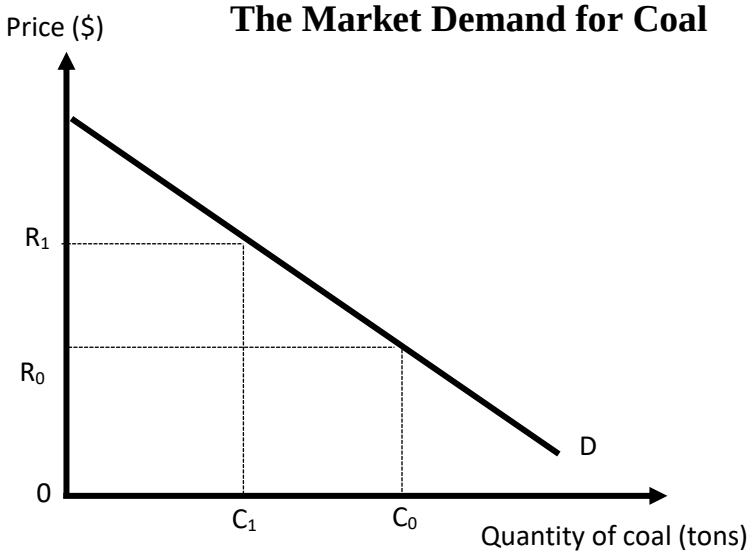
Summary No.5

Market Signals of Natural Resource Scarcity

The Demand for a Factor of Production: The Case of Natural Resources

The market demand for a factor of production shows the maximum prices producers are willing to pay for various levels of the resource available in the market at a point in time. If the amount of coal available in the market at a point in time is C_1, r_1 indicates the maximum price producers will be willing to pay. Similarly, if what is available in the market is increased to C_0, the price that producers are willing to pay falls to r_0. This inverse relationship between the price of coal and the quantity demanded clearly suggests that the demand curve for a factor of production is negatively sloped. As more and more of a given resource (coal, petroleum, natural gas, nuclear, solar, geothermal, etc.) is used, according to the law of diminishing marginal product, the marginal contribution of the resource in terms of output declines.

The Market Demand for Coal



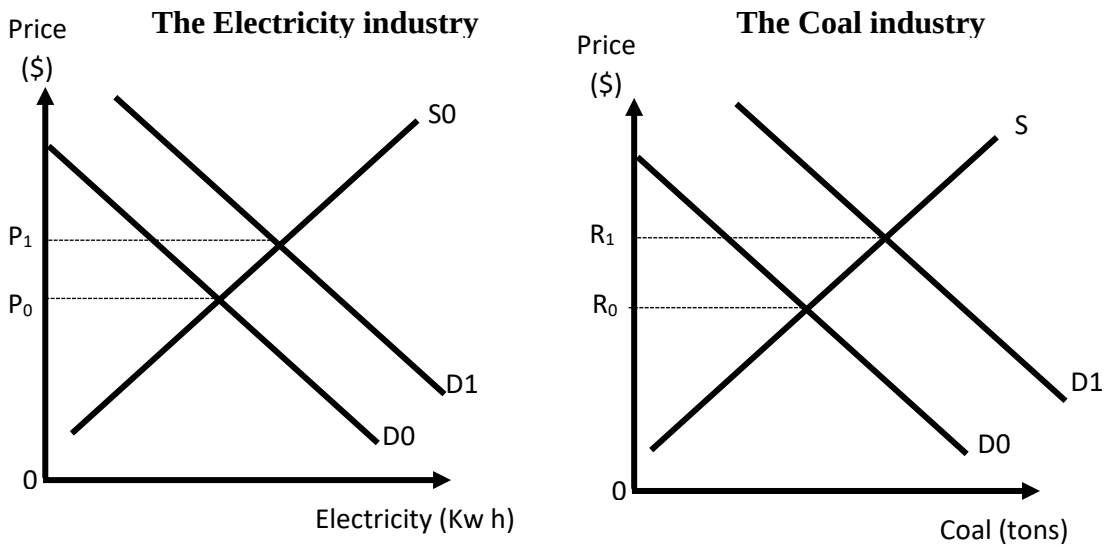
Suppose coal is used to produce electricity. According to the law of diminishing marginal productivity, as more coal is used to produce electricity, the marginal contribution of coal in terms of kilowatt-hours of electricity produced will tend to decline. For this reason, other things being equal, producers will be willing to buy more of a resource (such as coal) if, and only if, its price is lowered to compensate for the decline in the productivity of the resource at the margin.

Note here that, unlike the market demand for a product, it is productivity, not utility, that determines the demand (value) for a factor of production.

Another significant difference between the demand for a product and the demand for a factor of production is the fact that the demand for a factor of production is viewed as a derived demand. That is, the demand for any factor of production is determined by the consumer demand for the goods and services that are produced using the resources under consideration.

This makes the price of the final good one of the most important factors in determining the demand for (or value of) factors of production. For example, if the primary use of coal is to generate electricity (the final product), other things being equal the demand for, and hence the price of, coal depends on the demand (price) for electricity. In general, the higher the price of electricity, the higher the demand (price) for coal will be.

Suppose now, as shown in the following figure, the demand for electricity is increased to D1 as a result of an increase in consumer income.



In this situation, the new equilibrium price for electricity will be P_1. If other things are equal, this increase in the price of electricity will cause a shift in the demand for coal from D_0 to D_1. Thus, the increase in price of electricity ultimately resulted in an increase in the price of coal from r_0 to r_1.

In addition to product price and productivity, there are two other important factors that affect the demand for a factor of production: the prices of other factors of production, and technology. The effect of a change in either one of these two factors is manifested by a shift in the demand curve. For example, if capital and coal are considered as substitutes (this would be the case if, say, the use of more capital reduced the energy required to produce a unit of electricity), then a decrease in the price of capital will cause a downward shift in the demand curve for coal. Other things being equal, this will result in a decline in the price for coal.

