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# HANDOUTS

# INDUSTRY ANALYSIS

## -GENERAL-


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# INDUSTRY ANALYSIS
*Industrial economics and economics of innovation*

## Basic microeconomics and market structures (oligopoly)

**Industrial Organization** (IO) -> we study firms, markets and how industries are organised. We study how do they work in the demand and supply side. We'll study how organisation compete, and how they gain competitive advantage in markets with different structures. There are different ways in which a organisation can gain competitive advantage.

> We'll study how firms compete with each other (*focus mainly on the supply side*) -> it studies the working of markets an industries -> consumers won't be able to set the price of the market (the price is given by the market) -> for the supply side there are many market structures that can set different power for the industries to set the prices

An **industry** is  the set of firms that produce a specific (substitutable) good/service -> ***set of firms that compete with one another*** -> they produce something that if substitutable for the consumers (they are exchangeable and not that reason the firms are competitors) -> it's difficult to define who is part of the industry or not -> industrial classification by product classes, cross elasticity (good/services that are substitutes, complement or not related -> define how the amount of a good changes based on the changes of the amount of an other product -> *i.e.* if the prices of sugar increase and the amount of coffee decrease, then coffee and sugar are complements…) **Cross elasticity of demand** (often called cross-price elasticity of demand) measures the responsiveness of the quantity demanded of one good to a change in the price of another good. It's a way to understand how the demand for one product is affected by changes in the price of a different product.

It's important to study industrial organisation because it helps us understand in which environment a firm stands (perfect competition, oligopoly …) and how it can reach more market power. It's important to understand this in order to give advises to the company in which we work.

> Thus, industrial organisation uses ***microeconomics*** (markets) + ***firm strategy*** mainly concerned with oligopoly with strategic interactions among firms (different from monopoly and perfect competition) -> firms interact one another -> their actions effects the profits of all the environment and not just the one of one company -> firms must try to observe the strategies and actions of the various firms, when it's not possibile they must conjecture what the other firms are doing

In particular we will study the concept, origin and effect of **Market power** -> it is the capacity/ possibility for a firm to increase price above (marginal) costs without losing all buyers -> it's important because market power implies extra profits and firm value -> there are different types of industries: when we talk about perfectly competitive markets, we talk about industries characterised by *low entry-barrier* and a l*arge number of companies* (zero extra-profit). If both sides are *price takers*, there is *no market power*. We focus on markets in which firms have some degree of market power.

**Strategic interaction** -> we'll use analytical tools to study situations where profits (or utility) of economic agents *depend not only on their choices/actions, but also the choices/actions of other economic agents in the market* -> an action by one firm can affect the profit and the actions not only of this firm but also of other firms.

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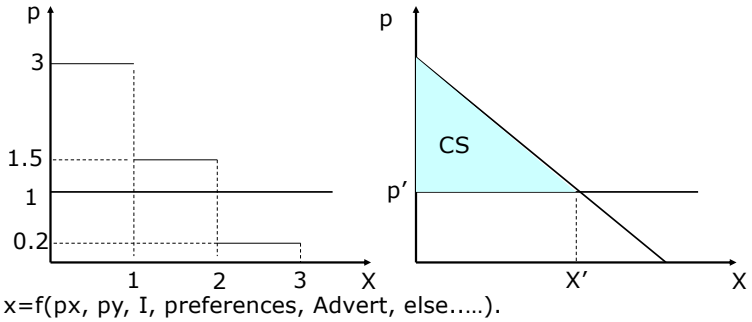
## *Basic microeconomics*

**Demand elasticity** -> Demand elasticity, often referred to simply as price elasticity of demand, measures how sensitive the quantity demanded of a good is to a change in its price. It quantifies the responsiveness of consumers to price changes.

A *demand curve* describes the relationship between the price of a product/service and the quantity that consumers demand of it -> it can be a continuous function or a series of points (p as a function of x -> price for quantity) -> if the function is decreasing is because of the decreasing marginal utility (i.e. for first slice of pizza, if your hungry, you are willing to pay more)

**Demand side: the demand curve**




x=f(px, py, I, preferences, Advert, else…..).
Everything else being equal, **x=D(p)** → inverse demand function: $p=D^{-1}(x)$ with $p'(x)<0$ (**decreasing marginal utility**)
D(p) identifies quantity demanded by consumers for different p
**CS**=consumer surplus, i.e. difference between willingness to pay and actual price for all units purchased

X = f (px, py, I, preferences, Advert, …) -> the quantity can depend on many different variables, we assume that prices and quantity are related with all the other things fixed

**CS= consumer surplus** -> i.e. difference between willingness to pay and actual price for all units purchased -> Consumer surplus is a concept in economics that measures the difference between *what consumers are willing to pay for a good or service and what they actually pay*. It represents the benefit or value consumers receive when they pay less for a product than they were willing to pay.

**CS = Willingness to Pay–Market Price Consumer Surplus**

**PS = producer surplus** -> i.e. minimus price at which the firms is willing to sell the good and the actual price at which it can sell the good -> Producer surplus is a concept in economics that measures the difference between the amount producers are willing to accept for a good or service and the amount they actually receive. It represents the benefit producers receive when they sell a product for a higher price than the minimum price they were willing to accept

**PS = Total amount Received - Total Minimum Amount Willing to Accept**

**Demand elasticity** measures how reactive are consumers to changes in prices -> how much does the quantity demanded change as a result of a price change (irrespective of units of measurements) -> ration between percent variation of quantity demanded and percent variation in price. It is *negative*

$$\varepsilon = -\frac{\Delta x / x}{\Delta p_x / p_x}$$

- *If ε is greater than 1* -> demand is elastic -> highly reactive to changing in prices -> if the price increase, the quantity decrease more than proportionally
- *If ε is lower than 1* -> demand is inelastic -> not much relative to changing in prices
- *If ε is equal to 1* -> demand changes exactly as the price change

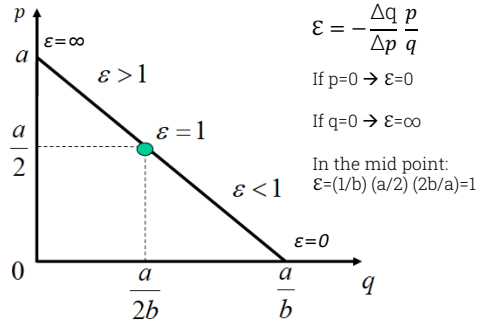
The demand elasticity is useful to compare demand curves for different goods (reaction of X to changes in p). It's also useful for price, advert., taxation strategies on X. This measure is influenced by: time needed to adjust X, share of the consumer's budget spent on X, possibility to find substitutes for the good.

The *demand side* of a market (buyers) will be described by the inverse demand function

**p(Q)= a-bQ with p'(Q)<0**

$p = a - bq$ (inverse demand function)

*Or: q= a/b – (1/b)p*




$$\varepsilon = -\frac{\Delta q}{\Delta p}\frac{p}{q}$$

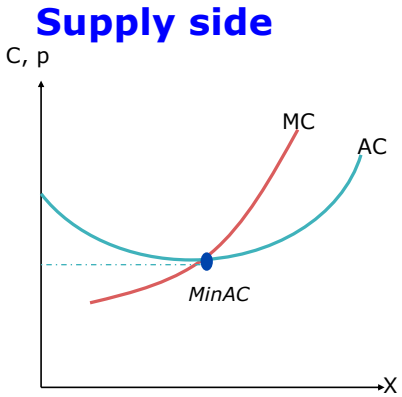
If p=0 → ε=0

If q=0 → ε=∞

In the mid point:
ε=(1/b) (a/2) (2b/a)=1

The *supply side* (sellers) is our main concern:

There is a relationship between AC and MC -> if the MC for an extra unit is higher than the AC, then if we measure again the AC (considering the extra unit), it increase. Viceversa if the MC for an extra unit is lower than the AC, if we measure again the AC, it decrease. The two lines cross each other when the AC stop decreasing and it start increasing (from being lower to being higher then the MC) -> *MinAC*




Relationship between MC and AC:

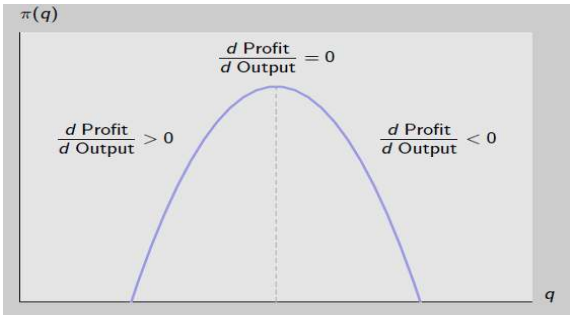
If MC<AC, then AC downward slope

If MC>AC, then AC upward slope

If MC=AC, then MinAC

**Profit maximisation**

**Profit = TR (total revenues) - TC (total costs)**




Profit is maximised when the marginal revenue is equal to the marginal cost

**Marginal revenue (MR)** -> Marginal Revenue is the additional revenue that a firm earns from selling one more unit of a good or service -> **MR = ΔTR/Δx**

**Marginal cost (MC)** -> Marginal Cost is the additional cost incurred from producing one more unit of a good or service -> **MC = ΔTC/Δx** -> change in the total cost for a change of x=1 (small change of x) -> extra cost for an extra unit that we produce

**Average cost (AC)** -> total cost/x

- Profit and marginal profit:

$$\pi(q) \equiv R(q) - C(q)$$

$$\frac{d\pi(q)}{dq} = \frac{dR(q)}{dq} - \frac{dC(q)}{dq}$$

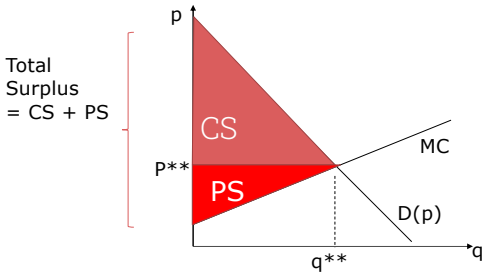
- Marginal revenue: $MR \equiv \frac{dR(q)}{dq}$
- Marginal cost: $MC \equiv \frac{dC(q)}{dq}$
- Profit maximization implies that $\frac{d\pi(q)}{dq} = 0$, which is equivalent to

$$MR = MC$$

**Total cost** -> fixed cost (does not depend on the quantity of good produced -> cost for machines, buildings, energy…) + variable cost (cost that change according to the number of units of goods produced -> materials..)

*How do firms set prices and quantities in the market, set the number of advertisement and promotions, differentiate their products in order to maximise their profit?*

The optimum quantity to produce is not the one for which the profits are zero, but they should stop somewhere in the middle of the positive part of the graph above, in order to maximise the profit -> **the derivative of the profit with respect to x should be equal to zero** -> MR = MC




**Efficiency** -> allocative efficiency (static efficiency) -> sum of consumer surplus + producer surplus -> CS + PS = TS

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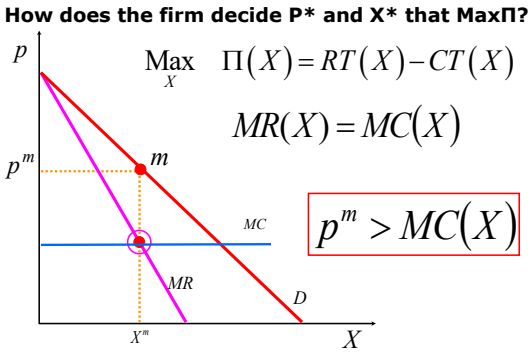
## *Market structures*

There are different degrees of market structure -> monopoly and perfect competition will be used as benchmarks to better understand how oligopoly work

**Monopoly** -> one dominant firm/provider with market power (can set prices above MC without losing customers) -> first step into the study of the causes and consequences of market power -> they can set prices and quantities strategically in order to maximise the profit -> A firm that has the power to set the price of a good, and that uses this power to sell at a price substantially above (marginal) cost (without loosing all the demand for that good), is a firm with a certain degree of market power-> Competition policies based on the idea that abuse of market power is bad for customers -> there are government actions to try to keep an eye on markets that are very concentrated because of this capacity to set prices and quantities

1. *The supplier (single supplier) is price-maker* -> it sets price p and quantity Q to sell that maximise profits, the monopolist is not price-taker -> *D(p) has a downward slope* (it can increase the quantity that it sells by decreasing the price) -> optimum for producers but not for customers
2. *Buyers are price-takers* -> they can't change the demand curve, they must accept the price fixed buy the firm
3. *Seller does not behave strategically* -> there is only one firm
4. *Entry barriers to the market* (no substitutes to the monopolist's good) -> licence to enter the market, firms do not have access to the same best technology or there is not the same level of informations between different firms -> the presence of obstacles that prevent the entering of other firms in the market is a key element of the monopoly structure (otherwise firms could see an opportunity for their profits and we would have a perfect competition situation)

**How does the firm decide P* and X* that MaxΠ?**




MR curve is below the demand curve because, in order to sell an additional unit I'll have to lower the price of all the units that are sold so far -> the distance between the two curves will increase for every additional units that we sell.
The slope is double the slope of the demand curve

**Perfect competition** -> atomic market (very small markets) -> each firm create a part of the quantity produced in the market

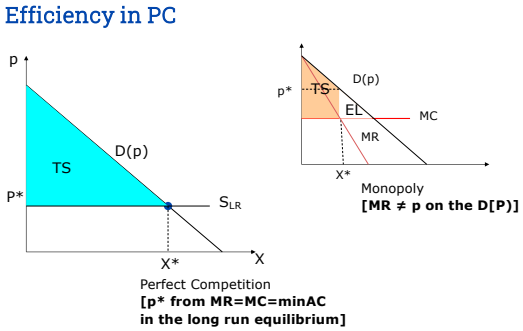
1. *The supplier is not price-marker* -> each firm contribute for a very small amount of the quantity and they can't change the price of the product -> the firms are price-takers and for that reason they can only change the quantity
2. *Many competitors* -> many firms but with smaller size and market share
3. *Buyers are price-takers*
4. *Sellers do not behave strategically* -> They don't because they can't change the price in any case (they are not able)
5. *There aren't barriers to the market* -> free entry and exit -> (there are different substitutes for the good produced by a firm) > there is transparency on the price and potential entrants can decide if they want to enter or not depending on the opportunity to make profit

In a situation of perfect competition, *suppliers and buyers are price-taker*. They are many and small (atomicity). Thus, their actions have no significant impact on the market p and X, and thus on competitors' profits. Product is *homogeneous*. For that reason, suppliers do not behave strategically and we have a situation of free entry and exit -> (no barriers to entry): firms can enter and exit the market at no cost (only K and L). There is perfect information about prices set by other firms and equal access to production technologies. In the long run firms can enter the market since they have the time to get the necessary capital and labels, as long as profits are greater than zero in the short run (then they will become equal to zero and there will be no interest in entering the market).

