Microeconomics – product innovation and welfare

MGT 641

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Economists have been thinking for decades about one measure that may help us to determine the value of technological innovation in our economy. It is *consumer surplus*. Consumer surplus is the aggregate net benefit that consumers receive from using a good or a service after subtracting the price they paid. Thus, the consumer surplus does not depend ONLY on the 'quality' of the innovation. It depends also (and mostly) on the pricing of the innovation – the higher the price, the lower the consumer surplus.

[1] This document draws heavily on *Micoreconomics – a very short introduction* by A.Dixit (Oxford University Press, 2014). This is a short book, which is very well adapted to beginners. We encourage you to read it if you think you need a more complete introduction to the field.

1) We will use the following figures to "measure" consumer surplus as well as a few other things

The vertical and horizontal lines are called 'axes'. In our context the vertical line is the price/cost axis, and the horizontal line the quantity axis. Any point in the area enclosed by the two axes represents a price- quantity combination.

The first curve is the market demand curve. It describes the relationship between the quantity demanded and the price, whether for an individual or for the market as a whole. The curve is drawn as a straight line for visual simplicity. It is downward sloping: there is only few people ready to pay the highest prices for the considered good (price is high, quantity small) while there are many people ready to consume this good at lower prices. The demand curve express the *buyer's willingness to pay*. One can rank consumers from the most eager to buy the considered good or service to the least eager to buy. One needs to note that *the willingness to pay* does not reflect just your "love" for a product – but also your pre-existing wealth.

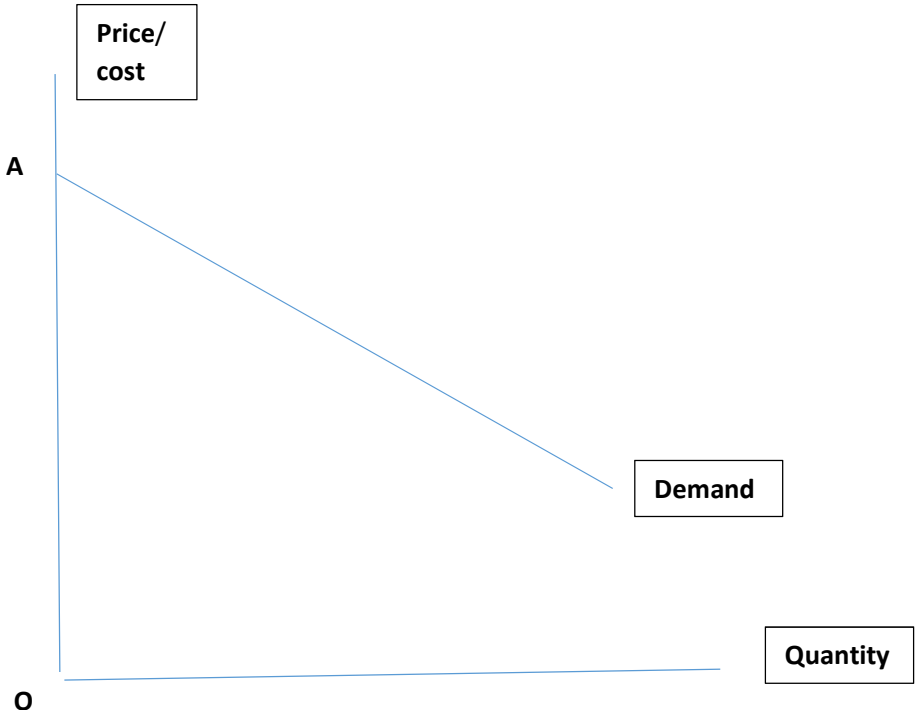

Figure 1 – Demand curve

An important property to be considered for many strategic decisions about pricing a good is the price-responsiveness of market demand. Some products are barely affected by changes in prices. This can be the case of healthcare emergency service. In some other contexts, a small change in price can make a big difference: a seller trying to charge even a little more than the going spot price for oil would have no

takers, but one charging a penny less would have no trouble finding buyers. Figures 2a and b shows these two possibilities: high responsiveness (the technical term is elastic demand) on Figure 2a, and low responsiveness (inelastic demand) on Figure 2b. These different elasticities are represented here with demand curves as straight lines. However, in many cases, responsiveness can vary along the length of the demand curve: in the case of air travel fares, demand is inelastic at high price (people affording a business class ticket don't care about price changes) and elastic at low price (a small change of the price of a low cost trip will have a big impact on demand). The demand curves for such products have a particular shape: they flatten out as they move down and to the right, as shown in Figure 3.

