Product innovation

Product innovation

A pure product innovation creates a new or improved product for sale without any change in the production process – except that more inputs (labour, machine time and materials) may be required.

- In practice, a new product will often require some innovations in the production process, just as a new and improved process often leads to incidental improvements in the product.

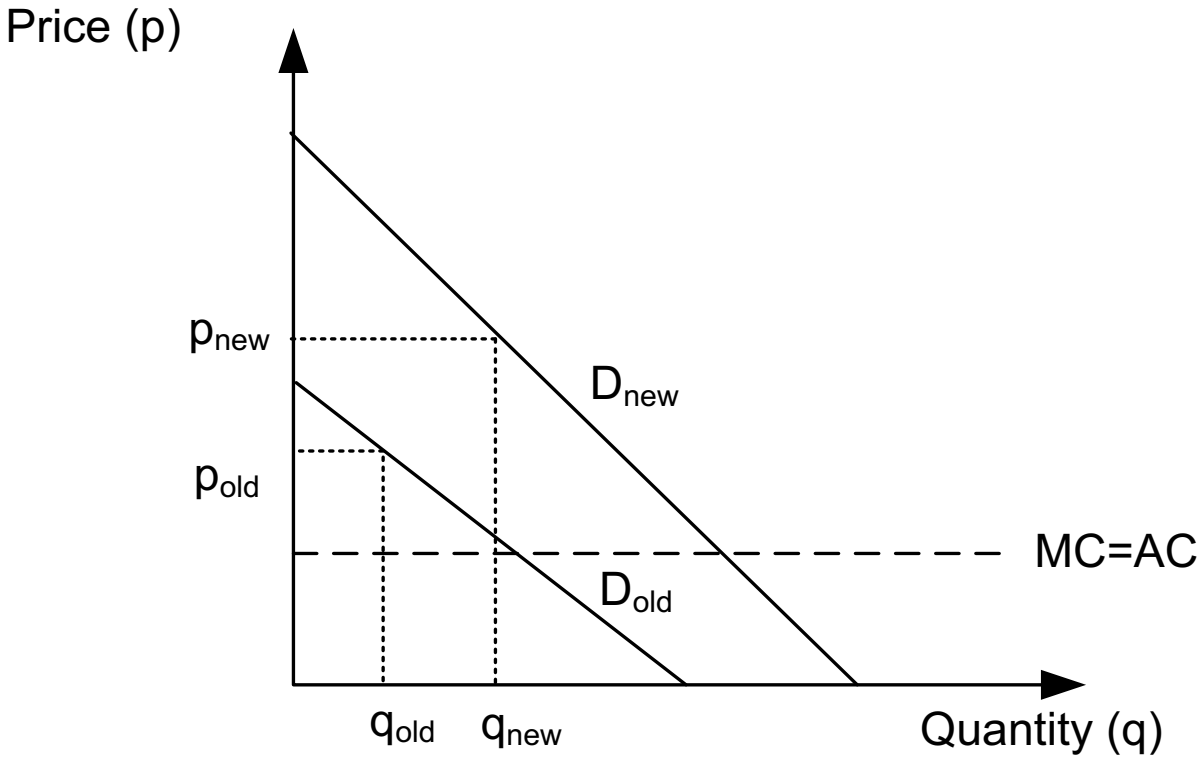
Nevertheless, the conceptual distinction is an important one.

The development of a new product

The successful development of a new product results in a different configuration of changes in costs and rewards.

- In a perfectly competitive market, and in the absence of IPRs over the new product (i.e., we assume that any product innovation can be immediately copied), there is no gain to the innovator. This case of immediate imitation by all other firms in the market is very unlikely.
- More realistically, the innovator uses some form of IPR or, failing this, relies on secrecy or first-mover advantages to delay imitation .

A product innovation represented by a shift in existing demand curve

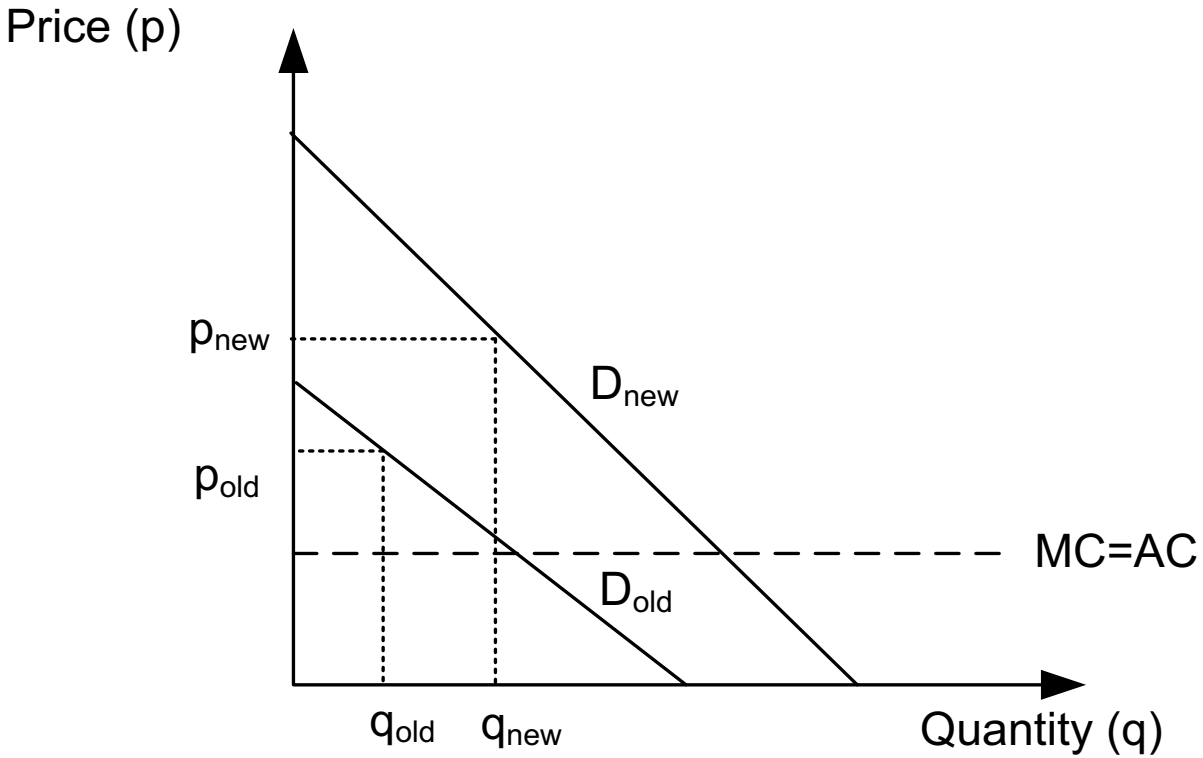


By introducing a new product the firm aims to achieve an outward shift and steeper slope to the demand for its product (analogous to the effect of advertising, increasing product loyalty to the firm).

Even though consumers are charged a higher price, they buy more and have more consumer surplus.
Of course, over time the market may become more competitive as more product innovation occurs and this may reduce prices.

A general way of describing this situation is to say that consumers benefit from the increase in product variety and/or the rise in the quality of the products on offer.

