is the rate of increase of the nominal wage, y_F is the national growth rate of GDP, and λ is a positive shift parameter. Equation (12.7) means that if the real wage rate is constant ($\Pi = w$), GDP grows at the rate of natural economic growth, which corresponds to full employment in the labor market. If the real wage rate declines, the economy grows at a higher rate than the natural growth rate. Alternatively, this equation implies a negative relationship between unemployment and economic growth, as the Okun law suggests. Namely, if employment is higher than the natural level of full employment, GDP is also higher than the natural level of GDP.

The nominal wage is set by a one-period labor contract in which the rate of increase of the nominal wage is equal to the expected rate of inflation:

$$w_t = \Pi_t^e, \quad (12.8)$$

Where Π_t^e denotes the expected inflation rate at the beginning of period t . This expectation is rationally formed. Thus,

$$\Pi_t^e = E(\Pi_t / I_{t-1}), \quad (12.9)$$

where Π_t^e means the expected value of Π_t , which is obtained by all the available information accumulated at the end of period $t - 1$, I_{t-1} .

From these three equations, we have

$$y_t = \lambda(\Pi_t - \Pi_t^e) + y_F. \quad (12.10)$$

This is a fundamental equation of the macroeconomic model. As long as the rate of inflation is perfectly expected, GDP is equal to full employment GDP. We have

$y_t = y_F$. In the long run, the rate of inflation becomes neutral; hence, it does not affect any real economic variables, including the real economic growth rate.

5.2 The Behavior of Two Parties

Let us formulate the objectives of two parties, D and R. Party D has a strong preference for growth (or the benefit of a decline in unemployment) but does not care much about the cost of high inflation. In contrast, party R does not have a strong preference for growth (or the benefit of a decline in unemployment) but does care significantly about the cost of high inflation. Then, each party's welfare, u^D and u^R , is given as

$$u^D = -(\Pi_t - \Pi^{*D})^2 + b^D y_t, \text{ and} \quad (12.11)$$

$$u^R = -(\Pi_t - \Pi^{*R})^2 + b^R y_t \quad (12.12)$$

$$\Pi^{*D} > \Pi^{*R} > 0, b^D > b^R > 0,$$

where Π^{*D} and Π^{*R} denote party D and party R's most desirable (bliss) rate of inflation respectively. Parameters b^D and b^R indicate how much each party evaluates the benefit of high growth (low unemployment). We assume that party D prefers high inflation more than party R; thus, party D wishes to spend more through inflationary taxes and reduce the real rate of interest. Namely, party D is more concerned with the benefit of growth than with the cost of inflation, while party R has the opposite preference. Both parties regard higher growth rates and economic prosperity as desirable, but the relative evaluation between the cost of inflation and the benefit of growth differs between the two parties.

Now, we investigate the optimal choice of party D. Suppose at time t the wage rate is set to the expected rate of inflation. Party D determines the desirable rate of inflation by taking this expected rate of inflation as given. Namely, party D maximizes its objective function, Eq. (12.11), subject to Eq. (12.10) by choosing Π_t . Then, party D's optimal rate of inflation, Π^{**D} , is given as

$$\Pi_t = \Pi^{**D} = \Pi^{*D} + b^D \lambda / 2. \quad (12.13)$$

Since the private agent forms expectation rationally, she or he anticipates party D's optimizing behavior correctly. Thus, if the outcome of the election is perfectly anticipated, namely if the agent believes with certainty that party D will win the election, the agent anticipates that the rate of inflation at time t is given by Eq. (12.13). Thus,

$$\Pi_t^e = \Pi^{**D} = \Pi^{*D} + b^D \lambda / 2. \quad (12.14)$$

Consequently, the actual rate of inflation is equal to the expected rate of inflation, and the actual growth rate is given by the natural growth rate:

$$y_t = y_F. \quad (12.15)$$

Similarly, if party R wins the election, we have

$$\Pi^{**R} = \Pi^{*R} + b^R \lambda / 2 \quad (12.16)$$

and obtain, as a result of the certain outcome of the election,

$$\Pi_t^e = \Pi^{**R} = \Pi^{*R} + b^R \lambda / 2 \quad (12.17)$$

$$y_t = y_F. \quad (12.18)$$

Comparing these two cases, the actual growth rate is given by the natural growth rate, whichever party wins. However, considering the inequality $\Pi^{*D} > \Pi^{*R} > 0$ and $b^D > b^R > 0$, we know that

$$\Pi^{**D} > \Pi^{**R}.$$

This means that party R realizes a lower rate of inflation than party D if party R wins the election, and vice versa.

5.3 The Effect of the Election

We now consider the effect of the election. Suppose the ruling party has office in two periods. At the beginning of period 1, the labor contract is conducted. Then, the election occurs and the winning party determines policy variables. At the end of period 1, the next labor contract is conducted. Then, the winning party determines policy variables in period 2.

The outcome of the election is a stochastic variable that cannot be predicted correctly ex ante. Let us denote the probability of a win for party D as P , and the probability of a win for party R as $1 - P$; namely, P means the probability that more than 50 % of voters prefer Π^{D**} to Π^{R**} .

In period 1, we have

$$\Pi_1^e = P\Pi^{D**} + (1 - P)\Pi^{R**}. \quad (12.19)$$

If party D actually wins, we have

$$y_1^D = \lambda(1 - P)(\Pi^{D**} - \Pi^{R**}) + y_F. \quad (12.20)$$

If party R wins, we have

$$y_1^R = -\lambda P(\Pi^{D**} - \Pi^{R**}) + y_F. \quad (12.21)$$

In period 2, the expectation is adjusted, so that we have

$$\Pi_2^e = \Pi^{D**} \text{ (if Party D is the ruling party),} \quad (12.22)$$

$$\Pi_2^e = \Pi^{R**} \text{ (if party R is the ruling party), and} \quad (12.23)$$

$$y_t = y_F \text{ (whichever party is the ruling party).} \quad (12.24)$$

If the election causes a business cycle, it is because the outcome of the election is uncertain *ex ante*. The private agent cannot anticipate the rate of inflation in period 1 correctly. Since the election is not conducted in period 2, the agent anticipates with certainty the inflation rate in period 2.

For example, suppose the ruling party in period 1 is party D. Since this outcome was not correctly anticipated before the election, the actual inflation rate is higher than the expected rate. From Eq. (12.20), the actual growth rate is higher than the natural growth rate. In contrast, if the ruling party in period 1 is party R, the actual rate of inflation is lower than the expected rate. Hence, from Eq. (12.21), the actual growth rate is lower than the natural growth rate. In period 2, the actual inflation rate is equal to the expected rate, whichever party is the ruling party.

In Fig. 12.8, suppose $P = 0.5$ and party D wins at $t = 3, 7$, while party R wins at $t = 1, 5$. The growth rate is larger in period 3 when party D wins and equates to the natural rate in period 4. Then, it is lower than the natural rate in period 5 when party D wins. In period 6, both rates are the same. It follows that the business cycle occurs during a stochastic change of governments.

The size of the business cycle corresponds to the gap between the actual growth rate and the natural growth rate, which corresponds to the degree of divergence of preferences between two parties. The larger the difference of preferences on inflation and growth, the larger the size of the business cycle. In addition, the larger the uncertainty about the election's outcome, the larger the size of the business cycle.

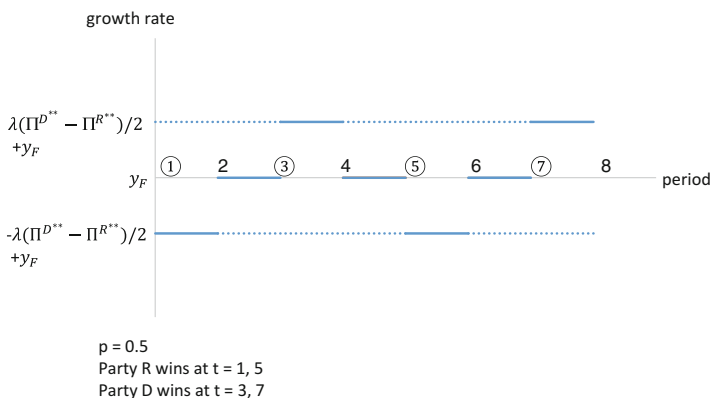


Fig. 12.8 The effect of the election

5.4 The Probability of Winning the Election

How would the probability, P , of party D winning be determined? Voters have preferences for Π_i^* and b_i . It is plausible to assume that these preferences change randomly. As a result, the outcome of the election becomes stochastic.

Voter i votes for party R if her or his utility when party R is the ruling party, u_i^R , is higher than her or his utility when party D is the ruling party, u_i^D . Let us denote the discount factor as β ($\beta < 1$). Considering that the actual growth rate is always given by y^* in period 2, we have

$$u_i^R = -(\Pi^{R**} - \Pi_i^*)^2 + b_i y_1^R + \beta \left[-(\Pi^{R**} - \Pi_i^*)^2 + b_i y_F \right] \text{ and} \quad (12.25)$$

$$u_i^D = -(\Pi^{D**} - \Pi_i^*)^2 + b_i y_1^D + \beta \left[-(\Pi^{D**} - \Pi_i^*)^2 + b_i y_F \right], \quad (12.26)$$

where y_1^D and y_1^R denote the growth rates in period 1 when each party is the ruling party. These rates are given by Eqs. (12.22) and (12.23).

P means that for more than 50 % of voters, the following condition holds:

$$u_i^D > u_i^R.$$

Since $y_1^D > y_F > y_1^R$, voters with higher b_i vote for party D, and voters with higher Π_i^* vote for party D. Then, P is determined by the distribution of voters' preferences.

In this model, voters determine their voting behavior independent of economic conditions at the election time or before the election time. This formulation is different from the assumption of the political business cycle model. Moreover, in a different way from Hibbs's (1987) partisan model of the business cycle, voters rationally anticipate future economic conditions and the behavior of parties. Note that in Hibbs's model, expected inflation is formed by the adapted expectation hypothesis. As a result, the partisan shock continues in period 2. In contrast, the rational model of the business cycle in this section predicts that the partisan shock occurs only in period 1; hence, the business cycle is a temporary phenomenon that occurs in one period only.

6 Further Comments

6.1 Change of Government

When a change of government is likely, the role of public debt is important. Namely, public debt is a stock variable and cannot be changed in the short run. If a new government gains office, the existing stock of public debt cannot be reduced

at once. In a revolutionary change of government, the new government may declare a default of public debt, although in reality this is unlikely to occur.

If there is a possibility of a change of government, the current ruling party has an incentive to manipulate public debt strategically in order to influence the future fiscal policy conducted by the opposing party. This is because taxes and spending are flow variables, which can be freely controlled by the ruling party. However, public debt is a stock variable that limits the freedom of fiscal management to some extent. Past fiscal measures can affect future fiscal policy in terms of the redemption of public debt.

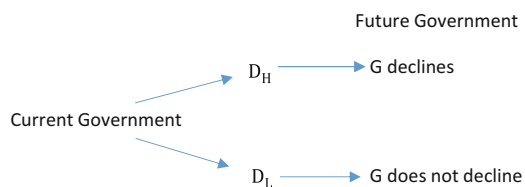
When the government changes, different policies are conducted with respect to the evaluation of government spending. For example, imagine changes between the Democrat Party and Republican Party in the US and the Labour Party and Conservative Party in the UK. If the current right-wing ruling party is likely to be replaced by the opposing left-wing party, which prefers bigger government spending, how is current fiscal policy affected?

Imagine that the current government wants less spending than the future government. The current government, once the future change of government is a possibility, has an incentive to conduct further excessive fiscal measures such as tax cut and accumulate a greater fiscal deficit. By so doing, the future government is forced to reduce public spending to some extent because the significant public debt produces great pressure to conduct fiscal consolidation.

When the initial fiscal situation is bad, any government has to take certain measures with regard to fiscal consolidation. The government may introduce fiscal constraint against raising public spending. Thus, a conservative government has an incentive to expand the fiscal deficit if a change of government is likely to occur in the near future. This explains why in the 1980s, the Republican government in the US increased the fiscal deficit by reducing taxes.

Figure 12.9 explains this outcome. The current government has two choices, issuing a high level of debt, D_H , or a low level of debt, D_L . If it issues D_H , the future government has to reduce its spending. G declines significantly. If it issues D_L , the future government does not have to reduce its spending significantly. G does not decline by much. Hence, if the current government seeks small government, it prefers to issue D_H now.

Fig. 12.9 Change of government



6.2 The Evaluation of Public Spending

Differences in public spending preferences may explain the relationship between a change of government and public debt. Suppose there are two types of public expenditure and two parties have different preferences about spending. For example, suppose that the Republican evaluates defense spending positively but does not attach great importance to social welfare. In contrast, the Democrat evaluates social welfare positively but places little importance on defense spending. In this regard, the larger the difference among preferences, the larger the fiscal deficit. In addition, the smaller the possibility of re-election of the current ruling party, the larger the fiscal deficit.

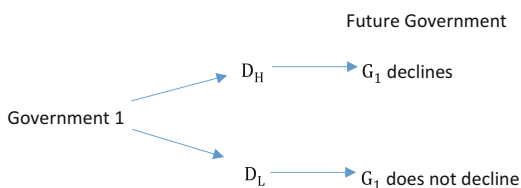
Intuitively, the following applies. Issuing public debt has two costs. The first is the cost of raising taxes in the future to redeem the public debt. This cost includes the distortionary cost of raising non-lump sum taxes. The second is the cost of reducing public spending in the future. In order to redeem the public debt, it is necessary to raise taxes and/or reduce public spending.

The second cost occurs only if the current government is still in office in the future by winning the election. Since the current government spends a great deal on its preferred type of expenditure, it has to reduce such spending in order to redeem the public debt. If the future government is the rival party, the resulting reduction of spending is irrelevant for the future government. It does not harm the future government since the government can reduce any adverse type of expenditure. Thus, if the possibility of re-election is high, the current government incorporates the cost of significantly reducing spending. In this regard, public debt issuance is small. However, if the possibility of a change of government is high, the current government has an incentive to shift the burden of public debt to the future government. Then, the future government has to reduce spending, a situation that is not significantly evaluated by the future government.

To sum up, a politically stable country with little chance of a change of government has a small amount of public debt, and vice versa.

Figure 12.10 explains this outcome. Suppose that government 1 prefers G_1 to G_2 where G_1 and G_2 are different types of public spending. Suppose also that it would likely stay at office in the next period. If it issues D_H , it has to reduce G_1 in the next period to cope with fiscal consolidation. If it issues D_L , it does not have to reduce G_1 much. Thus, a politically stable country with little chance of a change of government has a small amount of public debt.

Fig. 12.10 The evaluation of public spending



Appendix A: Fiscal Privileges, Consolidation Attempts, and Pigouvian Taxes

A1 Introduction

Much attention has been given to the long-run effects on the fiscal situation of political efforts that seek fiscal privileges. Although consumption is usually regarded as a measure of private benefit and enhances welfare, political efforts to seek consumption in the form of fiscal privileges may adversely affect the fiscal situation, resulting in a reduction of useful public goods and welfare. In other words, political efforts by any interest groups hurt fiscal situations, thereby reducing useful public goods. In the analysis of the political economy, it is well recognized that some political efforts may accumulate fiscal privileges, harming public goods provision, while voluntary attempts at consolidation can be employed in order to improve the fiscal situation.

The purpose of this advanced study is to explore how the crowding-out effects of seeking fiscal privileges and the offsetting effects of consolidation attempts affect economic welfare and growth. We then investigate the normative role of Pigouvian taxes in internalizing these effects.

Researchers have investigated mechanisms under which a market economy may successfully internalize externalities such as environmental issues. The standard analysis is of static conflict, which is the free-rider problem within a static situation. The common approach is to impose a Pigouvian tax on externalities (see Pigou 1920). Fiscal privileges and environmental pollution have similar properties in the sense that both activities have negative externalities in the overall economy, while fiscal consolidation and environmental abatement have similar properties in the sense that both attempts have positive externalities in the overall economy.

With regard to fiscal issues, there are differing views on political efforts to seek fiscal privileges. Analytically, a voluntary activity of fiscal improvement, such as an acceptance of the need to raise taxes, could be important for fiscal consolidation. Additionally, the fiscal consolidation efforts made by private agents can improve the overall fiscal situation and thereby have the nature of public goods. Hence, as shown by Ihuri and Itaya (2001, 2004) and Ihuri (2011), the analytical framework of the private provision of public goods, as explained in Chap. 11, is useful in examining the outcome of Pigouvian taxes on fiscal consolidation. See also Auerbach (2006), Velasco (2000), and Woo (2005), among others.

With regard to the perception of the government budget constraint by private agents, we can assume two circumstances. One is the assumption that the agents do not incorporate the government budget constraint into optimizing behavior. The other is to assume that they do. Thus, this advanced study considers both circumstances, one at a time. We first consider the situation where each agent views public goods as given, although voluntary attempts at fiscal consolidation are technically feasible. We then consider the situation where voluntary attempts to improve the fiscal situation are active.

In this advanced study, fiscal privileges and private consumption are not necessarily perfect substitutes. We shall show that an introduction of Pigouvian taxes on political activities that seek fiscal privileges is not always desirable. If privileges and useful public goods are complements, it is not desirable to tax privileges in a three-commodity model. The optimal level of Pigouvian taxes generally increases with the number of agents (the degree of static externalities) in a political economy model.

Section A2 presents the simple analytical model of fiscal privileges and investigates the first best solution. Section A3 considers the situation where each agent views public goods as given, although the voluntary improvement of the fiscal situation is technically feasible. Section A4 investigates the circumstance where voluntary attempts at fiscal consolidation are active. Finally, Sect. A5 concludes the advanced study, Appendix A.