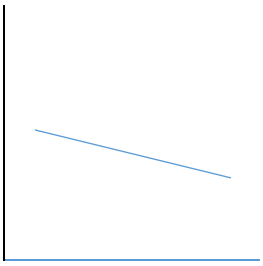

Figure 2a - Price responsive (elastic)

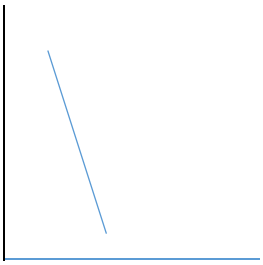

Figure 2b - Less price responsive (inelastic)

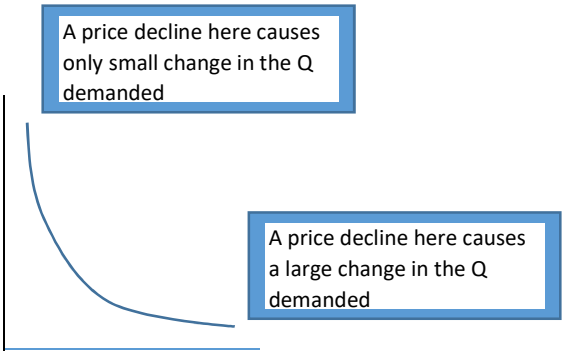

Figure 3 - Demand curve with different elasticities in various price zones

The second curve is the supply curve, which describes the relationship between the quantity supplied of a good and the cost, whether for a single firm or the market as a whole. The supply curve is logically determined by marginal costs (mc) - *the additional cost corresponding to the production of an additional unit of the considered good.* When marginal costs are increasing (it is more costly to produce the second unit than the first one and more costly to produce the n unit than the n-1 unit), the supply curve is upward sloping: costs increase with quantity. When marginal costs are **constant** as on Figure 4, then the supply curve is flat: same cost at any quantity. In some other situations marginal costs are decreasing as quantity increases, so further expansion becomes even more profitable at a given price. For now, let us stay with marginal costs remaining constant according to quantity.

It is important to understand that marginal cost includes all extra-costs incurred for the production of an additional unit (of the considered product or service). It covers therefore extra-costs of salaries, energy and raw materials, equipments, etc.). It does not include the fixed costs (costs which don't vary with quantities and result from fixed inputs) such as the physical infrastructure (plants, factories) or the R&D activities.

Figure 4 – Supply curve

The price curve can be the same as the supply curve or can be different. This depends on the degree of competition as well as business/social strategies. Such difference (or no difference) is a crucial factor to

explain and understand the tension between generating high incentives to innovate (when price is above mc) and maximizing access to consumers (when price is equal to mc).

On Figure 4, the price curve is the same as the supply curve. This means that **P = mc** at any quantity. When **P = mc,** all production costs are covered (including equipment, energy, distribution, marketing and wages) but as we will see there is no profit.

Figure 5 shows a supply-demand graph. Each curve is drawn as a straight line for visual simplicity. The two curves meet at point **E** which corresponds to a price **P** and a quantity **Q**. On Figure 5, all consumers to the left of the intercept E are willing to pay more than marginal cost. The consumers to the right are willing to pay less.