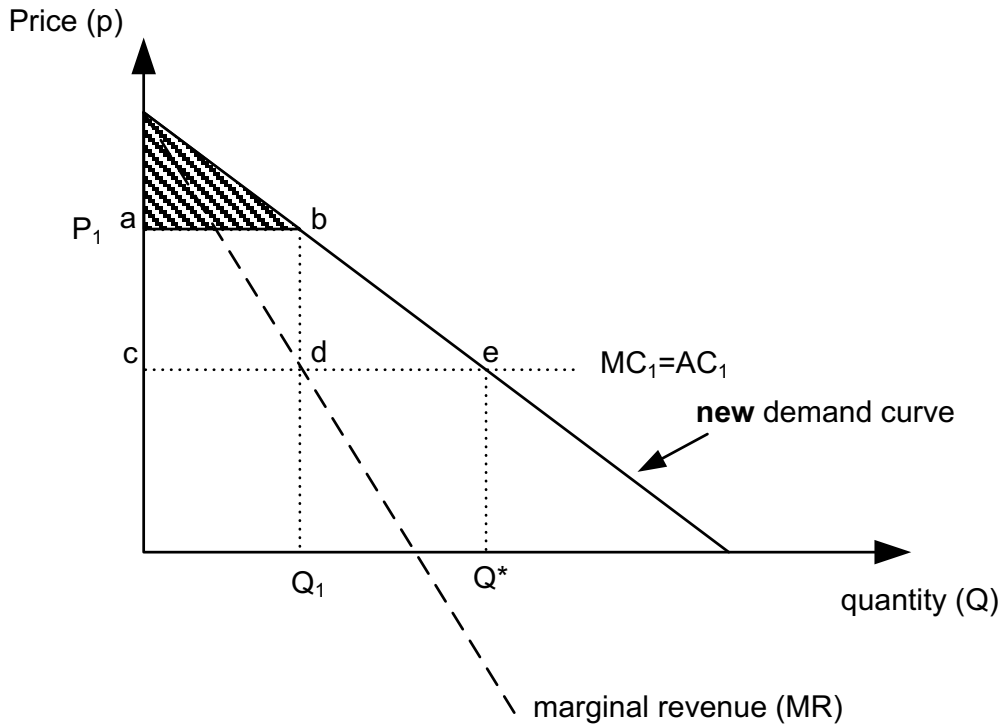
A product innovation represented by a shift in existing demand curve



Even if a new product is more expensive than existing ones, if it has exactly the right set of **characteristics to match the customers' tastes, they may be happier to buy this item.**

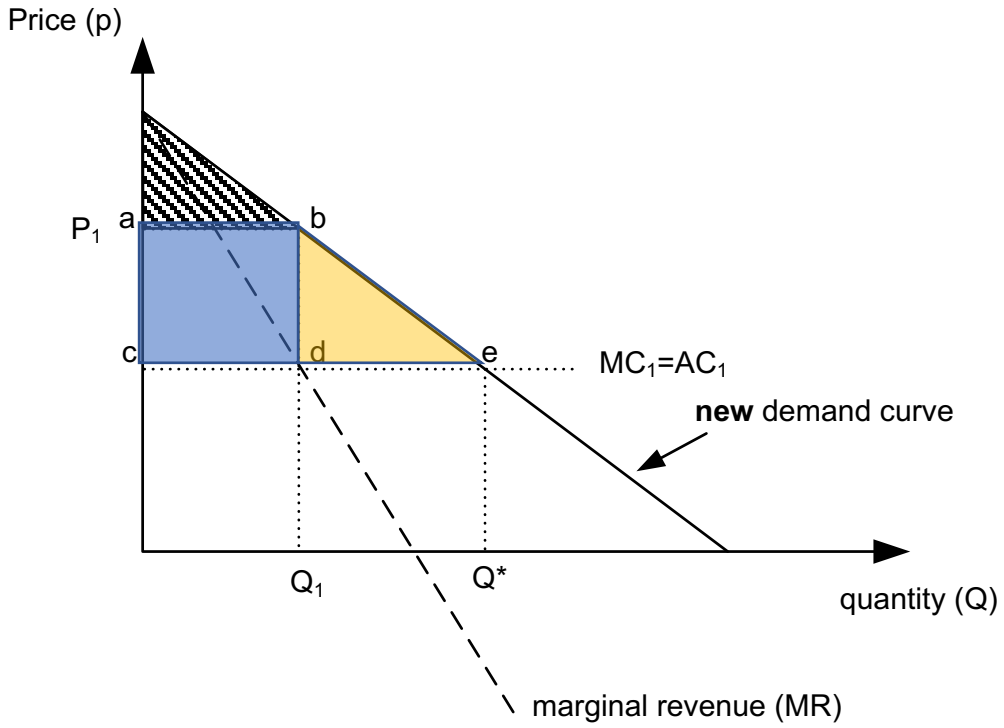
If the product has a broader and more favorable set of characteristics than an earlier variety, then, even with a higher price, it can still be seen as good value for money.

New product demand curve



We can represent the introduction of the new product with a new demand curve.
Figure shows the demand curve for a new consumer good.
The position and elasticity of the demand curve depends on how much the **new product is valued, which in turn depends on the availability of substitute products.** If we assume that the firm has an IPR that prevents imitators, the firm acts like a monopolist and maximizes profits.

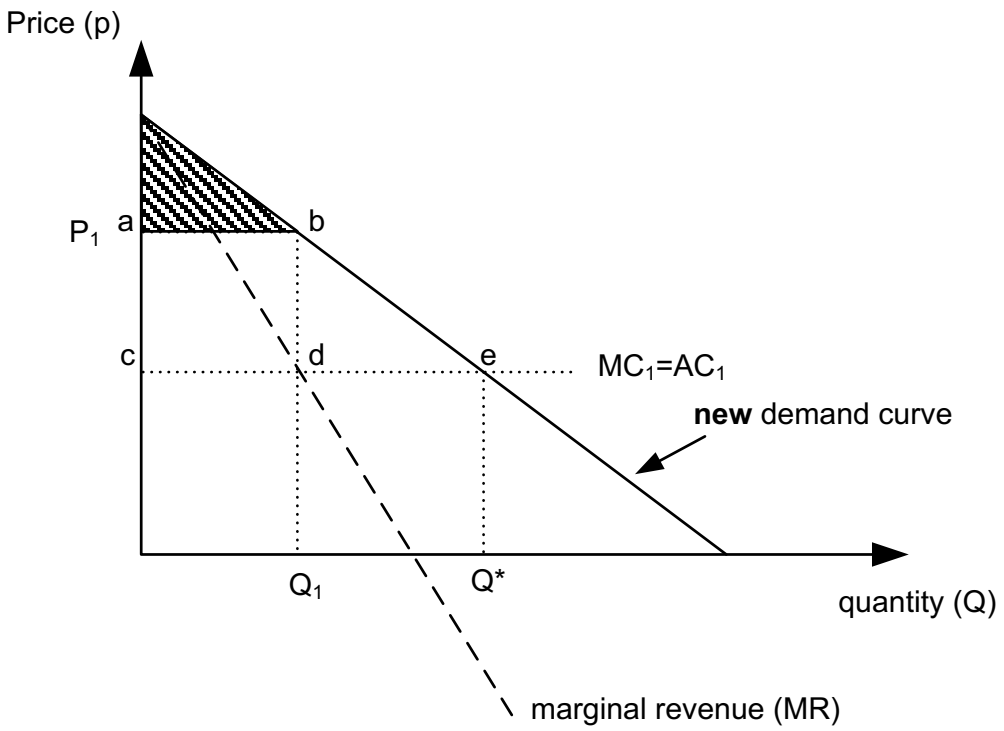
New product demand curve



The new product creates "consumer surplus": the triangular area above the price but below the demand curve. This is a measure of the surplus value to the consumers over and above the price they have to pay.

However, because price (P1) is greater than marginal cost (MC1), consumer surplus is not maximized, since this would occur at *Q*∗. It is clear that rewarding innovations with profits (i.e., allowing *P* to be greater than MC) creates a further problem. Looking at figure, we can see that some of the lost consumer surplus is, in fact, profits to the innovator (i.e., area ABCD), but some of the lost consumer surplus is wasted (i.e., area BDE). For this reason, area BDE is called the "deadweight loss" associated with monopoly pricing.

Figure 3. New product demand curve



Consider as an example the situation where an important new drug, that can treat a serious disease, is developed.

During the period of protection by a patent, it is sold at a higher price than its marginal cost of production. Some sufferers who could afford the drug if priced at marginal cost are not able to obtain it at this higher price;

the number of people affected is proportional to the distance $Q* - Q1$.

CHARACTERISTICS, QUALITY AND PREFERENCES

- Economics uses the **characteristics approach** to analyse questions of product choice and product innovation.
- The characteristics approach treats the product as a collection of features or characteristics. This makes it possible to analyse what happens to markets when improved versions of existing products are introduced.
- It is very simple in theory.
- But it is rather harder to apply in practice because it is necessary to count a large number of characteristics to do justice to most real products.
- While it is easy enough to draw a map of competing products when no more than one or two characteristics are important, that cannot be done when products are truly multi-dimensional – meaning that they embody a large number of characteristics. Another complication, in practice, is that the dimensions of product space tend to expand over time.