A2 The Basic Model

Assume that there are n (more than two) identical agents in the world. Agent i 's utility is given by

$$U^i = U(c_i, h_i, G), \quad (12.A1)$$

where U^i is the welfare of agent i ; h_i is the private fiscal privilege of agent i , which benefits agent i only; c_i is the private consumption of agent i ; and G is the public good for agent i , which is common to all agents and may be regarded as a pure public good. ($i = 1, 2, \dots, n$). Alternatively, we may say that fiscal privilege, h_i , is a local public good that benefits the corresponding interest group only, while the public good G is a pure public good, benefiting all interest groups. We assume that c_i , h_i , and G are normal goods.

From the government budget constraint, the public good G is given by

$$G = \bar{G} - \sum_{i=1}^n h_i + \sum_i g_i, \quad (12.A2)$$

where $\bar{G}$ is the initial level of the fiscal surplus or the exogenously given amount of government revenues, and g_i is the (net of transfer) tax burden that could be determined by each agent. In this sense, g_i captures voluntary consolidation attempts if each agent determines a positive value for g_i .

The private budget constraint or feasibility condition is given by

$$c_i + a(h_i) + g_i = y, \quad (12.A3)$$

where y is the exogenously given identical income of agent i and a is an expenditure on political efforts. In a political economy, h_i is determined as the outcome of political process. $a(h_i)$ is the cost function for agent i to obtain a given amount of fiscal privilege, h_i . For simplicity, we assume

$$a(h_i) = ah_i$$

where α denotes the efficiency of political efforts to obtain fiscal privilege. If α is large, it means that the political effort activity is inefficient and requires a great deal of expenditures to obtain a given amount of privilege. Alternatively, $1/\alpha$ denotes the efficiency of political effort.

The feasibility condition then reduces to

$$n(1 + \alpha)h + nc + G = \bar{G} + ny. \quad (12.A4)$$

As the benchmark case, we first consider the first best. The optimality conditions at the first best solution are given by

$$\frac{U_h}{U_c} = 1 + \alpha \text{ and} \quad (12.A5.1)$$

$$\frac{U_h}{U_G} = (1 + \alpha)n, \quad (12.A5.2)$$

where $U_c \equiv \frac{\partial U}{\partial c}$, $U_h \equiv \frac{\partial U}{\partial h}$, and $U_G \equiv \frac{\partial U}{\partial G}$. It is assumed that $g > 0$ at the first best solution. Note that h_i is a local public good or publicly provided private good, benefiting each agent, so that the optimal level of h is positive at the first best solution. Equation (12.A5.2) is the Samuelson condition for a pure public good, G .

A3 The Model Without Consolidation Attempts

A3.1 The Competitive Solution

In this section, we assume that each agent views G as given, ignoring the government budget constraint or the crowding-out effect of fiscal privilege on public goods. Then, each agent does not have an incentive to conduct consolidation attempts. $g = 0$. In other words, an agent's budget constraint reduces to

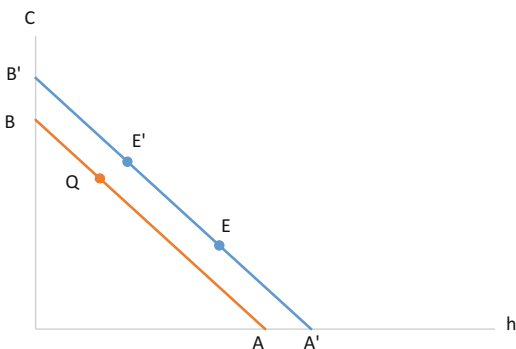
$$c_i + \alpha h_i = y. \quad (12.A6)$$

At the competitive solution, we have as the first-order condition,

$$\frac{U_h}{U_c} = \alpha, \quad (12.A7)$$

while at the first best solution we have Eq. (12.A5.1). In Fig. 12.A1, line A'B' represents the budget constraint, Eq. (12.A6), and line AB represents the feasibility condition, Eq. (12.A4), at the optimal level of G . The competitive solution is given by point E, while the first best solution is given by point Q on line AB. At the competitive solution, fiscal privilege h is too high, while private consumption c may be too low. Hence, public good G is provided at too low a level, which corresponds to a bad fiscal condition.

Fig. 12.A1 The competitive solution without consolidation attempts



A3.2 Pigouvian Tax

When the government imposes a Pigouvian tax, τ , on expenditures regarding political activity that seeks fiscal privilege, the budget constraint is rewritten as

$$(1 + \tau)\alpha h_i + c_i = y + T_i, \quad (12.A8)$$

where T_i is a lump sum transfer. We could consider the situation where T is not transferred to the private sector but used to provide G . We could also consider the situation where the government imposes a Pigouvian tax on privilege consumption, h , rather than political expenditures, αh . The analytical result is qualitatively the same. The government budget constraint for this policy is given as

$$\tau\alpha \sum_i h_i = \sum_i T_i. \quad (12.A9)$$

Thus, in place of Eq. (12.A6), we have

$$\frac{U_h}{U_c} = (1 + \tau)\alpha. \quad (12.A10)$$

Hence, if the government intends to satisfy the optimality condition, Eq. (12.A5.1), the corresponding tax, τ , is simply given as

$$\tau^* = \frac{1}{\alpha}. \quad (12.A11)$$

This is equal to the dollar cost of the fiscal deterioration damage per unit of fiscal privilege. It increases with the degree of efficiency in obtaining fiscal privilege $1/\alpha$. Note that $\tau^* > 0$ even if $n = 1$. It should be stressed that this Pigouvian tax cannot realize the first best solution since another optimality condition, Eq. (12.A5.2), is not satisfied. In addition, $g = 0$ in the model of Sect. A3, while $g > 0$ at the first best solution. Even if this optimal tax τ^* is imposed, h is still too much. The tax can stimulate c but cannot stimulate g . In Fig. 12.A1, the equilibrium point moves from E to E' , not to Q .

Note that the tax rate given by Eq. (12.A11) does not maximize welfare at the second best since only one optimality condition is satisfied there. It is useful to investigate the optimal tax rate so as to maximize welfare at the second best solution. In order to do so, we may define the expenditure function $E(\cdot)$ by minimizing the left-hand side of the budget constraint, Eq. (12.A8), at a given level of G . The model may be summarized by

$$E((1 + \tau)\alpha, U, G) = y + \tau\alpha E_1((1 + \tau)\alpha, U, G) \text{ and} \quad (12.A12)$$

$$G = \bar{G} - nE_1((1 + \tau)\alpha, U, G), \quad (12.A13)$$

where $E_1 = \partial E / \partial (1 + \tau)\alpha$ is the compensated demand function for fiscal privilege, h .

Differentiating Eqs. (12.A12) and (12.A13),

$$\frac{dU}{d\tau} = \frac{E_{11}n\alpha E_G + \tau\alpha^2 E_{11}}{E_U(1 + nE_{1G}) - nE_{1U}E_G}. \quad (12.A14)$$

We know that

$$\begin{aligned} E_U = \partial E / \partial U > 0, E_G = \partial E / \partial G < 0, E_{11} = \partial E_1 / \partial (1 + \tau)\alpha < 0, E_{1U} \\ = \partial E_1 / \partial U > 0 \end{aligned}$$

and $E_{1G} = \partial E_1 / \partial G > 0$.

Note that an increase in G enhances welfare, so that it may reduce the minimum cost of private expenditures to attain the same amount of U .

Thus, by setting Eq. (12.A14) to zero, the optimal tax rate is given by

$$\tau^{**} = -\frac{nE_G}{\alpha}, \quad (12.A11')$$

which increases with the degree of negative spillovers, n . τ^{**} could be larger than τ^* if n is large.

Because of informational difficulty, the government may not internalize the precise level of disexternalities or impose the optimal tax rate τ^{**} . Then, an interesting question is whether an introduction of the Pigouvian tax on expenditures regarding political activity (or privilege consumption) is desirable or not. Evaluating Eq. (12.A14) at $\tau = 0$, we have

$$\frac{dU}{d\tau} = \frac{E_{11}n\alpha E_G}{E_U(1 + nE_{1G}) - nE_{1U}E_G}. \quad (12.A14')$$

It is easy to see that Eq. (12.A14') is positive. In other words, an introduction of the Pigouvian tax on political effort expenditure that seeks fiscal privilege is always desirable. The intuition is as follows. Since c is too little and h is too much, the introduction of τ reduces h , resulting in an increase in c .

A4 The Model with Consolidation Attempts

A4.1 The Competitive Solution

We now examine the situation where the agent considers the government budget constraint. The agent is concerned with the fiscal situation; thus, voluntary improvement of the fiscal situation may occur.

Substituting Eq. (12.A2) into Eq. (12.A3), we have

$$c_i + \alpha h_i + G = y - \sum_{i=1}^n h_i + \sum_{j \neq i} g_j + \bar{G}$$

or

$$\alpha h_i + h_i + c_i + G = y - \sum_{j \neq i} h_j + \sum_{j \neq i} g_j + \bar{G}. \quad (12.A15)$$

We assume that each agent determines her or his attempt at fiscal consolidation g_i (or effectively G) and two types of consumption, c_i and h_i . We regard the others' spending, h_j and g_j ; the effective price of political activity, $1 + \alpha$; the initial fiscal situation parameter, $\bar{G}$; the number of agents, n ; and income y as given. Thus, the right-hand side of Eq. (12.A15) may be regarded as effective income, which includes disexternalities of fiscal privileges of other agents, externalities of fiscal consolidation attempts from others, and the initial level of the fiscal situation (or government revenue). As in the standard model of the voluntary provision of a pure public good, we exclude binding contracts or cooperative behavior among the agents and explore the outcome of non-cooperative Nash behavior.

At the competitive solution, we have Eq. (12.A5.1). We also have

$$\frac{U_h}{U_G} = 1 + \alpha, \quad (12.A16)$$

which is smaller than Eq. (12.A5.2).

It should be noted that h/c is now $1 + \alpha$ in this laissez-faire economy, the same ratio as in the first best because the relative price of fiscal privilege and private consumption in the laissez-faire economy is given by $1 + \alpha$, the optimal price. The agent can recognize her or his own crowding-out effect of political activity in terms of private consumption. However, since the spillover effect of public good G is not internalized, h/G is still larger than the first best level, although it becomes smaller than in the prior section without the voluntary provision of fiscal consolidation.

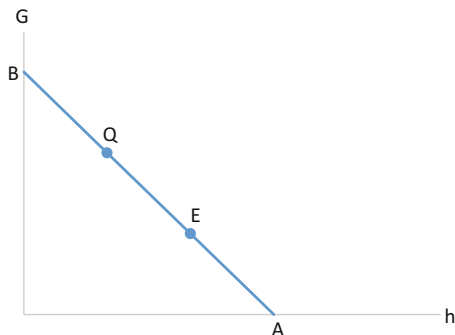
Suppose the utility function is given by the log-linear form,

$$U^i = \log c_i + \log h_i + \log G. \quad (12.A1')$$

Then, from Eq. (12.A4) and Eq. (12.A5.1), the feasibility condition reduces to

$$\bar{G} + ny = G + 2n(1 + \alpha)h, \quad (12.A4')$$

Fig. 12.A2 The competitive solution with consolidation attempts



which is shown as line AB in Fig. 12.A2. Point Q is the steady-state first best point associated with the condition in Eq. (12.A5.2), while point E is the steady-state laissez-faire equilibrium point associated with the condition in Eq. (12.A16). As shown in Fig. 12.A2, c and h are too high and G (or g) is too low in the laissez-faire static model B because of negative externalities ($n > 1$).

A4.2 Pigouvian Tax

When a Pigouvian tax, τ , is imposed on expenditures regarding political costs for seeking fiscal privilege, h_i , of agent i , the budget constraint, Eq. (12.A15), is rewritten as

$$(1 + \alpha + \tau\alpha)h_i + c_i + G = y + T_i - \sum_{j \neq i} h_j + \sum_{j \neq i} g_j + \bar{G}. \quad (12.A15')$$

Now the agent chooses g_i (or G_i) in addition to c_i and h_i . Thus, we have at the competitive solution,

$$\frac{U_h}{U_c} = 1 + \alpha + \tau\alpha \text{ and} \quad (12.A17.1)$$

$$\frac{U_h}{U_G} = 1 + \alpha + \tau\alpha. \quad (12.A17.2)$$

From these two equations, it is easy to see that the Pigouvian tax cannot realize the first best solution given by Eqs. (12.A5.1) and (12.A5.2). For example, in order to realize Eq. (12.A5.1), condition $\tau = 0$ is required. However, in such an instance, we cannot attain Eq. (12.A5.2). The Pigouvian tax on fiscal privilege consumption has a similar effect as subsidizing private consumption. Taxing the political costs for fiscal privilege (or privilege consumption) alone cannot realize the first best solution. In order to attain the first best, G must be stimulated more than c .

As in the prior section, we define the expenditure function $E()$ by minimizing the left-hand side of the budget constraint, Eq. (12.A15'). Then, considering Eq. (12.A2), the model may be summarized by

$$E(1 + \alpha + \alpha\tau, U) = y + \frac{n-1}{n}E_3(1 + \alpha + \alpha\tau, U) + \frac{\bar{G}}{n} + \tau\alpha E_1(1 + \alpha + \alpha\tau, U), \quad (12.A18)$$

where E_1 is the compensated demand function for fiscal privileges, h , and E_3 is the compensated demand function for useful public goods, G . Differentiating Eq. (12.A18), we have

$$\frac{dU}{d\tau} = \frac{\alpha(n-1)E_{31} + n\tau\alpha^2 E_{11}}{nE_U - (n-1)E_{3U}}, \quad (12.A19)$$

where $E_{3U} = \partial E_3 / \partial U > 0$, $E_{31} = \partial E_3 / \partial (1 + \alpha + \alpha\tau)$. Thus, the optimal tax rate is given as

$$\tau^{**} = -\frac{(n-1)E_{31}}{n\alpha E_{11}},$$

which is positive and increases with n if $E_{31} > 0$. However, if $E_{31} < 0$, the optimal tax rate is negative. If h and G are complements, it is not desirable to tax h . In contrast, subsidizing h results in stimulating G , which is desirable.

We then investigate whether an introduction of the Pigouvian tax on political costs in the model of the voluntary provision of fiscal consolidation is desirable or not. Evaluating Eq. (12.A19.1) at $\tau = 0$, we have

$$\frac{dU}{d\tau} = \frac{\alpha(n-1)E_{31}}{nE_U - (n-1)E_{3U}}. \quad (12.A19')$$

Thus, the sign of Eq. (12.A19') is determined by the sign of E_{31} . If $E_{31} > 0$ (i.e., h and G are substitutes), Eq. (12.A19') is positive, and vice versa.

It follows that an introduction of the Pigouvian tax on privilege consumption is not necessarily desirable. An introduction of τ is desirable if and only if h and G are substitutes. If, in contrast, h and G are complements, taxing h reduces welfare. In such a circumstance, it becomes desirable to subsidize h . In a three-commodity model, it is possible to have the latter situation. The intuition is as follows. An introduction of τ reduces h ; however, its effect on g is generally ambiguous. If h and G are complements, reducing h means reducing G , which is not desirable.

A4.3 The Consumption Tax

We now introduce a policy variable for taxing private consumption in addition to the Pigouvian tax. In such an instance, the budget constraint, Eq. (12.A3), is rewritten as

$$(1 + \alpha + \alpha\tau)h_i + (1 + \sigma)c_i + g_i = y + T_i, \quad (12.A20)$$

where σ is the tax rate on private consumption. Then, we have Eq. (12.A17.2), and in place of Eq. (12.A17.1) at the competitive solution, we have

$$\frac{U_h}{U_c} = \frac{1 + \alpha + \alpha\tau}{1 + \sigma}. \quad (12.A21)$$

Comparing Eqs. (12.A5.2) and (12.A17.2), the optimal Pigouvian tax, τ^{***} , to attain the optimality condition, Eq. (12.A5.2), is given as

$$\tau^{***} = \frac{(n-1)(1+\alpha)}{\alpha}. \quad (12.A22.1)$$

Comparing Eqs. (12.A5.1) and (12.A21), the optimal private consumption tax, σ^* , to attain the optimality condition, Eq. (12.A5.1), is given as

$$\sigma^* = n - 1. \quad (12.A22.2)$$

By imposing both taxes, Eqs. (12.A22.1) and (12.A22.2), at the same time, we may attain the first best solution. τ^{***} , σ^* increase with the number of agents; namely, the degree of static externalities. σ^* is less than τ^{***} . It is desirable to tax private consumption less than fiscal privilege. The intuition is as follows. Different taxes on c and h reduce both c and h , while attaining the optimal allocation between c and h . At the same time, g (or G) is stimulated, which is desirable.

Alternatively, the government may use a subsidy for the fiscal consolidation attempt, g by $1/(1+\sigma)$. Then, Eq. (12.A20) may be rewritten as

$$(1 + \alpha + \alpha\tau)h_i + c_i + \frac{1}{1 + \sigma}g_i = y + T_i. \quad (12.A20')$$

In this instance, it is easy to see that the optimal rate of σ is given by Eq. (12.A22.2). It is also optimal not to tax expenditures on political efforts, $\tau = 0$. This is because we have Eq. (12.A16) at the competitive solution as in the first best solution. Since G is too little, it is desirable to stimulate G with a subsidy to g .

A5 Conclusion

Pigouvian taxes on privilege consumption are not always sufficient to attain the first best solution. They may reduce welfare when fiscal privilege and public goods are complements and voluntary contributions to fiscal consolidation are present. The intuition is as follows. If privilege consumption is depressed by the tax, useful public spending is also depressed. Further, private consumption is stimulated when fiscal privilege and public goods are complements. This outcome is not desirable. The optimal Pigouvian tax rate normally increases with the degree of political behavior and the number of agents.