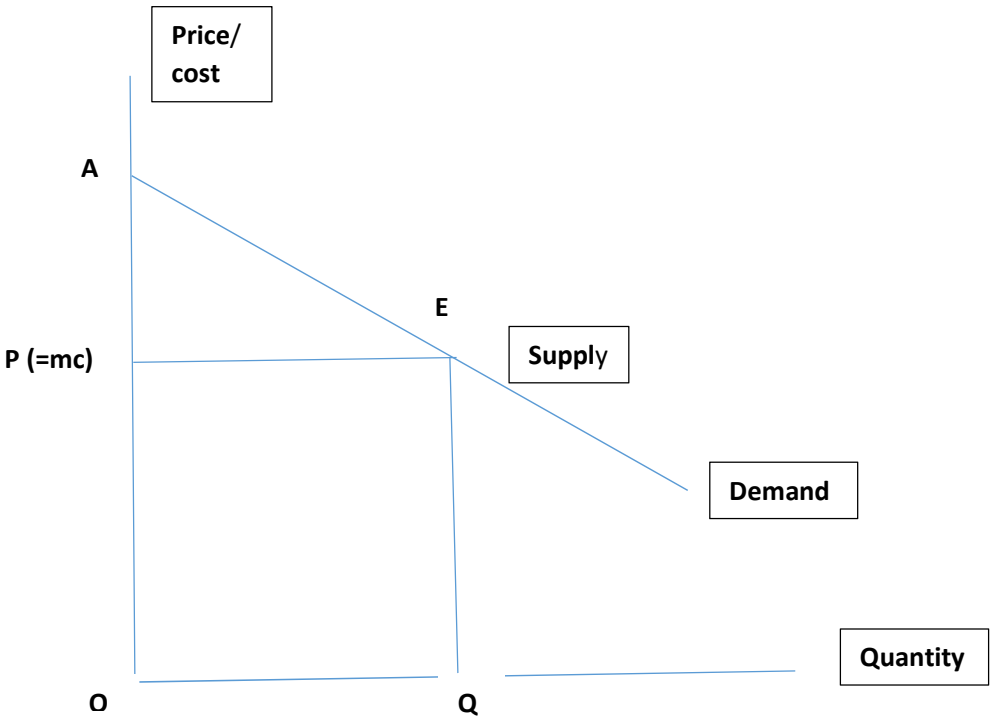

Figure 5 – Supply-demand equilibrium and the various surplus

On Figure 5:

- **APE** represents *the consumer surplus* – the area below the demand curve but above the equilibrium price – this is the gap between the price and the consumer's *willingness to pay*. The consumer surplus is the sum of each individual consumer surplus resulting from *willingness to pay* higher than the price: The buyer of the very first unit is willing to pay the price indicated by the height **A**, but only has to pay **P**. Therefore, this buyer derives an extra-benefit – the consumer surplus – equal to height **AP**. Proceeding to successive higher quantities, the *willingness to pay* falls (law of demand). The *marginal buyer* at **E** has 0 surplus which is the same as saying that he/she is indifferent to buying or not buying the good at the current price. The

consumers to the right of **E** have a *willingness to pay* (measured along the falling demand curve) would be less than the producer's marginal cost (measured along the flat supply curve).

- **PEOQ** (the rectangle with corners at the origin, the equilibrium price, E and the equilibrium quantity) represents *the total revenues from the sale of the good or service* : this is the rectangle created when the market price is multiplied by the equilibrium quantity
- There is no producer surplus here since price equals marginal cost. This means that the total surplus is equal to the consumer surplus (**APE**)

The market equilibrium price has **efficient properties**. All consumers willing to pay a price above cost are served while all producers willing to sell at this price can recoup her marginal cost: on an efficient market, all consumers willing to pay at marginal cost or higher should be able to buy or access to the good. At price **P** and quantity **Q**, the consumer surplus (and the total surplus) is maximized – **E** is a (Pareto) efficient equilibrium. There is no other price which could maximize efficiency in this particular supply-demand situation (i.e. no other price could generate a higher total surplus than **APE**).

We will see now on Figure 6 a situation in which these efficient properties are gone.

2) Let's generate a producer surplus

To generate a producer surplus, price needs to be higher than cost as on Figure 6. The consequence of pricing above cost is that both consumer and total surplus are decreasing.