CHARACTERISTICS, QUALITY AND PREFERENCES

We distinguish between three types of characteristics:

1. **Intrinsic characteristics** – characteristics embodied in the product. *These include many dimensions of quality, performance, reliability, features, design and style, and so on.*
2. **Perceptual characteristics** – characteristics that are not embodied in the product in a physical sense, but are 'attached to' the product by branding or advertising.
3. **Extrinsic characteristics** – often measuring the quality of the service element provided with the product. *This includes delivery, service and support, and a variety of indirect network effects.*

CHARACTERISTICS, QUALITY AND PREFERENCES

Within the characteristics framework, we can distinguish product innovations of differing degrees.

1. An **improvement** in **one characteristic only**.
2. An **improvement** in **several characteristics**.
3. The **introduction** of **one new characteristic**.
4. The **introduction** of **so many new product characteristics** that we have, arguably, a completely **new product**.

CHARACTERISTICS, QUALITY AND PREFERENCES

One other important distinction is between vertical and horizontal differentiation.

- When two products are **vertically differentiated**, we say that one is unambiguously better than the other.
  - If two personal computers A and B are identical except that B has more memory than A, then we could say that B is (vertically) superior to A.
- When two products are **horizontally differentiated**, on the other hand, we can only say that they are different, but we cannot say that one is superior to the other.
  - For example, a red Fiat Panda and a green Fiat Panda (identical apart from colour) are horizontally differentiated, meaning that they are different. But we cannot say that one is superior to the other: it depends on one's tastes. Some prefer red to green, some prefer green to red and some others are indifferent.
- It is almost impossible to assert any general principles about preferences.

Willingness to pay (WTP)

- In most cases of vertical differentiation, we can say that most people prefer better to less good (if the price is the same),
- though a few may not care about quality and are hence indifferent between better and less good.
- People differ however in the intensity with which they prefer better to less good.
- Some don’t care much and are not prepared to pay much for superior quality.
- Some care a lot and are prepared to pay a lot.
- We shall see how this simple observation can be made operational through what is called a willingness-to-pay (WTP) curve.

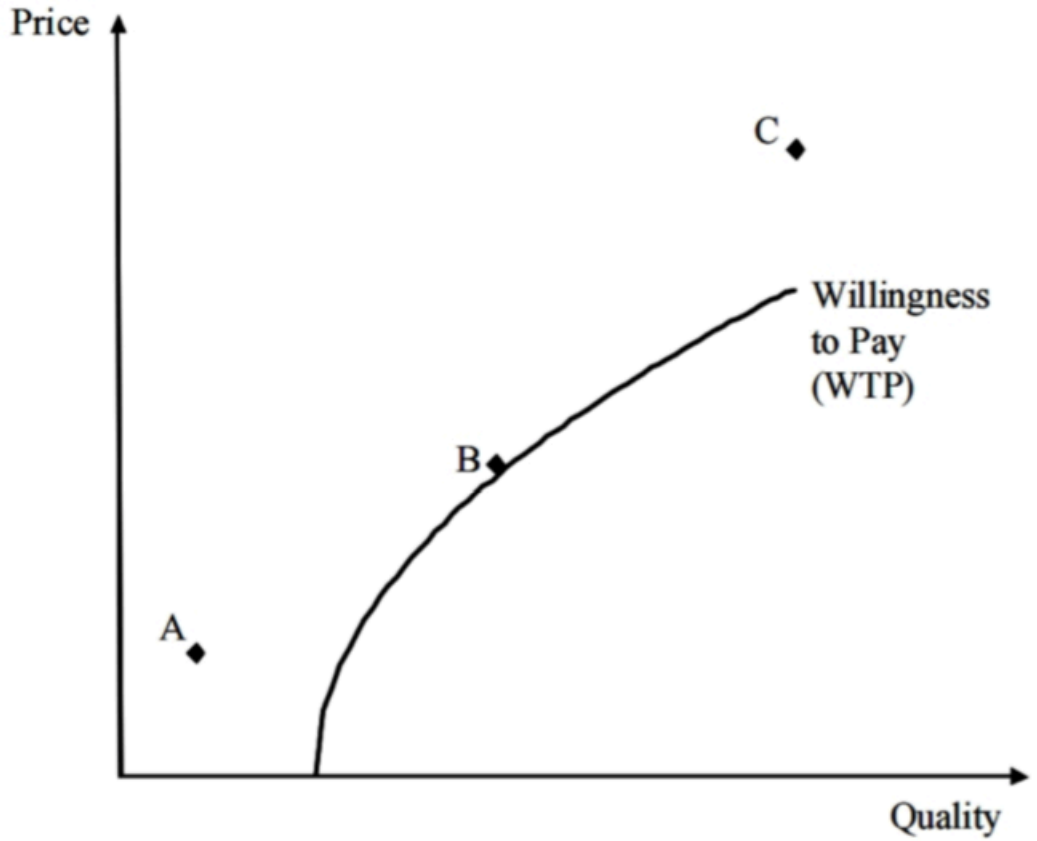
PRODUCT MAPS, CHOICE AND TERRITORY MAPS

For graphical simplicity, we shall analyse the case where different varieties of a product can be compared in terms of one characteristic alone (and price). Figure illustrates the case of three products.

- product A represents the cheap and cheerful product,
- product C the premium product,
- product B the mid-market product.

In addition we have drawn a typical willingness-to-pay (WTP) curve. This describes how much the consumer is prepared to pay for increases in quality.

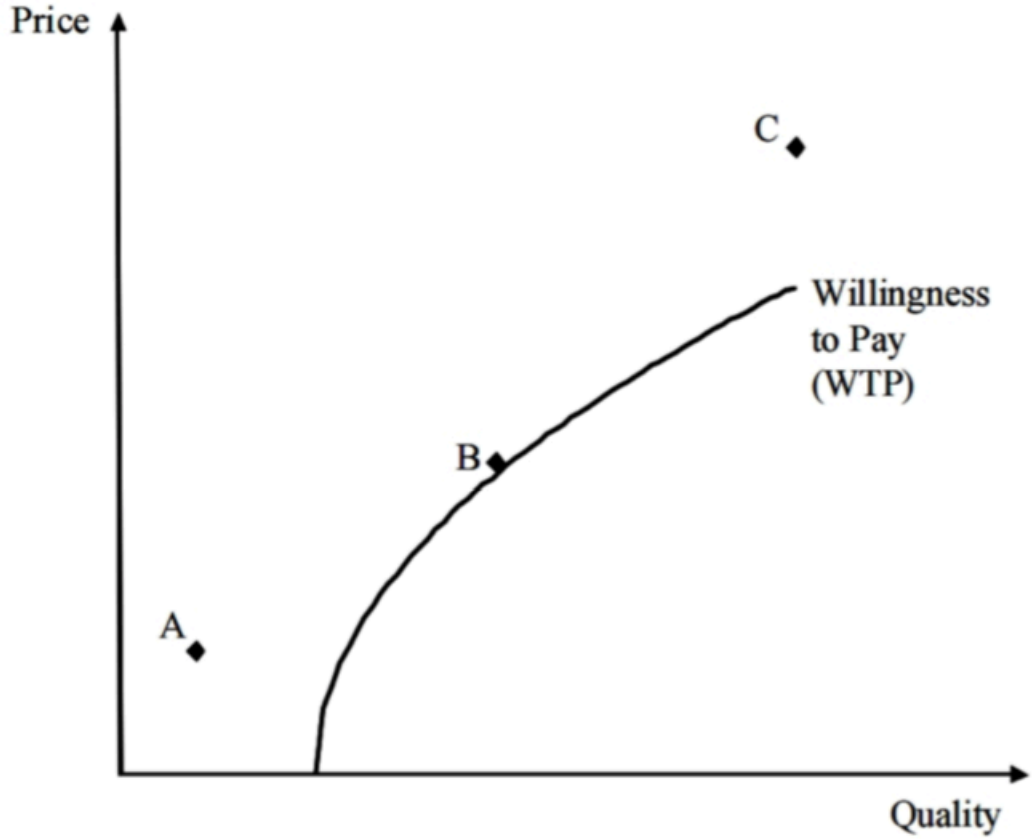
It is also common to find that for many consumers, willingness-to-pay tends to level off at high quality – indicating that beyond a certain point, typical consumers become satiated, and place little value on further improvements in quality. There are of course exceptions to both of these generalisations – especially the second, as the existence of premium brands and products will testify. Nevertheless, this general shape of willingness-to- pay curve is common, even if the curves for different consumers may be located in different parts of the diagram.