When a nationwide public good is regarded as given by the agent, the tax rate to attain the static efficiency between private consumption and fiscal privilege is independent of the number of agents. Pigouvian taxes alone cannot internalize

two types of static externality caused by fiscal privileges, the effect on private consumption, and the effect of useful public goods at the same time.

Appendix B: Political Factors and Public Investment Policy in Japan

B1 Political Pressures from Local Interest Groups

Even if the government is benevolent, it may not always pursue the most appropriate public investment policy in a political economy. When the government is politically weak, it may not conduct public work measures effectively. In reality, the political strength of a government is affected by the rent-seeking activities of interest groups. Thus, it is important to consider the role of political factors in public finance policies.

As explained in Chap. 1, since the 1990s, government deficits in Japan have increased rapidly, partly because the Japanese government has been politically weakened by the pressure of many interest groups. Such political factors contributed to increasingly wasteful public works in the 1990s (see, among others, Asako et al. 1994).

One important reason why funds for public works have not been efficiently allocated is that the government faces political pressures from local interest groups. In Japan, many local interest groups (or politicians) seek to obtain more funds from the central and local governments through a variety of lobbying activities. In particular, local interest groups living in the rural and agricultural areas have received substantial grants, mainly in the form of wasteful public works. These interest groups may be regarded as one of the most powerful political actors in Japan, a plausible explanation for which is as follows.

The ruling party (the Liberal Democratic Party, LDP) exerts influence on deciding the national budget. Providing extended grants is important for the party if it is to be re-elected. Comparatively, since the post-war period, a higher number of representatives in the ruling party, the LDP, have represented rural regions rather than urban areas. Thus, people in the rural regions have more representatives in the ruling party than their urban counterparts. Usually, a region with a higher number of representatives from the ruling party receives more subsidies from the central government throughout the period of the party's rule. Thus, representatives of the Diet appeal to the cabinet or the central bureaucrats to allocate more funds to their own regions. The Japanese government is politically weak at implementing microeconomic measures; thus, it has failed to control fiscal privileges such as wasteful public works.

When the central government is politically weak, it may respond to political pressures by simply granting subsidies to local governments. This soft budget mechanism further stimulates rent-seeking behavior on the part of local governments and politicians. Namely, even when the economy is not in recession, the predominant focus on public investment policy by local governments results in a huge amount of wasteful public works, thereby deteriorating Japan's fiscal situation. Local governments may free ride on subsidies from the central

government without imposing sufficient taxes on their own residents. As a result, the overall government deficit may increase.

B2 Intergovernmental Transfers in Japan

In particular, in Japan intergovernmental transfers are mainly conducted by using the local allocation tax, whereby the gap between the basic fiscal needs and basic fiscal revenues of each local government is offset by transfers from the central government (see Chapter 13). The criterion of basic fiscal needs in the local allocation tax formula has not been explicitly specified. Thus, the amount of local allocation tax is actually determined by political negotiation among various interest groups and politicians, wherein local politicians have strong bargaining power. Further, local governments do not determine the local tax rates of their respective regions in accordance with the regions' needs; instead, they seek heavy subsidies from the central government.

As a result, Japan's intergovernmental finance system is characterized by a substantial amount of transfers from the central government to local governments. The central government subsidizes local governments with an amount that is approximately 5 % of GDP every year. Since local governments depend heavily upon such subsidies from the central government, the former may try to obtain as much money as possible from the latter, irrespective of regional economic conditions.

Comparing the data on Japan's public works with those of other countries, we can say that local residents in Japan have greater privileges than those in other countries, reflecting the influential role of their interest groups. As explained in Chapter 1, although expansionary fiscal measures have often been conducted in the 1990s, these measures have not produced any expansionary effects on the economy. In particular, agriculture, fishing, forestry, and flood control are allocated substantial financial resources because of the lobbying activities of local interest groups.

In Japan, representatives of the rural regions, influenced by local interest groups and voters, exert political pressure on the central government to allocate higher grants to the rural regions. As a result, the allocation of region-specific privileges in the form of subsidies and public works from the central government has been determined mainly by political factors. Indeed, the lobbying activities of local interest groups and local governments were exaggerated during the 1990s, as shown in Ihori et al. (2011) and in the empirical evidence of Doi and Ihori (2009). This is one of the main reasons for excessive counter-cyclical measures adopted by the government in the form of wasteful public works, and the lack of progress of fiscal reconstruction in the 1990s.

B3 The Impact of Interregional Transfers

Recently, Kondoh (2014) analyzed whether the distribution of interregional transfers or public investment to each region is affected by political incentives and whether this expenditure contributes to regional economic growth. In this regard, Kondoh used a set of Japanese prefectural-level data during the period 1980–2010. He employed a simultaneous-equation approach in order to attain this

aim and estimated the regional distribution functions and the regional growth regression. The empirical results were as follows.

1. The regional distribution of public investment or interregional transfers is affected by political factors such as the incentive of the governing party (the LDP) to buy votes and pressure from local interest groups.
2. The funds distributed to each region do not necessarily contribute to regional economic growth. Funds distributed to each region are not beneficial for citizens and become a kind of transfer for rent-seekers.

Kondoh (2014) also conjectured that public investment or intergovernmental transfers are used for wasteful purposes or partially used as a means of transfer to special interest groups. An important policy implication of this is that decentralization reform is needed to mitigate the economic loss caused by distributive politics. Moreover, a more transparent government is desirable in order to limit the influence of special interest groups such as the construction industry.

Levitt and Poterba (1999) showed that in the US, politically powerful states enjoy higher economic benefits than the politically weaker ones. However, Kondoh's result suggested that in Japan, redistributive politics does not necessarily benefit politically powerful regions in the long run because the productivity effects of public works in rural areas have proved to be limited.

B4 Efficient and Effective Public Investment Management

In order to attain efficient and effective public investment management, it is necessary to restrain political activities that seek fiscal privileges and to reform intergovernmental financing (see, among others, Doi and Ihori 2009). Reforms in intergenerational financing may also restore the efficacy of counter-cyclical measures using public works.

In order to make local public projects more efficient and effective, local governments should refrain from relying on the central government under hard budget constraints. It is important to revise the local allocation tax formula so that local governments and residents may take the burden of tax revenues without relying on subsidies from the central government under soft budget constraints. Seeking to enhance efficiency and transparency of public investment management by a politically independent reassessment system of public works is important for reducing local privileges and wasteful local public works.

Questions

- 12.1 Suppose three persons, A, B, and C, have the same income but different preferences for public goods. Explain how the median voter theorem holds in this situation.
- 12.2 Suppose two parties, A and B, have the same objective to stay as the ruling party as long as possible. If voters do not necessarily vote, does the convergence of policies hypothesis hold?

12.3 12.3 Say whether the following statement is true or false and explain the reason.

In the model of the partisan business cycle, the size of the business cycle corresponds to the degree of divergence of preferences among voters.

References

- Alesina, A., & Rosenthal, H. (1995). *Partisan politics, divided government, and the economy*. Cambridge: Cambridge University Press.
- Alesina, A., Cohen, G., & Roubini, N. (1993). Electoral business cycles in industrial democracies. *European Journal of Political Economy*, 23, 1–25.
- Asako, K., Tsuneki, A., Fukuda, S., Teruyama, H., Tsukamoto, T., & Sugiyama, M. (1994). Productivity effect of public capital and welfare evaluation of public investment policy. *Economic Analysis*, 135 (in Japanese).
- Auerbach, A. J. (2006). Budget windows, sunsets, and fiscal control. *Journal of Public Economics*, 90, 87–100.
- Batina, R. G., & Ihori, T. (2005). *Public goods: Theories and evidence*. Berlin: Springer.
- Becker, G. S. (1985). Public policies, pressure groups, and dead weight costs. *Journal of Public Economics*, 28, 329–347.
- Buchanan, J. M. (1967). *Public finance in democratic process: Fiscal institutions and individual choice*. Chapel Hill: UNC Press.
- d'Aspremont, C., Gabszewicz, J. J., & Thisse, J. F. (1979). On Hotelling's "stability in competition". *Econometrica*, 47, 1145–1150.
- Doi, T., & Ihori, T. (2009). *The public sector in Japan: Past developments and future prospects*. Cheltenham: Edward Elgar.
- Downs, A. (1957). *An economic theory of democracy*. New York: Harper and Row.
- Hibbs, D. (1987). *The American political economy: Electoral policy and macroeconomics in contemporary America*. Cambridge, MA: Harvard University Press.
- Hotelling, H. (1929). Stability in competition. *Economic Journal*, 39, 41–57.
- Ihori, T. (2011). Overlapping tax revenue, soft budget, and rent seeking. *International Tax and Public Finance*, 18, 36–55.
- Ihori, T., & Itaya, J. (2001). A dynamic model of fiscal reconstruction. *European Journal of Political Economy*, 17, 1057–1097.
- Ihori, T., & Itaya, J. (2004). Fiscal reconstruction and local government financing. *International Tax and Public Finance*, 11, 1–13.
- Ihori, T., Kato, R. R., Kawade, M., & Bessho, S. (2011). Health insurance reform and economic growth: Simulation analysis in Japan. *Japan and the World Economy*, 23, 227–239.
- Kondoh, H. (2014). Redistributive politics and regional economic growth: Evidence from Japanese prefectures, presented at IIPF conference.
- Levitt, S. D., & Poterba, J. M. (1999). Congressional distributive politics and state economic performance. *Public Choice*, 99, 185–216.
- Nordhaus, W. (1975). The political business cycle. *Review of Economic Studies*, 42, 169–190.
- Pigou, A. (1920). *The economics of welfare*. London: Macmillan.
- Plott, C. R. (1967). A notion of equilibrium and its possibility under majority rule. *American Economic Review*, 57, 787–806.
- Prescott, E. C., & Visscher, M. (1977). Sequential location among firms with foresight. *The Bell Journal of Economics*, 8, 378–393.
- Velasco, A. (2000). Debts and deficits with fragmented fiscal policymaking. *Journal of Public Economics*, 76, 105–125.
- Woo, J. (2005). Social polarization, fiscal instability, and growth. *European Economic Review*, 49, 1451–1477.

1 Intergovernmental Finance

1.1 Decentralization and Local Finance

So far, we have regarded the government as one agent. In reality, there are many governments at different levels of the public sector. From now on, we consider multiple governments, including local governments and central government. Recently, fiscal decentralization and deregulation between central and local governments have been discussed a great deal as a policy issue. This is partly because many governments fail in a real economy, as pointed out in Chap. 12.

In a federal system, many local governments compete with each other. People can choose desirable local governments from among many local governments. Thus, local governments are more sensitive to the preferences of local residents. Thus, it would be desirable for local governments to provide impure public goods or local public services. However, competition among local governments does not necessarily attain the first-best outcome. Central government can do better than local governments in a variety of issues.

From this viewpoint, it is important to investigate the appropriate division of power among the various levels of government. Thus, what is the optimal allocation of economic responsibilities among levels of government? This chapter considers local public finance from the viewpoint of the appropriate roles of the national and subnational governments and the associated responsibilities among levels of government.

1.2 The Decision System of Intergovernmental Finance

Theoretically, there are two extreme decision systems for intergovernmental finance.

- (i) All decisions are conducted by central government and local governments simply follow these decisions.
- (ii) All decisions are conducted by each local government and central government does not intervene.

The former system is the centralized type of decision system, while the latter system is the fully decentralized type. A more realistic situation is one that is a mix of (i) and (ii). Namely, we have a third system.

- (iii) Central and local governments make decisions and both have appropriate roles in intergovernmental finance.

Many developed countries adopt the third system for intergovernmental finance. If governments are perfect in the sense that they know the precise details of residents' preferences and public needs and can control resources optimally, any system can attain the first best. System (i) is the simplest; however, system (ii) can also attain the first best if local governments can cooperate and coordinate appropriately with each other. In addition, system (iii) can attain the first best. If the administrative and management costs are the same, the choice among the three systems does not matter.

In reality, though, the economic activity of the public sector has certain scales of economy. For example, fixed costs may be needed to establish and maintain governmental organization for decision-making. Then, it may well be more efficient to make decisions through one central government rather than many overlapping local governments. However, if informational asymmetry and/or government failure are serious, the choice between the three systems really matters.

1.3 The Centralized System

The centralized system (i) should be suitable for nationwide decision-making. For example, the government is required to provide nationwide public goods such as national defense, large infrastructures, and diplomacy. In this regard, local governments or a fully decentralized system cannot handle the spillover problem effectively unless policy coordination is perfect. Each local government does not easily internalize the spillover effects of its public spending on other local governments. As explained in Chap. 11, at the non-cooperative Nash equilibrium, the private provision of public provision becomes too small. Even the Lindahl mechanism cannot easily solve the free rider problem. Thus, it is hard for local governments to provide pure public goods nationwide in an appropriate manner.

Moreover, with regard to income redistribution policy, local governments face a severe limitation in the sense that residents living in a region with high progressive taxes can move to other regions with low progressive taxes. For example, the rich can easily leave a region with high progressive taxes. This means that tax competition may occur among local governments by reducing taxes in order to attract the mobile tax base such as rich residents or capital income. As a result, not all local

governments can raise enough taxes from the mobile tax base. From this point of view, redistribution should be conducted by central government.

In reality, income redistribution is often conducted by means of interregional redistribution rather than interpersonal redistribution. This is because governments may not know those are rich or poor. An indirect indicator of true income may well be the regions where people live; if so, interregional redistribution becomes useful.

However, it seems difficult for local governments to concur about the degree of interregional redistribution in the decentralized system. Rich regions are always against a large amount of redistribution, while poor regions always seek a large amount of subsidies. Hence, interregional redistribution may be conducted only by central government. Thus, the centralized system (i) is better than the decentralized system (ii) in many regards.

1.4 The Decentralized System

In contrast, the decentralized system (ii) is more suitable when an informational gap exists between central and local governments with respect to regional-specific needs and when residents are heterogeneous. For example, if residents in a region have different preferences about their local government's activities compared with residents in other regions, unified intervention by central government does not work well in all regions.

For example, imagine that central government intends to provide a local public good to all regions. If residents in one region evaluate the good as more desirable compared with residents in another region, preferences diverge among regions. If central government has precise details about the residents in their regions, it may differentiate the levels of local public goods according to region-specific preferences.

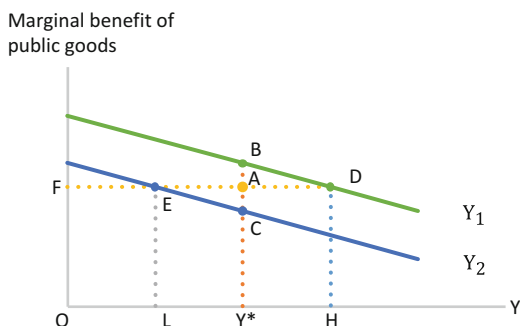
However, it is plausible to assume that central government may not have such details. If so, it is likely to provide the same level of the local public good to all regions. Thus, not all residents in the regions are satisfied with the level of the local public good. In order to coordinate region-specific preferences, central government should provide a larger amount to the region with a higher evaluation of the desirability of the good and a smaller amount to the region with a lower evaluation.

Under the concept of informational asymmetry whereby local governments may know more about residents' preferences than central government, it is desirable for local governments to have the main role in the provision of local public goods.

In Fig. 13.1, the vertical axis denotes the marginal benefit of local public goods and the horizontal axis denotes the level of public goods. Curves Y_1 and Y_2 denote the marginal evaluation of local public goods in region 1 and region 2 respectively. We assume that residents in region 1 evaluate the public goods as more important compared with residents in region 2. Curve OF is the common marginal cost.

If central government provides the goods at the same level of Y^* , the marginal benefit is not equal to the marginal cost in each region. For region 1, the marginal benefit and marginal cost are the same at OH, while for region 2 they are the same at

Fig. 13.1 Fiscal decentralization



OL. Comparing these cases, the level at Y^* produces an excess burden of triangle $\triangle ABD$ in region 1 and triangle $\triangle ACE$ in region 2.

The above example assumes different preferences with respect to the quantity of public goods. A similar argument is maintained in a situation where the quality of public goods diverges among regions. Alternatively, the cost of public goods may differ among regions. When preferences and/or costs diverge significantly, it is difficult for central government to recognize the information more effectively than local governments. Thus, it is desirable for local governments, not central government, to provide these public goods.

We must also consider the possibility of the free rider problem. Local governments may be able to handle this problem effectively because they are relatively familiar with the preferences of their local residents. Thus, we have the decentralized theorem:

It is desirable for local governments to have the main role in the provision of local public goods.

This decentralized theorem was first highlighted by Oates (1972).

Moreover, certain competitive incentives work for local governments. Note that a government does not behave in order to maximize profits. Its supposed objective is to maximize social welfare. However, in reality politicians may be rent seekers and may not represent the interests of residents or voters. Thus, it is difficult to evaluate government behavior quantitatively. With regard to central government, changes through elections are the only method that voters can use to express their judgments. With regard to local governments, elections are also effective. In addition, local residents can easily apply and/or revoke political pressure. Indeed, voice, as well as voting, is very effective for local residents as a means to control and monitor politicians. Further, local residents can choose their optimal local government by moving from one region to another. This is called voting with their feet. Since it is easy for local residents to compare similar local governments, the decentralized system has the benefit of choosing a desirable government more clearly.

1.5 Intergovernmental Finance

In reality, an intergovernmental finance system is likely to be established between systems (i) and (ii) whereby government incorporates the benefits of both systems into a unified system. Namely, central government has the role of providing nationwide public goods and redistribution measures, while local governments have the role of providing local public goods and other local public services.

