The Microeconomic Effects of Innovation

There are two main types of innovation:

- *process innovation*, the introduction of new techniques for production,
- *product innovation*, the offer for sale of a new type or design of a good or service product.

These two are not always independent: often it is the introduction of a new process that permits the design and development of a range of new products, while the introduction of a new intermediate product permits a purchasing firm to change its production process.

For the moment, let us consider the different nature of the two kinds of innovation to examine how they impact on prices and costs.

Their impact will, in turn, depend on the "market structure" in which the firm operates. Market structure refers to the nature of competition between the firms in the market. The two polar cases are "perfect competition," where there are a larger number of firms, and monopoly, where one firm dominates the market.


Process Innovation

PROCESS INNOVATION

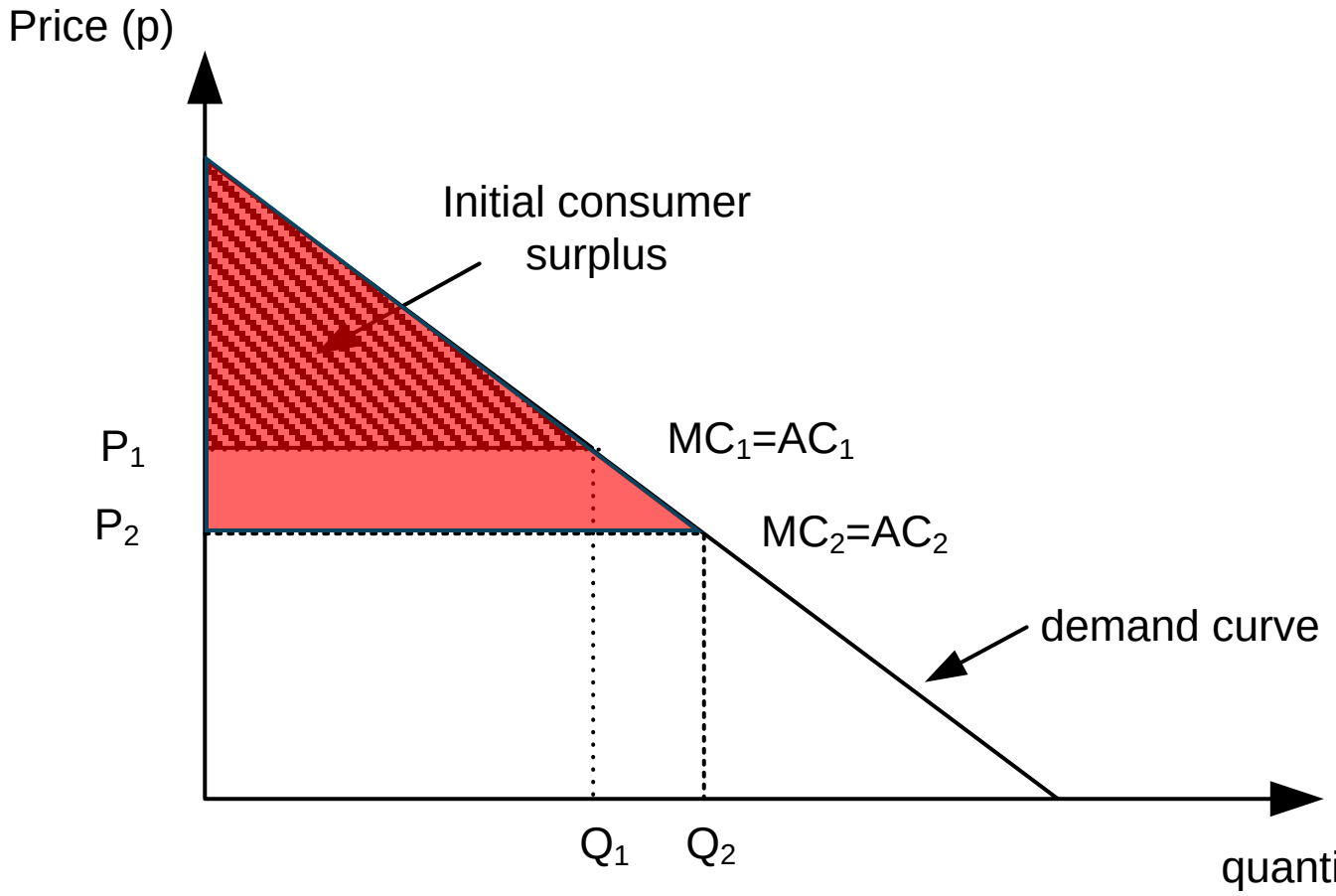
A pure process innovation simply **changes the way in which a product is made**, without changing the product itself (**except** perhaps **the price** at which it will be sold).