Willingness-to-pay and product choice

PRODUCT MAPS, CHOICE AND TERRITORY MAPS

Product A does not appear attractive to this particular consumer, since he is not willing to pay the asking price. While cheap, it does not appear to be good value for money.
Product C though of high quality, is too expensive in the eyes of this consumer.
Product B looks the best value for money to this consumer, since the asking price is about equal to what the consumer would be willing to pay for it.



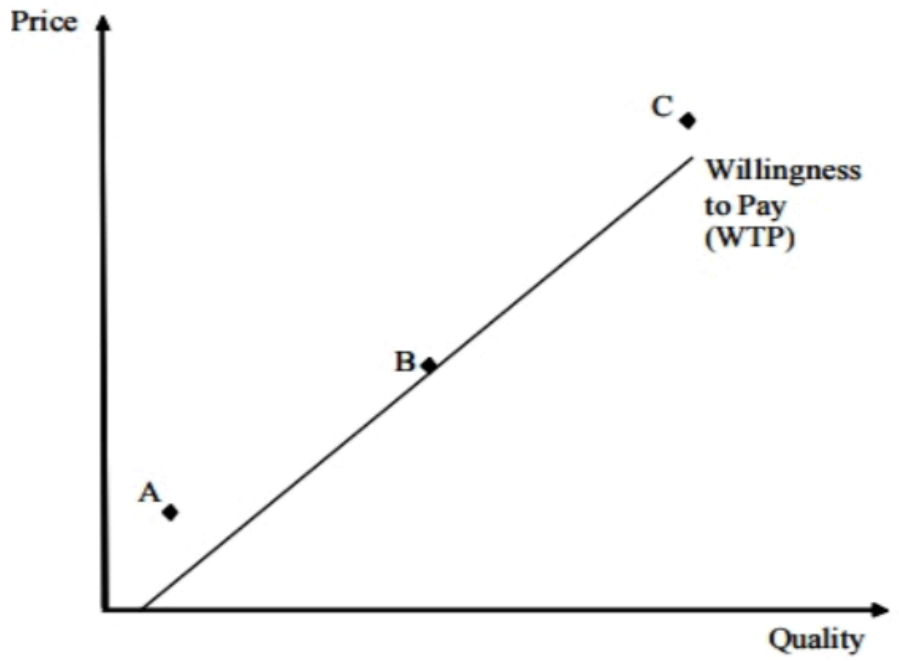
We would expect a well-informed and rational consumer to choose product B in preference to A or C in this setting. That is, the consumer would choose the product offering best value for money, which is priced at or below the consumer's willingness-to-pay.

PRODUCT MAPS, CHOICE AND TERRITORY MAPS

Now, although WTP is often curved as shown, it is useful shorthand in what follows to make the assumption that WTP lines are linear.

In this case, again, the consumer with the WTP line as shown would normally choose product B.

The other two products are just too expensive for the quality they offer. This assumption of linearity allows us to draw what are sometimes called, ‘product territory maps’.



Willingness-to-pay and product choice (linear WTP)

The territory map

The territory map shows, for different slopes of the WTP line, which product will be chosen.

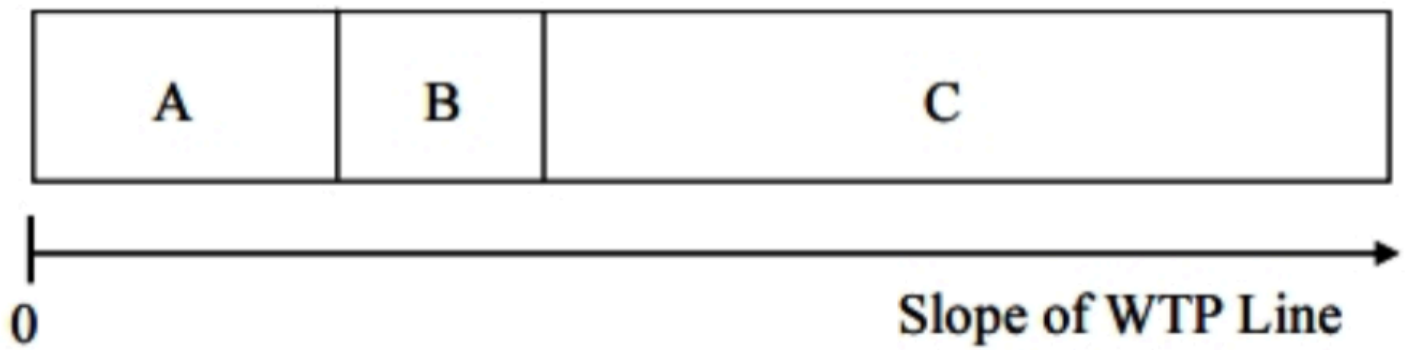
If the WTP line is flat (slope = 0), then the consumer is not willing to pay for increased quality, and therefore buys just the cheapest product (A).

Now consider what happens as the slope of the WTP increases. Eventually we reach a point where the consumer is indifferent between A at its lower price and B at its intermediate price. As the slope of the WTP increases beyond that, B is preferred to A.

Then eventually we reach a slope where the consumer is indifferent between B at its intermediate price and C at its high price (while preferring either to A). Then as the slope increases beyond that, C is the clear first choice. The territory map captures this in a simple way. It shows, for each slope of the WTP line, the consumer choice from A, B and C.

The product territory map as shown is unexceptional. It just captures the idea that:

- product A will be bought by low-end consumers,
- product B by mid-market consumers
- product C by premium consumers.

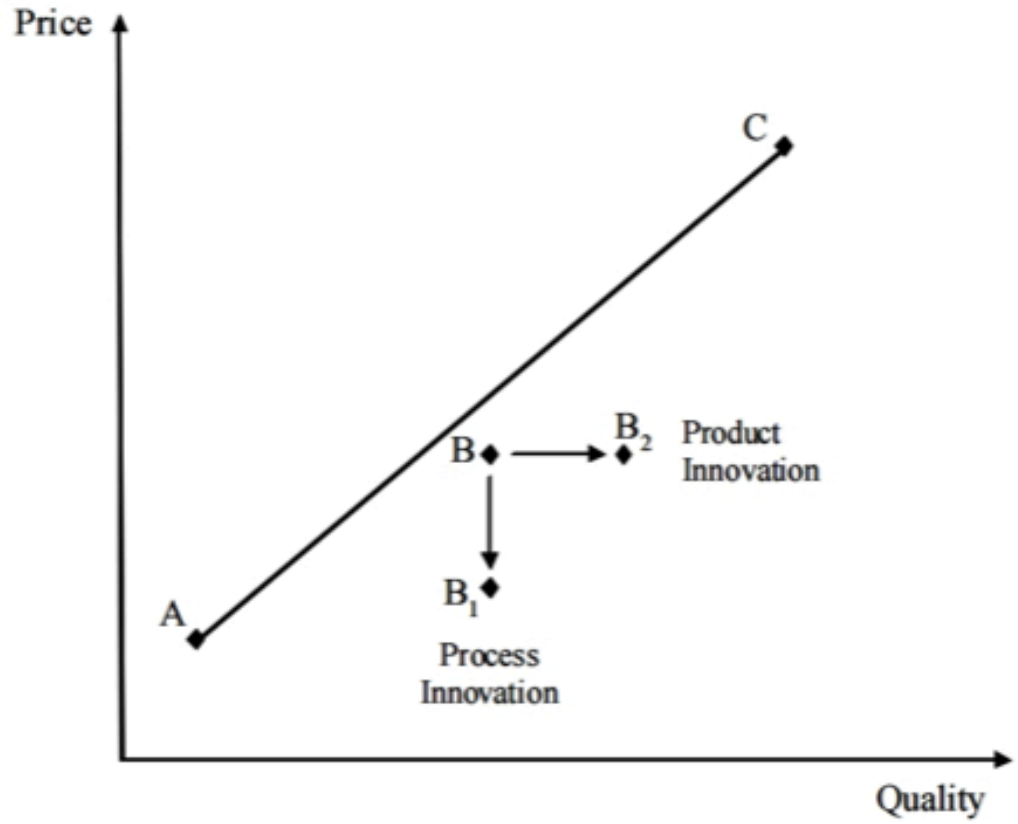


PRODUCT AND PROCESS INNOVATION COMPARED

We already done a clear distinction between product and process innovations.