If the objectives of central and local governments are not consistent with the interests of residents, the above intergovernmental allocation of public finance may not be optimal. Generally, both types of government could fail. Moreover, some local residents apply significant political pressure in order to seek their own fiscal privileges. If local governments are politically weak and influenced by such political activities of interest groups, they may well fail.

In Japan, some local politicians in rural areas often seek their own privileges from their local governments rather than maximize overall residents' welfare in the regions. Thus, local governments may not be effective at maximizing residents' welfare in a political economy. If so, higher-ranking governments are required to monitor local governments. In addition, central government should have notable power in terms of intergovernmental finance.

2 The Supply of Local Public Goods

2.1 Local Public Goods

A public good with a benefit that is limited to a specific region is called a local public good, or a club good, as explained in Chap. 11. This type of good has the following properties. (1) Although it is not excludable within a region, the benefit does not spill over to other regions. (2) Although it is not a rival with respect to consumption, it may be excludable in a region.

With regard to (1), excludability works only beyond the region. The degree of spillover is not necessarily equal to the administrative range of local governments. In this regard, strictly speaking, the decentralized system results in inefficient allocation unless spillover effects are appropriately internalized. However, the degree of inefficiency is less than in the centralized system. If the spillover effect is large, central government must intervene to internalize this.

With regard to (2), local governments can restrict the range of the benefit. If the range of the benefit is limited within a region, the local government can attain optimal efficiency of allocation. In this sense, most local public goods may be regarded as club goods.

2.2 The Optimal Provision of Local Public Goods

Imagine that the utility function of a representative agent in a region is given as

$$U = U(c, G), \quad (13.1)$$

where c is private consumption and G is a local public good as a club good. The agent's budget constraint is

$$Y = c + T, \quad (13.2)$$

where Y is per capita income and T is the lump sum tax used to provide the local public good.

The government budget constraint is given as

$$nT = pG, \quad (13.3)$$

where p is the unit cost of the local public good and n is the size of population in this region. The left-hand side of the equation is the total tax revenue and the right-hand side is local government spending. It is plausible to assume that p increases with n , the size of the population in a region. Thus,

$$p = p(n) \quad p' > 0, \quad p'' > 0. \quad (13.4)$$

Here, p increases with n because of the congestion effect. When n is large, a greater cost is borne in order to provide the same quality of the local public good, G , because of the congestion effect.

From the private and government budget constraints, we have the feasibility condition of the economy:

$$nY = nc + p(n)G. \quad (13.5)$$

Substituting this equation into the utility function, we have

$$U = U\left(Y - \frac{p(n)G}{n}, G\right). \quad (13.6)$$

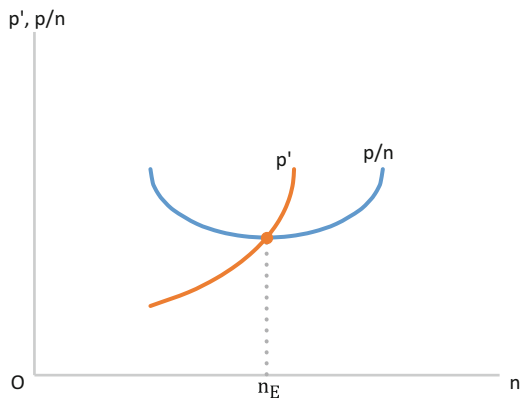
By maximizing this utility with respect to G , the optimal level of G satisfies the following first order condition:

$$\frac{U_c p}{n} = U_G \quad (13.7)$$

or

$$\frac{nU_G}{U_c} = p \quad (13.7')$$

where U_c is the marginal utility of private consumption and U_G is the marginal utility of the local public good. This condition is the Samuelson condition for the

Fig. 13.2 The optimal level of population

optimal provision of public goods. If n is fixed, G may be regarded as a pure public good and hence the optimal supply condition of G is given by the Samuelson rule.

In addition, by maximizing utility (13.6) with respect to n , the optimal level of n satisfies the following first order condition:

$$np'(n) = p(n) \quad (13.8)$$

or

$$p'(n) = p(n)/n. \quad (13.8')$$

This condition means that the marginal cost of a local public good, $p'(n)$, should be equal to the unit cost, or average cost, of the public good, p/n . In other words, the optimal level of n is given as the level where the average cost of a local public good is minimized.

In Fig. 13.2, the marginal cost curve, p' , intersects the average cost curve, p/n , at point E. The associate population, n_E , is the optimal level of population in this region. If the local government chooses the optimal size of population, Eq. (13.8) gives the optimal condition.

2.3 Voting with Their Feet: The Tiebout Hypothesis

In the private market, a private good is efficiently allocated by the market mechanism if the market does not fail. In local public good provision, a similar adjustment mechanism could work through the choice of local government. This is called voting with their feet and was first identified by Tiebout (1956). He argued that the ability of individuals to move among jurisdictions produces a market-like solution to the local public goods problem.

Tiebout emphasized that if residents freely move among regions, local governments compete with each other with respect to the provision of local public

goods. Individuals vote with their feet and locate in the community that offers the bundle of public services and taxes that they like best. As a result, the efficient allocation of local public goods should be attained under the following assumptions.

1. People can move freely among local governments.
2. People know everything about the provision of local public goods and their financing.
3. Local public goods do not spill over beyond the region.
4. The region where people live does not necessarily coincide with the region where they work.
5. Many local governments are available.
6. There is an optimal size of population with respect to the provision of local public goods.
7. In a region where the population is larger than the optimal size, local government intends to reduce the size of the population and vice versa.

In accordance with these assumptions, Tiebout pointed out:

- (i) The local public good is efficiently provided because people vote with their feet and choose their desirable regions.
- (ii) Heterogeneous people with respect to income and preferences move to form homogenous groups so that homogenous groups live in the same local government regions.

Tiebout only provided a heuristic discussion of his result. It was left to later researchers to provide the details and critics eventually emerged. His assumptions are not theoretically clear and later research has not necessarily confirmed Tiebout's two results, (i) and (ii), given above. Indeed, the Tiebout model is plainly not an exact description of the real world.

2.4 Plausibility of the Tiebout Hypothesis

As explained above, Tiebout (1956) assumed that consumers are perfectly mobile, have complete information regarding the various policy alternatives available to them in every jurisdiction, receive income from dividends independent of location, and are not restricted in their employment. Implicitly in these circumstances, public spending is financed by head taxes. On the other side of the market, Tiebout assumed that there is a large number of communities, no spillover effects across communities, and an optimal community size for every location where the public good is produced at minimum average cost.

From this, it follows that localities compete for residents based on the mix of local public goods and services. Further, consumers arrange themselves into homogeneous communities by "voting with their feet" and choosing a location that is best

for them. Thus, an optimum can be achieved. This not only solves the Samuelson problem of determining public spending optimally, it also solves the political problem of voting because unanimity prevails in each community.

One detail is how people express their dissent from policies they do not like. Hirschman (1970), for example, argued that leaving one community for another (exit) because of a disagreement about policy is one way of dissenting. Another equally valuable way of dissenting is to work for change from within the community (voice).

Another detail is the precise definition of a local public good. Some authors have assumed that a public good is a pure public good locally; namely, inside the jurisdiction. They have also assumed that a private good is a pure private good globally; namely, outside the jurisdiction. Thus, only local residents benefit from a local public good and there is no congestion locally. Others have included congestion costs in order to generate an optimal size location where the average cost of providing a public good is minimized. This is what the simple model of Sect. 2.2 assumed.

Some actual goods provided by local governments appear to exhibit congestion such as city sidewalks and streets where exclusion is impossible, given the current technology. Other goods such as a bridge or highway with limited access exhibit exclusion. Still other goods such as schools, libraries, and museums may be excludable but may have other benefits that warrant avoiding exclusion.

It is probably fair to say that the Tiebout hypothesis about homogeneous arranging is inaccurate as a complete description or explanation of the real world. It may not even be appropriate in theoretical models except where the most stringent conditions are satisfied. The hypothesis fails in a broad range of instances: There are existence problems and difficulties associated with the optimality of an equilibrium when it does exist. However, the real value of the hypothesis may be in organizing one's thoughts about modeling economic behavior and studying policy at the local level when resources are mobile. The "voting with their feet" mechanism is important in order to explore the possibility that competition among local governments can attain the efficient allocation of local public goods. Residents can put a lot of pressure on local governments by voting with their feet.

3 Tax Competition

3.1 The Competition for a Mobile Tax Base

A number of researchers have argued that there are spillover effects across the budgets of local governments. For example, Oates (1972) suggested that competition for a mobile tax base, such as business investment, would force local governments to keep taxes and hence spending low, and that this downward bias is inefficient. Many papers have presented the argument in a formal model.

In particular, Zodrow and Mieszkowski (1986) presented a static model of capital allocation across a number of different locations where public spending is financed by a tax imposed on mobile capital and labor is immobile. The tax distorts the capital allocation decision. Each local government chooses the local tax rate on capital to maximize local welfare subject to its budget constraint.

The critical feature of the analysis is that each local government ignores the impact it has on other local governments. Under these conditions, the marginal cost of funds is greater than the marginal cost in magnitude. Zodrow and Mieszkowski showed that the level of a public good that confers a consumption benefit increases if greater reliance is placed on a non-distorting tax rather than a capital tax.

A plausible conjecture is that the tax rate on capital and spending on the public good are too low when the mobile factor is taxed because of competition among governments. In the situation where public capital improves productivity, this result is ambiguous. However, if an unusual instance can be ruled out, the result also holds with public capital.

The impact of one location's tax system on another community can be thought of as an externality. When one local government raises its tax rate on mobile capital, some of the capital, and hence the tax base, moves to other locations. Such other locations benefit from the increases in their tax bases. Unfortunately, the first government does not consider this effect when choosing its optimal tax rate, a point that is true of each local government. It follows that each government tends to tax capital at too low a rate and provides fewer local public goods than otherwise.

Suppose the local government at location j raises its tax rate by dt^j . The outflow of capital to other locations is dk^j/dt^j and the flow of additional tax revenue is $t^j(dk^j/dt^j)$. If S^j is local government j 's subsidy, then $dS^j/dt^j = \sum_{i \neq j} t^i (dk^i/dt^j)$ is the marginal effect on the subsidy. Wildasin (1989) presented numerical examples indicating that the size of the subsidy and the marginal cost of public funds was substantial. For a reasonable benchmark case, the marginal subsidy rate is approximately 40%. Further, the social marginal cost of public spending, when the externality is taken into account, is approximately 70% of the actual cost as perceived by the local government when it ignores the externality. These results were derived in a partial equilibrium framework that implicitly assumed that the federal government had access to a non-distorting tax to finance the subsidy.

Sinn (1997) expressed extreme skepticism regarding the possibility that competition among local governments can essentially solve inefficiency problems, as the Tiebout hypothesis claims. The reason is that the problems confronting local governments exist because the private sector is incapable of solving them. Expecting competition among governments to solve inefficiency problems is perhaps asking too much. Sinn provided an example that involves public capital with congestion. Here, tax competition does not lead to an equilibrium where public capital is lower when private capital is taxed compared with when it is not taxed.

3.2 Taxing Mobile Capital

Consider the following model. There is a large number of jurisdictions or locations, the agents are identical, capital is perfectly mobile, and labor is immobile. There are n^i agents residing at location i , and $n^i = 1$ for simplicity. There is one consumption good produced via a well-behaved, neoclassical, constant returns-to-scale technology. This production uses capital and labor, in accordance with $y = f(k)$, in intensive form, where k is the capital per unit of labor.

Firm i producing the consumption good at location i maximizes profit, Π^i . Thus,

$$\Pi^i = F^i(k^i) - w^i - (r + \tau^i)k^i, \quad (13.9)$$

where w^i is the wage, r is the return to capital, and τ^i is a source-based tax on capital used in production at location i . Hence, under profit maximization,

$$F_k^i = r + \tau^i, \quad (13.10)$$

and

$$w^i = F^i(k^i) - (r + \tau^i)k^i \quad (13.11)$$

is the residual paid to labor. We can solve Eq. (13.10) to obtain the demand for capital,

$$k^i = k^i(r + \tau^i), \quad (13.12)$$

which decreases with the after-tax rate of interest $r + \tau^i$. Namely, $k_r = dk/dr < 0$.

The wage can be determined from

$$w^i(r + \tau^i) = F^i(k^i(r + \tau^i)) - (r + \tau^i)k^i(r + \tau^i). \quad (13.13)$$

It is straightforward to show that $w_r^i = dw^i/dr = -k^i$ by the envelope theorem.

Each consumer is endowed with one unit of labor, which is completely supplied to the local labor market where the individual resides. Agent j at location j is endowed with k^{*j} units of capital.

Preferences are represented by a utility function,

$$u^j = u(c^j, g^j), \quad (13.14)$$

where c^j is private consumption and g^j is the local public good. The consumer maximizes utility subject to the budget constraint,

$$w^j + \sum r^i k^{ji} - T^j = c^j, \quad (13.15)$$

where w^j is the wage paid at location j ; $r^i k^{ji}$ is the interest income agent j earns from an investment in location i ; T^j is a lump sum tax paid by j ; and $k^{*j} = \Sigma_i k^{ji}$, where k^{*j} is j 's endowment of capital per worker.

The first order conditions of the consumer's optimization problem imply that $r^j = r$. The constraint becomes

$$c^j = w^j + r k^{*j} - T^j. \quad (13.16)$$

Thus, the consumer's indirect utility function is given by $v^j(w^j + r k^{*j} - T^j, g^j)$. We can easily extend this model to allow for an endogenous saving decision.

The local government's budget constraint at location i is

$$T^i + \Sigma_i \tau^i k^i = p^i g^i / n^i, \quad (13.17)$$

where p^i is the constant unit cost of the local public good, g^i is a local public good, and $k^i = \Sigma_j k^{ji}$ is capital invested at location i per unit of labor. The local government i chooses (T^i, τ^i, g^i) to maximize indirect utility subject to its constraint and $k^i(r + \tau^i)$. r and the policies of the other governments are taken as given. The solution is a function of (r, p^i) .

Equilibrium in the capital market requires

$$\Sigma k^{*i} = \Sigma_i k^i. \quad (13.18)$$

An equilibrium is an allocation of capital, a choice of output, and a policy such that consumers, firms, and local governments optimize and Eqs. (13.17) and (13.18) hold.

The first order conditions of the representative government's decision problem can be manipulated to obtain the following main result,

$$n^i m^i = [1 + \theta^i \epsilon_{kr}]^{-1} p^i, \quad (13.19)$$

where θ^i is the tax rate on capital and ϵ_{kr} is the elasticity of capital with respect to r . The term $[1 + \theta^i \epsilon_{kr}]^{-1}$ captures the marginal cost of funds (MCF). Since the demand for capital is negatively related to the cost of capital, the $MCF > 1$. m^i is the marginal benefit of the public goods.

Second, if a person-specific tax is available and can be chosen optimally, we have the first best Samuelson rule instead, $n^i m^i = p^i$. Thus,

$$(n^i m^i)^s / (n^i m^i)^f = [1 + \theta^i \epsilon_{kr}]^{-1}, \quad (13.20)$$

where the f superscript denotes the first best level and the s superscript denotes the second best level. It follows that if the aggregate demand for the publicly provided good is strictly decreasing in accordance with the level of the good and that income

effects are small in magnitude, the second best level of the publicly provided good is less than the first best level.

In addition to this, Bucovetsky and Wilson (1991) and Hoyt (1991) showed that the tax on capital income goes to zero as the number of locations increases. As the number of locations increases, the ability of mobile capital to escape taxation also increases. At the limit, it is impossible for local governments to tax capital. The resulting tax competition equilibrium with a finite number of locations may not be constrained efficiently. Each local government's policy may have an impact on aggregate prices and may cause a pecuniary externality across locations as a result. Ithori and Yang (2009) investigated the tax competition in a political economy.

4 The Time Consistency of a Tax Policy

4.1 The Time Consistency Problem

As explained in Chap. 1, the time consistency problem refers to a situation where a decision maker's optimal rule for future actions is no longer optimal when the future actually arrives because the initial conditions have changed. If the decision maker can solve the decision problem again as the future arrives, it is generally better to deviate from the rule that was initially optimal. For example, the government should state that it will not help anyone who moves to a flood plain, but then once people have moved to the flood plain and a flood has occurred, it is optimal to help them.

The famous capital levy is another example of this general problem. In a closed economy, the national government should promise to impose a low tax rate on capital in the future in order to provide an incentive for people to save and invest. This is a simple application of the Ramsey rule of optimal tax theory. However, when the future arrives, the government notices that the capital stock is fixed by saving and investment decisions taken in the past. If it can optimize again, the government reapplies the Ramsey rule and imposes a high tax rate on capital since capital is now in fixed supply.

In each of these examples, the initial conditions at a moment in time include a stock variable that responds to policy; for example, people living in a flood plain and private capital stock. The problem is that the agents involved can determine this inconsistency and choose suboptimal behavior as a result. Thus, people move to the flood plain and consumers do not save as much.

4.2 A Simple Model

In the context of the tax competition problem, imagine the following sequence. First, local governments solve the Ramsey-Samuelson tax-spending problem and announce their optimal rules; for example, Eq. (13.19) or Eq. (13.20). Second, private agents make their saving and allocation decisions. Finally, the local

governments impose their announced policies. In equilibrium, everyone is behaving optimally, the markets are clear, and each government's budget balances. This is the equilibrium on which the literature has focused.