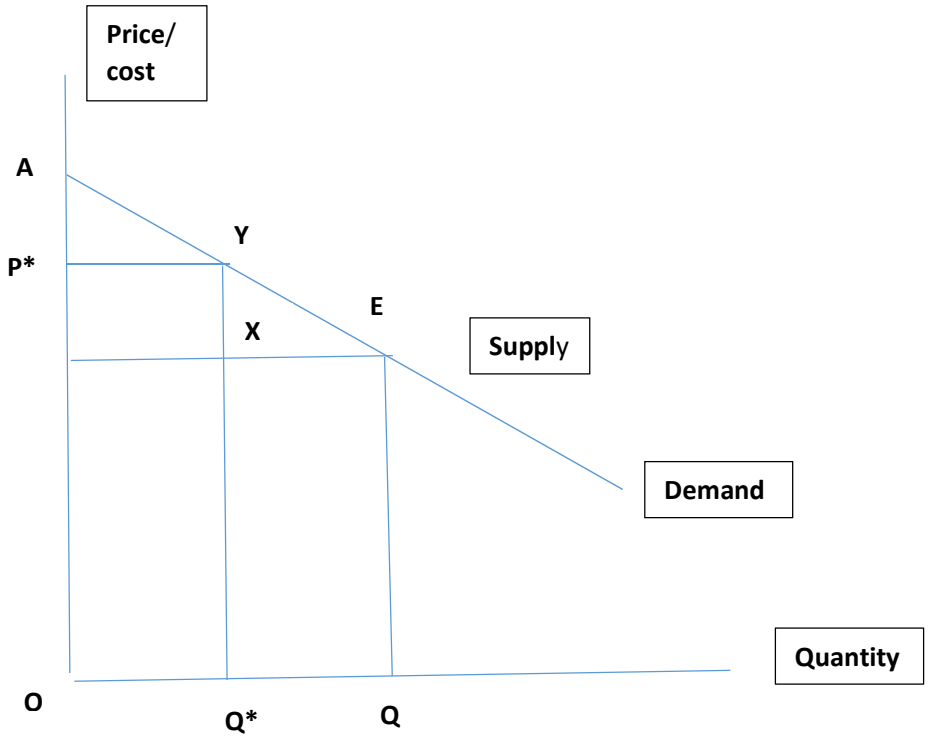

Figure 6 – Welfare effect of pricing above marginal cost

The first unit is produced at marginal cost **C**, but the producer get the price **P*** for it, thus deriving an extra-benefit – the producer surplus –equal to height **PP***. For the first unit the consumer surplus is now **AP***. Adding the two surplus, the first unit of quantity yields an extra benefit to the economy as a whole – the total surplus – equal to the height **AP**.

Now we have the following new results

P*Y X P represents *the producer surplus (or profits)* – the area above the supply curve, below the price and bounded on the right by the quantity **Q* (=X).** This is the gap between the price and the cost for quantity **Q***.

AP*Y represents the new and smaller consumer surplus**.**

APXY is the sum of consumer and producer surplus, i.e. the total surplus

On Figure 6 we can measure the surplus loss created by price > marginal cost through the triangle **YXE** (this is the quantity of the given good that the consumers would have been willing to buy if the price were equal to the marginal cost). Actually, one part of the lost consumer surplus is transferred to the producer surplus – this is **P*PYX.** But the other part – **YXE** – is not transferred – it is simply lost. This is why the total surplus is now lower than in the situation of Figure 5. There is therefore a *negative welfare effect*.

3) Welfare optimality

If we compare Figures 5 and 6, we see that the consumer surplus is maximized when the good is priced at its marginal cost (Figure 5). At this point, producer surplus (profit) was 0. However, 0 profit will not provide an incentive to the innovator to develop and launch a new product for the market. To generate an incentive, the surplus distribution (among consumers and producers) should need to be closer to Figure 6 than Figure 5.

Welfare optimality is therefore a complex problem. While in Figure 6 the situation favours innovation but reduces both the consumer surplus and the total surplus, in Figure 5 consumer and social surplus are maximized but there is no incentive to innovate.

Solving this optimality problem involves a lot of issues: the welfare optimal position will not necessarily be the one that maximizes the consumer surplus but be the one which tries to find a good balance between sufficient consumer surplus and sufficient incentives for innovators. Economists generally argue that a market will generate a welfare optimal outcome when the incentives for an action (innovation) equal the social benefit that will arise from that action. In case of fundamental and/or vital innovation, the social benefit can be high implying high incentives and by deduction high profit. All debates about the pricing of new drugs can be put in such a framework.