The analytical framework described above can illustrate their different effects on the product market.

To see this, consider previous figure, but two possible innovations are added.



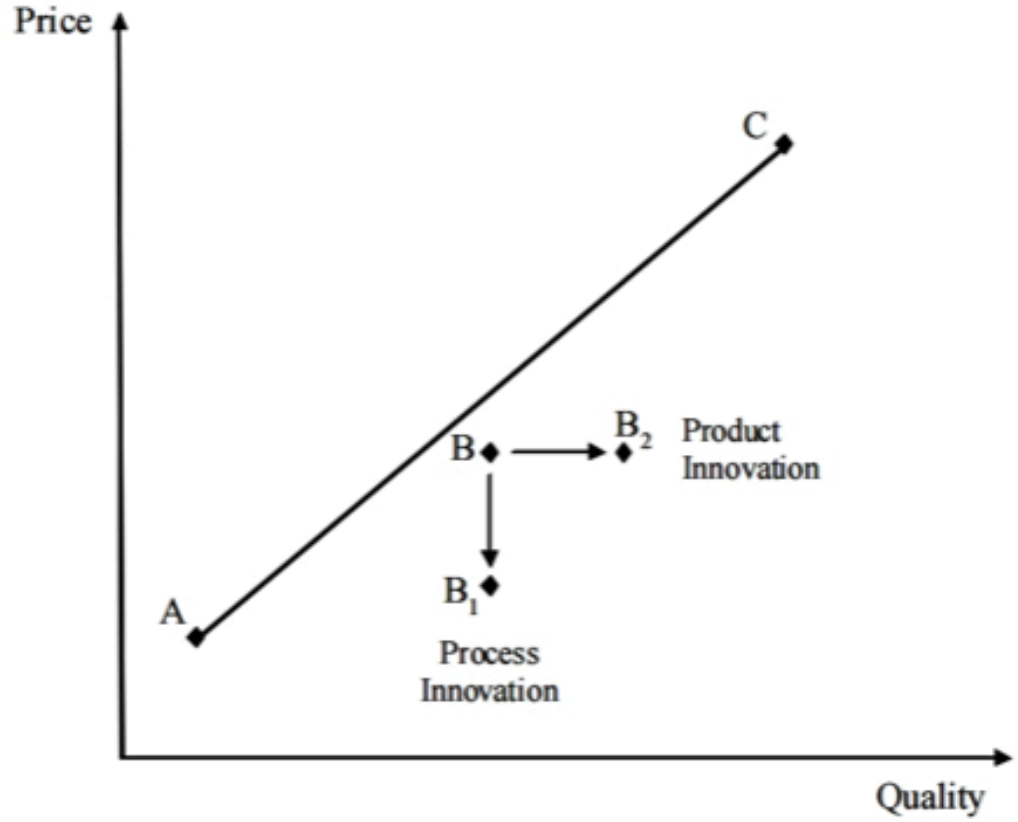
PRODUCT AND PROCESS INNOVATION COMPARED

If the producer of B implements a cost-saving process innovation in the production of B, then it would be possible for that producer to relocate B to a reduced price (B1). We shall describe this strategic move as using a cost-reducing process innovation to cut price.

Alternatively, if the producer of B can achieve a product innovation with no addition to costs, then it is possible to relocate B to a higher quality (B2).

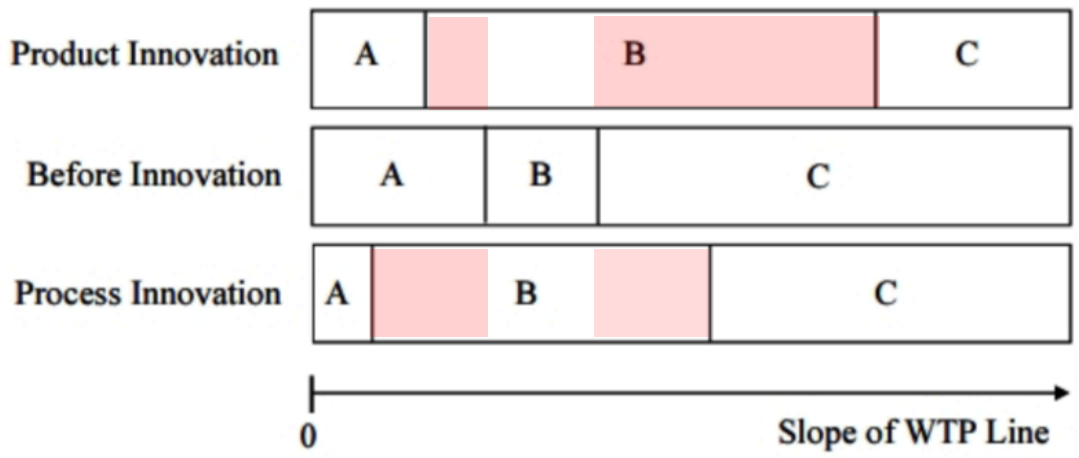
The move to B1 brings B closer (both in terms of the diagram and in economic terms) to product A. Intuitively, we would expect this price reduction to mean that B cuts significantly into the market share of product A.

The move to B2 brings B closer to product C. Intuitively, we would expect this quality increase to mean that B cuts significantly into the market share of product C. The product territory map confirms these intuitions -->



Product territory maps before and after innovations

The figure shows the product territory maps before any innovation (the middle row), after the product innovation (top row) and after the process innovation (bottom row).



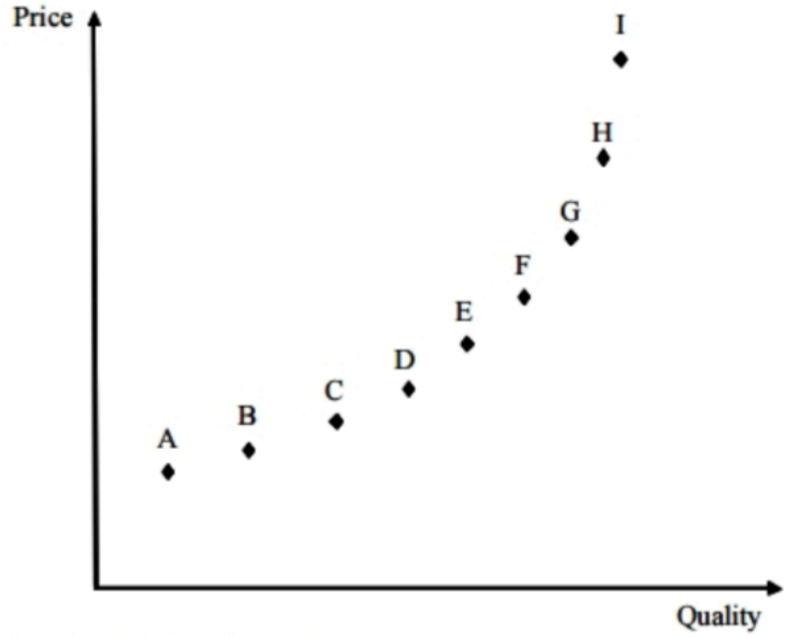
Compared to the pre-innovation picture, both innovations allow product B to capture a larger market share.

But they achieve this increased market share in different ways.

- The process innovation takes market share from A and C: the territory for B expands more or less equally in both directions.
- The product innovation, by contrast, mostly takes share from product C and much less so from A.