In practice, many process innovations are not ‘pure’ in this way.

Often a new and improved process will lead to incidental improvements in the product.

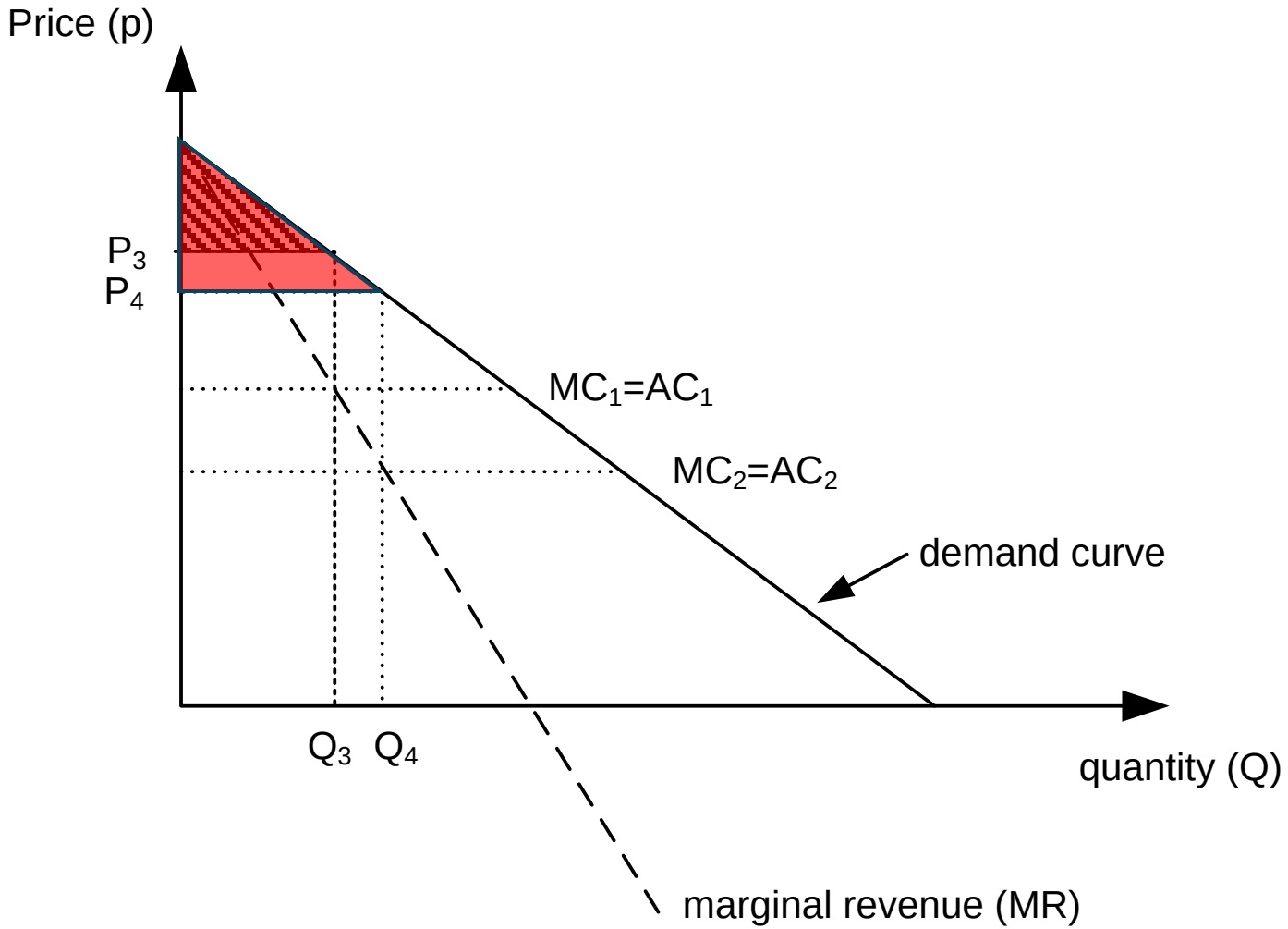
Nevertheless, it is helpful to understand the simple economics of the ‘pure’ process innovation.