However, suppose a local government can solve its decision problem again just before it is supposed to impose its policy. The capital invested at that location is now in fixed supply, say k^{+i} . This means that the wage is given by

$$w^{+i} = F(k^{+i}) - (r + \tau^i)k^{+i}. \quad (13.21)$$

If the representative agent's indirect utility is given by $v^i(w^i(\tau^i) + rk^{*i}, g^i)$ and the government's budget constraint is $\tau^i k^{+i} = p^i g^i$, then differentiating with respect to g^i and τ , and combining equations, yields Samuelson's first best rule for the local public good, $m^i = p^i$.

More generally, if output is produced by capital, labor, and land, and the technology is a type with constant returns to scale, profit is given by

$$\Pi^i = F(k^{+i}, \ell^i) - (r + \tau^i)k^{+i} - (w^i + \theta^i)\ell^i, \quad (13.22)$$

where k is capital per unit of land, ℓ is labor per unit of land, and θ is now a tax on labor.

If the government moves first and imposes its policy, it chooses tax rates and a level of the public good in accordance with the second best Ramsey and Samuelson rules. In this context, it is generally optimal to tax both capital and labor. However, if the government moves after capital has been allocated, the capital tax becomes a lump sum. It is then optimal not to tax labor if labor is in elastic supply. Thus, there is also a movement in the composition of taxes.

The main point is that instead of imposing a small tax rate on capital, as per the Ramsey-Samuelson rule of Eq. (13.19), the government chooses a much higher tax rate when it reapplies the Ramsey rule after capital has been allocated because the tax is non-distorting. Thus, the first best Samuelson rule governs the optimal choice of a local public good that confers consumption benefits. This suggests that local governments may impose a high tax rate on capital if policy is inconsistent and that this may lead to a high level of spending rather than a low level, as discussed in the literature.

Unfortunately, consumers and firms understand this, or can eventually work it out. Several possibilities emerge. For example, consumers may save less as a result if the return on saving is perceived to be low. Firms may reduce the capital intensity of production in favor of other inputs such as labor and land. This may lower the wage, which may in turn cause consumers to save less. Land rents may also be adversely affected. Thus, the real issue may not be that tax rates are too low because of tax competition, but that there are strong incentives to impose high tax rates on current capital investments because these are temporarily in fixed supply locally.

If the economy lasts forever and local governments must decide on a capital income tax rate each period, a strong incentive exists to tax existing capital at a

higher rate than future capital. In order to circumvent this, the local government can try to establish a reputation for imposing Eq. (13.19) over time and continue with it. However, governments are easily replaced in a democracy and a new government may deviate from the last government's policy. Another possibility is that taxpayers may evade some or all of their mobile capital tax liability. If effective, this can limit the government's ability to exploit the capital levy. However, taxpayers face a cost in doing so if caught. See Batina and Ihuri (2005) for more discussions on this topic.

5 The Principle of Local Tax

5.1 The Overlapping Tax Base

One interesting feature of intergovernmental financing is that central and local governments may impose the same tax base. This is called the overlapping tax base and tax revenue. Suppose the tax rate is fixed; then, an increase in the tax base has a positive spillover effect on the other governments' revenue. There is a vertical externality of public investment because of the overlapping tax base. Consequently, more local public investment means an increase in the revenue of the central government; hence, the central government may subsidize the local government further.

With regard to the competition among governments, it is useful to differentiate horizontal externality from vertical externality. Horizontal externality among governments means that many governments in different regions tax the same tax base. In this situation, tax competition results in tax rates that are too low, as explained in the prior section. However, vertical externality among governments means that the central government and the local government impose the same tax base at the same time.

In this circumstance, tax competition on the overlapping tax base results in tax rates that are too high. Vertical externalities are likely to leave local taxes too high because each local government unduly discounts the pressure on central government's spending that it creates by raising its own tax rate. In order to cope with vertical externality, it may be desirable for the central government to impose the standard rate for local taxes so as to set a limit for raising taxes.

5.2 The Soft Budget Problem

The central government usually gives a large amount in the form of grants to the local governments. The transfers may be conducted in two forms: unconditional transfers and conditional transfers. It is always good for the local government to receive unconditional transfers from the central government since the local government has the freedom to allocate the grant to various projects. Thus, the local

government has the comparative advantage of evaluating the projects that are in most need.

However, the central government considers conditional transfer as an effective tool to influence its preferences on the local government's allocation of a grant. If the central government is benevolent and efficient, but the local government is not, conditional transfers are better than unconditional transfers. If local spending has spillover effects over regions, conditional transfers may internalize the spillover effect by matching grants to local spending.

The central government may give an additional transfer *ex post* if the local government faces fiscal difficulties. In such an instance, if the local government anticipates such an additional transfer, it may have an incentive to spend too much. This produces the soft budget problem (see the advanced study of this chapter and also Ihuri 2011). If local governments face soft budget constraints, they have an incentive to over-borrow and/or pay insufficient attention to the quality of the investments that their borrowing finances. This bad outcome occurred in the Greece crisis, where the EU corresponds to the central government and Greece corresponds to the local government.

5.3 The Benefit-to-Pay Principle

Since the role of local governments is to provide local public goods and services, the desirable tax principle for local tax should be the benefit-to-pay principle. Namely, local residents pay taxes according to the benefits they receive. Thus, only if people with a high evaluation of public goods pay a high amount of taxes can differences about the preferences of public goods be solved. Further, the optimal personalized price to attain the efficient provision of public goods differs among people and regions.

However, it is difficult to perceive the true benefits of residents. It is plausible to assume that the benefits of basic local services are almost the same among residents or that they increase with income. Thus, the fundamental local tax should be a per capita lump sum tax or a proportional tax according to income. A progressive tax is not suitable for local tax since its main objective is to redistribute income among people. In reality, central government does not have more accurate information about who is rich or poor compared with local governments. Thus, local governments can conduct redistribution measures more effectively. This is the situation for social welfare programs rather than for tax measures.

Consider garbage collection services. A local government may impose fees for garbage collection services based on the benefit-to-pay principle. The problem is that it is difficult for local governments to handle free riding. For example, people can throw away garbage without paying fees if local government cannot monitor illegal dumping. In this regard, a per capita lump sum tax for the basic service would be reasonable as the second best solution. If residents want a better service than the basic one, local government may charge for the extra service.

5.4 The Fixed Asset Tax

A desirable and realistic local tax system would be a proportional tax on the tax base. This corresponds to benefits directly or indirectly. From this viewpoint, a fixed asset tax is plausible. In particular, since land value is based on the future benefit of living in a region, a land tax would be desirable from the viewpoint of the benefit-to-pay principle. If the tax rate is flat and has no tax deduction, it is also desirable from the efficiency viewpoint since the marginal tax rate could be set at a low level. In this sense, land is an important tax base for local government with regard to decision-making.

However, in reality, imposing a fixed asset tax has a difficulty. It is not easy to evaluate the market value of an asset such as land and/or houses because most land and houses are not traded on the market. Government has to estimate the market value indirectly. Such evaluation should correspond to the market value, although to some extent this is arbitrary. This may be a serious issue for local governments. If land value changes significantly, it is difficult to adjust market evaluation appropriately.

Moreover, it may be hard to collect taxes from residents who have a large asset but do not have much cash. Unless assets are sold in the market, owners do not earn cash just by holding their assets. By manipulating market value, a local government can change the effective tax rate. However, if the estimation of market value differs very much among taxpayers or regions, it would distort economic activities considerably. Although the tax rate may vary among local governments, the estimation of market value should be the same among regions.

5.5 The Inhabitant Tax

The inhabitant (or income) tax is also useful for local governments. Income may well correspond to the benefit of local public services. For example, if local governments institute public services such as local infrastructures, local firms enjoy the benefits, some of which may be reflected in their employees' wage income. If so, a proportional income tax is justified in accordance with the benefit-to-pay principle.

With regard to Japan, the per capita amount of the inhabitant tax is small. The amount of the tax deduction is also large. It is desirable to raise the amount of the per capita part of the inhabitant tax. At the same time, it is desirable to reduce the amount of the tax deduction.

Such a reform would harm the poor. However, redistribution considerations should be handled by central government with regard to a progressive income tax. Alternatively, social welfare programs can handle this issue. Even among the poor, there may be divergence with respect to preferences about local public goods. It would be better to incorporate the benefit-to-pay principle into the local tax system as much as possible. As a result, local residents would recognize the cost of local

public services; hence, this approach may contribute to a reduction in wasteful public services by local governments.

5.6 The Consumption Tax

The consumption tax is also useful for local governments. It is an indirect tax and does not have any redistribution effect. If a proportional inhabitant tax is in use, the consumption tax is similar in its effect. Indeed, the inhabitant tax is almost the same as the consumption tax if interest income is not included as a tax base. In other words, if it is difficult to impose a proportional inhabitant tax, then the role of a consumption tax becomes important.

5.7 Basic Principles of a Local Tax System

With regard to the basic principles of a local tax system, two opposing principles are well known. First, the benefit principle means that people should pay their taxes according to the benefits they receive. Examples of this principle may include a property tax, a per head tax, and a linear income tax with a low tax rate.

Second, the ability-to-pay principle means that people should pay their taxes according to their ability to pay. Examples of this principle may include a progressive income tax or wealth tax. In general, the benefit principle is good for the local tax system, while the ability-to-pay principle is good for the national tax system.

In sum, the local tax system should center on a fixed-asset tax on land (or property tax) based on a correct asset valuation of the tax base. It is also acceptable that a local consumption tax (that is, a value added tax (VAT)) plays a more important role in the local taxation system in order to stabilize tax revenue. It is important to raise the inhabitant tax per capita if necessary. However, local governments should not levy taxes that lead to tax exports.

As explained, competition among local governments could make the provision of public goods more efficient. Similarly, it is important to promote competition in collecting taxes. Government budget constraint suggests that competition in spending and taxes at the same time is necessary for efficient government activities and wider choices for local residents. Otherwise, without strict government budget constraint, local governments tend to raise spending and reduce taxes. Then, local residents have an incentive to free ride on subsidies from central government, resulting in significant deficits. This creates the soft budget problem.

With regard to Japan, the central government should substantially move taxation responsibilities to local governments so that the latter can determine local tax items and their tax rates in principle.

6 Redistribution among Local Governments

6.1 Regional Diversity of Local Tax

One important issue of local finance is the diversity of local tax revenue among regions. For example, in Japan, in urban areas such as Tokyo's metropolitan regions, local governments collect a lot of tax revenue, while in rural areas tax revenue is low and per capita tax is low. Thus, many local governments depend upon subsidies from central government through the local allocation tax system. In Japan, local allocation tax has an important role for the redistribution of revenue among regions. Indeed, central government has an objective to develop regions equally over Japan (see [Appendix B](#) of Chap. 12).

It is necessary to redistribute tax revenue among regions to some extent. In particular, some public services should be provided to all regions as a national minimum. In order to do so, the central government should support poor local governments through subsidies. Public investment can be used to stimulate rural regions. However, excessive redistribution among regions may produce some undesirable outcomes by taxing rich regions too much.

In Japan, the central government collects the local allocation tax as a national tax. The tax base of the local allocation tax is a part of income tax, consumption tax, and corporate tax. Then, central government transfers the local allocation tax to poor local governments as subsidies. Regional redistribution is conducted by central government using part of the national taxes. As a result, the mechanism of regional redistribution is obscure and can be politically biased (see [Appendix](#) of this chapter).

When benefit and cost are separated in local public services, local residents do not have a strong incentive to monitor local governments. Moreover, if subsidies from central government almost offset the revenue loss, local governments and residents do not experience any additional costs. Local governments do not have an incentive to collect more local taxes by themselves. This is an unwanted outcome because of the moral hazard and soft budget problem.

6.2 The Three-Person Model of Regional Redistribution

Regional redistribution may not produce a desirable outcome if some agents can choose the regions. Let us explain this paradoxical case using a simple numerical example.

Imagine that initially one person lives in region A and two persons live in region B (see [Table 13.1a](#)). In region A, an agent earns an income of 10 and in region B an agent earns an income of 40. A is a poor rural area and B is a rich urban area; thus, an agent living in region B can earn a higher income than in region A. Because earning an income requires a cost (or excess burden) to some extent, an agent's welfare is assumed to be half of his or her earned income.

Table 13.1a Outcome before move

Region	A	B
Earned income	10	40, 40
Cost of earning income	5	20, 20
Initial welfare	5	20, 20
Income after redistribution	30	30, 30
Welfare after redistribution	25	10, 10
Initial social welfare	5	
Social welfare after redistribution	10	

Table 13.1b Outcome after move

Region	A	B
Earned income	10, 10	40
Cost of earning income	5, 5	20
Initial welfare	5, 5	20
Income after redistribution	20, 20	20
Welfare after redistribution	15, 15	0
Initial social welfare	5	
Social welfare after redistribution		0

Hence, in region A an agent's welfare is 5 and in region B it is 20. Because welfare is still higher in region B than in region A, people prefer to live in region B if they can move. In this three-person model, we assume that only one person can move and that other persons cannot move but live in their original regions A and B. Thus, the person who can move lives in region B.

Now let us introduce an extreme redistribution policy managed by central government. Namely, central government imposes a tax of 10 on a person in region B and transfers $10 + 10 = 20$ to a person in region A; thus, after-tax income is equalized as 30 for all persons. Then, welfare in region A is 25 ($= 5 + 20$) and welfare in region B becomes 10 ($= 20 - 10$). From the viewpoint of the Rawls criterion, social welfare increases from 5 to 10. In this sense, the redistribution policy may be desirable.

For the person who can move, it is now better to move to region A from region B because welfare in region B is 10, which is lower than welfare in region A, which is now 25. Thus, he or she moves to region B. Table 13.1b presents the outcome after the person moves to region A.

In region A, two persons earn 10 and in region B one person earns 40. Because of the extreme redistribution policy, a person in region B now pays a tax of 20 and two persons in region A receive a subsidy of 10. Thus, after-tax income is equalized as 20 for all persons. Welfare after redistribution is now 15 ($= 5 + 10$) in region A and 0 ($= 20 - 20$) in region B. The person who can move obtains higher welfare compared with the person who is unable to move in region B. Thus, the person who can move prefers to move to region A.

Social welfare under the Rawls criterion is now 0, which is the welfare of the person who is unable to move in region B. In other words, social welfare declines from 5 to 0. Hence, considering the possibility of movement between the two

regions, a redistribution policy may not be desirable. We may derive a similar policy implication if we adopt the Bentham criterion instead of the Rawls criterion.

6.3 Efficiency

In the foregoing numerical example, an extreme redistribution policy is undesirable because total income declines to 60 from 90. The person who can move earns less in region A than in region B. It is more efficient for her or him to stay in region B. Even if the before-tax income is fixed, the after-tax income declines when some agents can move across regions. Thus, the disincentive effect of taxation becomes serious if someone may choose the region in which she or he lives.

Regional inequality should be handled more effectively in accordance with the efficiency viewpoint rather than the equity viewpoint. For example, if concentrating on the Tokyo metropolitan area is efficient in accordance with resource allocation all over Japan, it is unnecessary to subsidize rural regions significantly through fiscal measures. The standard theory of urban economics suggests that the merit of concentrating on a metropolitan area is efficient if the market does not fail. Thus, policy intervention aimed toward regional redistribution is undesirable. Rather, fiscal decentralization should be promoted so that core cities in rural areas can develop with their own taxes.

In rural areas where the population is small, the per capita cost is large in order to provide a given amount of public goods. Thus, some argue that central government should provide more subsidies to these local governments. For example, imagine that a local government has to construct a bridge. In an urban area, it may collect the tax revenue by imposing a small amount of tax per capita on a large population, while in a rural area the new bridge may only be feasible if central government provides a great deal of money. Moreover, as shown in Chap. 11, the optimal provision of the public good rule implies that the total marginal benefit should be equal to the marginal cost. In a rural area, the total marginal benefit is small because the population is small. In this regard, it is inefficient for the local government to construct a bridge by itself.

7 Further Issues on Intergovernmental Finance

7.1 Local Public Debt

Central government may set a debt limit for local public debt. If the market is perfect, local public debt is evaluated in the market. A local government with poor fiscal resources cannot issue new public debt unless its interest rate is high. However, if the market is imperfect, a local government with poor fiscal revenue may issue too much public debt at a low rate of interest. If so, such a local government may well face financial difficulties regarding the redemption of public debt. Once the local government goes bankrupt, in order to alleviate the bad outcome of bankruptcy, central government, in a political economy, has to rescue

the region. Considering this ex post response by central government, local governments have an incentive to issue public debt by too great an extent. This is an unwanted outcome of soft budget constraint. Thus, it may be desirable for central government to impose a debt limit so as to restrict the issuance of local public debt.

It is worth noting that local public debt has a unique feature. Residents may move away from a region before taxes are increased to redeem the public debt. Such residents may enjoy the benefit of public spending financed by local public debt and avoid the tax burden by moving to other regions. This behavior is called the runaway effect of local public debt.

However, such behavior may not work well. If residents intend to sell their land in order to move away, they cannot sell the land for a high price. Since the future tax burden is likely to rise, the land price is reduced by the amount of the present discount value of the future tax burden. The future tax may well be capitalized in the land price at once. Thus, a current resident effectively pays the future tax by selling the land at a low price. This means that the runaway effect does not easily occur.

7.2 A Decentralized Fiscal System

The idea of fiscal decentralization is very popular in a political economy. However, in the real world of Japan's intergovernmental finance, for example, the role of local government is not yet important. Central government is still powerful and dominant in intergovernmental finance in Japan. Local governments heavily depend upon subsidies from central government. Consequently, local residents do not recognize the true cost of local public services. Thus, it is now necessary to reconsider the role of central and local governments and establish a plausible link between the benefit and cost of public services.