PRODUCT PROLIFERATION

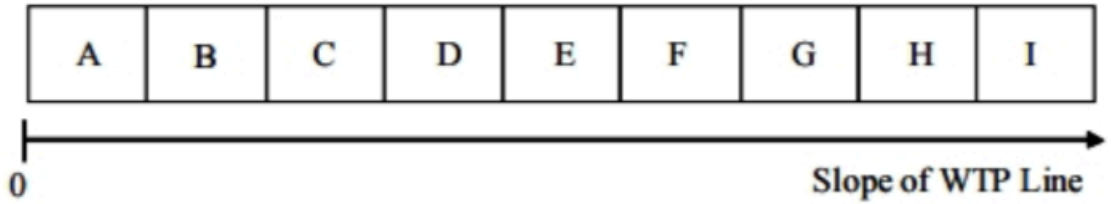
Product proliferation is a special type of product innovation. It is the practice of proliferating a wide variety of slightly differentiated products across the entire characteristics space.



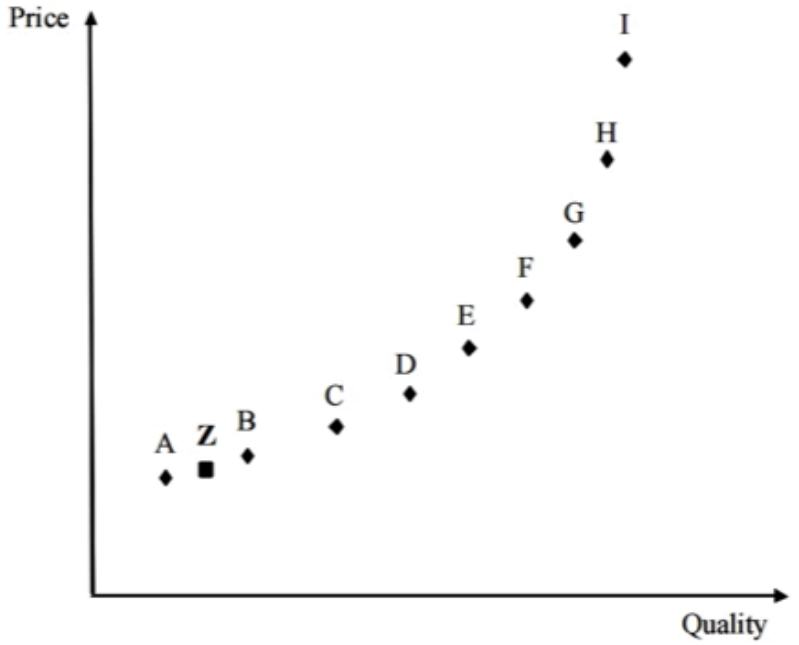
Product territory map in case of product proliferation

This proliferation of products breaks up the consumer space into small territories or segments. There are two reasons why a firm might wish to do that.

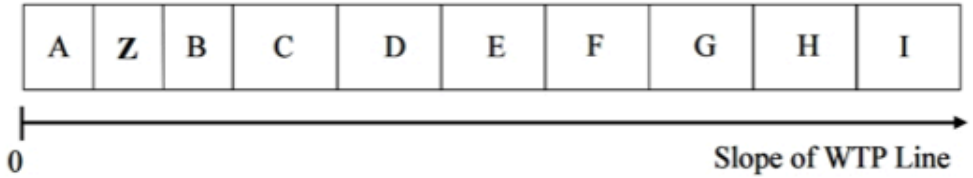
- **Market segmentation**. The marketing technique of market segmentation aims to break the consumer base into different groups and to set different prices in each in order to increase profitability. In economic terms, we can show that this sort of product proliferation allows the company to achieve an ever more efficient form of second-degree price discrimination.
- **Deter entry by others**. Proliferation of products can deter small scale entry because a single product entrant in a congested marketplace can only expect to achieve a small market share, and may not cover the fixed costs of entry.



Small scale entrant takes only a small niche in territory map



A small scale entrant tries to enter this congested market by offering only product Z (in between A and B). Although this product is priced so that it will make some sales, its share of the market is pretty small, as shown in the corresponding territory map.



NEW CHARACTERISTICS/DIMENSIONS

- Product differentiation by introducing new product characteristics becomes increasingly attractive as a competitive strategy when a characteristic space becomes congested – as for example in the case of product proliferation.
- Demand becomes less price-sensitive as the product is differentiated.
- As a result, we tend to observe that producers tend to increase the dimensions of product space (add new characteristics) when it gets congested.
- To see this, consider the the product Z. When the space is congested, a single product entry cannot expect to take much market share, and cross-price elasticities between incumbents' products and the entrant's product will be high. In that context it is attractive to try to make more competitive space.

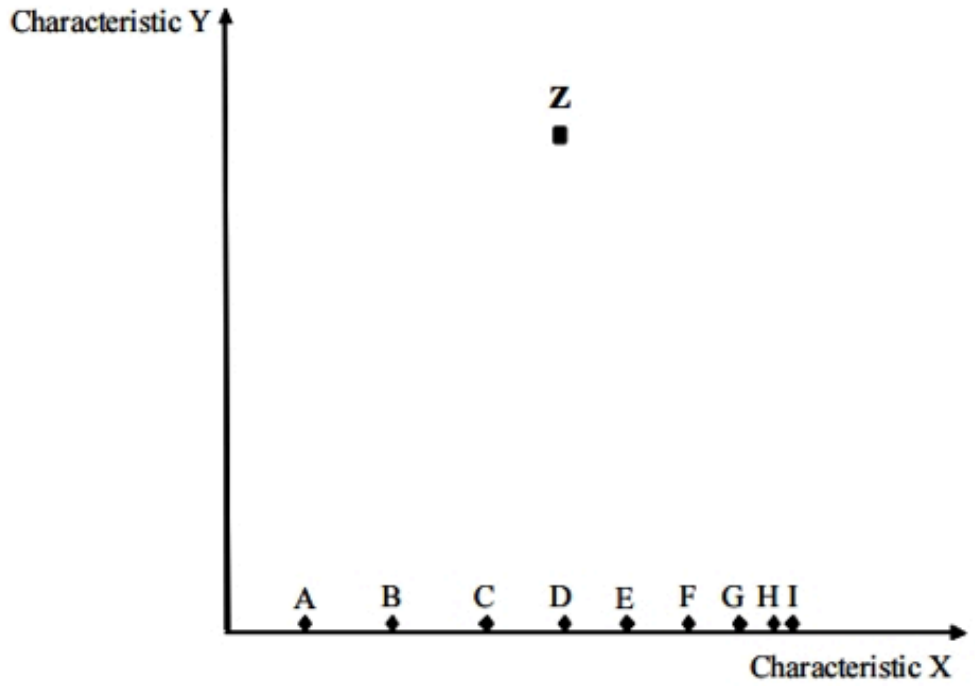
Entrant introduces new product characteristic

Figure shows entrant that introduces new product characteristic

This is derived from previous figures but dropping the price axis and introducing a new characteristic on the vertical axis.

All incumbent products A-I are clustered along the horizontal axis.

But if the entrant can introduce an additional product characteristic (Y) as shown and, assuming that this characteristic is valued by at least some consumers, then the entrant can expect to gain a larger market share and reduce the cross-price elasticities between demand for the product and other products.