**General principle** -> *competition eliminates extra profits and it's economically efficient* -> a perfectly competitive market is the one in which economic forces (**the invisible hand**) operate unimpeded -> the invisible hand is a metaphor that describes the self-regulating nature of a free market economy, where individual self-interest unintentionally benefits society as a whole.

There are many results of a perfect competitive market:

1. In the long run run equilibrium, **price=MinAC**. This produces the highest level of allocative efficiency: Max Total Surplus, and particularly Max Consumer Surplus.
2. The number of firms in the market is efficient in the sense that there is a number of firms such that p=MinAC -> N= X*/Xi*
3. There are zero Extra-profits
4. When the  the market is in equilibrium there is neither entry, nor exit. When the market is not in equilibrium there is either entry of new firms (if profits are positive) or exit (if profits are negative). Entry and exit do not occur together.
5. Perfect information and equal access to production technologies imply that, in the long run, all firms have the same size (the efficient size ... MinAC).




**Oligopoly** -> there is a strategic interdependence between competitors -> need to take into account conjectures about competitors' actions

1. *Suppliers are price-maker* and the number of firms is finite (no atomicity) -> few large firms able to change the market (prices or quantities)
2. *Buyers are price-taker* -> they are numerous and smalls
3. *Suppliers behave strategically* -> each firm knows that its actions influence other firms' profit
4. *Models with free entry and exit, or models with barriers to enter*

Product can be either homogeneous or differentiated -> we deal with **homogeneous** products -> Homogeneous products are goods or services that are identical or nearly identical in terms of their characteristics, quality, and functionality, regardless of who produces or sells them. This concept is crucial in various economic theories, particularly in market competition and pricing strategies. The assumptions presented above are valid both for the Bertrand and the Cournot model -> differences in the quantity variable (short-run / long-run variable)

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## *Models with homogeneous products*

**Bertrand** -> price competition (when quantity is a short-run variable -> e.g. software industry) -> easy to adjust the quantity -> firms decide the price that maximise the profit, the quantity depends on the maximisation of the profit (quantity is a short run variable -> i.e. software industry, Netflix)

1. *Two firms populate a market (duopoly)* -> they set p *simultaneously* for an homogeneous product -> the firm that set the lower price will get all the demand (until there is not profit)
2. *No capacity constraints* (firms can serve the whole market if they want to)
3. *Barriers to entry*

4. *Firms have same marginal and average cost c* -> equally efficient -> same cost function to produce one unit of the good (same input for the same output)

We are looking for an equilibrium, i.e., pi* and pj* for the two firms such that each Maxπ (thus, *no incentive to deviate unilaterally*), given conjectures on the other firm's actions (and, ex post, conjectures are correct). ... that is, no firm increases profits by unilaterally changing p

**(Bertrand-Nash equilibrium, p1*, p2*)**

To find the equilibrium we start from each firm's best strategy (**firm's best response**) to the competitor's conjectured strategy.

For **any p2 conjectured by Firm1 (with p2>MC)** Firm1 will choose p1 just below p2 (p1=p2-ε). In so doing, Firm1 gets all the demand and receives positive profits (because p1>MC).

However, also Firm2 will conjecture p1 set by Firm1 and sets p2 just below p1 to get all the demand (p2=p1-ε).

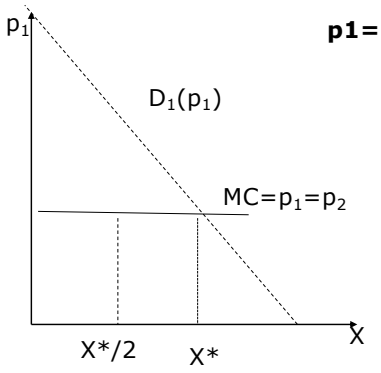
**If both firms anticipate the competitor's best strategy**, the only possible **equilibrium** (such that no firm has an incentive to change p unilaterally because this will not increase profits) is for

**p1=p2=MC**

Indeed, for any (conjectured) p>MC, each firm has an incentive to set a p lower than its competitor in order to get all the demand.

Equilibrium

**p1=p2=MC**




Formally, best p1 and choice based on conjectures on p2 choices (and vice-versa) is described by the Reaction (or Best Response) Function as follows:

**p1*(p2) and p2*(p1)** -> p1 best decision with conjectured p2 and p2 best decision with conjectured p1

If we call the generic firm 1, 2= i, j and pm the monopolist price:

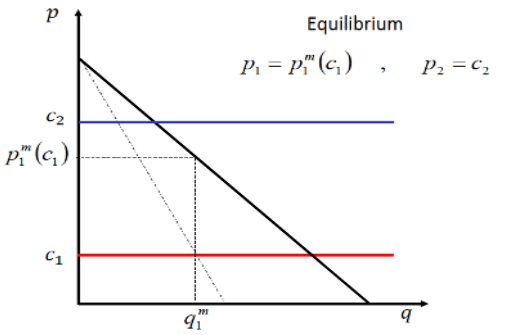
$$p_i^*(p_j) = \begin{cases} p^m & \text{if} \quad p_j > p^m \\ p_j - \varepsilon & \text{if} \quad c < p_j \leq p^m \\ c & \text{if} \quad p_j \leq c \end{cases}$$

If both prices are higher than the MC, the two firms will have an incentive to lower the price to get the whole demand -> p1=p2=MC is the only possible equilibrium -> same a Perfect competition.

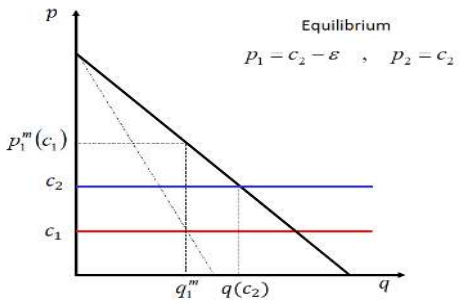
If we consider a different situation, in which the cost efficient of the two firms differ, the Bertrand equilibrium will change:

$$C_1(q_1) = c_1 q_1$$
$$C_2(q_2) = c_2 q_2$$
with $c_1 < c_2$

*Firm 2* less efficient than *Firm 1* ($c_2$ higher than monopoly price):




*Firm 2* less efficient than *Firm 1* (with $c_2$ lower than monopoly price):




The firm that is more efficient can set a price that is lower than the MC of the less efficient firm. In this way this firm can be a monopolist in the market. If c2 is higher than pm, the best option for firm1 is to put p1=pm1. On the other hand, if c2 is lower than pm1, then p1 should be lower slightly than c2 but higher than c1.

## RESULTS OF THE BERTRAND MODEL

Both firms set p=MC ... the same as in Perfect Competition. Also X produced is the same as in perfect competition! Two competitors are sufficient to lead to the results of a perfectly competitive market: **zero market power**! Also, **Extra-profits are zero** for both firms, unless heterogeneous cost functions **Max Total Surplus** (and Consumer Surplus)... Allocative efficiency.

*Bertrand's result is paradoxical* -> if the number of firms goes from one to two, the price decreases from monopoly price to competitive price and stays at the same level as the number of firms increases further. The paradox highlights that, under certain conditions, price competition can drive prices down to the point where firms earn zero economic profit, even if there are only a few firms in the market.

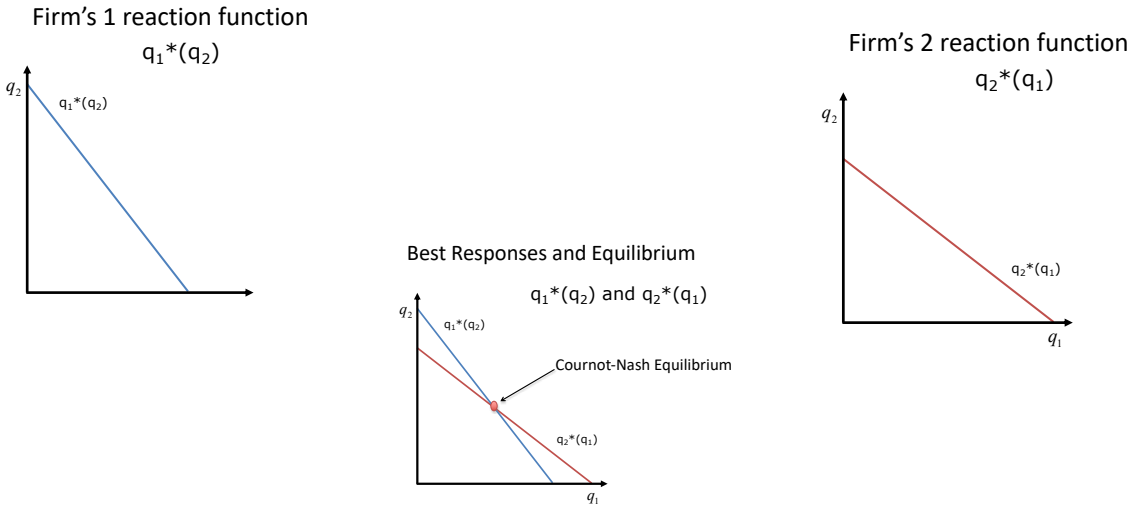
However, there are industries with only two competitors (**strategies on p**) that make *positive extra-profits*. How can this be? There are different possible explanations:

- **Product differentiation** (... other models of IO)
- **Dynamic competition** -> if the game is repeated more than one period, then equilibrium is possible with p>MC
- **Capacity constraints** -> p set >MC if Firms do not have sufficient capacity to satisfy all the potential demand.
- if **MC differ** between the two firms
- Moreover, this is a non-cooperative equilibrium. Firms, however, might **Collude** and behave as a monopolist (share the market and profits)

**Cournot** -> competition on output (when quantity is a long-run variance -> e.g. energy plant) -> difficult to adjust the quantity

1. *Two firms populate a market (duopoly)* -> they set x (quantity) simultaneously for an homogeneous product
2. *Barriers to entry*
3. *Firms have same marginal and average cost c* -> equally efficient

Equilibrium (Xi* and Xj*) such that each firm Maxπ given conjectures on the other firm's actions (and conjectures are correct). ... Thus, no firm increases profits by unilaterally changing X **(Cournot-Nash equilibrium, X1*, X2***). Price is set on the demand curve for the level of output produced by the two firms together **p=p1=p2=p(X1+X2).**




We have to understand which is the best way to maximise the profit, given a determined quantity of product -> How much should I produced to maximise my profit, given conjectures on the quantity produced by the other firm.
If we have different conjecture on how much firm2 is gonna produce, we can set different quantities for firm1 in order to maximise the profit of firm1. If we want to find an equilibrium that doesn't give any firm the incentive to change the situation, we can only find a point of equilibrium -> intersection of the two reaction functions. In the Cournot model, firms compete on the quantity of output they produce. Each firm decides its production quantity assuming that the quantities produced by its competitors are fixed. The main assumption is that firms do not consider the strategic interaction in terms of price but rather in terms of quantities. The Cournot best response function illustrates how a firm's optimal output depends on the output levels of its competitors. Each firm takes into account the total quantity produced by others when deciding its own production level. In equilibrium, each firm's production level will be such that it is the best response to the production levels of the other firms, leading to a Cournot-Nash equilibrium where no firm has an incentive to unilaterally change its output. In order to find the best response for a firms, we must start by the residual on the demand curve (if we conjecture than over a total of 100 units, firm2 will produce 10, the residual il 90) and maximising the profit on this -> *maximisation of the profit for firm 1 on bases of the residual*

*demand curve for firm1, given conjecturers of the quantity produced by the other firm2.* -> equilibrium is in the intersection of the two curves given the conjectures of the other firm.