Local governments can provide various public services to local residents more appropriately than central government because they should know the needs of local residents better than central government. In order to promote local governments' efficient decision-making, a decentralized fiscal system is needed. Local governments should collect taxes by their own efforts from their residents. By so doing, individuals are more sensitive to the cost and benefit of public services. It should be noted that fiscal decentralization is desirable only if local residents do not rely significantly on central government's fiscal subsidies.

Appendix: An Analytical Model of Central and Local Governments in Japan

A1 The Local Allocation Tax in Japan

The local allocation tax (LAT) grants are a proportion of national taxes that the central government transfers to local governments. The purpose, in principle, is to balance local revenue sources between the central government and local

governments without prejudicing the independence of local governments. The tax ensures smooth local administration.

The LAT grants have three functions.

- (i) To redistribute revenue between the central government and local governments. In particular, where central government and a local government share a function, the grant provides the local government with some of the funds needed to perform its part of the function.
- (ii) To ensure adequate local government revenue sources. If a local government lacks sufficient revenue sources to provide required administrative services, the central government fills the gap.
- (iii) To equalize revenue among local governments. The central government adjusts financial resources so that differences in financial condition among local governments do not affect the level and quality of the administration of services.

Figure 13.A1 describes the Japan's complicated intergovernmental finance.

In principle, the central government determines the total amount of the LAT grants available to allocate to local governments. The total amount of the LAT grants in the general account is normally calculated in accordance with the "macro-allocation rule of the LAT grants," which is prescribed by the Local Allocation Tax

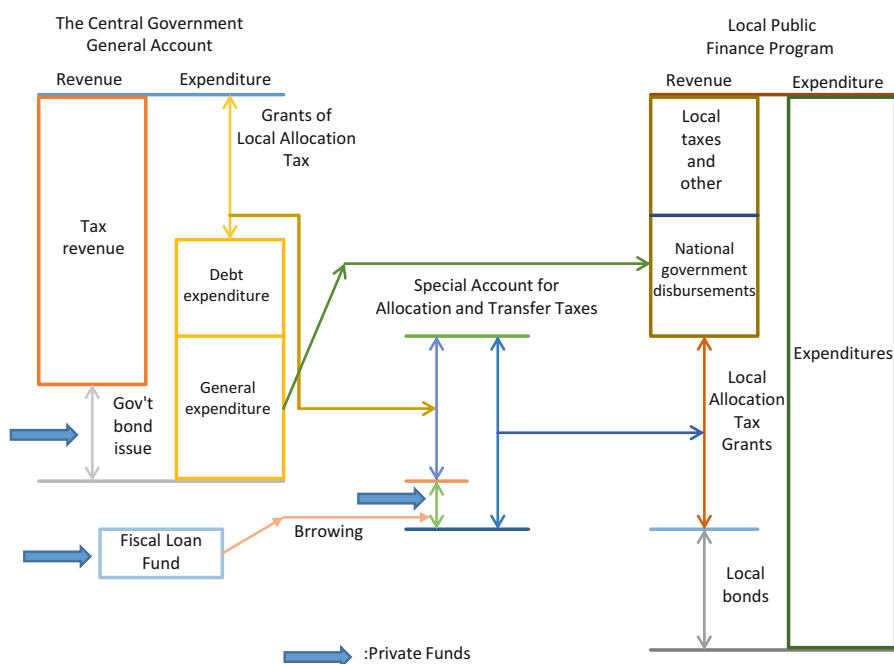


Fig. 13.A1 Intergovernmental finance in Japan

Act. The percentages in the formula are called the “local allocation tax rates.” For fiscal 2016, the formula is as follows.

Total amount of the LAT grants

= 33.1 % of personal income tax and corporate income tax
 + 100 % of local corporate income tax
 + 50 % of liquor tax
 + 22.3 % of consumption tax (as a national tax).

The amount determined in accordance with the macro-allocation rule is distributed as follows: 94 % for ordinary LAT grants and 6 % for special LAT grants. The latter are granted according to special circumstances such as a natural disaster.

A serious issue is that there is no guarantee that the total amount of LAT grants calculated by the Ministry of Finance (MOF) (the supply side) is consistent with the balanced revenue-source shortfall estimated by the Ministry of Internal Affairs and Communications (MIAC) (the demand side). The balanced revenue-source shortfall is computed by totaling the shortfall in the revenue sources of all local governments. In any year, the supply and demand numbers do not equal each other.

Any shortfall in the revenue sources of local governments is covered by an increase in the LAT grants (incrementally adding transfers from the general account, borrowing in the LAT special account, and so on) and an additional increase in issuing local government bonds. These measures mean that there are choices about whether the shortfall is covered by incurring debt on the part of the central government (in the LAT special account) or through the debt of local governments. The latter are called “revenue source measures bonds.”

A2 An Analytical Model of Central and Local Governments

A2.1 The Soft Budget Constraint

It is well recognized that if local governments face soft budget constraints, they will have an incentive to over-spend, over-borrow, and/or pay insufficient attention to the quality of the investments that their borrowing finances. Such welfare deteriorating over-spending/borrowing can occur through the common pool mechanism. See, for example, Wildasin (1997, 2004), Goodspeed (2002), Akai and Sato (2005), and Boadway and Tremblay (2005) among others. That is, the standard result is that if the central government imposes soft budget constraints, inefficient too much investment should arise. On the other hand, Besfamille and Lockwood (2004) showed that hard budget constraints can be too hard and discourage investment that is socially efficient. Namely, they pointed out the possibility that the hard budget constraint over-incentives the soft budget constraint to provide effort by penalizing it too much for project failure, thus leading ultimately to the possibility that socially efficient projects may not be undertaken. Thus, welfare implications of soft budget constraint seem ambiguous. However, the conventional conjecture is

that the soft budget is welfare deteriorating if public investment is too much, and vice versa.

We pay attention to the vertical externality of shared tax bases between the central and local governments in a real economy. Multileveled government normally means some commonality of tax base between central and local governments. As a result the tax base may overlap and shared tax bases create the common pool problem. It is now well recognized in the tax competition literature that such vertical externalities are likely to leave local taxes too high. This is because each local government unduly discounts the pressure on central government's spending it creates by raising its own tax rate.

We develop a two-period intergovernmental financing model of two governments, the central government (or CG), the lower-level local government (or LG) in a small open economy, in order to explore how local public investment and wasteful spending may be stimulated under the soft-budget constraint. For simplicity, we consider the representative local government, and do not consider the free-riding and/or spillover effects within multi local governments. There are many papers to explore the horizontal and vertical externalities due to non-cooperative competition among multi local governments. See Wilson (1999) among others. In Japan many local governments often cooperate. The analytical results would be qualitatively almost the same even if we consider non-cooperative behavior of multi-local governments. Moreover, this is in particular a good approximation in Japan where many local governments behave cooperatively against the central government and their rent-seeking behavior may be summarized by the representative local government.

One contribution of this appendix is to show that the soft-budget outcome could occur even in the case of the representative local government where the central government intends to transfer between central and local governments to attain the optimal allocation of central and local public goods. This is a new result since the conventional literature on the soft budget normally assumes multi-local governments where the central government intends to transfer among local governments to attain the optimal allocation among local public goods. Moreover, the soft budget outcome may occur even if we assume away information asymmetry or cost sharing. In our framework rent seeking is crucial for the soft budget game. Another important contribution is that the soft budget is shown to be welfare deteriorating even if it may attain the first best level of public investment. Thus, our formulation captures important aspects of intergovernmental finance in Japan.

A2.2 An Analytical Framework

The representative local government (LG) provides useful local public goods g_t in each period, and the central government (CG) provides useful nation-wide public goods G_t in period 2 only. Each public good is beneficial and its utility is given by a twice-continuously differentiable and strictly quasi-concave function. Moreover, we assume that all goods are normal ones. The relative price of each good is set to

be unity for simplicity. Thus, the social welfare, W , which reflects the representative agent's preferences over public goods, is given by

$$W = v(g_1) + \delta\{u(G_2) + v(g_2)\} \quad (13.A1)$$

where $0 < \delta < 1$ is a discount factor. For simplicity, private consumption is assumed to be fixed and hence we only consider utility from public goods. This formulation may be justified since we assume that the tax rate on income is fixed and labor supply is exogenously given, so that private consumption is also fixed. If we consider private consumption explicitly in the social welfare, the analytical results are qualitatively almost the same.

The local government conducts public investment k in period 1, which has a productive effect of raising tax revenue in period 2. Let Y_t represent total tax revenue of the two governments in period t ($t = 1, 2$). We assume that Y_1 is exogenously given but Y_2 is dependent on public works conducted by the local government in period 1, k . $Y_2 = Y_1 + f(k)$. Local public investment increases total tax revenue of period 2. Investment product function $f(\cdot)$ satisfies the standard Inada condition: $f'(\cdot) > 0$, $f''(\cdot) < 0$. For simplicity we do not consider public investment by the central government. In a multi-local government setting local public investment may have spillover effects over regions. However, in this formulation since we consider the representative local government, we do not incorporate such horizontal spillovers. Public investment has the vertical externality effect on the central government's tax revenue.

Both central and local governments levy taxes on overlapping economic activities in period 2. The tax revenue is shared by the two governments. We set β as local government's portion of total tax revenue, $0 < \beta < 1$. Thus $1 - \beta$ means share of the central government to total tax revenue. The share parameter β is assumed to be exogenously given. Or we could regard βY as the subsidy from CG to LG if we regard Y as national tax revenue.

We consider pork barrel spending by the local government. As shown in DelRossi and Inman (1999), pork barrel projects are too high due to subsidies from the central government caused by local governments' political demand. In the tradition of Leviathan models of government, the local politicians prefer "wasteful" public spending (S_1, S_2), which provides them with rent-seeking opportunities but does not benefit voters or consumers. In this sense, useful local spending is divided among g_1, g_2, k and wasteful local spending is divided between S_1, S_2 . In a real economy some of public works are wasteful. Such wasteful public investment corresponds to S_i , not k in this model.

Next, we specify each government's budget constraint. The budget constraint of CG in period 2 is given as follows,

$$G_2 = (1 - \beta)Y_2 - A \quad (13.A2)$$

where A is a lump sum subsidy to LG ($A \geq 0$). Note that in period 1 $G_1 = (1 - \beta)Y_1$ is exogenously given and hence we do not explicitly consider G_1 or $(1 - \beta)Y_1$ in the

analytical framework. If CG commits to the initial value of A , we call the game the hard budget game. In this game CG is the leader, while LG is the follower. If CG may change the level of A when the hard-budget game is over, we call it the soft budget game. In this game LG becomes the leader, while CG becomes the follower.

The period-by-period budget constraints of LG are given as follows,

$$D = g_1 + k - \beta Y_1 + S_1 \quad (13.A3.1)$$

$$g_2 + S_2 + (1 + r)D = \beta Y_2 + A \quad (13.A3.2)$$

where D is the local government debt, which is controlled by CG. Or, we may simply assume that LG cannot issue local debt: $D = 0$. $r > 0$ is the exogenously given world interest rate.

From Eqs. (13.A3.1, 13.A3.2) we can write the objective function of the local government as follows.

$$S \equiv S_1 + \frac{S_2}{1 + r} = \beta Y_1 + \frac{\beta Y_2}{1 + r} + \frac{A}{1 + r} - g_1 - \frac{g_2}{1 + r} - k \quad (13.A3.3)$$

A2.3 The Pareto Efficient Solution

First of all, we investigate the Pareto efficient first best allocation in this model as a benchmark. Unitary benevolent government, consolidating CG and LG, could attain the first best by allocating optimally the total tax revenues among nation-wide public goods and local public goods in each period. Namely, the unitary government, who implements the optimal allocation $\{G_t, g_t, k\}$, maximizes social welfare (13.A1) subject to the following overall feasibility constraint

$$\beta Y_1 + \frac{Y_2}{1 + r} = \frac{G_2}{1 + r} + g_1 + \frac{g_2}{1 + r} + k + S_1 + \frac{S_2}{1 + r} \quad (13.A4)$$

which is obtained from Eq. (13.A2) and Eqs. (13.A3.1, 13.A3.2) by eliminating A .

First order conditions of this optimization problem are as follows,

$$\delta u_{G_2} - \frac{\mu}{1 + r} = 0 \quad \text{where} \quad u_{G_2} \equiv \frac{\partial u(G_2)}{\partial G_2}$$

$$v_{g_1} - \mu = 0$$

$$\delta v_{g_2} - \frac{\mu}{1 + r} = 0 \quad \text{where} \quad v_{g_t} \equiv \frac{\partial v(g_t)}{\partial g_t}$$

$$\mu \left\{ \frac{f'(k)}{1 + r} - 1 \right\} = 0$$

$$S_1 = S_2 = 0$$

μ is the Lagrange multiplier of Eq. (13.A4). From these conditions we have

$$u_{G2} = v_{g2} \quad (13.A5.1)$$

$$\frac{v_{g1}}{v_{g2}} = (1+r)\delta \quad (13.A5.2)$$

$$f'(k) = 1+r \quad (13.A5.3)$$

$$S_1 = S_2 = 0 \quad (13.A5.4)$$

The above optimality conditions (13.A5.1,,13.A5.4) and the overall feasibility condition (13.A4) determine the Pareto efficient allocation as the benchmark case. Condition (13.A5.1) means that the marginal benefit of public goods is equalized between CG and LG. Condition (13.A5.2) governs the standard (intertemporal) optimal allocation of local public spending between two periods. Condition (13.A5.3) is the standard first-best criterion of public investment. Finally, condition (13.A5.4) is obviously the efficiency condition. We do not have any rent-seeking activities at the first best solution.

A3 The Hard Budget Game

We now investigate outcomes in a decentralized system of a multi-government non-cooperative world where benevolent central and rent-seeking local governments decide their policy variables non-cooperatively. First of all, we consider the hard budget game. Here we investigate the fully (or isolated) decentralized Nash equilibrium at the exogenously given $\beta > 0$. In this game, CG is the leader and LG is the follower. The hard-budget game is done at the beginning of period 1.

Namely, at the first stage of this hard-budget game CG determines grants and its own public goods A, G_2 , and then at the second stage LG determines its expenditures, g_1, g_2, k , and rent seeking activities S_1, S_2 . When period 2 comes CG gives the committed value of a lump sum transfer A to LG. Here we assume the restricted scheme of local debt issuance, and LG may not choose the optimal amount of D . Note that this assumption would not restrict the opportunity set of LG since LG may transfer resources effectively by choosing S_1, S_2 appropriately.

CG maximizes Eq. (13.A1) subject to Eq. (13.A2) by choosing nation-wide public goods and a transfer to LG. On the other hand, LG, who represents the interest of rent-seeking local politicians, maximizes the present value of wasteful public spending or rent, $S = S_1 + S_2/(1+r)$ by choosing local public goods and investment subject to the following survival constraint.

$$v(g_1) + \delta v(g_2) = \bar{U} \quad (13.A6)$$

where $\bar{U}$ means the reservation utility which represents the preferences of voters. If (13.A6) is not satisfied, voters do not re-elect them and local politicians cannot stay at the office of local government. In this sense, we implicitly assume that there are many politicians in each region. It is plausible to assume that

$$\bar{U} < U^F \equiv v(g_1^F) + \delta v(g_2^F)$$

where g_1^F, g_2^F are the first best levels of g_1, g_2 , respectively.

A3.1 The Second Stage

Let us investigate the outcome of this hard budget game. LG's problem at the second stage is to maximize

$$S = \beta \left(Y_1 + \frac{Y_2}{1+r} \right) - \left(g_1 + \frac{g_2}{1+r} + k \right) + \frac{A}{1+r} \quad \text{subject to (13.A6)}$$

Then, first order conditions with respect to g_1, g_2, k are as follows,

$$-1 + \psi v_{g1} = 0 \quad (13.A7a)$$

$$-\frac{1}{1+r} + \psi \delta v_{g2} = 0 \quad (13.A7b)$$

$$\frac{f'(k)\beta}{1+r} - 1 = 0 \quad (13.A7c)$$

where $\psi (>0)$ is the Lagrange multiplier of (13.A6). Thus, we have

$$\frac{v_{g1}}{v_{g2}} = (1+r)\delta \quad (13.A5.2)$$

From these conditions (13.A6), (13.A7), (13.A5.2), the optimal levels of g_1^*, g_2^*, k^* , and S are determined. Condition (13.A5.2) means that the total expenditure on local public goods, $g_1 + \frac{1}{1+r}g_2$ is minimized under the survival condition (13.A6). Two conditions (13.A6) and (13.A5.2) determine the equilibrium values of g_1, g_2 in this game, g_1^*, g_2^* . Equation (13.A7c) determines k in this game, k^* . Note that the optimal levels of g_1^*, g_2^*, k^* are not dependent on CG's choice variables of A, G_2 . Note also that S (or S_2) increases with A . S_1, S_2 are uniquely determined at a given level of D to meet with the budget constraints (13.A3.1), (13.A3.2). If we assume that D is optimally chosen by LG, but either S_1 or S_2 is exogenously given, we still obtain the same conditions (13.A6), (13.A7) and (13.A5.2).

A3.2 The First Stage

CG maximizes Eq. (13.A1) subject to Eq. (13.A2) by choosing nation-wide public goods and a transfer to LG by taking account of the optimizing behavior of LG,

examined in section A3.1. That is, CG anticipates that LG determines its choice variables under the constraint (13.A6) at the second stage. Hence, the resulting social welfare reduces to $W = \delta u(G_2) + \bar{U}$. The equilibrium social welfare increases with G_2 and hence decreases with A at a given level of k .