PRODUCT CHOICE BY THE PRODUCER

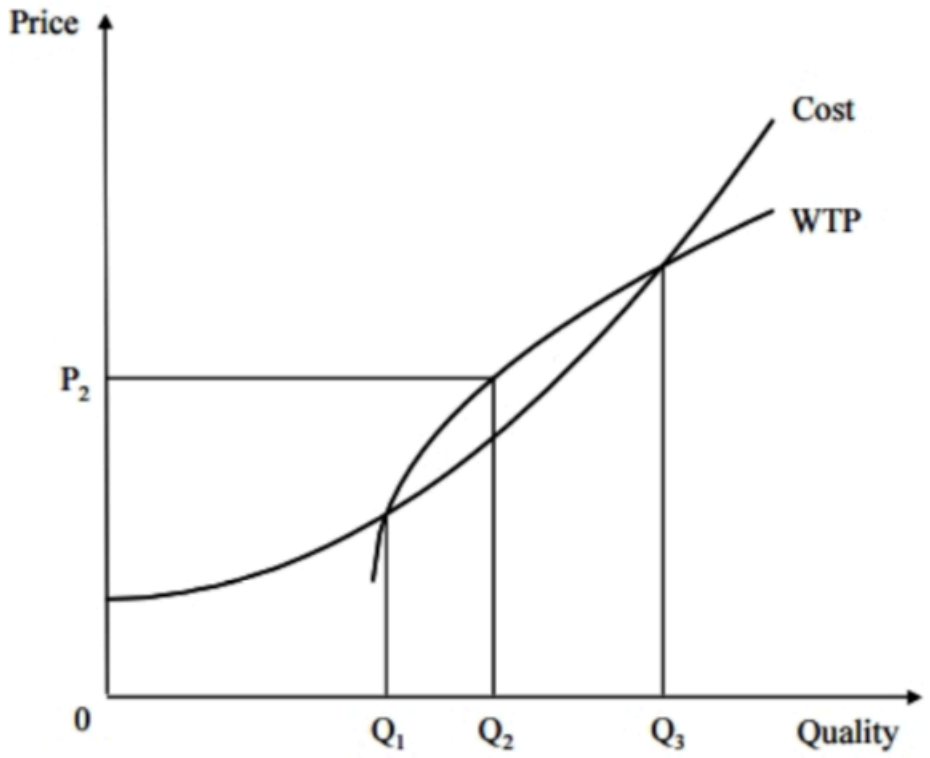
We have used the characteristics approach to analyse consumer choice. We can also use it to analyse the producer's choice of what product specification to offer.

Figure shows the cost curve which suggest that at high levels of quality, the cost of further improvements in quality may be much greater than at moderate levels of quality.

Any quality between Q1 and Q3 would be a possible choice for the producer in that the consumer's willingness-to-pay for this variety would equal or exceed the cost of production.

If the producer were concerned with maximising his profit margin, then product Q2 would be chosen, and sold at price P2.

This is the quality at which the willingness-to- pay exceeds cost by the largest possible amount.



FLEXIBLE MANUFACTURING AND PRODUCT VARIETY

How many different models should the producer choose to sell, and how does flexible manufacturing change the answer?

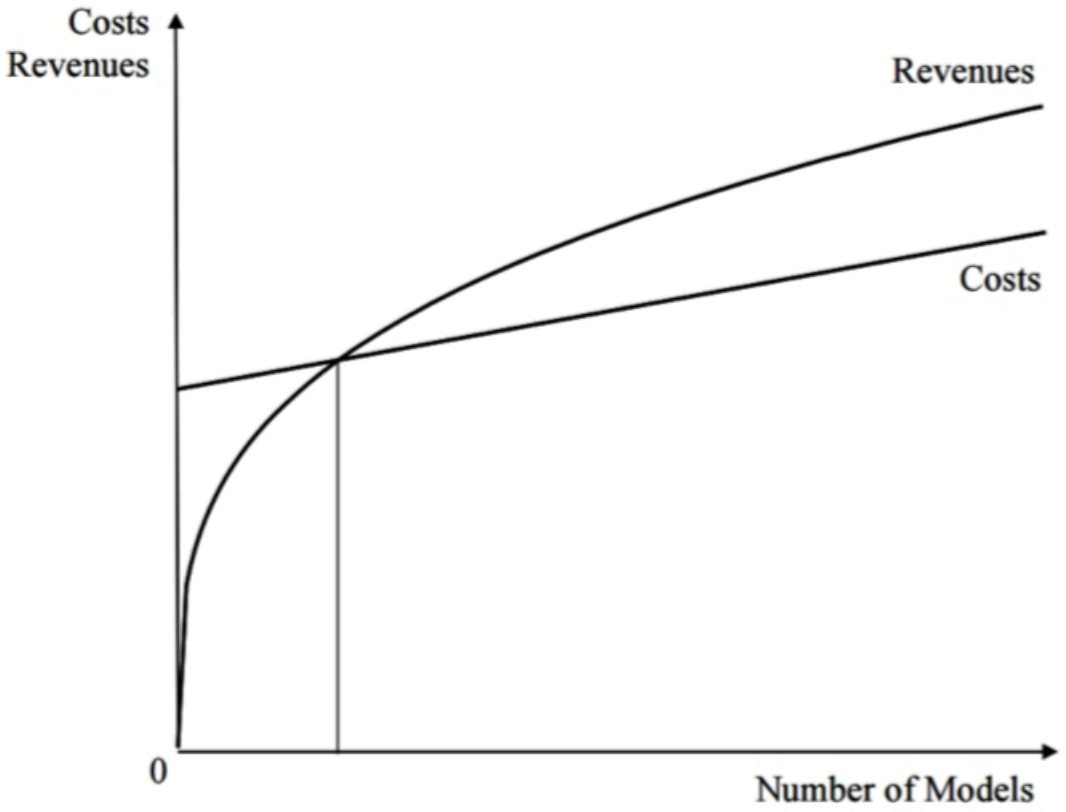
Essentially it depends on the balance between two factors.

1. If consumer tastes are very diverse, then it may well be that the producer needs to make a wide variety of brands in order to maximise sales, and the revenues from sales.
2. There is a fixed cost in producing any additional brand so there is also an incentive to limit the number of brands produced to restrain costs.

The balance between these factors will determine how wide the portfolio of products should be.

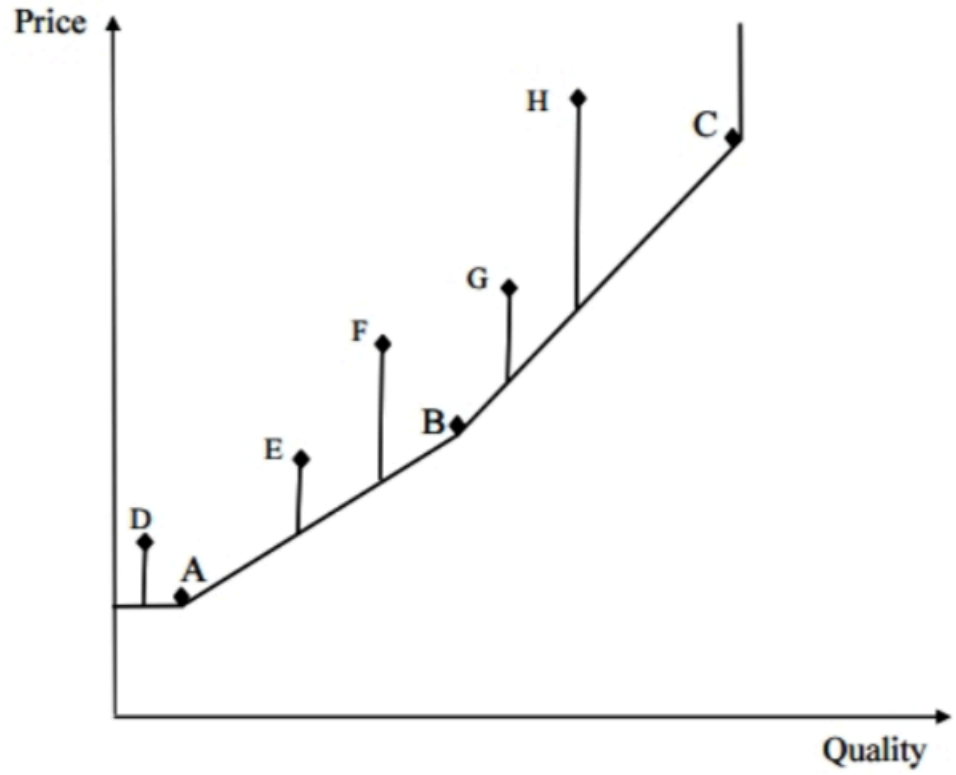
In this case, there are a minimum number of models before the company breaks even, but beyond that, the company can proliferate an almost unlimited variety. Even at the right-hand side of this diagram we have not reached the most profitable number of models, still less the break-even number of models.

How many models to produce? (flexible manufacturing process)



MEASURING PRODUCT COMPETITIVENESS

- To see how this analytical framework can be used to measure the competitiveness of individual products, we take the basic structure of WTP and add some more products (D-H) as shown in Figure. We also draw an envelope around the lower boundary of the various products.
- Now, suppose that WTP is linear. Then we know from the territory map that all consumers will buy one of the following: A, B or C.
- The consumer with a WTP line given by AB will be indifferent between A and B. If the WTP line is flatter, he will buy A. If steeper, he will prefer B. Likewise, the consumer with a WTP line given by BC will be indifferent between B and C. If the WTP line is flatter, he will prefer B. If steeper, he will buy C. Whatever the slope of the WTP line, nobody will buy any of the other products D-H.