## RESULTS OF THE COURNOT MODEL

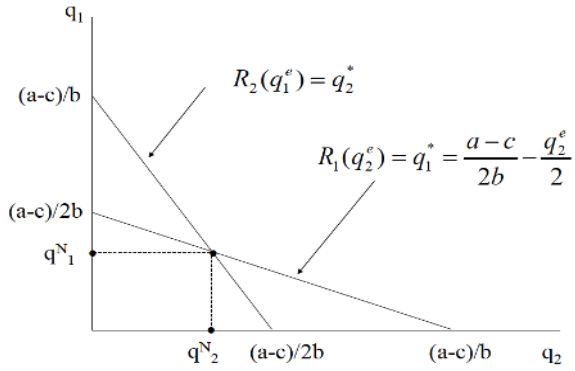
The price is higher than MC but lower than in Monopoly -> there is come market power. There are positive Extra-profits equally shared between firms if they have the same cost function. Otherwise, the most efficient firm earns higher profits. There is no allocative efficiency -> Total Surplus (and also p* and Q*) between monopoly and perfect competition -> TS is not maximised.

## *COURNOT FORMAL MODEL*

Inverse demand function **p= a-b(Q)** with **$Q=q_1+q_2$**

Thus, **profits** by firm 1 is given by pq1-cq1:

$$\pi_1(q_1,q^e_2) = [a - b(q_1 + q^e_2)]q_1 - cq_1$$




And the **reaction function (best response)** is given by:

$$\partial\pi_1 / \partial q_1 = 0$$

$$a - bq^e_2 - 2bq_1 - c = 0$$

$$R_1(q_2^e) = q_1^* = \frac{a-c}{2b} - \frac{q_2^e}{2}$$

**Nash-Cournot equilibrium**:

$$\begin{cases} q_1^N = q_1^*(q_2^N) \\ q_2^N = q_2^*(q_1^N) \end{cases}$$

With best response functions:

$$q_1^N = \frac{a-c}{2b} - \frac{q_2^N}{2}$$

If firms are symmetric: $q_1^N = q_2^N = q^N$

$$q^N = \frac{a-c}{2b} - \frac{q^N}{2} \quad \Rightarrow \quad q^N = \frac{a-c}{3b}$$

**Equilibrium price**:

$$P(q_1^N + q_2^N) = a - 2b\frac{(a-c)}{3b} = \frac{a+2c}{3} > c$$

**Equilibrium profits:**

$$\pi_1^N = \left(\frac{a+2c}{3} - c\right)\frac{a-c}{3b} = \frac{(a-c)^2}{9b} > 0$$

In the Cournot model is important to remember that the quantity produced is the total of the quantities produced by both the two firms considered. The same process we saw for firm1, can be applied for firm2 since the two firms are symmetric. When firms are symmetric (same cost function, same MC), in equilibrium they will produce the same quantity so we can use q1=q2=q

### Differences between Bertrand and Cournot

There are different assumptions on the "strategic variable" (p vs. x) leads to very different conclusions. There not an absolute answer to the question "Which model is more realistic?" -> it depends on the type of industry. In sectors where **quantity is a long-run decision** (because, once set, it is difficult to adjust in the short-run) compared to prices, then the Cournot model is a better approximation of how markets work. By contrast, if **quantity is a short-run variable** (easy to change rapidly), then the right model is Bertrand: firms choose prices and then adjust quantity accordingly (example: software).

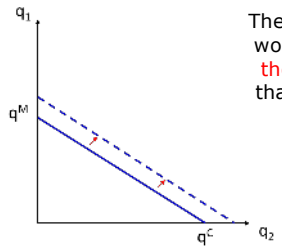
## Comparative statics

We now compare equilibrium situation with a change in a variable, searching for differences. We compare two equilibria with two sets of exogenous conditions and predict how a **change in one variable** influences the other variables in **equilibrium**, i.e., once all adjustments have taken place. We need to see how things change if we change the cost structure in a Cournot market (different MC)

If we consider that we have the same assumptions that we made before, but due to same external reasons, the two firms become less efficient by the same amount (MC increases for both firms of the same amount). We need to start for the usual graph with the total demand function for a firm1. In order to decide which is the amount that the firms need to produce in order to maximise its profits, we need to consider the residual demand curve.  Suppose that the conjecture is that q2 is equal to 10, the residual demand is below the demand curve and the difference between the two is equal to 10. We consider the MC curve (horizontal) and the MR we look for the q1* to maximise the profit.
If there is an increase in the MC for both firms, this means that they both become less efficient and, with everything else equale (same conjecture…), we can observe that the equilibrium will be lower (less amount produced than before -> q1' < q1*) and the price will be higher -> the less efficient the firm becomes, the lower will be the reaction function. Obviously, the same occurs to the other firm since they are symmetric -> TS will decrease.

## Asymmetric marginal costs change

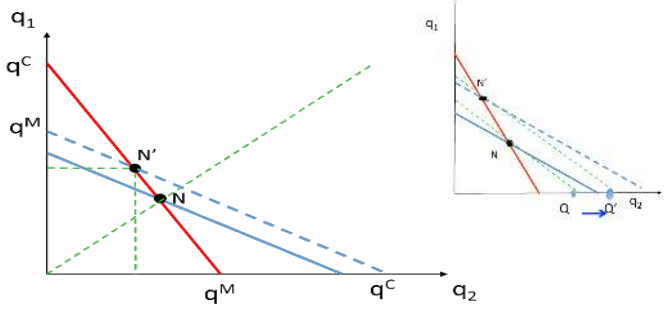
For two firms competing for quantity (Cournot), if, for example, **only one firm** faces a decrease in its marginal cost by 15%, how does the new equilibrium look like? (example: a new technology that is introduced and that is cost saving)




The reduction of the marginal cost would produce an upward shift in the reaction function of the firm that has benefitted from the new technology

Thus, the new Cournot-Nash equilibrium is:

The firm that has not changed technology sticks to the same reaction function. The new equilibrium will be in N': (1) the **most efficient firm1 will produce more** than in N, and more than the less efficient firm2; **Profits of firm1** increase (2) **total quantity also increases** (it can be seen by drawing the *iso-output lines*, with slope -1 (-45° ) that cross N and N').




If the two firms are asymmetric (one firm remains as it was, while the other has a decrease in the MC -> one is more efficient than the other), the reaction function of the most efficient firm goes upwards -> this firm will produce more since is more efficient. This create an asymmetry in the two firms in the sense that they won't produce the same amount -> we can not call q=q1=q2 because they are not the same anymore. Since the demand curve is moving upward, this means that the equilibrium will shift too -> the initial equilibrium is lower than the equilibrium that we can obtain if one of the two firms become more efficient. When we are considering a situation in which the MC of one firm increase while the other is decreasing, we might have some problems determining in which direction will go the demand curve and the equilibrium. We can do two things: we can solve the empirical exercise (numerical version) or we can use **iso-outputs lines** (graphical version) -> lines with a -45 degree slope that has some characteristics in the constructer: the sum of q1 + q2 is constant and this help us determine the quantity produced by each firm just by looking at the intersection with the axis (is we see that the intersection with the horizontal axis is 100, then we know that q1+q2 is equal to 100 and we can determine every combination of q1 and q2).

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## Price competition with capacity constraints

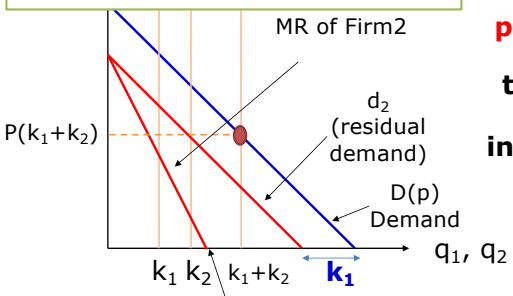
In Bertrand Model, if p>MC, by undercutting the rival, a Bertrand duopolist receives all the market demand. This happens, however, under an important assumption of Bertrand Model: firms have no capacity constraint. What happens if firms are **capacity constrained**?

There are some general assumptions:

- *Firms simultaneously set prices*

Suppose Firm 2 has a greater capacity: $k_2>k_1$
Total industry capacity: $k_1+k_2$
MC=0

Equilibrium in Bertrand with no capacity constraint would be X* such that $p_1=p_2=MC$. Note that MC corresponds to horiz axis. However, with capacity constraint, Max X= k1+k2<X*




Here, d2 is the demand for **Firm 2 that operates as a monopolist if Firm 1 produces $k_1$**. Thus, MR=MC for Firm2. but Firm2 is capacity constrained, so cannot produce more than $K_2$

The **equilibrium** of the price-setting game is derived from the intersection between total capacity and D(p):

**$p_1=p_2=p(k_1+k_2)$** such that **total demand is equal to total industry capacity**

Is this an equilibrium? Any incentive to deviate to gain higher profits?

-*Marginal cost is constant* (assume MC=0 for simplicity -> each marginal unit has no cost -> we just consider fix costs, graphically MC overlap the horizontal axis)
-*Products are homogeneous*
-*Each firm is constrained by its capacity ki* (I.e. firm cannot sell more than ki, even if the demand is larger thank ki)

With standard Bertrand Competition, if Firm 2 sets a p2 greater than that of Firm1, its demand is zero and the other firm will get the total demand. The same is not necessarily true if Firm 1 is capacity constrained. With **capacity constrain**, suppose **k1< D(p1)**, that is, the demand Firm1 receives (for p=p1) is higher than its capacity k1 -> in this case, firm1 sells up to its full capacity k1 (by setting a price lower than competitors). However, the residual demand for Firm2 will not be zero -> it is **D(p2)-k1** with D(p2) being Firm2's demand for p=p2
Note that D(p2)-k1 is zero only if k1 is >= D(p1). Even if a firm set a higher price, the demand for this firm can still be positive since the will be still part of the demand not cover by the firm that set the lower price.

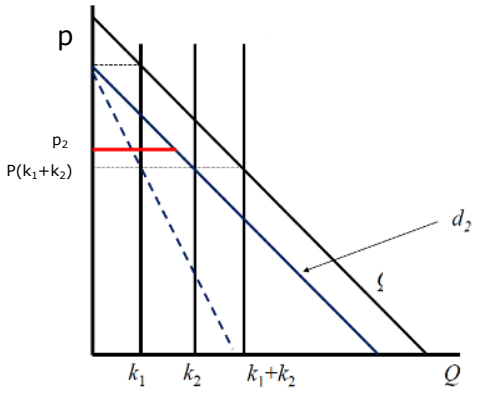
Can Firm 2 do better than setting $p_2=p_1=p(k_1+k_2)$ assuming that this is the price that Firm 1 is setting?

**Option 1** → Would Firm 2's profits increase with $p_2<p(k_1+k_2)$? With a

.

Would Firm 2's profits increase with $p_2>p(k_1+k_2)$? Firm 1 is capacity constrained (and would sell $K_1$ for $p_1<p_2$): Firm 2 receives positive demand $D(p2)-k_1$ even if it sets the price above Firm 1.

F




However: **higher price** but **quantity sold lower than $k_2$** → lower profits for Firm 2

→ this is because, MR of Firm2 is greater than MC (=0) for every value of output less than Firm 2's total capacity. Thus Firm 2 could increase profits until the point in which MR=MC (i.e., better to expand quantity at least until full $k_2$)

… Same for Firm 1.

Thus, in general, in a Bertrand industry with capacity constrained firms:

- In equilibrium, p2=p1=p(k1+k2) and no one will have an incentive to set a different price -> the competition on prices is less harsh
- If total industry capacity (k1+k2) is lower than the market demand (when p=MC), then equilibrium price is grater than marginal cost (differently from Bertrand with no capacity constraints)

## Competition with N firms

We'll look at the relationship in the market structure between firms when we have N firms and when N increases -> changes in the market structure. Since we are considering firms that are symmetric (same cost function), we'll look at the relationship between the number of firms present in the market and the ability to set prices above the MC. Market concentration is the related to the number of firms present in the market -> A concentrated market refers to a market where a small number of firms or entities control a large share. A market is concentrated if there are few dominant firms with higher market share; on the other side we can say that a market is not highly concentrated if there are many small firms with the same size of market-share. The fewer and larger the firms are, the more concentrated the market is -> the power is in the hand of few firms. If we have a dominant firm with the 99% of the market share and then 2000 firms that share the last 1% of the market-share, we can say that this market is concentrated. If firms are symmetrical, in equilibrium they will have the same size -> the number of firms is an indicator of the level of market concentration -> we don't need to

know which is the market share of each firm if they are all the same, since they have the same cost function.

## Cournot Model with n Symmetric Firms

Suppose a symmetric Cournot oligopoly ($q_i^N=q^N$) with more than 2 firms.