4) Under what condition the price will always tend to P (the equilibrium price)?

It is easy to understand intuitively why - under conditions of pure and perfect competition - there is only one price which is stable – so that firms are price taker (and not price maker). Pure and perfect competition means that: 1) there is a large number of buyers and sellers, 2) buyers have perfect information about prices, 3) nothing prevents additional firms to enter the market with the same product.

Figure 7 can help us to understand how the equilibrium at price **P** and quantity **Q** is arising from successive decisions about price and quantity taken by producers and consumers in a context of perfect competition.

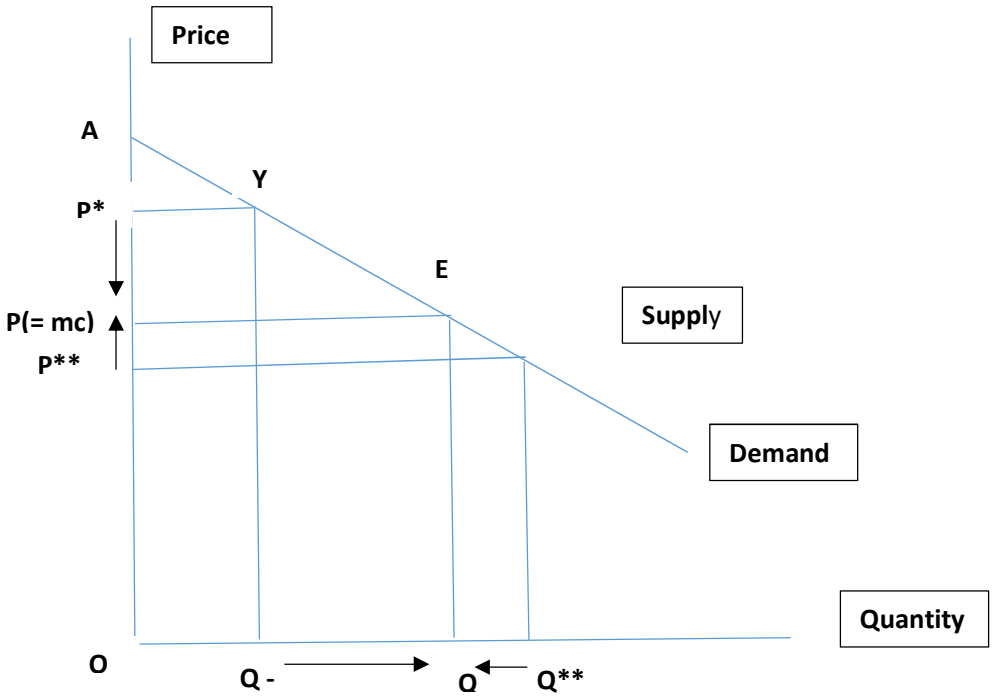

Figure 7 – What process brings about P ?

Let's imagine a situation where a first entrepreneur offers a new product and set a higher price than **P**, say **P*** (as on Figure 6). Such price is not stable. At **P***, only a small fraction of consumers can afford the product; those whose *willingness to pay* is measured by [**A:Y**]. However other suppliers can enter freely – let's assume that the first entrepreneur has no patent or other mechanism to protect her exclusive offer – this perfect competition. The other suppliers will enter because there are opportunities of profit by selling the same product at prices between **P*** and **P** . At the same time, some consumers are ready to buy at these prices since the interval **[P* : P]** includes prices that are lower than their *willingness to pay*, which is defined by the interval **[Y:E]**. Of course, the first entrepreneur **cannot** keep her initial price

(remember condition 2 of pure and perfect competition) and needs to adjust her price down to **P**. This is why in such situation firms are characterized as price taker (not price maker).

Prices are going down to **P** as the process of entry unfolds. But the process cannot continue to reach **P** and Q****. At such price which is lower than marginal cost, the activity is no longer viable. **P** becomes the market price that all firms must adopt at the end of the process.