Then, it is always desirable for CG to reduce A (and hence S) by raising G_2 as much as possible. That is, a decrease in A raises social welfare by reducing S and S_2 . Considering the non-negativity constraint: $A \geq 0$, the optimal level of A is given by $A = 0$. Social welfare, which is increasing with G_2 , is maximized at $A = 0$ at the given level of local public expenditures, g_1, g_2, S_1, S_2 , associated with k^* . Although S_2 is minimized at $A = 0$, we still have positive values of S_1, S_2 .

A3.3 Outcome

The subgame perfect outcome of this hard budget game is given by

$$f'(k) = \frac{1+r}{\beta} > 1+r \quad (13.A7c)$$

$$\frac{v_{g1}}{v_{g2}} = (1+r)\delta \quad (13.A5.2)$$

$$A = 0 \quad (13.A8)$$

Condition (13.A5.2) implies that relative (intertemporal) allocation between g_1 and g_2 is efficient in this game. But the levels of these public goods and local investment are not necessarily provided optimally. In other words, condition (13.A5.1) does not necessarily hold since the total levels of public goods, G_2 and $g_1 + \frac{g_2}{1+r}$, are arbitrarily set, depending on the exogenous parameter, β , the rent-seeking behavior of LG, and the survival condition (13.A6).

Condition (13.A5.3) does not hold either. Considering $\beta < 1$, Eq. (13.A7c) means that k is under-provided due to the vertical externality of the overlapping tax base: $k^* < k^F$, where k^* is the solution of k in this game and k^F is the solution of k at the first best solution. Since the local government does not take into account the positive spillover effect of increasing the overlapping tax base on the central government, local public investment is not sufficient. And total tax revenue shared by both governments in period 2 is too little.

To sum up, there are three sources of inefficiency in the decentralized system. First, since β is not necessarily set at the optimal level, the allocation of public spending between CG and LG is not determined optimally. Second, there is a vertical externality of public investment due to the overlapping tax base, and hence k is too little ($k^* < k^F$). Finally, due to the rent-seeking activities of LG ($\bar{U} < U^F$), local public goods g_1, g_2 are too little and wasteful public spending (S_1, S_2) becomes positive.

A4 The Soft-Budget Game

A4.1 CG's Ex Post Transfer: The Second Stage

As explained before, at the first stage of the hard budget game CG determines A, G_2 under the anticipation that LG chooses g_1, g_2, k, S_1, S_2 to meet with the survival condition (13.A6) at the second stage. Then it is optimal to set $A = 0$ since it depresses rent seeking to some extent.

However, when the hard budget game is over, LG's optimizing behavior becomes also fixed, so that the survival condition is not binding ex post. CG may now have an incentive to change the committed desired value of $A = 0$. Namely, when the hard budget game is over and period 2 comes, CG may not want to commit to the initial desired level of $A = 0$. CG may raise A by creating grants to LG ex post, in order to raise the social welfare effectively. This is a time inconsistency problem. Thus, LG faces the soft-budget constraint. In this soft budget game LG becomes the leader and CG is the follower.

We first investigate the optimizing behavior of CG at the beginning of the second period. After LG determines local expenditures, $g_1, \widehat{g}_2, S_1, S_2$, and k , at the first stage of this soft budget game, CG may choose its public spending, G_2 (and effectively g_2), subject to the budget conditions (13.A2) and (13.A3.2) by creating an additional grant, A , appropriately in period 2 as the second stage of this soft-budget game. Here $\widehat{g}_2$ is the level of second-period local public spending chosen by LG at the first stage of soft budget game and g_2 is the final outcome of second-period local public spending effectively chosen by CG at the second stage of soft budget game. Note that $g_2 = \widehat{g}_2 + A$. At a given level of $\widehat{g}_2$, an increase in A means an increase in g_2 by the same amount because k and S_2 are chosen at the first stage of this game.

From Eqs. (13.A2) and (13.A3.2) eliminating A gives the relevant overall budget constraint in period 2 as

$$G_2 + g_2 + S_2 + (1 + r)D = Y_2 \quad (13.A9)$$

Note that S_2 and Y_2 are determined at the first stage by LG. By choosing A ex post in period 2, CG may in fact choose the allocation of G_2 and g_2 under the above overall budget constraint (13.A9) to maximize the social welfare in period 2; $u(G_2) + v(g_2)$. Since the rent seeking activity was already done at the first stage of this game, the survival condition (13.A6) is no longer binding at this stage. This is the reason why we have the soft budget game without information asymmetry or cost sharing. Thus, the first-order condition at the second stage of this game is given by

$$u_{G2} = v_{g2} \quad (13.A5.1)$$

From the above optimality condition (13.A5.1) and the second-period budget constraints (13.A2) and (13.A3.2), at given levels of local expenditures S_2 , and k ,

which are chosen at the first stage of this soft budget game by LG, we may derive the optimal response of A , g_2 (and hence G_2) of CG as functions of S_2 , and k , respectively. Although A and g_2 change in the same direction by the same amount at a given level of $\widehat{g}_2$, they may change in a different way when S_2, k (and hence $\widehat{g}_2$) change.

$$A = A(S_2, k) \quad (13.A10.1)$$

$$g_2 = g(S_2, k) \quad (13.A10.2)$$

By totally differentiating the budget conditions (13.A2) and (13.A9) and the optimality condition (13.A5.1), we have

$$dG_2 = (1 - \beta)f'(k)dk - dA$$

$$dG_2 + dg_2 + dS_2 = f'(k)dk$$

$$(1 - \eta)dG_2 = \eta dg_2$$

where $\eta \equiv |v_{gg2}| / [|u_{GG2}| + |v_{gg2}|]$ means the relative evaluation of G_2 compared with g_2 . It is assumed for simplicity that $0 < \eta < 1$ is constant. Then, we have as the property of response functions

$$A_S = \frac{\partial A}{\partial S_2} = -\frac{\partial G_2}{\partial S_2} = \eta > 0 \quad (13.A11.1)$$

$$A_k = \frac{\partial A}{\partial k} = -\frac{\partial G_2}{\partial k} + (1 - \beta)f'(k) = (1 - \beta)f'(k) - \eta f'(k) \quad (13.A11.2)$$

$$g_{S_2} = \frac{\partial g_2}{\partial S_2} = -(1 - \eta) < 0 \quad (13.A11.3)$$

$$g_k = \frac{\partial g_2}{\partial k} = (1 - \eta)f'(k) \quad (13.A11.4)$$

Equation (13.A11.1) shows the plausible outcome of the soft budget constraint due to rent-seeking activity. An increase in S_2 (or a decrease in $\widehat{g}_2$) at the given levels of k and A results in a decrease in g_2 , leading to more grants A from the central government. $A_S > 0$. Intuition is as follows. When LG conducts more rent seeking S_2 at the first stage of this soft budget game, $\widehat{g}_2$ (and hence g_2) falls from Eq. (13.A3.2). This outcome is not good for CG since it would like to realize the optimality condition (13.A5.2) to raise social welfare ex post. Thus, CG has an incentive to make additional subsidies to LG in period 2 to raise the ex post level of g_2 and reduce the ex post level of G_2 . This positive effect of S_2 on A is an important outcome of the soft budget game.

Moreover, we have another outcome of the soft-budget result due to public investment, A_k , which is another new channel due to the vertical externality. As shown in Eq. (13.A11.2), the sign of A_k is generally ambiguous. If $1-\beta > \eta$, then $A_k > 0$ (and vice versa). That is, if the marginal valuation of G_2 is relatively small and $1-\beta$ is too high, then g_2 is too low compared with G_2 . In such a case, when k increases, CG would react to increase A in order to maximize the ex post social welfare.

Intuition is as follows. An increase in k raises the tax revenue of CG by the amount of $(1-\beta)f'$, resulting in an increase in utility of G_2 by the amount of $(1-\beta)f' u_{G_2}$ at a given level of A . This increase in G_2 is optimal if utility of g_2 increases by the amount of $(1-\beta)(1-\eta)f' v_{g_2}/\eta$. On the other hand, it actually raises the marginal utility of g_2 by the amount of $\beta f' v_{g_2}$ at a given level of A . Hence, if $1-\beta > \eta$, it is desirable to increase g_2 by reducing G_2 , and CG would react to give more grants A to LG to stimulate g_2 .

A key part of the model is the interaction between CG and LG. The central government intends to allocate revenues to equalize marginal gains of public goods between the central and local governments so long as the rent seeking is fixed and the survival constraint is not binding. The central government's benevolent incentives result in a soft budget constraint by creating additional grants in period 2 when the local government conducts rent seeking more and investment more.

Two channels through rent seeking and public investment cause the soft budget outcome. First, more rent seeking means a decline in local public goods in period 2 and hence upsets the central government's optimal allocation strategy. Second, more investment means an increase in the tax revenue of the central government and hence may raise the amount of central public goods too much. Then, the central government intends to make additional grants in period 2 in order to raise the ex post social welfare.

A4.2 LG's Behavior: The First Stage

We now investigate the optimizing behavior of LG at the first stage and the resulting sub-game perfect outcome of the soft budget game. The local government's survival constraint (13.A6) is effectively binding here under LG's anticipation that CG changes A in response to local expenditures, as summarized by Eqs. (13.A10.1, 13.A10.2). Namely, the survival condition and the objective function for the local government are rewritten as

$$v(g_1) + \delta v(g(S_2, k)) = \bar{U} \quad (13.A12)$$

$$S = \beta Y_1 + \frac{\beta[Y_1 + f(k)]}{1+r} + \frac{A(S_2, k)}{1+r} - g_1 - \frac{g(S_2, k)}{1+r} - k \quad (13.A13)$$

LG maximizes the objective S , (13.A13), subject to the survival condition, (13.A12), at given levels of tax share parameter β and the reservation utility $\bar{U}$

Therefore, the first order conditions with respect to its choice variables, g_1 , S_2 , and k , are respectively given as follows,

$$-1 + \omega v_{g1} = 0 \quad (13.A14.1)$$

$$-\frac{g_S - A_S}{1+r} + \omega \delta v_{g2} g_S = 0 \quad (13.A14.2)$$

$$-\left(1 + \frac{g_k}{1+r} - \frac{\beta}{1+r} f'(k) - \frac{A_k}{1+r}\right) + \omega \delta v_{g2} g_k = 0 \quad (13.A14.3)$$

where $\omega (>0)$ is the Lagrange multiplier of survival constraint (13.A12). Equations (13.A14.1, 13.A14.2) govern the allocation of g_1 and g_2 at a given level of tax share parameter β , and $\bar{U}$.

Substituting Eqs. (13.A11.1, 13.A11.3) into Eqs. (13.A14.1, 13.A14.2), we have

$$v_{g1} = \delta v_{g2} (1 - \eta) (1 + r) \quad (13.A15.1)$$

Thus, the (first-best) optimality condition between g_1 and g_2 given by Eq. (13.A5.2)

$$\frac{v_{g1}}{v_{g2}} = (1 + r) \delta \quad (13.A5.2)$$

is not realized here at the subgame perfect solution of the soft budget game. This is an important difference between the hard budget and soft budget outcomes. If CG did not make additional grants A as in the hard budget case, the optimizing behavior of LG could have attained this optimality condition (13.A5.2) with respect to the relative allocation of g_1 and g_2 .

When LG takes into account the response functions of CG, (13.A10.1, 13.A10.2), it would effectively reduce the marginal cost of raising g_1 , stimulating g_1 in period 1. Namely, LG would reduce $\hat{g}_2$ (and hence g_2) but raise g_1 to satisfy the survival condition (13.A6). By doing so, LG may increase the present value of rent seeking S by receiving more grants from CG. Equation (13.A15.1) means that g_1 is too high, compared with g_2 and G_2 . The soft budget constraint results in an increase in A , which has a positive effect on g_1 as well as S_2 . It should be noted that the soft budget game actually reduces the equilibrium levels of g_2 and G_2 compared with the hard budget game. In response to the anticipation of more A , LG has an incentive to reduce $\hat{g}_2$, which results in a decrease in g_2 although CG raises A . This is because G_2 and g_2 move in the same direction to meet Eq. (13.A5.1).

In the hard budget case we have shown that Eq. (13.A5.2) is attained but Eq. (13.A5.4) is not attained. On the contrary, in the soft budget case substituting Eqs. (13.A11.2, 13.A11.4) into Eq. (13.A14.3), we have

$$v_{g1} = \delta (1 - \eta) f' v_{g2} \quad (13.A15.2)$$

Considering Eqs. (13.A15.1) and (13.A15.2), we finally get

$$1 + r = f' \quad (13.A5.3)$$

The first best level of k is attained here. Intuition is as follows. When k rises, LG may expect additional grants A from CG resulting from an increase in $(1 - \beta)Y_2$ in addition to an increase in its own tax revenue, βY_2 , so that the effective marginal benefit of an increase in k becomes f' , not $\beta f'$. As shown in Eq. (13.A11.2), the direct effect of an increase in k on A is $(1 - \beta)f' - \eta f'$. In addition, as shown in Eq. (13.A11.4), an increase in k would raise g_2 and it would indirectly benefit LG by alleviating the survival constraint.

This indirect benefit may be expressed as

$$\delta \omega v_{g_2} g_k (1 + r) - g_k = \eta f' + (1 + r) - f'.$$

Thus, the overall beneficial effect through CG's response in the soft budget game is $(1 - \beta)f'$ at $1 + r = f'$, and hence it may internalize the vertical externality. It follows that at the subgame perfect solution k is given by the first best level, k^F , larger than k^* in the hard budget case of $A = 0$. This is an interesting result of the soft budget constraint. CG does not intend to internalize the vertical externality by raising A to LG. Nevertheless, CG's additional grants in response to k effectively internalize the vertical externality.

A5 Welfare Implications

We may think that if the central government imposes soft budget constraints, inefficient too much investment should arise. However, under the vertical externality because of overlapping tax bases, local public investment is too little in the hard budget game. From this viewpoint the soft budget may be welfare improving by stimulating inefficient local investment. Actually, we have shown that the first best level of public investment is attained.

Thus, the natural conjecture is that the soft budget could be welfare improving if public investment is too little in the hard budget game. However, since we incorporate rent seeking activities, the soft budget game is actually welfare deteriorating by depressing useful public goods provided by both the central and local governments. We have shown that the welfare implication of soft budget is not only dependent on the efficiency of local public investment but also dependent on the degree of rent seeking.

Questions

- 13.1 What is the greatest advantage of local governments in intergovernmental finance?
- 13.2 Discuss the plausibility of the Tiebout hypothesis in your country.
- 13.3 Explain an example of the soft budget problem in intergovernmental finance.

References

- Akai, N., & Sato, M. (2005). *Decentralized leadership meets soft budget*. Discussion paper series in University of Tokyo.
- Batina, R. G., & Ihori, T. (2005). *Public goods: Theories and evidence*. Berlin: Springer.
- Besfamille, M., & Lockwood, B. (2004). *Are hard budget constraints for sub-national governments always efficient?* (Warwick Economic Research papers, 717). Coventry: University of Warwick.
- Boadway, R., & Tremblay, J. F. (2005). *A theory of vertical fiscal imbalance*. Queen's University, DP.
- Bucovetsky, S., & Wilson, J. D. (1991). Tax competition with two tax instruments. *Regional Science and Urban Economics*, 21, 333–350.
- DelRossi, A. F., & Inman, R. P. (1999). Changing the price of pork: The impact of local cost sharing on legislators' demands for distributive public goods. *Journal of Public Economics*, 71, 247–273.
- Goodspeed, T. J. (2002). Bailouts in a federalism. *International Tax and Public Finance*, 9, 409–421.
- Hirschman, A. (1970). *Exit, voice, and loyalty*. Cambridge: Harvard University Press.
- Hoyt, W. H. (1991). Competitive jurisdictions, congestion, and the Henry George theorem: When should property be taxed instead of land. *Regional Science and Urban Economics*, 21, 351–370.
- Ihori, T. (2011). Overlapping tax revenue, soft budget, and rent seeking. *International Tax and Public Finance*, 18, 36–55.
- Ihori, T., & Yang, C. C. (2009). Interregional tax competition and intraregional political competition: The optimal provision of public goods under representative democracy. *Journal of Urban Economics*, 66, 210–217.
- Oates, W. E. (1972). *Fiscal federalism*. New York: Harcourt Brace Jovanovich.
- Sinn, H. W. (1997). The selection principle and market failure in systems competition. *Journal of Public Economics*, 66, 247–274.
- Tiebout, C. (1956). A pure theory of local expenditures. *Journal of Political Economy*, 64, 416–424.
- Wildasin, D. E. (1989). Interjurisdictional capital mobility: Fiscal externality and a corrective subsidy. *Journal of Urban Economics*, 25, 193–212.
- Wildasin, D. E. (1997). *Externalities and bail-outs: Hard and soft budget constraints in intergovernmental fiscal relations*. Mimeo: Vanderbilt University.
- Wildasin D. E. (2004). The institutions of federalism: Toward an analytical framework. *National-Tax-Journal*. Part 1, 57(2), 247–72.
- Wilson, J. (1999). Theories of tax competition. *National Tax Journal*, 52, 269–304.
- Zodrow, G. R., & Mieszkowski, P. (1986). Pigou, tiebout, property taxation, and the underprovision of local public goods. *Journal of Urban Economics*, 19, 356–370.

