Chapter 4  
Economies of Scale with Intertemporal Links

The last chapter served the function to show that temporal interdependence of costs or of demand are necessary, if economies of scale should lead to a distortion in the allocation of resources, which could be called barriers to entry. Indeed, the concept of an incumbent firm as opposed to an entering firm only begins to make sense, if there are factors which make it relevant for today, whether or not a firm was a supplier yesterday. But this can only be the case, if costs or demand are intertemporally related. The standard assumption used in the economic literature to distinguish incumbent and (potential) entrant is the assumption of nonzero sunk costs. It means that expenditures required for the supply of output in preceding periods lead to lower expenditures for the supply of output in this period.

It is well understood by the economists working in this field that this assumption of sunk costs is not equivalent to the assumption that capital is required for the production. If capital consists simply of machinery which does not have, after being used in this industry, a comparative advantage of being further used in this industry, it is not a sunk cost. It can be sold to be used in any other industry without loss. This implies that any entrant into the industry can hire or purchase this fungible equipment on the open market and thereby put himself into the same position as any incumbent. The latter does not reap any benefit from having used his equipment before. To use a term, which is much en vogue these days, capital intensity of production is not equivalent to intertemporal "economies of scope" in the supply of an industry. Only if the latter prevail and hence the joint supply over several periods offers cost advantages over the separate supply in different periods does the distinction between incumbent and entrant matter.

In this chapter I do not present a complete theory of intertemporal economies of scope in combination with economies of scale as a basis of market structure analysis. Such a reasonably complete theory does not yet exist, and it clearly is not an easy task to develop it. It probably would in itself require a book's length of theoretical work. Here, I try to show that the traditional view of economies of scale as entry barriers - even granted the phenomenon of sunk costs - is not satisfactory. In doing so, I want to emphasize the importance of industry growth for the analysis of barriers to entry. All analytical re-
suits are derived by means of a fairly simple model of an industry with a homogeneous product. (The following model and its analysis are adopted from section 2 of an article of mine published in the Autumn-issue of the Bell Journal of Economics (von Weizsäcker (1980)). I assume that the demand function for the homogeneous product of the industry is constant through time and is given by

\[ x = A - p \]

where \( x \) is demand, \( p \) is price, and \( A \) is a constant. The cost structure for each supplier in the industry can be characterized by the following cost function

\[ C = k + az + \frac{1}{2} bz^2 \]

where \( z \) is the individual supplier's output and \( k, a, b \) are nonnegative constants. The average cost minimizing level of output, as the reader can easily verify, is given by

\[ z = \sqrt{\frac{2k}{b}} \]

The minimum average cost is

\[ \frac{C}{z} = a + \sqrt{2kb} \]

An optimum finite firm size, which is implied by a positive \( b \), can be explained along the lines of the rising administrative costs of coordinating more and more people. This is the theory of optimum firm size as developed by E.A.G. Robinson (1931) and applied to explain firm growth by E. Penrose (1959). Modern management techniques, including the decentralising of decisions within the firm, have obvious implications for the optimum firm size and thus the analysis of market structure. On this theme see Chandler's (1977) historical account and Williamson's (1975a) transaction cost based analysis. For me it is important to realize that the modern industrial organization literature implicitly or explicitly assumes that firms beyond the optimum size do not suffer great cost disadvantages. Marris and Mueller (1980) in their recent survey draw this conclusion. Since large firms can make use of the advantages of decentralization within the firm, this hypothesis is plausible.