5) Market power – monopoly and monopolistic competition

To keep price at p* such as on figure 6 (which is the objective of a profit maximisation strategy), the firm needs some kind of market power: something (for example a patent on an innovative product) which will prevent potential rivals to enter with a copy of the same product. Having a market power, the innovator can benefit from a temporary monopoly position and the associated rent (the profit).

Technically, the monopolist will decide quantity Q* at the point X where the marginal revenue curve is crossing the mc curve. This quantity gives a certain price P*. This figure is similar to figure 6 but includes the marginal revenue curve to determine the monopoly price.

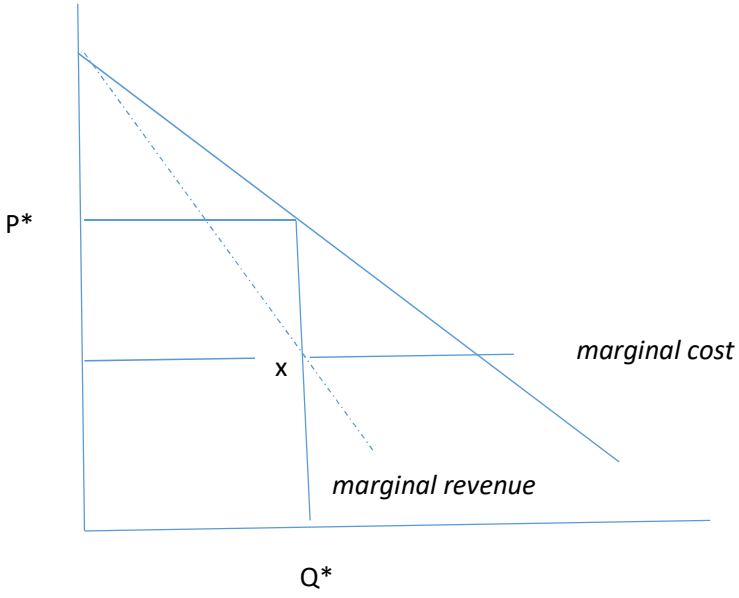

Figure 8 – Marginal revenue and marginal cost to determine monopoly price

Between pure and perfect competition and a monopoly, an interesting situation is captured by the expression “monopolistic competition”. The situation is a mix of monopoly and competition. It is generated by the introduction of slightly differentiated products or services (called “horizontal differentiation”). In this case demand curve shifts to the left. Price of the first

innovative product and profit go down as some consumers switch to the substitute (figure 8). With new entries of weakly differentiated products or services, this will continue until the end of any profit. Monopolistic competition drives product differentiation and hence innovation or get prices close to competitive market price.

