Chapter 8

Natural Resources: Types, Classification and Scarcity

The term 'resources' covers a multitude of meanings and it is necessary to be very precise about its use in what follows. We also discuss various measures of resource scarcity, introducing some which will be important in Chapters 9 to 11.

8.1 Natural resource types and classification

In Chapter 1, a distinction was made between 'material' and 'energy' resources. This distinction relates to the conventional end-uses of these resources, in that material (or mineral) resources are utilised as part of the physical constituency of commodities (iron ore, converted into steel, in car bodies; aluminium in saucepans; copper in pipes; and cobalt in jet engines). (A mineral is defined as a solid crystalline chemical element or compound in fixed composition. A mineroid is a mineral which occurs in non-solid form. Rocks are aggregates of one or more minerals. A mineral deposit is an accumulation of a specific mineral.) Energy resources, on the other hand, are converted into heat and other forms of energy. Thus the chemical energy in natural gas is converted into heat energy when gas is burnt in domestic central heating boilers. Clearly, some resources are used both as material and as energy sources; oil is the prime example here, being used for propulsion in internal combustion engines and to make plastics. Conversion of material resources into useable forms also requires inputs of energy resources (for smelting and for mining). Material resources may be further divided into metallic and non-metallic materials, the latter including soils, water and sand. There are some 88 minerals occurring on earth. Of these, only 12 make up 99 per cent of the earth's crust: the most common of these are silicon (27 per cent), aluminium (8 per cent) and iron (6 per cent).

One obvious distinction between resource types is in terms of their potential for natural growth. Clearly a forest, which may be used as both a material and an energy resource, is different to a deposit of iron ore, in that the former exhibits a natural rate of growth, whilst the latter does not. It is usual, then, to distinguish between 'renewable' and 'non-renewable' resources, with the former classification reserved for those resources exhibiting a positive natural rate of growth. This is a clearer distinction than the classification into 'exhaustible' and 'non-exhaustible' resources, since even a renewable resource can be exhausted (by continuing to harvest in excess of the natural rate of growth, for example), and a non-renewable resource may not be exhausted if it becomes uneconomic to extract the last reserves.

8.2 Measuring resource scarcity

8.2.1 *Some basics*

One of the most common questions in debates over the use of natural resources is 'are we running out of resources?' Clearly, for any non-renewable resource (in this sub-section, we concentrate on non-renewable resources), a positive rate of extraction means that the physical stock of the resource is reduced in size. However, (1) there are major problems in defining what this physical stock should represent; (2) the economic measure of the size of the reserve of this material is not the same as the physical size of the reserves; (3) the value of the economic reserve will change over time; and (4) there are alternative measures for the *scarcity* of this economic reserve, which may well give different answers to the above question.

To anticipate some of this discussion, consider Figure 8.1, which is adapted from Zwartendyk (1973). The two axes show the influence of physical and economic parameters. As the ratio of the price of the resource to its marginal extraction cost falls, then clearly extracting the resource today becomes less attractive: the term 'economic reserves' is often used to describe that portion of a deposit (or collection of deposits) which it is profitable to extract, given current prices and costs. Costs, as will be seen in Chapter 9, depend partly on the state of technology, and on cumulative extraction: clearly these costs will be changing over time. Prices will also change, in response to the decisions of extractors over extraction rates (which might depend, for example, on the agreement reached by a cartel of producers, such as OPEC), demand for the material and government intervention on prices (the setting of price ceilings and floors). Thus the dashed horizontal line in Figure 8.1 will move up and down over time,