Process innovation in perfectly competitive market



The essential effect is one of cost reduction in production. In economics, total costs are divided into fixed and variable costs and, in turn, we can define average costs (ACs) and marginal costs (MCs). Figure 1 shows a simple case where, before the innovation, firms have costs AC1 and MC1, which are equal, so we assume that there are no fixed costs

Process innovation for a monopoly



Perfect competition is unlikely to occur in many industries so economists are interested in studying the other extreme form of market structure: monopoly. Assuming there is a permanent monopoly supplier with the demand and initial cost conditions specified, would it have any incentive to make a process innovation? Figure shows the same demand curve and initial costs as in figure 1 **but in the case of a monopolist it will maximize profit by producing where marginal revenue (MR) is equal to MC1**.

Fixed Cost vs. Variable Cost

A **fixed cost** is a cost that remains constant; it does not change with the output level of goods and services. It is an operating expense of a business, but it is independent of business activity.

- An example of fixed cost is a rent payment. If a company pays $5,000 in rent per month, it remains the same even if there is no output for the month.

A **variable cost** is dependent on the production output level of goods and services. Unlike a fixed cost, a variable cost is always fluctuating. This cost rises as the production output level rises and decreases as the production output level decreases.

- For example, say a company owns a manufacturing plant and produces toys. The electricity bill varies as the production output level of toys varies. If no toys are produced, the company spends less on the electricity bill. If the production output of toys increases, the cost of electricity increases.

Marginal Cost of Production

The marginal cost of production is an economics concept as a means of isolating an optimum production level.

Manufacturers often examine the cost of **adding one more unit to their production** schedules.

At a certain level of production, the benefit of producing one additional unit and generating revenue from that item will bring the overall cost of producing the product line down. The key to optimizing manufacturing costs is to find that point or level as quickly as possible.

Marginal cost of production includes all of the costs that vary with that level of production.

- For example, if a company needs to build an entirely new factory in order to produce more goods, the cost of building the factory is a marginal cost. The amount of marginal cost varies according to the volume of the goods being produced.

How Do Fixed and Variable Costs Affect the Marginal Cost of Production?

The total cost of a business is composed of fixed costs and variable costs.

Fixed costs and variable costs affect the marginal cost of production only if variable costs exist.

The marginal cost of production is calculated by dividing the change in the total cost by a one-unit change in the production output level.

The calculation determines the cost of production for one more unit of the good. It is useful in measuring the point at which a business can achieve economies of scale.

PROCESS INNOVATIONS AND COST CONDITIONS

A very simple way of representing the economic effects of a process innovation is to show what it does to production costs, as described by the cost curves --> the total, average and marginal cost curves.

We shall consider four different types of process innovation and their associated effects on cost curves. These are:

1. A reduction in fixed costs, with no change in marginal costs
2. A reduction in marginal costs, with no change in fixed costs
3. A reduction in marginal costs accompanied by an increase in fixed costs
4. A reduction in the marginal cost of an additional model.