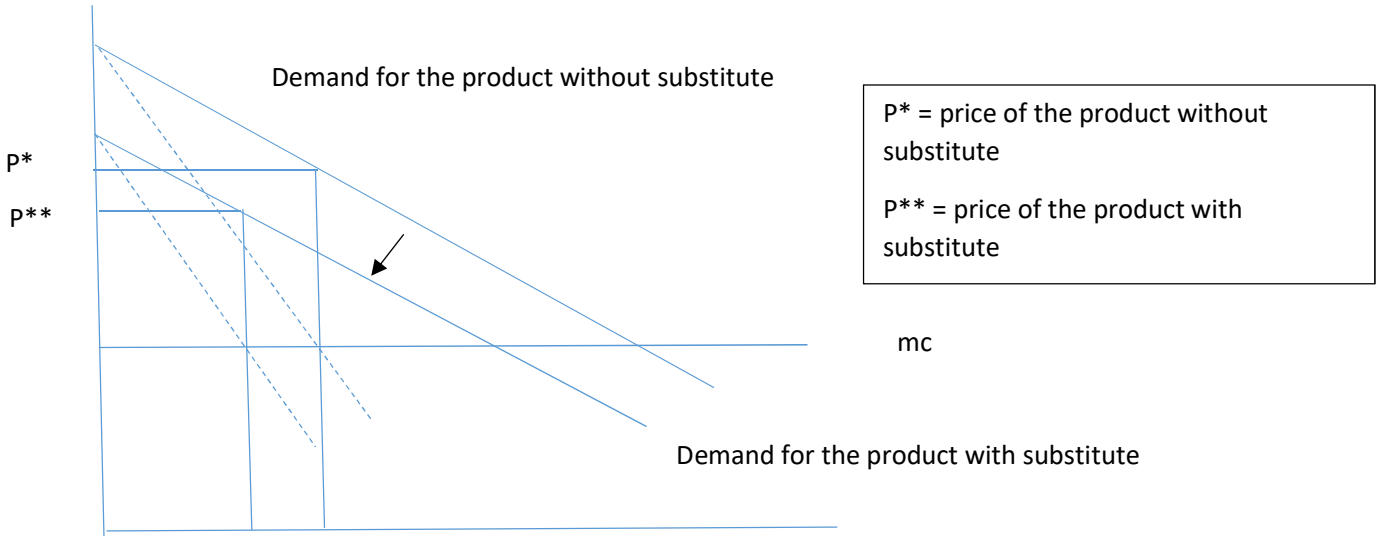

Figure 9– Monopolistic competition

On Figure 9, prices and profits decrease but not under the same logic as on Figure 7. On Figure 7, price is decreasing because rivals enter with the **same** product at lower price – meaning that all offers need to be adjusted to the lowest price (because of perfect competition and homogeneous supply). On Figure 9, there are **different** versions of a generic product, so prices are still established under a profit maximisation logic (considering marginal revenue as on figure 8) but given a lower demand curve.

6) Complete Exercise A

Estimate the welfare effect of a product innovation – with price = marginal cost (the case of, say, a social entrepreneur)

We assume a product innovation: a better smartphone. Consequences on Figure 5: the willingness to pay is increasing and therefore the demand curve is shifting upward. Costs and price remain unchanged (with c = P) although there is an innovation - which can happen in many circumstances. This can be the consequence of a social choice but other causes involve government's regulation on prices, competition intensity, long term contracts with large buyers, consumers actions,... (we will discuss such circumstances, called *market failures*, during the course). What are the consequences of this innovation on quantity, consumer surplus and total revenues?

Draw Figure 10 – including the old demand curve and the new one which is shifting upward and price and cost remaining unchanged and put capital letters on the graph to measure the "new" consumer surplus and total revenues from the sales of the new good.

However in such a situation – as we said - there is no incentives for innovators and such a surplus distribution is therefore not socially optimal.

7) Complete Exercise B

Estimate the welfare effect of a product innovation – with a price above marginal cost (case of a monopolist or patented innovation)

Let's assume that the innovator enjoys a monopoly situation (the innovation is patented) – then it is realistic to think that price will be higher than marginal costs. This price is "stable" but not efficient. It is stable (contrary to Figure 7) because we are no longer in a context of perfect competition; meaning that no rivals can enter this market with the same product, even if some potential consumers are ready to buy the product at a price below the one set up by firm **i** and above **P**. Firm **i** has a patent which prevents entry.

In this case, firm **i** will use its market power to set a price above marginal cost (technically it will adjust the price until the marginal revenue of supplying an additional unit equals the marginal cost of doing so – see Figure 8). In any case the firm does not care any more about potential entry by rivals, but will maximize benefits only considering marginal cost and the demand curve.

For our exercise, you do not need to consider the marginal revenue curve to set the new price. Just put it at any point above marginal cost.

Draw now Figure 11 with the old demand curve and the new one which is shifting upward, the cost curve and a price higher than the cost. Measure new consumer surplus, producer surplus and total surplus as well as the loss of consumer surplus.

Doing this final exercise, you have identified a pure profit or monopoly rents – the profit earned by a monopolist which results from it reducing output and increasing the price from the level at which price equals marginal cost. You have also measured the consumer surplus loss – which measures the inefficiency of the monopoly.

Based on these simple microeconomics tools, we will ask during the class whether an innovation can be priced at the competitive equilibrium price level (in such case the consumer will enjoy a better product or service at the best price – consumer surplus is maximized), how is the total surplus shared in case of a monopoly (a patented innovation), etc.. We will be able also to provide a sound theoretical foundation to the concepts of business innovation versus social innovation.

With that, you are fully prepared for our micro-economics session!