Firm1: $\Pi_1=P(Q)q_1-C(q_1)$
Where:
$q_1$ is quantity produced by Firm1
Q is total quantity

We can say that two firms are symmetrical if they produce the same amount.

**Firm1 produces $q_1$ that Max$\Pi_1$,** given the quantity produced by the **n-1 firms** (i.e. Max$\Pi_1$ on the residual demand curve). **Reaction curve** of Firm1: best strategy on $q_1$, given conjectures on $Q_{-1}=\Sigma^N_{i=2}(q_i)= (n-1)q_i$

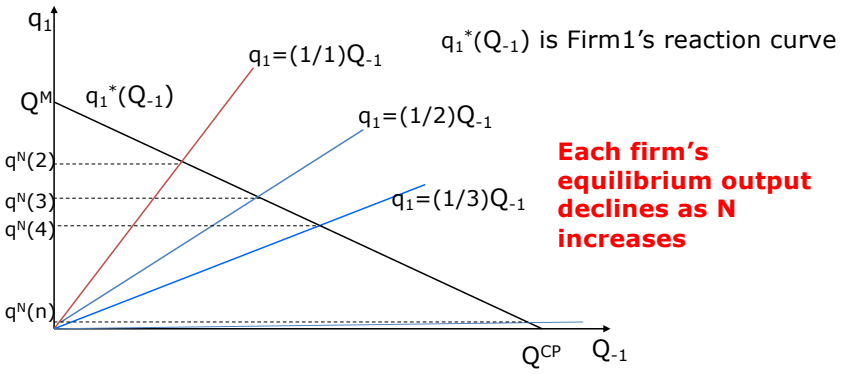
*Equilibrium* -> every firm produces qi* such that nobody has an incentive to deviate unilaterally:

1. Firm1 chooses q1* that Maxπ (MR=MC), given conjectures on rivals (reaction curve)
2. By symmetry, the other n-1 firms choose the same output as Firm1 qi=q1 for all i

Thus, **$Q_{-1}$ = qi (n-1)**

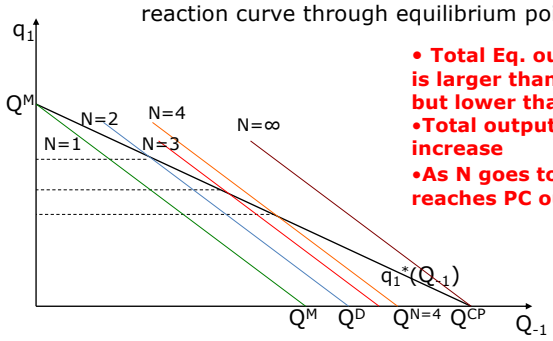
Graphically -> the equilibrium is in the intersection between the reaction curve (1) and curve **$Q_{-1}$=qi(n-1)**, or **qi=$Q_{-1}$/(n-1)** (2)
We are interest in how the equilibrium q* and Q* changes as n (number of firms) changes

Equilibrium $q^*$ (and $Q_{-1}$) for different N: intersection between reaction curve of Firm1 and $q_1=Q_{-1}/(n-1)$



What happens to Total output $Q=Q_{-1}+q_1$ when N increases?

$q_1^*(Q_{-1})$ is Firm1's reaction curve. Iso-output lines cross reaction curve through equilibrium points.




**• Total Eq. output in Cournot is larger than in Monopoly but lower than in PC.**
**•Total output increases as N increase**
**•As N goes to ∞, total output reaches PC output**

**... and efficiency increases as N goes to ∞! It decreases as N goes to 1.**

**STRUCTURE →PERFORMANCE.**
**... as N→∞ efficiency loss→0 (like in PC)**

## The Analytical Cournot Model with n Symmetric Firms

What happens to the total quantity produced in the market as N increases?

We use the iso-line trick and see what happens to the horizontal axe and we see that the total quantity produced in the market increases. What we see is that **as N increases** in the market:

- The quantity produced by each firm reduces
- The total quantity produced in the market increases from a monopoly to a PC market.
- Given the demand curve, this implies a decrease in the equilibrium price as the total quantity produced in the market increases, the price will decrease.

We want to to look what happens when we want to increase the number of firms from the analytical point of view. We use the same procedure we saw for a duopoly: we take each firm, we maximase the profits considering the actions conjectured on the other firms. What is important here is that all the firms are symmetric. So, we can write our goal as: **Qi* Max π / Q-1**

Remember that Q-1 = (n-1)qi

So firm1 produces q1 that maximise profit 1, given the quantity produced by the n-1 firms (i.e. Maxπ1 on the residual demand curve).

**Reaction curve of Firm1**: best strategy on q1, given conjectures on $\mathbf{Q\text{-}1}=\sum Ni=2(qi)= (n-1)qi$

Now we see graphically what happens:

We remember that in a duopoly we had:
$p = a - bQ$
where $Q = q1 + q2$
NOW, since we have many N, we must generalize it as:

$$Q = q_1 + q_2 + ... + q_n = \sum_{i=1}^{n} q_i$$

And, if firms are symmetric, the **inverse demand function** can be written as $P(Q) = a - bQ = a - b\sum_{i=1}^{n} q_i$

The **profit function** of the individual firm is then given by TR-TC = pqi - chi, that is:

$$\pi_i = \left[ a - b\sum_{i=1}^{n} q_i \right] q_i - cq_i$$

What is q* that maximizes profits?
(dπ/dq)=0 (that is, MR=MC)

$$\pi_i = [a - b(q_1 + q_2 + \ldots q_{i-1} + q_i + q_{i+1} + \ldots q_n)]q_i - cq_i$$

$$\pi_i = \left[a - bq_i - b\sum_{\substack{j=1 \\ j\neq i}}^{n} q_j\right] q_i - cq_i$$

We then take the derivative of the profit function wrt $q_i$:

$$\frac{\partial \pi_i}{\partial q_i} = 0 \qquad a - 2bq_i - b\sum_{\substack{j=1 \\ j\neq i}}^{n} q_j - c = 0$$

This profit function shows how the quantity conjectured by other firms concerns the profits of the single firm.

We are always working with **symmetric firms** = which means that firms have the same access to the technologies to produce the outputs and the same cost structure. The profit function is the same we did with the duopoly except for the fact that we have more than 2 firms. Remember that in the parenthesis we have the sum of qi. Our purpose is always to figure out the q* that maximizes the profit, once we know all the qi and N, then we know everything. The key variables that we have to figure out are qi and we get them from the usual maximization process (MR = MC) or through the derivative of the function = 0. SO What is q* that maximizes profits?

**(dπ/dq)=0 (that is, MR=MC)**

Before we do that, it would be convenient is to take out the qi produced by the firm about which we have to figure out the total quantity produced because if we have to do the derivative of qi we have to take it out.

SO now we re-wrote the profit function taking out the qi: the other q now we call them qj.

So we can do it like that:

Now we have to decide what are the values for different q. At this point, what we can do is to call qi=qj=q because we are symmetric firms and we have already done the derivate. And once we have q, we can do everything. Thus, we can rewrite the first-order condition (without i and j) as:

*a-2b-b(n-1)q-c = 0*

Which leads to **equilibrium output (q*)** that represents that represents the equilibrium quantity produced by each firm:

Finally, **profit** of Firm i is given by:

TR-TC = *pqi - cqi = (p - c) qi*:

$$\pi_i^N = \left[ c + \frac{a-c}{n+1} - c \right] \frac{a-c}{(n+1)b} = \frac{(a-c)^2}{(n+1)^2 b}$$

For n=1 → monopoly

For n=2 → duopoly

For n large → perfect competition

$$q^N = \frac{(a-c)}{b(n+1)}$$

Then, the total **quantity** produced in the market will be:

Total output is then= $n*q_i$=

$$Q^N{}_{TOT} = \sum_{i=1}^{n} q_i = \frac{n}{(n+1)} \frac{(a-c)}{b}$$

The equilibrium price is:

$$P^N = a - bQ = a - bn \frac{(a-c)}{b(n+1)} = \frac{a+nc}{n+1} = c + \frac{a-c}{n+1}$$

In order to find the equilibrium price we go back to the demand function, we take P and total Q and we substitute the equilibrium values.

Note that when we will have an exercise, a,b,c... are given by the text and they will be numbers. the reason why we have the generic formulations is because we want to know what happens when N increases from 1 to higher values. So what happens when a market is composed only by 1 firm or more.

So, how do price, output and profit change as n increases? As n increases (i.e. larger number of symmetric firms, lower concentration), n tends to infinitive, and the quantity tends to 0. Since the number of companies increase:

- the **single quantity** produced by each firm goes down and when N becomes very large the equilibrium quantity produced by each firm decreases until it tends to 0 // as in PC related to "atomicity".
- The **total quantity** produced in the market: it is = q(N+1) = (a-c)/b so it's all the quantity you can sell in the market given the demand function. Is the one you read on the demand curve.
- The **price**: (a-c)/(n+1) will tend to 0 so the price becomes = 0 meaning that it will tend to the MC as in Perfect competition. So there is no difference between price and Mc, there are no extra profits.

As n goes to infinity, price and total output converges to the values under Perfect Competition:

$$\lim_{n\to\infty} q^N = \lim_{n\to\infty} \frac{a-c}{(n+1)b} = 0$$

$$\lim_{n\to\infty} Q^N = \lim_{n\to\infty} \frac{(a-c)}{b}\frac{n}{n+1} = \frac{a-c}{b}$$

In perfect comp. with p=MC, P=a-bQ (D funcion) → a-bQ=c Q=(a-c)/b

$$\lim_{n\to\infty} P^N = \lim_{n\to\infty} c + \frac{a-c}{n+1} = c$$

## Collusion

We have seen the main market structures, putting them together. Now we see what can be done to increase the market power, sometimes those possibilities are legal, others they are forbidden. *Collusion* is usually used in order to increase market power, when they collude firms behave as a monopolist together. They decide the quantity to produce or the price and they maximize the profits as if they are monopolists.
One way to decide it is being transparent (showing transparently what their costs are), deciding the money they want to invest in adv. Usually they do not agree around a table in terms of price but they behave all in the same way. The general idea is that duopolistic firms usually decide to collude because it is convenient for both of them.

**Collusion** -> an agreement (mostly tacit) between two or more firms to limit competition by reducing total supply, increasing prices, setting advertising expenditures or levels of service quality -> goal = profit increase -> Clearly, this comes at the expenses of consumers...

ES: there was a doubt about gold price in Switzerland. There were indications that possible prohibited competitive agreements in the trading of precious metals were agreed among banks. There are cases in which it is hard to define the collusion.
The general idea is that collusion is good for firms BUT not good for consumers

**General principle** -> *game repetition in oligopolistic markets helps enforcing otherwise unenforceable agreements* -> What we will see is that (especially in Bertrand) when you have a one-shot game, the incentive for firms to exit possible agreement on price is very strong because mis-behaving (by exiting a possible collusion agreement) they would get the whole market -> this misbehavior is called **DEVIATION**. IF the game is not repeated, each firm in the market will have a strong incentive of not colluding. For this reason a necessary condition is the repetition of the game.
Usually what happens is that prices are not decided today and then never checked but they are repeatedly checked. The strategy when firms agree in higher price is that they agree in p1 = p2 = pm (monopoly price); if in the following period they see that all the firms in the market have behaved correctly according to the agreement, they keep doing collusion (so setting this monopoly price) but if a firm misbehaves then that firm will be punished by other firms by setting a price p = MC forever and due to that the profits will be = 0 for the following years. This is the punishment set by the firms that do not deviated. SO the repetition of the game is essential because:

- It allows to all the firms to check the behavior of everybody in the market
- The punishment for the years to come is a terrible threat that will make firms not deviating from the collusion

They can play the following **grim/trigger strategy** -> in the **first period** the two firms can collude and behave as a monopolist and then share market and profits: p1=p2=pM -> they set the monopoly price.

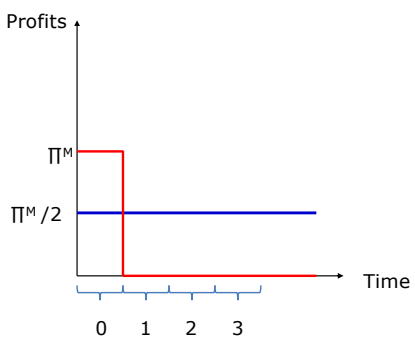
$$\pi 1 = \pi 2 = \pi M/2$$

In the **Following periods** when we have a repeated game there are two possibilities:

- if firms observe that the rival has respected the agreement (and kept price at monopoly level), then both will stay with monopoly price and collusion will continue. Firms are still in the agreement
- if however, one firm sets a lower p (= pM-ε and then gets all the demand) the rival will punish the deviation and will set p=MC forever. They incentive to deviate is putting price slightly lower of the other firms in order to get all the demand BUT then he gets zero profits because he gets punished.