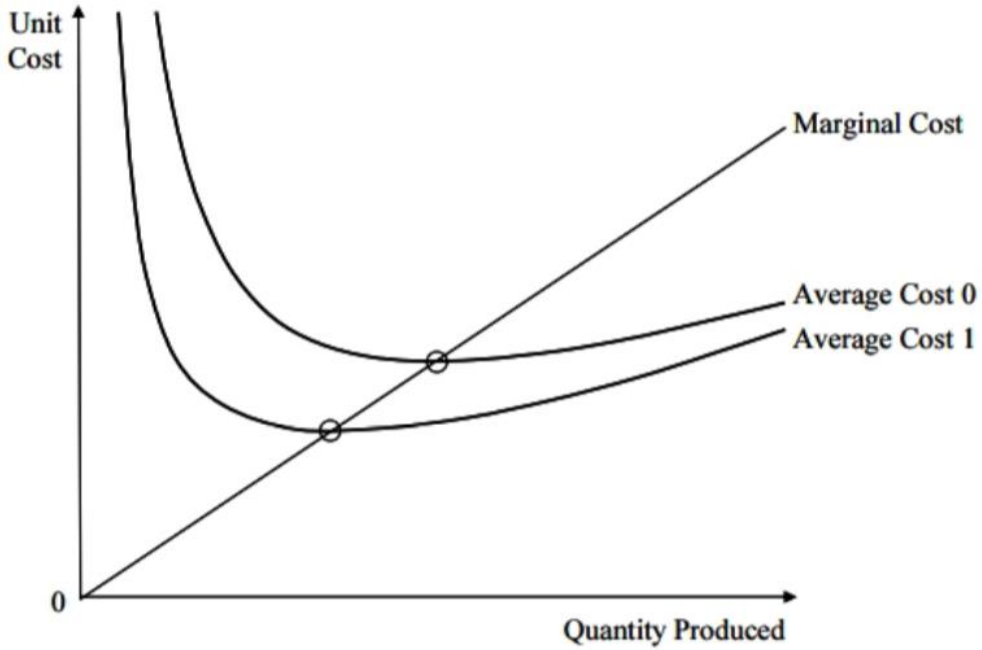
1) PROCESS INNOVATIONS AND COST CONDITIONS:
A reduction in fixed costs, with no change in marginal costs

It is a basic capital-saving innovation. This could be a reduction in the cost of an essential piece of capital equipment (e.g. a computer).
This innovation reduces economies of scale, and allows the small scale company a better chance to enter and survive in the market.

1) Reduced Fixed Cost

The first type of process innovation is the one where the fixed costs of production are reduced. For simplicity we shall focus on the case where marginal costs are unchanged.

Figure shows how this reduction in fixed costs affects average cost. The upper curve (labelled Average Cost 0) shows the picture before innovation. The lower curve (labelled Average Cost 1) shows the picture after innovation.



Process innovation that reduces fixed costs

We see that the average cost curve is pushed downwards, particularly at lower levels of production. Since we know that marginal cost always cuts the average cost curve from below at minimum average cost, we can say that this process innovation reduces the minimum efficient scale and hence reduces economies of scale.