Index

A

Ability-specific lump sum tax, 279
Ability-to-pay principle, 380
Accrual income, 231
Ad valorem tax, 221
Aggregate demand, 3, 21, 23, 24, 29, 30, 32, 41–45, 47, 48, 50, 62–66, 85, 101, 130, 141, 142, 159, 374
Aging Japan, 135, 179, 185–201
AK model, 114–115
Altruism, 87, 88, 92, 98, 99, 122
Altruistic bequest motive, 88, 99, 119, 122, 127, 178
Asymmetric information, 2, 170, 284

B

Balanced-budget multiplier, 33–34, 37
Balanced-budget policy, 34, 140–141
Barro's neutrality, 82–86, 88, 89, 100, 178
Benefit-to-pay principle, 312, 331, 378, 379
Bentham judgment, 268, 269
Bequest motive, 83, 99, 119, 122, 127, 178
Bequests, 82–85, 87, 88, 98–100, 118–127, 141, 175, 178, 192, 244, 249, 271
Biased Keynesian policy, 141
Big government, 331–333
Bohn condition, 151, 152, 167
Budgetary formula, 10–12
Budgetary process, 1, 12–13
Built-in stabilizer, 21, 32, 37, 45, 47–49
Burden of debt, 4, 82, 92, 97–98, 183
Burden of tax, 18, 87, 90, 144, 208, 222–224, 227, 232, 337, 360

C

Central government, 8–10, 14, 21, 45, 186, 187, 190, 225, 303, 318, 358–360, 363–365, 367, 377–388, 392, 394, 395, 397
Centralized system, 364–365, 367
Change of government, 342, 345–348
Clarke tax, 314–316, 326
Classical view, 216–217
Club goods, 296, 367, 368
Cobb-Douglas utility function, 207–208, 214–216, 227, 242, 292, 307
Commitment, 25, 50, 155, 156, 167, 284
Commons, 296
Compensation policy, 144–145
Comprehensive income, 231–232
Compulsory public pension, 172
Constrained maximization, 5–6
Consumer price, 7, 189, 221–223, 234, 240, 241, 251, 252, 254, 255, 257
Consumption function, 29, 31, 34, 57, 62, 67, 74, 89, 128, 224–226
Consumption tax, 24, 32, 194, 197, 198, 221–224, 227, 231, 232, 234, 236, 239, 240, 242–250, 254, 256, 258, 259, 264, 265, 356–357, 380, 381, 386
Convergence theorem, 338, 339
Corlett-Hague rule, 236
Corporate tax, 216–220, 381
Cost-benefit analysis, 133–134
Cost of capital, 60, 217–219, 374
Counter-cyclical fiscal policy, 141, 145, 146
Credibility, 46, 283
Crowding-in, 38–39, 65, 283
Crowding out, 36–37, 40, 64, 65, 139, 283, 318, 349, 351, 354
Current government, 63–67, 347, 348

D

Debt neutrality, 16, 75, 78, 79, 82, 84–90, 92, 97–100, 141, 159, 175, 176, 178, 244
 Decentralized system, 365–367, 390, 392
 Decentralized theorem, 366
 Deficit-covering debt, 139
 Defined-benefit (DB) system, 179–181, 189, 191, 194
 Defined-contribution (DC) system, 179–181, 189, 191, 194
 45-degree model, 29–30
 Degree of optimal redistribution, 277
 Demography, 68, 131, 179, 183, 189, 191, 193
 Depreciation, 39, 42, 44, 92, 219–220
 Differentiated linear tax, 281–282
 Direct crowding out, 37–38, 67
 Discount rate, 108–110, 155, 179, 183, 215
 Domar condition, 151, 167
 Double burden of transition, 181
 Dual approach, 7–8, 236, 237, 252–253
 Dynamic government budget constraint, 150, 153
 Dynamic inconsistency, 46
 Dynamic optimization, 4–5

E

Economic constraint, 282–284
 Educational investment model, 285, 289, 292
 Effective consumption, 66, 67, 69, 72
 Efficacy of fiscal policy, 16, 38, 43–47, 79, 86
 Efficiency of taxation, 208–211
 Elastic good, 235, 239
 Election, 24, 335, 337–341, 343–346, 348, 366
 Endogenous growth model, 113–117, 119–122, 127
 Enlarging the tax base, 242
 Equity, 3, 4, 18, 85, 99, 135, 139, 154, 155, 170, 172, 220, 232, 239, 267, 269, 270, 276, 279, 312, 383
 Equivalence theorem between consumption and labor income taxes, 244, 259
 Evaluation of government spending, 68–70, 347
 Excess burden, 18, 87, 90, 142–144, 154, 209–211, 224, 227, 233–236, 238, 255, 276, 278, 337, 366, 381
 Exchange rate, 21, 39, 41, 42, 44
 Expectation, 12, 22, 31, 32, 37, 38, 65, 82, 89, 93, 132, 166, 170, 179, 191, 192, 196, 197, 200, 224, 257, 270, 271, 283, 342, 343, 345, 346, 372, 397
 Expenditure function, 8, 237, 253, 262, 353, 355
 Expenditure tax, 232, 233, 242

F

Failure of government, 5, 329–331
 Failure of private pension, 171
 First best, 119, 122–123, 125–127, 145, 156, 159, 160, 162, 250, 253–254, 257, 278–279, 298, 299, 350–352, 354, 355, 357, 363, 364, 374, 376, 387, 389–392, 396, 397
 First optimality theorem, 7
 Fiscal bankruptcy, 141, 147–154
 Fiscal consolidation, 13, 16, 18, 22–25, 48, 89–91, 139, 141, 146, 154–167, 347–350, 354, 356, 357
 Fiscal decentralization, 363, 366, 383, 384
 Fiscal discipline, 140
 Fiscal expansion, 32, 48, 63, 65
 Fiscal multiplier, 16, 30–32, 34, 35, 40, 43, 49, 65, 66
 Fiscal policy, v, 4, 29, 53, 79, 101, 140, 177, 337–342
 Fiscal privileges, 154, 155, 166, 167, 349–358, 360, 367
 Fiscal year, 12–14
 Fixed asset tax, 379, 380
 Fixed exchange system, 39–40
 Flexible exchange system, 41, 42
 Free rider problem, 2, 310–316, 326, 349, 364, 366
 Fully funded system, 169, 181–182
 Fundamental equation of dynamic government budget constraint, 150
 Fundamental equation of economic growth, 111
 Future government, 46, 63, 147, 347, 348

G

General account budget, 9, 14
 Generational accounting, 97, 178
 Government budget constraint, 55, 70, 71, 78, 79, 82, 84, 95, 96, 103, 116, 121, 143, 145, 148–150, 153, 159, 160, 209, 237, 241, 251, 252, 254, 260, 274, 286, 318, 332, 349–352, 354, 368, 380
 Government expenditure, 9, 14–15, 48, 69, 70, 72–74, 158, 159, 161, 162, 164, 165

H

Haig-Simons definition, 231
 Hard budget game, 389–393, 396, 397
 Harrod-Domar model, 101–102, 115
 Heterogeneous households, 239, 250
 Human capital, 3, 113, 114, 117–127, 215, 216, 248, 283
 Human capital effect, 215, 216, 248

I

Immiserizing growth, 320, 325–326
 Impact lag, 44
 Implementation lag, 43, 44
 Implicit separability, 257
 Impure public goods, 295–297, 312, 326, 329, 331, 363
 Incidence, 87, 97, 121, 220–224, 227, 245–247, 258, 259, 263, 265
 Income effect, 59, 67, 68, 93, 166, 206–208, 213–216, 224, 227, 245, 264, 265, 289, 304, 308, 323, 326, 331, 333, 374
 Income inequality, 2, 117, 234, 239, 267–268, 272, 273, 277, 281, 283, 310, 324, 331
 Inelastic good, 235
 Inequality and economic growth, 117–118
 Inhabitant tax, 379–380
 Interest group, 24, 50, 135, 154–156, 166, 167, 187, 240, 330, 336–338, 349, 350, 358–360, 367
 Interest tax, 214, 229–234
 Intergenerational conflicts, 182, 185–191, 196, 200
 Intergenerational transfer, 92, 95–99, 118, 123, 124, 126, 169, 173, 177, 178, 184
 Intergovernmental finance, 5, 9, 14, 303, 359, 363–367, 383–385, 387, 397
 Intertemporal substitution effect, 59, 87
 Inverse elasticity proposition, 235–236, 239
 IS curve, 34–36, 40–42, 63
 IS/LM model, 34–37, 39
 Isolation effect, 42

J

Japan's fiscal management, 19–25
 Japan's health care system, 185–186
 Japan's public pension system, 188–189

K

Keynesian 45-degree diagram, 31
 Keynesian effect, 49, 89–91
 Keynesian model, 16, 29–34, 45, 48, 58, 62, 63, 65, 66, 79, 90, 102, 111, 146
 Kuznets hypothesis, 118

L

Labor demand, 60–61, 189
 Labor income tax, 18, 194, 198, 206–210, 227, 229–234, 236, 242–248, 250, 252, 256, 258, 264, 265, 281, 282

Labor supply, 18, 56, 58–60, 62, 94, 101, 114–116, 159, 184, 205–210, 214, 215, 227, 229–230, 232–233, 237, 242–244, 247, 250, 256, 259, 267, 271–276, 278, 284, 289, 292, 388
 Lagrange function, 5, 238, 253
 Legal commitments, 156
 Legal taxpayer, 221, 222
 Leisure, 58, 59, 205, 207, 208, 232, 236, 242, 250, 258, 272, 286
 Liberal Democratic Party (LDP), 24, 358, 360
 Life cycle saving hypothesis, 211–213
 Lindahl equilibrium, 308–311
 Lindahl reaction function, 308, 309
 Linear income tax, 102, 258, 272–274, 278, 279, 281, 284–292, 380
 LM curve, 34–36, 42, 63
 Local allocation tax, 9, 359, 360, 381, 384–386
 Local finance, 9, 363, 381
 Local government, 5, 9, 45, 132, 186, 225, 249, 296, 358, 363, 366
 Local interest group, 47, 358–360
 Local public debt, 9, 383–384
 Local public goods, 296, 350, 351, 365–374, 376, 378, 379, 387, 389–392, 395
 Long-run growth rate, 101–102, 112, 113, 115–117
 Lump sum tax, 46, 92, 95–98, 208–210, 233, 245, 247, 250–254, 256–265, 279, 281, 299, 318, 368, 374, 378

M

Macro IS balance, 159, 163, 166
 Macroeconomic production function, 94, 101, 105, 106, 110, 111, 114
 Majority voting, 331, 333–335, 337
 Marginal productivity of private investment, 103–106, 113
 Marginal productivity of public investment, 103–106, 113, 128, 129
 Marginal propensity to consume, 29, 30, 40, 58, 65, 307
 Marginal propensity to save, 30
 Maximin criterion, 268, 275, 280, 290
 Median voter theorem, 333–334, 338, 341, 360
 Mobile tax base, 364, 371–372
 Modified Ramsey rule, 255–258
 Monetary policy, 21, 22, 24, 39, 41, 42, 44, 45, 153, 157

N

Nash equilibrium approach, 302–308, 311, 319
 Nash reaction function, 304
 National finance, 9, 131
 Neoclassical macroeconomic model, 53, 58, 65
 Neutrality theorem of public goods, 316–326
 Non-excludability, 2, 18, 295, 296, 310
 Non-Keynesian effect, 49, 89–91, 141
 Nonlinear income tax, 258, 274, 278–282
 Non-rivalness, 2, 295, 296

O

Objective of parties, 337–338
 Okun law, 342
 Optimal deficits, 158, 159, 161–167
 Optimal growth model, 113–114
 Optimal marginal tax rate, 270, 276, 279–282, 285, 289, 290, 292
 Optimal provision of local public goods, 367–369
 Optimal provision of public goods, 298–302, 308, 310, 368
 Optimal public investment, 104–110
 Optimal saving, 78, 93, 212, 213
 Optimal size of government spending, 71
 Optimal taxation, 2, 18, 116, 208, 211, 233–240, 250–258, 267, 276–279, 281, 282, 289, 332, 353, 356, 372, 375
 Overlapping generations, 80–81, 88, 91–100, 119–122, 127, 179, 192, 245, 247–248, 250–258, 281
 Overlapping tax base, 377, 392, 397

P

Paradoxical case, 275
 Paradox of voting, 334–335
 Pareto optimality, 6–7, 300, 306, 315, 316
 Pareto optimum, 6, 7, 298, 305, 309–312, 316, 325
 Partisan business cycle, 341–346, 361
 Paternalism, 171–172
 Pay-as-you-go system, 95, 169, 170, 172–177, 179, 181–185, 188, 201
 2004 Pension reform, 179, 181, 191, 200
 Perfect capital market, 42, 70, 86, 109, 178
 Perfect capital movement, 86
 Perfect equality, 3, 270–272, 292
 Permanent disposable income, 57, 58, 63, 65, 66, 79, 82, 91, 99
 Permanent expansion, 63, 65, 66
 Permanent income hypothesis, 57–59, 89

Permanent level of fiscal variables, 53–57
 Person-specific burden ratio, 308, 309
 Phase diagram, 161
 Phillips curve, 341
 Pigouvian tax, 349–358
 Pivotal agent, 314
 Policymaker, 43–47, 320, 337, 341
 Political business cycle, 340–342, 346
 Political effort, 166, 167, 349, 350, 353, 357
 Political party, 18, 337–342
 Politician, 18, 24, 330, 337–341, 358, 366, 367, 388, 390
 Primary balance, 24, 147–150, 152, 158, 196, 197, 200
 Primary deficit, 149–152
 Private Finance Initiative (PFI), 132, 133
 Private provision of public goods, 18, 166, 302, 303, 307, 318, 320, 349
 Privatization, 131, 132, 135, 182–184, 201
 Producer price, 221–223, 234, 235, 240, 252
 Progressive income tax, 3, 18, 49, 239, 267–274, 379, 380
 Public bads, 320–326
 Public debt, 4, 55, 77, 110, 139–140, 247, 340, 383–384
 Public debt and public pension, 176–178
 Public debt issuance, 13, 16, 78, 79, 82, 84, 85, 139–140, 148, 149, 176, 177, 348
 Public goods, 2, 68, 145, 236, 274, 295–297, 329, 363
 Public investment, 1, 37, 101, 139, 159, 358–361, 377
 Public investment management, 49, 50, 130–135, 360–361
 Public pension, 3, 4, 9, 14, 18, 85, 169–187, 189–201, 282
 Public pension reform, 179–182, 194
 Public-Private Partnership (PPP), 132, 133
 Public sector of Japan, 8
 Pure public goods, 2, 295–297, 302, 311, 317, 326, 331, 350, 351, 354, 364, 369, 371

R

Ramsey rule, 18, 234–236, 239, 250, 255–258, 375, 376
 Ramsey-Samuelson rule, 376
 Rate of time preference, 56–58, 69, 108, 109, 113, 165, 213, 226, 249
 Rawls judgment, 268, 269, 275–276
 Recognition lag, 43
 Redistribution, 2–3, 82, 117–118, 141, 170–171, 267, 312, 330, 364

- Regional redistribution, 318, 365, 381–383
 Regressive income tax, 273
 Resource allocation, 1–2, 7, 46, 104, 160, 298, 299, 383
 Revenue-maximizing tax rate, 275, 276
 Ricardian debt neutrality, 75, 79, 97, 176, 178, 244
 Rules vs. discretion, 45–47
 Rural area, 21, 107, 129, 130, 186, 360, 367, 381, 383
- S**
 Samuelson rule, 18, 298–302, 305–307, 310, 369, 374, 376
 Savings elasticity, 224–227
 Second best, 254–258, 353, 374, 376, 378
 Second optimality theorem, 7
 Selfish bequest motive, 88
 Self-selection constraint, 279, 281, 282
 Shift of burden, 80–82, 221–222
 Simulation analysis, 181, 191–201, 247–250, 264, 265
 Simulation result, 193, 196–200, 250
 Small government, 2, 21, 75, 330–331, 333, 347
 Small open economy, 387
 Social indifference curve, 268, 275, 276, 285, 287–292
 Social welfare function, 122, 240, 253, 268–269, 275, 280, 281, 284, 285, 287–290
 Soft budget game, 387, 389, 393–397
 Soft budget problem, 377–378, 380, 381, 397
 Solow model, 110–111
 Solvency condition, 70
 Stabilization, 3–4, 21, 22, 32, 45, 47, 48, 50, 140–142, 144, 157, 158, 380
 Stigma, 284
 Streetlight game, 313, 314
 Substitutability between private consumption and public spending, 66
 Substitution effect, 18, 59, 67, 87, 93, 207, 208, 210–211, 213–216, 224, 234–236, 238, 248, 256, 259, 278
 Sustainability of fiscal management, 150, 341
- T**
 Tax competition, 364, 371–377, 387
 Tax possibility curve, 274–275, 292
 Tax possibility frontier (TPF), 285–287, 289–292
 Tax postponement effect, 259–263
 Tax rate, 24, 87, 102, 142, 194, 206, 229, 270, 331, 372
 Tax reform, v, 2, 13, 18, 220, 241, 263, 278, 280
 Tax revenue, 2, 31, 55, 78, 103, 139, 142, 144, 147–150, 153, 190, 208, 230, 274, 316, 332, 368
 Tax smoothing hypothesis, 87, 142–144
 Tax timing effect, 247, 256, 259, 261–264
 Temporary expansion, 63–64, 67
 Theory of public choice, 329–330
 Tiebout model, 370
 Time consistency, 339, 375–377
 Timing, 43, 87, 141, 245–248, 256, 259, 261–265, 271, 341
- U**
 Uniform tax rate proposition, 236, 239
 Unifying tax rates, 242
 Urban area, 21, 107, 129, 358, 381, 383
 Utilitarian criterion, 268, 276
- V**
 Voting model, 18, 330–337
 Voting with feet, 366, 369–371
- W**
 Wage elasticity of labor supply, 211
 Wealth effect, 71, 79, 81, 85
 Winning probability, 346
- Z**
 Zero capital movement, 42
 Zero crowding out, 36–37
 Zero-tax nation, 146