Graphically what we have is that:

- If we all stay in the collusion agreement forever, we have the blue line in terms of profits
  (which means half the monopolist profits)
- When they deviate, the firm that deviates have the full monopolist profit but then other
  firm sets the p=MC so they will have profits=0 for the rest



of the years

*When do firms have an incentive to deviate and set a different price than pM? And when instead is collusion a stable equilibrium (why do not we see collusion that often in real markets)?*

When you have 2 firms and you are in collusion, each firm will get half the profits of monopoly market BUT when you have N firms, each firm will have monopoly profit divided by N which means that the gains from deviating are much larger when there are many firms that are colluting. So it is very likely that the collusion equilibrium is more *unstable when there are many firms*. To understand whether collusion forms an equilibrium, we need to check the **NO-DEVIATION CONSTRAINT with 2 firms**.

We want to know which is the condition that has to be present in order not to deviate from the collusion and keep colluting without exiting the collusion agreement. We will compare the profits that firms make when they deviate to the profits they would make if they remain in the collusion for N years -> To be convenient, these profits should be higher than the profits they would make if they deviate but we have to *discount* these profits -> Of course, in order to be convenient, collusion profits need to be higher than deviation profits. The **profits with collusion** for each firm are given by the fact that each firm (now we work only with 2 firms) would make half-monopolist profits with collusion for N periods. So in the first period, we have: 1/2 πm

In the following years we have to consider the value of money in the future, so we use **δ** being the **discount factor** which is a variable between 0 and 1(remember that 100 € today is higher than 100€ tomorrow). The higher the discount factor is, the higher is the current amount of money that you get for that sum.

ES: if δ = 0.8, today you get 80 € (based on 100€ of profits). If it is 0.5, it means that the sum you get today is 50€. So the higher delta is, the higher is the sum of money you get now.

This indicator tells us the value of €1 one period into the future compared to €1 now (thus, *what is the current value of a future amount of money*?).

Note: *high δ means current value is high! Low δ, means current value is low.*

This comes from 'time value of money': the idea is that *the money available at the present time is worth more than the same amount in the future due to its potential earning capacity*.

This core principle of finance holds that, provided that money can earn interest, any amount of money is worth more the sooner it is received.

Note: high δ means current value is high! Low δ, means current value is low. The **discount factor** depends on different elements:

- Delta depends on **the interest rate *(r)*** (opportunity cost of time) -> given one period of time, an investor can use €1 to gain €(1+r) next period. The higher the interest rate, the higher the incentive to deviate (lower δ).

- The higher the **frequency** with which firms interact (f) and decide on p (and therefore, the higher the frequency with which deviation/ collusion can be observed), the lower the incentive to deviate (higher δ provided by the market)

SO:

**A)** FIRM'S DISCOUNTED PAYOFF (OR VALUE) **WITH COLLUSION**
as the number of periods tends to infinite, the limit of this sum will tend to:

$$V = \frac{1}{2}\Pi^M\left(\frac{1}{1-\delta}\right)$$

**B)** FIRM'S VALUE **WITH DEVIATION**
If instead a firm deviates, its future payoffs are zero (as the punishment will be to set p=MC). Who deviates will have only short-term profits by setting $p=p^M - \varepsilon$.
AND we are in a Bertrand world so who deviates will get full monopolist profits.
Profits of the deviating firm are:

$$V' = \Pi^M$$

Thus, firms will have no incentive to deviate when: $V \geq V'$
→ we will want to stay in the collusion only if this condition is true.

Thus, when the current value of the future stream of profits is higher/equal to the current profit of the monopolist. This is the **no-deviation constraint**:

$$\frac{1}{2}\Pi^M\left(\frac{1}{1-\delta}\right) \geq \Pi^M$$

- **Uncertainty** also play a role -> if the probability h to exist in the market in the future is high (low uncertainty), then δ will be higher (low incentive to deviate)

$$\frac{1}{2}\Pi^M + \delta\frac{1}{2}\Pi^M + \delta^2\frac{1}{2}\Pi^M + \ldots$$

And with δ being the discount factor.

And, as the number of periods tends to infinite, the limit of this sum tends to: $\left(1+\delta+\delta^2+\ldots\right) = \sum_{t=0}^{\infty}\delta^t = \frac{1}{1-\delta}$

- Finally, if the firms are in a **growing market** (1+g), the punishment on future profits is more costly, and therefore, the incentive to deviate is smaller (δ will be higher) because, even if I discount the value, the value will be higher in the future.

So the stream of money we'll have in N colluting years will be:

What is the condition that firms can use to predict whether others will stay in the collusive agreement? The rule compares the profits with collusion with the profits with deviation.

All this can be written as **δ>= 1/2** -> this delta is the condition for the individual firm -> I would remain in the collusion if the discount factor in the market is at least 0.5
There are many conditions that you have to apply to the market:

- It has to be a *Bertrand model*
- We need to have *2 firms*, otherwise things will change
- We need to have 2 firms *symmetric* with the same cost structure

*But what does it mean in real words?*
In more intuitive words we use at least delta 0.5 because the market should not force you to discount too much the profits that you are getting in every period following the first year.
The delta is real in the market and if this discount factor is too small (so the interest rate is very high) that means that if we stay in the collusive agreement, we'll get very little profits.
ES: suppose that the delta is 0.1, we are comparing full monopolist profits today to half monopolist profits x 0.1 -> *The smaller is the discount factor, the lower will be the current value of the future profits that you are making in all the following periods.* So, I need to get half monopolist profits and at least 0.5 discount factor. This is what the no-deviation constraint is telling us.

Now, we generalise the **NO-DEVIATION CONSTRAINT with N firms**

- When it comes to **deviation**, nothing changes because the firm that deviates becomes monopolist and then it will have 0 profits for the next years
- The thing that changes the most, is the profit that the firm makes with **collusion**. We are still supposing that firms share the profit equally, so instead of 1⁄2 we will have 1/n. It is the same of half monopolist profit but now we have monopolist profits/n

The same as before, the **condition of the no-deviation constraint** is:

$$\frac{\pi^m}{n}+\delta\frac{\pi^m}{n}+\delta^2\frac{\pi^m}{n}+\delta^3\frac{\pi^m}{n}+.....\geq \pi^m+\delta 0+\delta^2 0+\delta^3 0+.$$

Thus:

$$\frac{\pi^m}{n}\left(1+\delta+\delta^2+\delta^3+...\right)\geq \pi^m$$

And by multiplying and taking the first term to the right, we obtain:

$$\frac{\pi^m}{n}\left(\delta+\delta^2+\delta^3+...\right)\geq \pi^m-\frac{\pi^m}{n}$$

And therefore: $\frac{\pi^m}{n}\delta\left(1+\delta+\delta^2+...\right)\geq \pi^m-\frac{\pi^m}{n}$

Again with: $\left(1+\delta+\delta^2+...\right)=\sum_{t=0}^{\infty}\delta^t=\frac{1}{1-\delta}$

Thus: $\frac{\pi^m}{n}\frac{\delta}{1-\delta}\geq \pi^m-\frac{\pi^m}{n}$

And therefore: $\delta\geq 1-\frac{1}{n}\equiv\delta^*$

If n increases, the threshold that makes for the firms convenient to stay in the market becomes larger which means you need a higher discount factor to remain in the collusion agreement because there are more firms sharing the same monopolist profit and if you collude you get even less -> the incentive to stay in the market becomes lower -> higher incentive to deviate
In order to be convenient to stay in the collusion, what you get of the following years (delta) has to be a lot (so less loss in the following years) -> **A collusive equilibrium is stable only if the discount factor is large enough (threshold is d*)**. If the discount factor is low, the amount of profits that firms receive in the future will be less important (current value is lower) and they therefore prefer to deviate today to earn short term monopoly profits.

Now we generalise even more considering different market structures.
So far, we have assumed that if we deviate we get monopoly profits and then zero in the following years because there is the punishment. Now what we do is generalising having different possibilities of competition, Cournot and Bertrand with the difference that with Cournot the profits after the deviation are not 0 as in Bertrand.

Now the process is the same we did; we compare the 2 possibilities.
*Denote:*
**d :** discount factor
$\Pi_i^C \ \Pi_i^D \ \Pi_i^*$ **:** Profits of the i-th firm with collusion, deviation and competition (e.g., Bertrand or Cournot)

The discounted profits with competition (without collusion) would be $\pi^*\delta + \pi^*\delta 2 ...$ which we can write as $\pi^*\delta(1+\delta+\delta 2+\delta 3...) = \pi^*\delta(1/(1-\delta) = \pi^*(\delta/1-\delta)$

$$\Pi_i^C\left(\frac{1}{1-\delta}\right) \geq \Pi_i^D + \Pi_i\left(\frac{\delta}{1-\delta}\right)$$

By rearranging we obtain the threshold of the **discount factor**:

$$\delta \geq \frac{\Pi_i^D - \Pi_i^C}{\Pi_i^D - \Pi_i^*}$$

**Important**: those $\pi^*$ with competition are zero in Bertrand after the punishment (because firms go back to regular Bertrand equilibrium); but they are >0 in Cournot.

This is the same way to get the no-deviation constraint (d*):

1) How to include profits in the $\delta \geq \frac{\Pi_i^D - \Pi_i^C}{\Pi_i^D - \Pi_i^*}$
We started from here:

$V_1^{CO} = \pi^{CO}\left(1+\delta+\delta^2+.....\right) = \pi^{CO}\frac{1}{1-\delta}$ Current value of future profits with collusion (CO)

$V_1^D = \pi^D + \pi^P\left[\delta+\delta^2+...\right] = \pi^D + \frac{\delta\pi^P}{1-\delta}$ Current value of future profits with deviation (D) and punishment (P)

No deviation if:

$$V_1^{CO} \geq V_1^D$$

That is:

$$\pi^{CO}\frac{1}{1-\delta} \geq \pi^D + \frac{\delta\pi^P}{1-\delta} \Rightarrow \pi^{CO}\frac{1}{1-\delta} - \pi^D - \frac{\delta\pi^P}{1-\delta} \geq 0$$

$$\Rightarrow \frac{\pi^{CO} - (1-\delta)\pi^D - \delta\pi^P}{1-\delta} \geq 0$$

The denominator is positive because δ lower than 1, and therefore 1-δ greater than zero, thus →

$$\frac{\pi^{CO} - (1-\delta)\pi^{D} - \delta\pi^{P}}{1-\delta} \geq 0$$

Thus, the ratio is greater than zero if the numerator is positive, and this happens when:

$$\pi^{co} - \pi^{D} + \delta\pi^{D} - \delta\pi^{p} \geq 0$$

That is:

$$\delta\left[\pi^{D} - \pi^{P}\right] \geq \pi^{D} - \pi^{CO}$$

$$\delta \geq \frac{\pi^{D} - \pi^{CO}}{\pi^{D} - \pi^{P}}$$

If collusion produces higher profits than standard oligopoly equilibrium, why don't firms collude more often?

- **Anti-trust policies**
- Some industries have **high turnover** (thus h is low, e.g**. low probability to be in the industry in the future**) and therefore firms may have a high incentive to cheat.
- The promise of the punishment of turning p=MC if a firm deviates **may not be credible** (everybody would have zero profits, also the firm that did not deviate!), and this increases the incentive to deviate.
- Firms' decisions about p may not be perfectly observable, leading to **secret price-cuts**, which make collusion more difficult to sustain.
- **Market structure**
  - *Number of firms* -> it is easier to coordinate and collude in more concentrated markets (fewer firms)
  - *Firms symmetry* -> if a firm is more efficient (lower costs) than others, it also has higher incentives to deviate because profits from deviation are higher (bc of lower costs) and costs from punishment lower (bc more efficient firms could nonetheless make profits during punishment)
  - *Entry barriers* -> collusions means pm and therefore extra-profits. However, extra-profits may attract new entrants, making collusion more difficult. Entry barriers -> limit to entry -> collusion more likely
- **Demand fluctuations**

Clearly collusion is not a good thing for consumers -> allocative efficiency decrease as p increase and the surplus is transferred from buyers to sellers (decrease in consumer welfare) -> for that reason there are some public policy as the treaty of Rome that prohibits:

- Directly or indirectly fix purchase or selling prices
- Limit or control of production
- Share market sources of supply

Information exchange per se does not violate any of the laws against price fixing! ... But information exchange can facilitate price fixing

## Product differentiation

There is a possibility for firms to differentiate their products. There are different characteristics for the same goods within the same industry -> this can occur in the same company or between competitors. We'll look what can happen to the market power if firms apply product differentiation and apply different prices (even higher than MC). Product differentiation is a way through which a company can increase its market power -> consumer save on product adaptation and is willing to pay more for a good that fits better his preferences.

- No product homogeneity
- No perfect information

} Implications on market power?

Why do firms differentiate their products/services? Because consumers' preferences differ! Because of consumers' **different evaluations** of products/services relative merits -> firms can *set different prices* -> set prices above MC

Firms have to pay to differentiate but this allows them to set prices higher than the MC and to increase their market power.