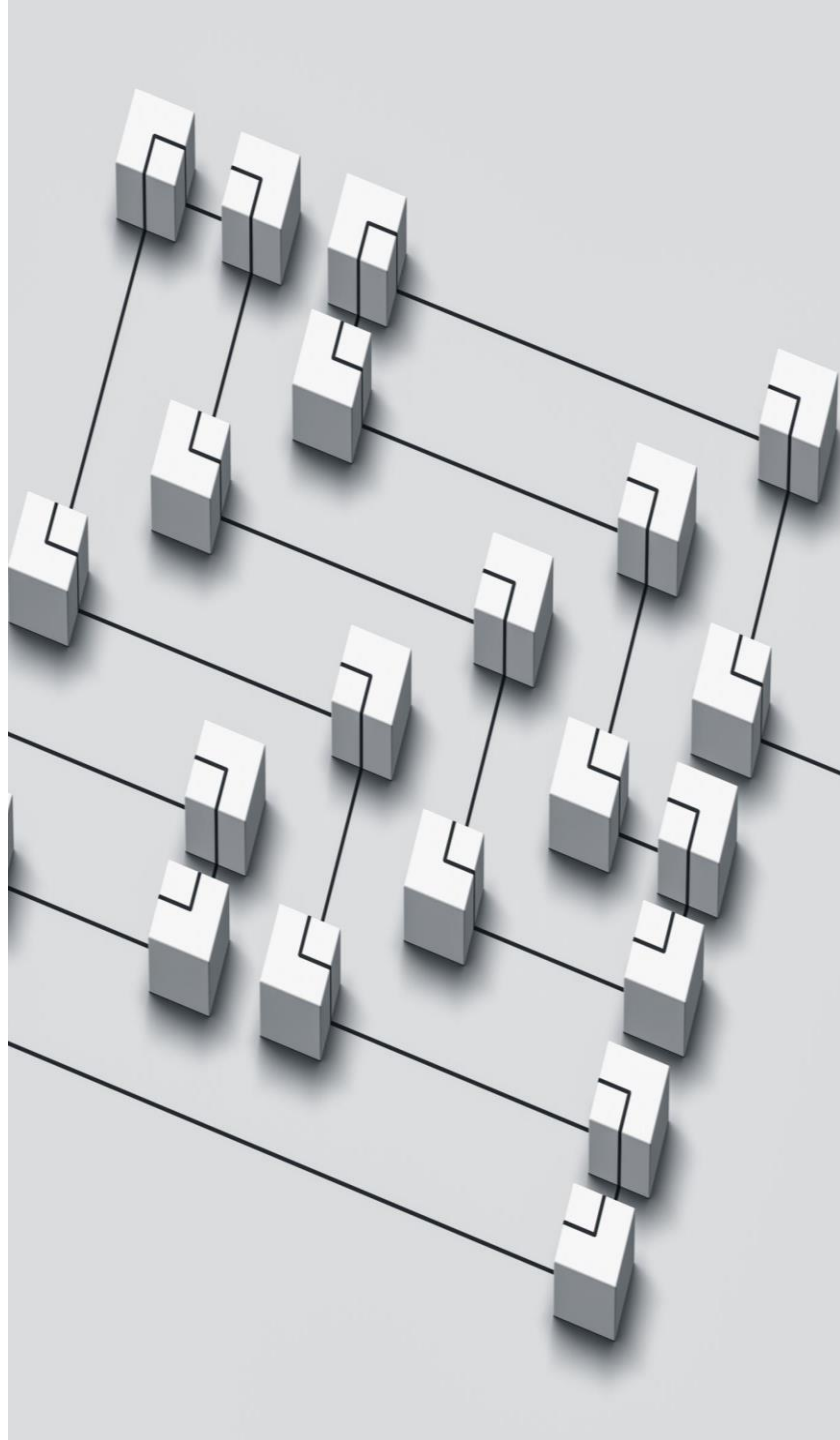
2) PROCESS INNOVATIONS AND COST CONDITIONS: A reduction in marginal costs, with no change in fixed costs

It is a basic input-saving innovation.

This could be a reduction in the use of raw material inputs or an increase in the efficiency with which raw material inputs are turned into final products.