MEASURING PRODUCT COMPETITIVENESS

We can now ask: what would have to happen to the price of product E (say) for someone to want to buy it?

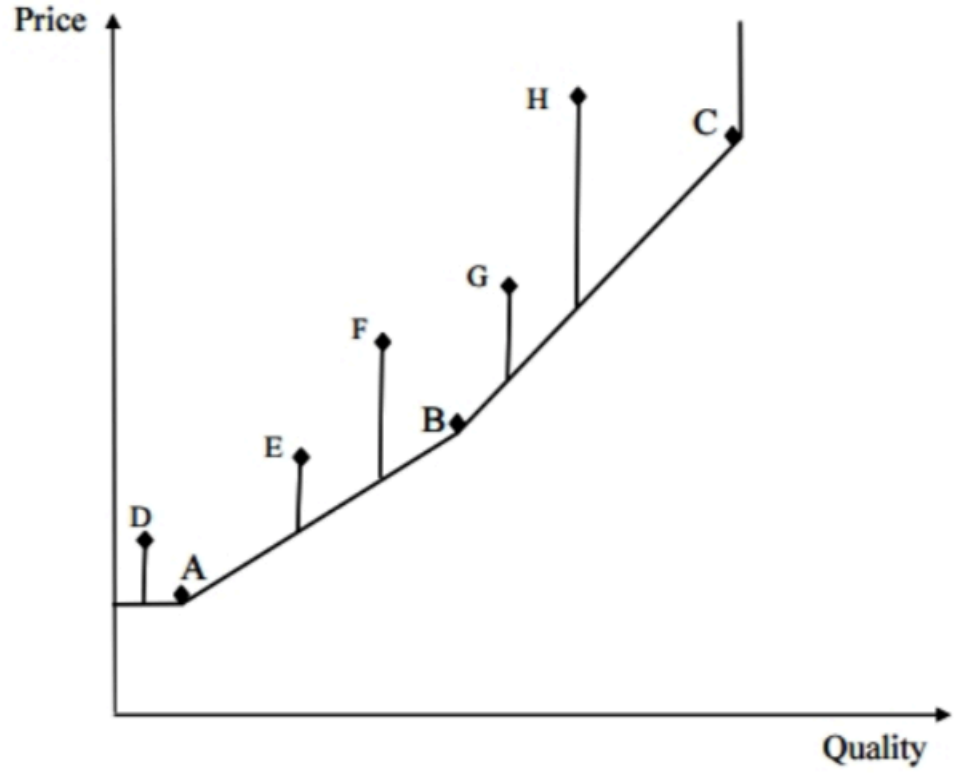
The answer is that the price would have to fall until it reaches the envelope.

This means the point at which the vertical line below E crosses the envelope.

At that price, a consumer with a WTP line given by AB would be indifferent between A, B and E.

This is the highest price at which E can expect to sell.

In the same way, we can compute the maximum prices at which all the other products (D, F-H) can expect to sell as the price at which that product would just lie on the envelope.



MEASURING PRODUCT COMPETITIVENESS: DEA

- This practice of computing an envelope or efficient frontier is known as Data Envelopment Analysis (DEA).
- It was originally used to compute productive efficiency but it is equally applicable to measuring product competitiveness. If a product lies on the envelope or frontier, then we can say it is competitive. There are at least some consumers who may buy it. In Figure, only three products are on the frontier (A, B and C).
- If a product lies inside (above) the envelope or frontier, then we can say it is uncompetitive. It cannot expect to find a buyer because any consumer, whatever the slope of his WTP line, will prefer one (or more) of the products on the frontier. The extent to which these products inside the frontier (D-H) lie above the frontier (i.e. the vertical line from these products to the frontier) is a measure of how over-priced the product is. That is a natural measure of the extent to which it is uncompetitive.
- Amongst the products inside the frontier, it is worth distinguishing them into two groups. Products D, F and H are obviously uncompetitive in the sense that there is another product on the market which is better and cheaper. A is better and cheaper than D; B is better and cheaper than F; and C is better and cheaper than H. Economists say that A dominates D; B dominates F; and C dominates H.
- However this observation does not apply to E or G. There are no products that are simultaneously better and cheaper than either of these. Why then are they uncompetitive? They are uncompetitive because any consumer (with a linear WTP) would prefer A and/or B to E, and any consumer (with a linear WTP) would prefer B and/or C to G.

Exercise - The introduction of a new product

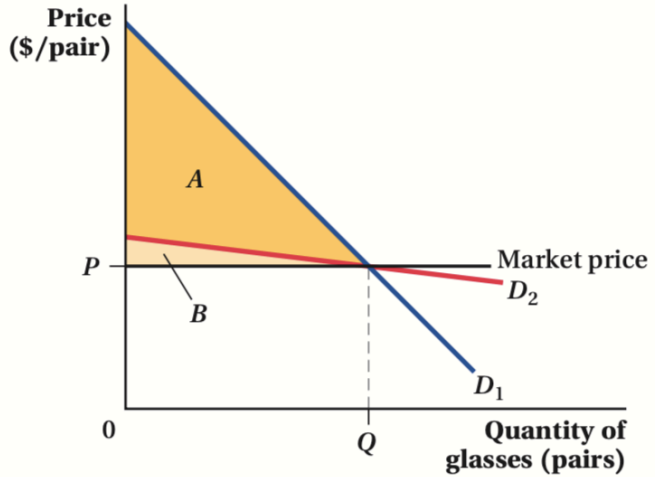
Let’s look at eyeglasses market. Glasses were first invented in 1280.

What appened when were first commercially available contact lenses on the market in the latter half of the twentieth century?

When are available substitute goods are likely to make demand more elastic.

This is true of glasses, too: When contact lenses became available, the demand for glasses became more price elastic. How would this change in elasticity affect the consumer surplus people get from the existence of eyeglasses?

Solution



Because many people in 1280 need glasses, the demand curve was very steep — there was a set of individuals with a very high willingness to pay for glasses. This would also imply that demand wasn't particularly sensitive to prices. This steepness of the demand curve probably remained stable for the next 700 years, until the first commercially available contact lenses came on the market in the latter half of the twentieth century.

Consumer surplus in 1950 is large because the demand for glasses *D*1 is inelastic — if you want to see better, glasses are the only game in town. The consumer surplus is the area above the price and below *D*1, or area *A* + *B*. Many people would be willing to buy glasses even if the price were much higher than *P*. (That's what having an inelastic demand means.)

When contact lenses become available, the demand for glasses becomes much more elastic, as shown by curve *D*2. Even if just as many people buy glasses at the equilibrium price as before, a sharp rise in the price of glasses would cause many people to stop buying them because now they have an alternative.

The figure shows that the consumer surplus from glasses declines after contacts come on the market. The area below the new, flatter demand curve and above the price is only area *B*. When contact lenses become available, the demand for glasses becomes much more elastic, as shown by curve *D*2. Even if just as many people buy glasses at the equilibrium price as before, a sharp rise in the price of glasses would cause many people to stop buying them because now they have an alternative. The figure shows that the consumer surplus from glasses declines after contacts come on the market. The area below the new, flatter demand curve and above the price is only area *B*.

Solution

After contacts are available, glasses are not worth as much to consumers because there are now other ways in which they can improve their eyesight. If glasses are the only way to fix your eyesight, you might be willing to pay thousands of dollars for them. Once you can buy contacts for €300, however, there is a limit to how much you would pay for glasses. You might still buy the glasses for $200, but you would certainly not be willing to pay $1,000 for them, and the change in consumer surplus reflects that change. Glasses are a miracle invention if they are the only way to correct one's vision (so they yield a higher consumer surplus). Remember that consumer surplus depends on the *most* that people would be willing to pay for the product. That maximum price goes down if alternatives are available. When alternative methods of vision correction are available, however, glasses are just another option rather than a virtual necessity, and the consumer surplus associated with them falls.