There are two types of differentiation:

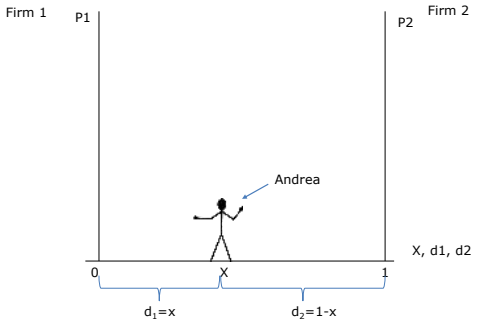
- **Horizontal differentiation** -> *for a given price, some consumers prefer product1 to product2, others prefer product2 to product1*. This happens when preferences are expressed according to *features that cannot be ordered in an objective way*: color, styles, shapes, flavor, tastes... -> you cannot rank the characteristic for the consumers, they depend on the preferences of the individual -> for a given price, there are two goods and, while some consumers will prefer the second one, others will prefer the first one but it's not possible to rank the different characteristics of the good in absolute terms of "best" or "worst" -> subjective preferences
- **Vertical differentiation** -> *for a given price, all consumers prefer product1 to product2.* Products can be ordered according to their *objective quality* from the highest to the lowest, and all consumers agree on specific features as good and favorables (e.g. computer's

speed, fuel efficiency) -> you can rank the characteristics so that some of them are always preferred by all the demand of consumers -> objective preferences

In reality, there are some goods that are both horizontal and vertical differentiated (i.e. cars with some comforts : speed, safety, colours…).
If we consider the horizontal product differentiation and the Market power, in a situation of oligopoly, we can consider the "**distance**" between consumers' preferences and product characteristics. The smaller this distance, the higher the fit.. So, how can firms set prices that are higher than the MC? We must consider the "distance" between consumers' preferences and product characteristics. The smaller the distance, the higher the fit and the closer are the preferences to the characteristics of the good. Consumers prefer the firm that is located nearby -> because of distance, consumers do not perceive firms (and products) as being equal, even if firms sell homogenous products. The higher the distance, the higher the adaptation cost consumers have to pay. We think of differentiation in terms of distance between the actual product and the preferences of the consumer -> the closer we are located to a firm, the shorter is the distance between our preference and the good, the better is product differentiation. The closer a consumer is to a firm, the closer the his preferences are to the product produced by that firm. The closer the two consider firms are, the more homogeneous are their products (if they are far from each other, the goods are very differentiated). We need to think at physical distance in terms of costs of adaptation by consumers.

**Hotelling model** -> consumers have to pay a *"transportation cost" (t)* per unit of distance –thus, total transportation cost increases with distance and adds to price. The model can be generalised to situations in which *distance (t) is the distance of consumers' preferences from product characteristics* (product differentiation) (in this case t = adaptation costs when products are not homogeneous)
How do firms compete on prices (market power) when products are differentiated? The hotelling model provides an answer by using *distance as a measure of differentiation*. We must suppose also that:

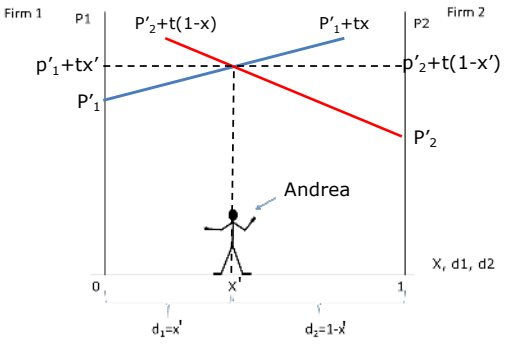
- **N number of buyers uniformly distributed along a 1km long segment** -> they choose where to buy from
- **2 sellers located at the two extremes of the segment** (maximum differentiation)
- **Homogeneous product**
- **Sellers simultaneously set prices** (i.e. Bertrand Competition)-> they can only decide how differentiated the goods are and can set different prices



The two functions cross for the buyer located in **x'**. This **buyer is indifferent between buying from Firm 1 and Firm 2**: total cost (i.e. price + transportation cost) is the same for product 1 and product 2.

The cheapest product is located further away than the more expensive product, and therefore the sum of (price + t) is the same [$p'_1+tx' = p'_2+t(1-x')$].

where $p'_1>p'_2$




hus:

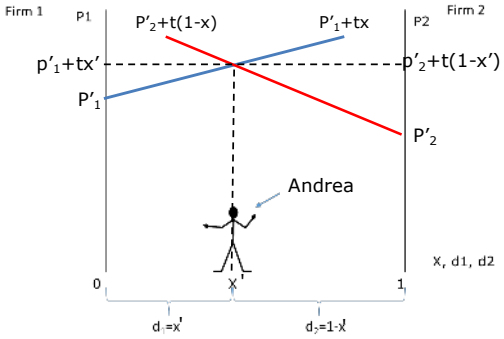
otal cost to buy from Firm1 is
'1+tx

otal cost to buy from Firm2 is
'2+t(1-x)

or example, if x=0, the buyer located at Firm1 and will ay only $p'_1$ for product 1 and '2+t for product 2. If the uyer is at Firm2 (x=1), he ould pay $p'_2$ for product 2 nd $p'_1$+t for product 1.

All buyers to the right of x' (1-x') prefer Firm 2; all buyers to the left of x' prefer Firm 1.

Thus, **though $p'_1>p'_2$, Firm1 receives a positive demand**!




**Why?**

Due to the **distance** (and transportation costs), the two **products are not identical for consumers!**

→ Firms can set different prices because the products are differentiated

We assume that the length of the segment is 1km, that there are many consumers along the segment and that every consumer buy a unit of the good (the sum of the units that all the consumers together can buy, is equal to the total demand of the market). The consumers are distributed uniformly along the segment and the total demand is equal to the sum of the demand of each consumer. The two firms start to serve the consumers that are closer to them and then continue to serve the others until the whole demand is covered. If we consider a consumer, that stands on the segment, we can divide the total length in two segments (x and 1-x).

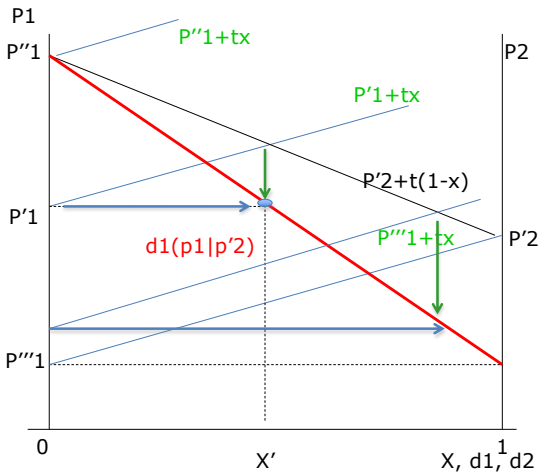
The total price **Pt = Pi + tx** (transportation cost -> depend on where they are located respect to the location of the firm).

If we consider a consumer that is located at the zero point (Firm1), he'll pay just P1, since there aren't any transportation costs. If he had to buy from Firm2, he would have to pay a large amount of transportation costs (that is far away from him) -> p2+t (1-x) -> p2+t. For this consumer it would be continent to buy from Firm1 even if p1 > p2. There is a point in which the consumer is indifferent in respect of buying from Firm1 or Firm2 -> intersection of the two lines.

From that point we can also derive the residual demand for both firms. All the people that are at the left of the indifferent consumer point, will buy from firm1 and all consumers that are at the right of this point will buy from Firm2.

Thus, if products sold by Firm 1 and Firm 2 differ because of different firm's location (i.e. different distance), consumers **choose the firm that minimises their total cost** (price + transportation cost). Based on consumers' choices, firms can predict their (downward sloping) **residual demand curve d1(p1|p'2)**, that is the demand they can serve given conjectures about the other firm's price. Based on this demand curve firms will set the price that maximises their profits. Given p2, the residual demand tells me how x1 changed as a function of p1 (not equilibrium quantity because it changes with changes in p1).

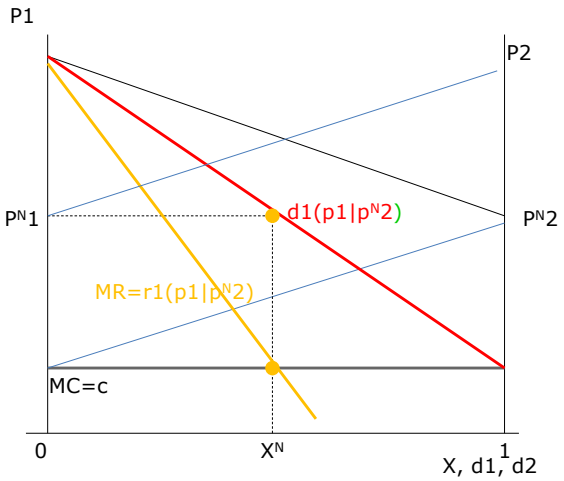
This is d1(p1|p'2):




Suppose Firm 2 sets **p'2**.
- If Firm1 sets **p1'**, d1=x' (as in the previous graph).
- If Firm1 sets **p''1**, price is so high that all consumers buy from Firm2 and d1=0
- If Firm1 sets **p'''1**, then price is so low that though there are t costs, all consumers buy from Firm1 and d1=1 (overall marker)

... If we repeat the exercise for all intermediates values of p1 we get the **d1(p1|p'2)**

Given this demand curve, what is the (Nash-Bertrand) equilibrium prices p1* and p2* such that no firm has an incentive to change price unilaterally?

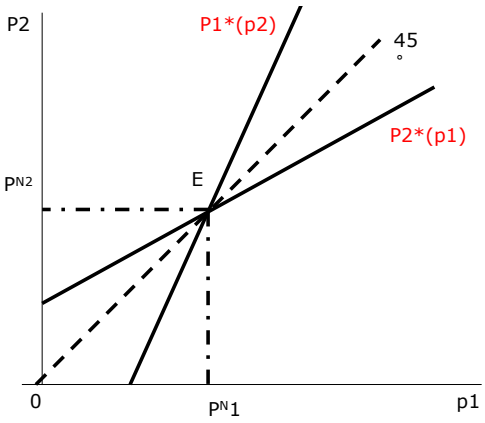



Suppose **MC=c** for both firms (and ***same t*** for consumers)

Given d1 we can draw the marginal revenue curve **r1**.

→MR=MC to Max profits -> optimal price for Firm1 is **$p^N1$**. The same applies to Firm2 that has the same c marginal cost.

Thus, the demand curve is continuous (differently from standard Bertrand). By using the marginal profit rule (MR=MC) for different conjectures about p2, we can derive different equilibrium combinations p1*(p2) (and, symmetrically p2*(p1)) to construct the **reaction curves** of Firm1 and Firm2




*Thus, reaction function by solving MR=MC:*
*p1*(p2)*
*p2*(p1)*

Bertrand-Nash equilibrium is on both reaction curves (E): $P^N1$, $P^N2$

If firms are symmetric, **$p^N1=p^N2$** and each firm serves ½ of the market

The point in which the two reaction curves cross each other, if we take this to cross the axis, can help us find the MC. The two lines correspond to the best response function of each firm. The combination of the two lines corresponds to the equilibrium of the market -> prices of equilibrium for both firms -> no incentive to behave different. If the two firms have the same MC and have the same t, they are symmetric and the two lines will be the same and symmetrical -> same prices in equilibrium if the firms are symmetric -> the higher the intercept of the two firms, the higher the two prices at which the firms can sell their products. The higher the conjecture on the price of the other firm, the higher the price of equilibrium for both firms. The only equilibrium possibile is the intersection of the reaction functions of the two firms since is the best option for both. If MC and t are the same for both firms, then the equilibrium price will be the same for the two firms (symmetrical reaction functions)

Thus, if we think of the distance as differentiation in some product characteristics, then firms can chose where to **position their product in the product characteristics space.** By doing this they also **chose p**.

- With differentiated products, both prices are higher than MC (no Bertrand results)
- In addiction, the greater the value attributed to product differentiation (t), the greater the degree of market power

Analytically, how do we find **pn1, pn2** that form the equilibrium? We start from the **demand function of firm A that we derive from** the "indifferent consumer" z* located at x' for whom:

$$p_A + tz = p_B + t(1-z)$$

$tz-t(1-z)=p_B-p_A$
$2tz-t=p_B-p_A$
$2tz=t+p_B-p_A$
$z=t/2t+(p_B-p_A)/2t$
$z=\mathbf{1/2+(p_B-p_A)/2t=d_A}$

Thus:

$$d_A = z^* = \frac{1}{2} + \frac{p_B - p_A}{2t}$$

And the demand for firm B products is:

$\mathbf{d_B}=1-d_A$
$=1-[1/2+(p_B-p_A)/2t]$
$=1/2 - (p_B-p_A)/2t]$
$=\mathbf{1/2+(p_A-p_B)/2t}$

$$d_B = 1 - z^* = \frac{1}{2} + \frac{p_A - p_B}{2t}$$

When we have p1 and p2, we need to understand that, anytime that a consumer is positioned at the left of the indifferent consumer point, it will buy from firm1 and viceversa, anytime it is positioned at the right of the indifferent consumer point, it will buy from firm2 (because the total price is lower than p1+tx).