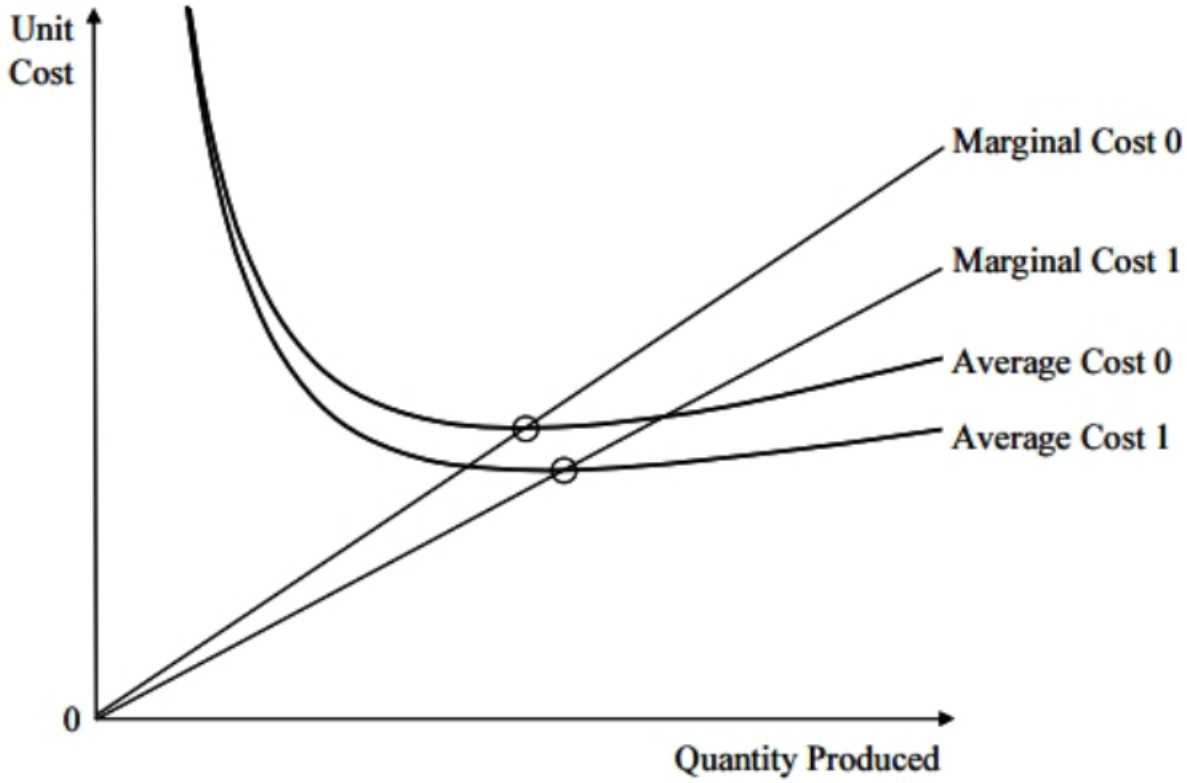
Both of these would mean that input costs constitute a smaller share of average cost, and therefore apportioned fixed costs constitute a greater share of average cost.

This means, as will become clearer, that economies of scale are increased.



2) Reduced Marginal Cost

This is an innovation that reduces marginal costs while leaving fixed costs unchanged. Figure shows how this reduction in marginal costs affects average cost. The upper curve (labelled Average Cost 0) and upper line (labelled Marginal Cost 0) show the picture before innovation. The lower curve (labelled Average Cost 1) and lower line (labelled Marginal Cost 1) show the picture after innovation.