In general, therefore, decreases in the price of a factor of production that is a substitute for coal cause a reduction in the demand for, and hence the price of, coal.

A technological change affects the demand for a factor of production in several ways. One way is through its direct effect on the productivity of the

resource under consideration. For example, a technological change could enhance the productivity of coal in the production of electricity (i.e., less coal would be needed to produce a unit of electricity). This would be the case if, for example, a new chemical additive to coal were to contribute significantly to the efficient combustion (or oxidation) of coal in the production process of electricity. Other things being equal, the effect of this would be to increase the demand for, and hence the price of, coal.

Another way technological change could affect the demand for a factor of production is by enhancing the productivity of substitutes. For example, if a new technology enhanced the relative productivity of natural gas (i.e., relative to coal) in the production of electricity, other things being equal this could cause a decline in the demand for, and price of, coal. Thus, in this case the demand for coal is affected by a technological advance in the use of natural gas, which is a substitute for coal.

For this reason, factor substitution possibilities—the degree to which a factor of production can be substituted by another input—are an important element in the analysis of a resource market.

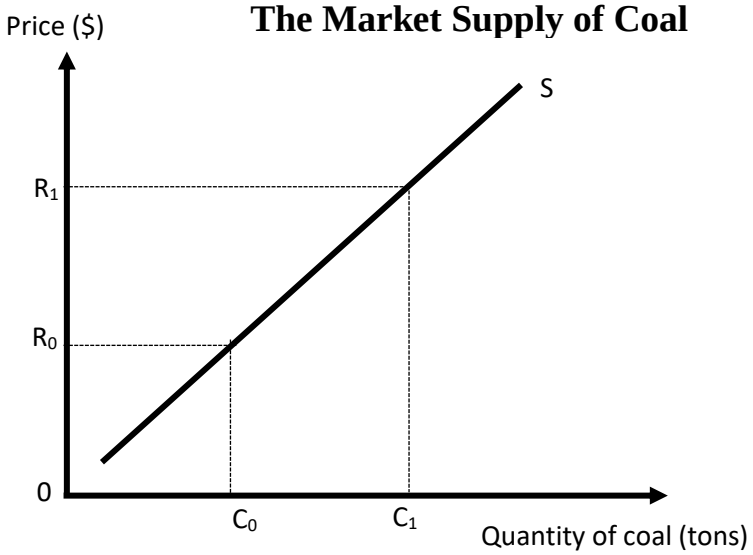
Key Variables Affecting the Supply of a Factor of Production: The Case of Natural Resources

In a market-oriented economy, as discussed in the circular flow, factors of production are assumed to be owned by households (consumers). Households use factors of production as means of generating income. This income is ultimately used to purchase final goods and services. Other things being equal, since more income means more final goods and services, it is in the best interest of households to get the highest possible price for the resources they own at a point in time. However, the price that resource owners

ultimately receive depends on both the demand for and the supply of the resource under consideration.

But, what are the key variables affecting the supply? for a factor of production, such as coal. The supply curve for a factor of production, such as in the following figure, shows all possible minimum prices owners of coal mines are willing to accept for various amounts of coal offered in the market at a specified point in time. For example, to provide amount C_1 of coal in the market, owners of coal would require a minimum price of r_1. To the extent that the supply curve is assumed to be positively sloped, the minimum price that producers are willing to accept increases with an increase in quantity of coal supplied to the market.

The Market Supply of Coal



What justification can be offered to make this generalization valid? In pricing coal, owners of coal mines need to cover the costs of extraction and transportation. It is for this reason that the minimum price owners of mines would require in order for them to sell a unit of coal should correspond to the cost of extracting and transporting that unit of coal. If we assume that transportation cost is negligible, a positively sloped supply curve for coal

therefore implies that the extraction cost for coal is increasing. What could explain this?

One possible explanation for an increasing extraction cost of coal or any other extractive resource is that such resources are not uniformly distributed, spatially and/or in terms of quality or grade of ore. The conventional explanation is that in a given mine, the high-grade coal is found first. Gradually, the grade tends to decline as extraction continues. Since the lower-grade coal requires further processing, other things being equal this will cause the cost of extraction to increase. Thus, the rise in extraction cost has more to do with the limits imposed by nature than anything else.

So, what are the key factors affecting the supply of a natural resource, such as coal? In accordance with the neoclassical economic school, the factors affecting the supply of a natural resource can be divided into two broad categories—one pertaining to nature, and the other pertaining to technology. Nature plays a role in determining the availability of natural resources. As, nature puts an upper limit on the reproductive (regenerative) capacity of a particular resource. Furthermore, the supply of certain resources is finite, given that the regenerative capacity of some natural resources (such as coal) is limited. Thus, by imposing upper limits to the supply of a particular natural resource, the possibility of eventually exhausting a particular natural resource is real.

As opposing view, number of economists believe that nature has only a minor role to play in determining the supply of natural resources. According to that view, the key factor that determines the supply of natural resources is technology.

Technology affects the supply of natural resources in a variety of ways. First, the supply of a natural resource could be enhanced through a

technological improvement in the methods of resource extraction. An example of this would be the possibility of extracting a higher proportion of the useful minerals from a given rock containing some known concentration of ore. Second, the supply of a natural resource could be augmented by means of conservation through technological improvements. For example, the supply of coal could be effectively increased by means of energy-saving technology. Third, the supply of a natural resource will be affected whenever, by means of technological innovation, it is possible to find a substitute resource. For example, the supply of energy would be enhanced by a technology that significantly improved the economic feasibility of solar energy for direct use in both the residential and the industrial sectors.