With **profits** computed as TR-TC= (p-c)*q:

$$\pi_A(p_A, p_B) = (p_A - c)\left[\frac{1}{2} + \frac{p_B - p_A}{2t}\right]$$

$$\pi_B(p_A, p_B) = (p_B - c)\left[\frac{1}{2} + \frac{p_A - p_B}{2t}\right]$$

$\Pi_A=(p_A-c)[1/2+(p_B-p_A)/2t]$

$=(1/2)p_A + (p_Ap_B)/2t - p_A^2/2t - (1/2)c - (P_Bc)/2t + (p_Ac)/2t$

To Max **profits, MR=MC**, that is, the **derivative of profits=0**

$$\frac{\partial \pi_A}{\partial p_A} = \frac{1}{2} + \frac{p_B}{2t} - \frac{p_A}{t} + \frac{c}{2t} = 0$$

$$\frac{\partial \pi_B}{\partial p_B} = \frac{1}{2} + \frac{p_A}{2t} - \frac{p_B}{t} + \frac{c}{2t} = 0$$

Thus:

$$p_A = \frac{t}{2} + \frac{p_B}{2} + \frac{c}{2}$$

$$p_B = \frac{t}{2} + \frac{p_A}{2} + \frac{c}{2}$$

Nash equilibrium

$$p_A^N = c + t$$

$$p_B^N = c + t$$

Prices higher than MC, and a function of t

Thus, since differentiation leads to market power, a strategic decision is **product positioning** compared to competitors. Product differentiation is useful to increase the market power when the competition is harsh. If Hotelling is a **two-stage game**, where firms first decide the extent of differentiation and product positioning, and then the price, there are two considerations to keep in mind when deciding product positioning:

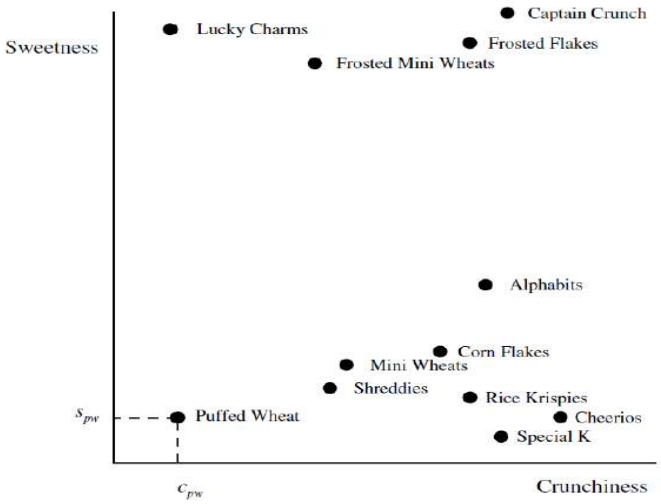
- **for a given price**, firms better produce similar products (*direct effect of product positioning*) -> position themselves close to the indifferent consumer
- However, a more central (homogeneous) location would induce a “price war” to increase profits -> thus firms (strategically) try to produce differentiated products in order to **avoid price competition** and gain market power (*strategic effect*)

## Product positioning

In general, if price competition is intense, differentiation prevails (i.e. far away locations); if price competition is not intense, the degree of product differentiation is low. Horizontal and vertical differentiation -> real world is a **combination of HD and VD**. Products have different characteristics, and consumers evaluate each of these characteristics differently. The "**characteristics approach**" makes it possible to *express consumers preferences* about differentiated products according to both HD and VD.

A consumer's evaluation of a product is the sum of the evaluation of each characteristic of the product.

Example: cornflakes can be described by two (or more) characteristics, and positioned in the "characteristics space" according to their combination




*The demand for each product can be derived from the demand for each characteristic.*

**Net consumer utility = characteristics of the product x consumer's evaluation of each of these characteristics** -> this determines the demand for the product

| | **CHARACTERISTICS (j=1,2,3,4)** | | | |
|---|---|---|---|---|
| **MODEL (k)** | **Processor** | **Fingerprint Reader** | **Memory** | **Price** |
| Computer 1 | 50 | 0 | 0,5 | 10 |
| Computer 2 | 10 | 1 | 1,5 | 30 |
| **consumer (i)** | **Evaluation of the characteristics** | | | |
| A | 2 | 0,5 | 5 | -1 |
| B | 0,5 | 40 | 20 | -1 |
| **Net Utility** | **Computer 1** | | **Computer 2** | |
| A | 2*50+0,5*0+5*0,5-1*10 =**92,5** | | 2*10+0,5*1+5*1,5-1*30 =**-2** | |
| B | 0,5*50+40*0+20*0,5-1*10 =**25** | | 0,5*10+40*1+20*1,5-1*30=**45** | |

A chooses PC1 while B chooses PC2

**Net utility ik = Vi1Ck1 + Vi2Ck2 + Vi3Ck3 - VipPk**

Consumer i (1,2)

Model/product k(1,2)

Characteristics j=1,2,3,4

Note that the price is negatively related to consumer utility. The evaluation of each characteristic can be also be considered as consumer's willingness to pay for that characteristic. Rational consumer choose the product with the **highest net utility**. Thus, by taking into account each characteristic and the way consumers evaluate it, the characteristics approach encompasses both horizontal and vertical product differentiation . But, *why do firms differentiate their products?*

Search cost and switching costs can be created by firms strategically or they exist in markets when markets are not perfect. With **SC and SwC**, though the product is homogeneous, consumers may be willing to pay **different prices** (as if products were different).

**Imperfect information and Search cost** -> we might have imperfect information about prices:

- consider a retail market with n competing stores and a large number of buyers
- Each consumer wants to buy 1 unit of the homogenous good
- Consumers are willing to pay up to (u)
- To find out the price set by each store, a consumer must visit that store, which implies a cost (s) for the consumer -> **search cost**

To search further he would have to pay s. This means that **each seller will have an incentive to set p=u** because consumers will buy from them to avoid the cost of searching for better prices. If every firm sets p=u, then no firm has an incentive to reduce prices. Because consumers expect every store to price at the same level and the search cost is positive, lowering the price will not attract new customers. Thus, search costs may lead to Monopoly pricing even though firms compete in prices and produce homogeneous products (Diamond paradox). Search costs can lead to **price dispersion**: different prices across sellers of an identical product -> Suppose there are two types of consumers, one ***with search costs*** and one with ***no search costs***:

- Firms that charge a high price sell only to consumers with positive search costs
- Firms that charge a low price sell both to consumers with positive search costs who happen to visit that store and to consumers with no search cost

This is known as the **Tourists-Locals Model**

**Switching costs**

In many industries **consumers must pay a cost to switch between sellers** (operating systems -> Windows, IOs) -> the sources of switching costs can be different: Investment in new hardware, Getting used to a new operating system, Repurchasing the software in a version compatible with the new operating system

Some switching costs are **created artificially** (airline industry) and the sources can be for example that there are many frequent flyer programs (e.g. Star Alliance, Skyteam, etc).

The effects of switching costs are similar to that of search costs . As long as there is a switching cost (sc), sellers can set prices higher than MC and higher than rivals: if the price difference with reference to rival firms is lower than the switching cost, consumers will not switch. Thus, the existence of switching costs leads firms to set a higher price than rivals, if **p1-p2 < sc** . In general we can say that *the greater the value of search or switching costs, the greater the sellers' market power*

## Advertising

Total Media Ad Spending Worldwide, by Region 2017-2022

| | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 |
|---|---|---|---|---|---|---|
| **Total media ad spending in billions** | | | | | | |
| North America | £168.48 | £179.55 | £191.59 | £203.50 | £213.23 | £223.15 |
| Asia-Pacific | £146.73 | £162.47 | £179.25 | £195.97 | £211.79 | £226.70 |
| Western Europe | £78.51 | £80.73 | £82.88 | £84.78 | £86.62 | £88.58 |
| Latin America | £27.02 | £29.37 | £30.93 | £32.13 | £33.27 | £34.25 |
| Middle East & Africa | £18.36 | £19.24 | £20.07 | £20.87 | £21.67 | £22.42 |
| Central & Eastern Europe | £12.95 | £14.04 | £14.92 | £15.70 | £16.44 | £17.29 |
| **Worldwide** | **£452.05** | **£485.40** | **£519.64** | **£552.95** | **£583.02** | **£612.39** |
| **Total media ad spending growth (% change)** | | | | | | |
| North America | 11.40% | 10.70% | 10.30% | 9.40% | 8.10% | 7% |
| Asia-Pacific | 8.70% | 8.70% | 5.30% | 3.90% | 3.50% | 3% |
| Western Europe | 7% | 8.50% | 6.20% | 5.40% | 4.60% | 5.20% |
| Latin America | 7.20% | 6.60% | 6.70% | 6.20% | 4.80% | 4.70% |
| Middle East & Africa | 4.60% | 4.80% | 4.30% | 4.00% | 3.80% | 3.50% |
| Central & Eastern Europe | 2.80% | 2.80% | 2.70% | 2.30% | 2.20% | 2.30% |
| **Worldwide** | **7.70%** | **7.40%** | **7%** | **6.40%** | **5.40%** | **5.10%** |

We can observe a general increase in the expenditure of companies for advertising in terms of money and percentage. Obviously the way through which the companies advertise has changed during the years -> now we have many online campaigns …

Advertising is a tool used by companies to increase their profits and market power (ability to set prices above MC). Advertising needs money to be done: it's an investment to increase the number of users and the profits they can gain from each consumer. A company will invest in advertising if this lead to a gain for the company itself. *How advertising can be used by firms in order to increase market power and market share?*

We consider different types of goods: we talk about **search goods** (ie. Computer) when we talk about a category of products or services that consumers can fully evaluate before making a purchase. Consumers are able to inspect and gather information about their attributes, quality, and price through research, comparison, and prior experience. This makes it easier for them to make informed purchasing decisions. A search good is a good for which we can test the characteristics before we consume it (the characteristics are known and we can predict the utility we can get by consuming that good) -> in this case a company should use an **informative advertising** that is a type of marketing strategy where the primary goal is to

provide detailed information about a product or service to potential consumers. Rather than focusing on emotional appeals or brand identity, informative advertising seeks to educate the audience on the product's features, benefits, price, uses, or availability. This helps consumers make informed purchasing decisions, especially for products that are new, complex, or require a significant investment. In summary, the goal of this type of advertising is to communicate to the consumer the characteristics of the specific good, while is not important to talk about the experience. Informative advertising is about educating and informing potential buyers with relevant facts, helping them decide based on knowledge rather than emotion or brand image. It plays an important role in markets where consumers need detailed product knowledge before making a decision.

On the other hand we have the **experience goods** (i.e meals, restaurants) that are a type of product or service whose quality or value can only be assessed after it has been purchased and used. Unlike search goods, which can be evaluated before purchase (e.g., clothing, electronics), the nature or effectiveness of an experience good becomes clear only through actual use or consumption. They require consumers to actually use or consume the product or service in order to assess its quality. This makes decision-making more uncertain, which is why factors like brand reputation, reviews, and risk-reducing tactics play a big role in selling experience goods. In this case, the best type of advertising is the **persuasive advertising** -> it's hard to pass on information on how the experience will be, before consuming, but the advertisement can try to persuade the consumer that the experience will be good. Experience are intangible and therefore is difficult to give the customer information about the product.

Both types of advertising are important! However, **advertising/sales ratio** (i.e. a measure of advertising intensity) is three times as large for experience goods compared to search goods. What type of information does advertising provide, other than the existence of the good? -> '**money-burning**' signal: 'we are spending large amounts of money on adv, and because our good is of **high quality**, we can afford it' -> **Advertising expenditures as a signal of quality** -> for the persuasive type of advertising, adv are higher probably because the informative ones don't need much more than the informations to let the consumer understand which are the characteristics of the good. On the other hand, companies spend more on the persuasive ones because is much more difficult to convince costumers to spend money in something that is actually intangibile and not predictable.