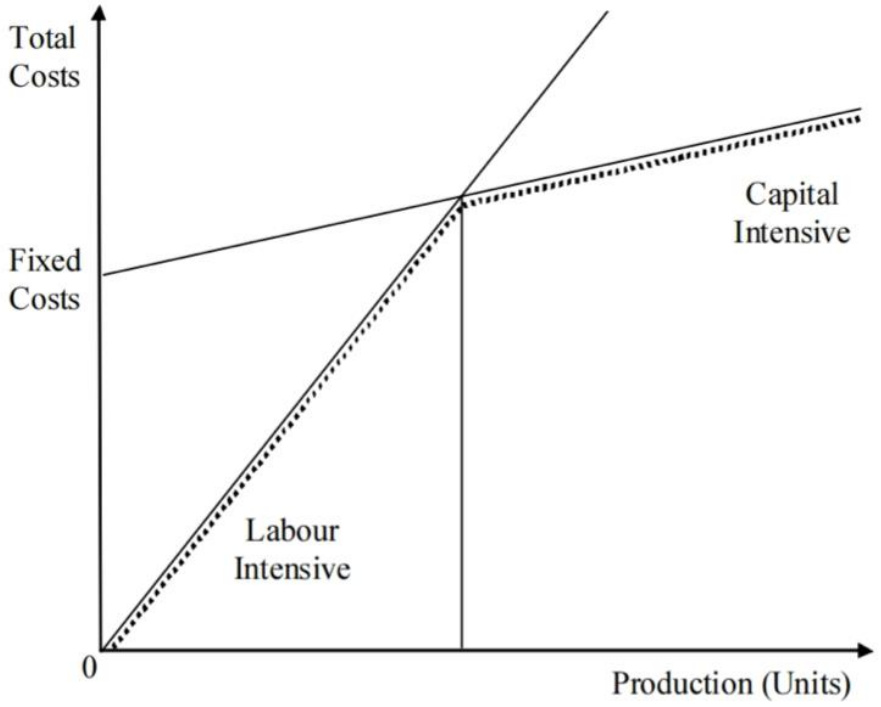


We see that the average cost curve is pushed downwards, particularly at higher levels of production. Since we know that marginal cost always cuts the average cost curve from below at minimum average cost, we can say that this process innovation increases the minimum efficient scale and hence increases economies of scale.

3) PROCESS INNOVATIONS AND COST CONDITIONS: A reduction in marginal costs accompanied by an increase in fixed costs

It is a typical characteristic of many process innovations where a labour-intensive process is replaced by a capital-intensive process. Fixed costs increase but marginal costs fall.

These effects, taken together, provide an important source of increased economies of scale.



3) Capital-intensive Process: Reduced Marginal Cost, Increased Fixed Cost

- One quite common sort of process innovation will reduce marginal costs while increasing fixed costs. Examples of such innovations include the replacement of a labour-intensive production process with a more capital-intensive form of production.
- The labour-intensive process has a low intercept (zero fixed costs) and a steep slope (high marginal cost). The capital-intensive process has a high intercept (high fixed costs) and a shallow slope (low marginal cost). At a low scale of production, the labour-intensive process can produce the required scale of output at lower cost. At a high scale of production, the capital-intensive process can produce the required scale of output at lower cost. The boundary between these two is marked by a vertical line in Figure. To the left of that, labour-intensive is best; to the right, capital-intensive is best.

The labour-intensive process, as drawn, has constant returns to scale. As the total cost line is a straight line, total costs are proportional to the scale of production and hence average cost is a constant. The capital-intensive process, when it is efficient to use it, introduces economies of scale and hence average cost starts to fall.

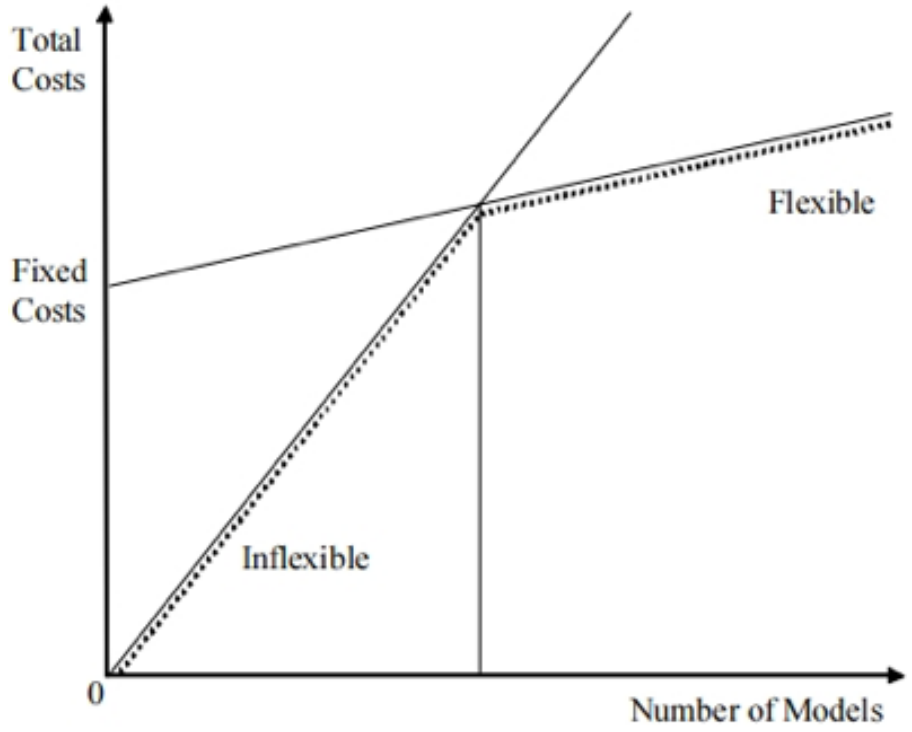
4) PROCESS INNOVATIONS AND COST CONDITIONS: A reduction in the marginal cost of an additional model.

It is an innovation that generates economies of scope rather than economies of scale.

It describes an innovation that reduces the marginal costs of producing additional variety of output.

4) Flexible Manufacturing: Reduced Marginal Cost, Increased Fixed Cost

- The flexible manufacturing system increases economies of scope. It does this by reducing the marginal cost of output variability – that is, the marginal cost of allowing one additional brand or model.
- The figure illustrates this. It is based on the following assumptions. The vertical axis represents the total costs of producing a given number of products (say *N*). The horizontal axis represents the number of different varieties (or models) amongst those *N* products.
- At the left end of the horizontal axis, all the *N* products are the same.
- As we move to the right, the variety of products amongst the *N* increases.

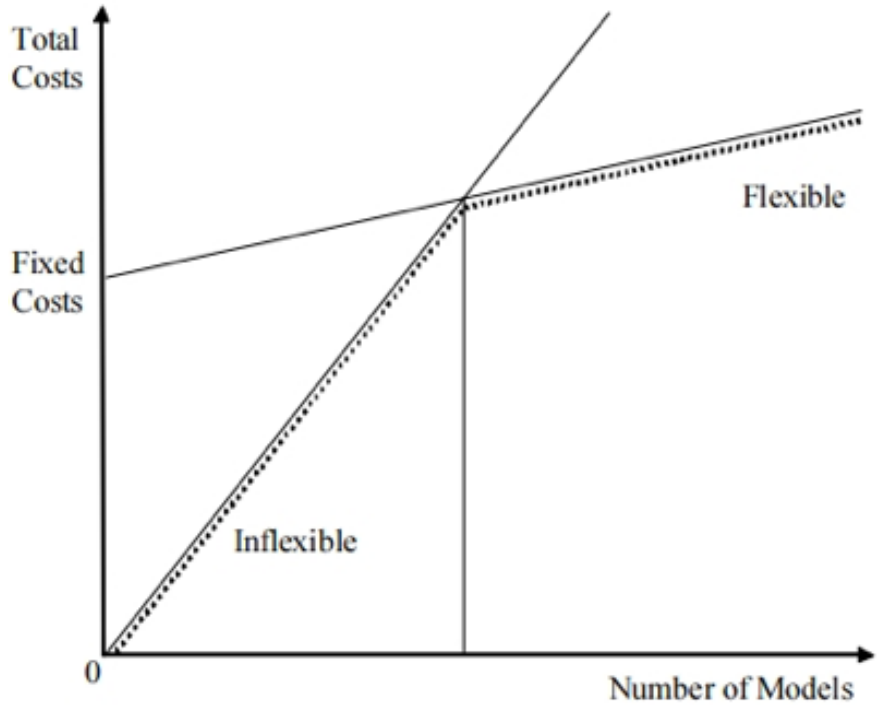


Process innovation that increases production flexibility

4) Flexible Manufacturing: Reduced Marginal Cost, Increased Fixed Cost

- The inflexible production technology enjoys lower fixed costs but a higher marginal cost per brand or model. The corresponding cost line has a lower intercept but a steeper slope.
- By contrast, the flexible production technology has a higher fixed cost but enjoys a lower marginal cost per brand or model. The corresponding cost line has a higher intercept but a flatter slope.

When little variety is required, the inflexible process is the more efficient. When much variety is required, the flexible process is preferred.



Process innovation that increases production flexibility

Example: the introduction of new process

Suppose that innovations in textile industry lower the cost of producing T-shirt.

Assume that at t_1 the price of T-shirt was 50€ and quantity 100 is determined by the forces of demand and supply.

The market structure is monopolistic.

Graph the market for T-shirt initially, and then illustrate the effects of the technological innovation. Which is the price and the quantity at $t_{2?}$

Solution exercise 1