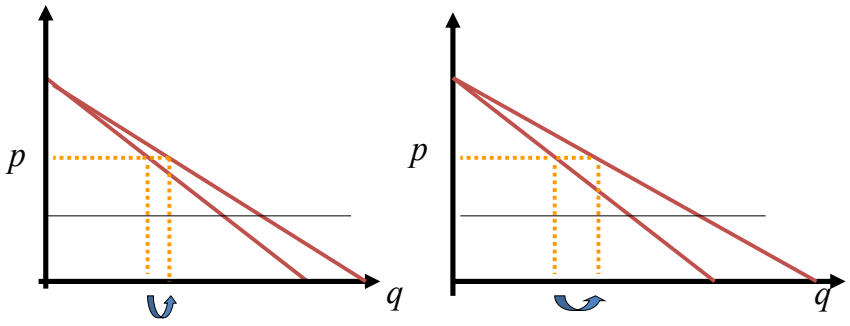
**Signaling** -> signal about **high-quality** is successful if goods are really of high quality (ascertained post-consumption):

- They get **repeated purchases**
- Repeat purchases help cover advertising expenditures

Why do some industries spend more on Advertising than others? i.e. why does advertising intensity (a/R =adv. expenditures/sales) differ across industries? It is because the **demand in**

**different industries reacts differently to advertising**. -> i.e. demand can be more or less sensitive to advertising expenditures -> Note: *gains produced by change in quantity sold and price-cost margin on each additional unit sold* -> advertising is effective if it increases firms profits thru revenues

Same advertising expenditures, but the marginal gain from advertising expenditures is greater the more sensitive (elastic) the demand - faced by the firm - is to advertising expenditures (larger shift in d(p))




**Ad-inelastic demand curve** **Ad-elastic demand curve**

**Elasticity of the demand with respect to advertising: (dQ/Q)/(dA/A)**
**We expect firms to advertise more in markets with ad-elastic demand curves**

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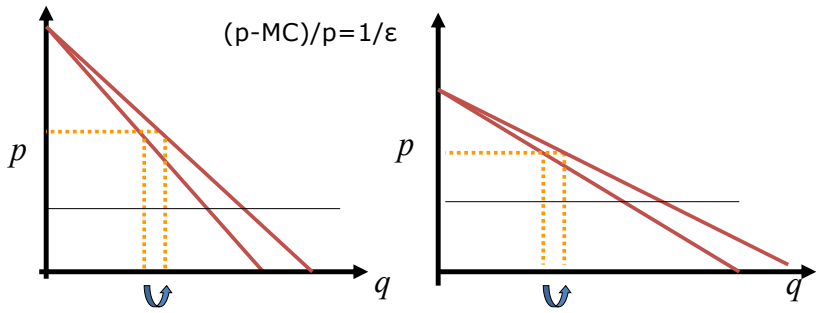
Same advertising expenditures, but different price elasticity of the demand. As a result of adv. exp.: smaller price-cost margin if price elasticity of the demand is high... smaller gains from advertising -> the flatter the demand curve, the smaller will be the price-cost margin on each additional unit.




**Inelastic demand curve** **Elastic demand curve**

**We expect firms to advertise more in markets where price elasticity of the demand is lower**

**Dorfman-Steiner** formula:
$a/R = [(p-MC)/p]\eta = \eta/\varepsilon$

Where:

**η**= demand elasticity with respect to advertising (% change in quantity due to a change of 1% in advertising expenditure)

**ε** = price elasticity of demand (% change in quantity if price changes by 1%)

If the demand curve shift due to advertising, the advertising is effective (the more the shift, the more the effectiveness) -> for the same price of the product, you sell more (higher demand) -> Thus, advertising-to-sales ratio is larger the greater is advertising elasticity of the demand and the lower is price elasticity of the demand. We know that **$a/R = [(p-MC)/p]\eta = \eta/\varepsilon$** ->Thus, less concentrated industries (more competitive industries) with lower price-cost margins (i.e. large **ε**) will have lower advertising intensity than concentrated industries (in Perfect Comp price cost margins are zero!... Highest in Monopoly.). The flatter the demand curve, the larger the elasticity.

**Intensive margin** -> changes in the *degree* or *level* of an activity among those who are already engaged in it. It answers the question: How much more or less of something does an individual or firm do? -> Adjusting *how much* someone already involved in an activity does (e.g., a worker working more hours, or a consumer buying more units of a product).
**Extensive margin** -> changes in the *number* of participants or entities engaged in an activity. It answers the question: How many people or firms start or stop doing something? -> Adjusting *how many* people or entities participate in an activity (e.g., more people entering the labor market or more consumers starting to buy a product).

As far as **η** is concerned: how does market structure affect firms' advertising elasticity of the demand? The number of firms in the market and the market concentration, affect **η** and **ε**

1. **Public good nature of advertising** -> suppose Adv. by one firm increases every firm's demand equally: demand for every firm shifts upwards, also for those that do not spend on Avd -> Advertising as a **public good** -> The benefits from Adv. is shared among all the firms in the market, though only one firm spends money on it (*externalities*) -> in this case, each firm's advertising elasticity decreases as concentration decreases (i.e. the **individual firm's benefits are smaller in more fragmented markets**: small % change in sales to 1% increase in adv. intensity) -> **η small**

2. **Demand shifts across competitors** -> suppose that total demand is fixed and does not increase with Adv. **The effect of Adv. is to shift demand across rivals** (i.e. the firm that spends on Adv. gains a larger market share taken from competitors) -> The benefit from Adv. is 0 in monopoly. It increases as the number of competitors increases in the market (duopoly, etc.) as there are competitors whose demand can go to the advertising firm -> in

this case, firm's advertising elasticity increases as concentration decreases, starting from high levels of concentration -> **η large**

Thus, to sum , **as market concentration decreases** (and the number of firms increases -> assuming that the firms have the same size):
- each firm's margin decreases
- each firm captures a smaller share of total demand shift due to advertising
- each firm captures a greater share of competitors' demand

The first two points would decrease advertising intensity (and elasticity); while the third point would increase it. Net effect is ambiguous because we don't know if the decrease in concentration will have a positive or negative impact on **η**.
When market concentration is high (few large firms), companies often engage in more advertising. This is because:
- Firms have larger budgets to spend on advertising
- They compete heavily with each other to maintain or grow their market share
- In highly concentrated markets, advertising can be a key tool for differentiation.

This means that, as concentration decreases (higher number of firms), **η** decreases and advertising is less successful in gaining market power. On the other side, if we are in a monopoly, the single dominant firm doesn't need advertising since the market power is all in one hand and if concentration decrease firms can capture a greater share of competitors' demand

**Price competition affects advertising** -> Suppose a duopoly. Total demand is fixed and does not change with Adv. The effect of Adv. is to shift demand across rivals: the firm that advertises receives all the market demand -> in this case, **joint incentive** of the duopolist would be to set Adv.=0 (no Adv expenditures; they share the market equally) -> But, **individually**, each firm will tend to set Adv. a bit higher that the competitor, for any conjecture on the competitor's level of Adv. -> equilibrium is for profits=0 as in Bertrand. Thus: **price competition leads firm to spend on Adv. more than firms should do to max profits.** In addition, advertising affects price competition:

1. **Advertising softens price competition** -> If firms use advertising to inform consumers about their product characteristics (for differentiated goods) -> Advertising product characteristics increases firms' benefits from product differentiation -> it softens price competition (e.g. Large adv. campaigns of pharma companies reduce the extent to which consumers buy generics, though products are homogeneous, prices differ)

2. **Advertising Intensifies Price Competition** -> If firms use advertising to inform consumers about their product prices (for homogeneous goods) -> Advertising product prices increases demand elasticity -> Increased demand elasticity increases price competition

If advertising is very effective, this could lead the firms to a Bertrand model with price competition -> you spend so much that in the end you make zero profit -> inefficient for firms

## Measurement of concentration and market power

We study the relationship between market structure (degree of concentration) and degree of market power.

In a **symmetric oligopoly** the market power can be measured by the price-cost margin (p-MC) or (p-MC)/p. The market concentration depends on the N number of firms (all the same size)

In **asymmetric oligopoly** firms have different cost function and therefore different MC and qj. Thus different firms have different price cost margins and firms have different size: N is not a good indicator of market concentration -> we need to find other measures

The market power measured by the **Lerner index** -> weighted average of each firm's price-cost margin, with weights given by firms' market shares. It ranges between 0 and 1, with higher indexes suggesting higher market power.

$$L = \sum_{i=1}^{n} s_i \frac{p - MC_i}{p}$$

If MC is the the same for all firms, than L is the common price cost margin as in symmetric oligopoly.

**Market concentration** measured by:

$C_m$ coefficient: sum of market shares of the largest m firms ordered by market shares.

$$C_m = \sum_{i=1}^{m} s_i$$

0(Min conc)<$C_m$<1(Max conc)

$$C_4 = \sum_{i=1}^{4} s_i$$

Herfindahl index (or Herfindahl–Hirschman Index): sum of the square of all firms' market shares.

$$H = \sum_{i=1}^{n} s_i^2$$

0(Min conc)<H<1(Max conc)

H-index depends on both the **N of firms** and their market share (**symmetry or asymmetry**)

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Herfindahl index -> the value of H is often multiplied by 10,000, then the H index varies between 0 < HHI < 10,000

- ***H below 0.01*** (or 100) -> (nearly) perfect competition
- ***H below 0.15*** (or 1,500) -> low concentration
- ***H between 0.15 - 0.25*** (or 1,500 - 2,500) -> moderate concentration
- ***H above 0.25*** (above 2,500) -> high concentration

Also, given n, H increases if firms' asymmetry (in terms of market share) increases.
The higher the asymmetry, the higher the index. The level of concentration depends both on the number of firms and the asymmetry between them. If we have four firms in the market but one has a market share that is a lot larger then the others, then the market can be considered concentrated.

$$\sigma^2 = \sum_{i=1}^{n} \frac{(s_i - \bar{s})^2}{n}$$

The sigma squared index tells us that how asymmetric are the firms within the market. When firms split the market equally, the difference in the numerator is zero and the index is zero too. The higher is this indicator, the more asymmetric is the industry

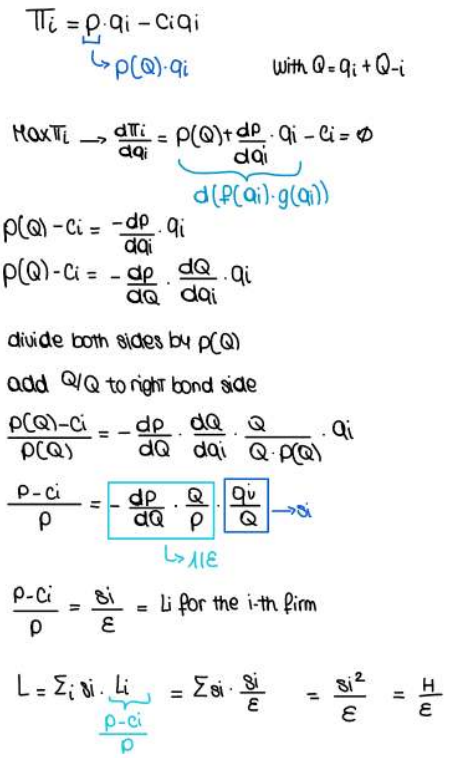
It can be be shown that market power and market concentration are linked as follows (derivation from a general formulation of the Cournot mode)

$$\mathrm{L} = \frac{H}{\varepsilon}$$

The greater is market concentration and structure (H), the greater is also market power (L).... However, the elasticity of the demand mediates this relationship. The higher is H, the lower is the number of firms and the higher is the market power.

The larger is ε (demand is very elastic -> change in quantity over quantity, relative to a change in price over the total price), the lower is the market power (smaller price-cost margin -> little room to increase prices and profit). When H increases (concentration of a market), the price-cost margin increases and N decreases, giving a higher market power.
If in a market we have free entry/exit, we'll see firms entering/exiting the industry until the individual profits are equal to zero -> N depends on the possibility to have positive profits in the market -> N depend on the condition of the market; we will try to understand how the number of firms depends on the **size** of the market (larger size, higher number of firms due to a larger demand) and on the **technology** that firms use (invest in Fixed costs and c to produce their good, higher the fix cost/set-up costs, the fewer the firms). If N decreases, then H increase and the total surplus decrease too -> (i.e. from duopoly to monopoly)

Proof (Analytical set up of Cournot model with N firms) - qi* that Max profits, based on Q-i




The Lerner index is the sum of the si (market share of a single firm) in the market decided by the demand elasticity.

**Empirical evidence** -> positive statical relationship … but this is weak! Because of some behaviours, market that are more concentrated allows higher price-cost margin, in more concentrated market, firms are allow to sell more -> causal relationship between concentration and market power -> weak relationship than what we can expect.

There are different problems:

1. **Lack of data** -> the Lerner index requires information on firms' marginal cost (price-cost margin) not observable by outsiders. Investigators use the weighted average of **profits rates** as proxy for the Lerner index. Industries with higher concentration are expected to have higher average profit rates. ... results: positive but weak link! Firms are not willing to tell you the total cost function since we can derive the total profits they make -> difficult to get the data
2. **Endogeneity** (simultaneity problem) -> Basic hypothesis of the struct-perform model is that market structure is exogenous: it comes first and explains market power. But, actually, market structure (concentration) is also affected by firms' market power and behavior. e.g.: entry and exit of firms determine concentration and then performance. Performance, in turn, influences entry and exit, and thus market concentration. This two-way relationship might also explain the weak statistical relation between structure and market power: sum of two effects with opposite signs -> endogeneity refers to a situation in econometrics or statistical modeling where an explanatory variable (independent variable) is correlated with the error term in a regression model. This violates one of the key assumptions of ordinary least squares (OLS) regression, which requires the explanatory variables to be exogenous (uncorrelated with the error term). When endogeneity is present, it leads to biased and inconsistent estimates, making it difficult to determine the true relationship between the variables.
3. Even if correlation is positive and statistically significant, what would the **interpretation** and **associated policies** be? Need to assess mechanism.

- *Collusion hypothesis* -> concentration leads to market power through collusion between firms. Thus policymakers should adopt antitrust policies and pro-competitive public policies in industries with high H.
- *Efficiency hypothesis* -> technological change is more likely in concentrated markets because: 1) monopoly position compensates firms for R&D investment; 2) innovation reduces MC of innovative firms, thus higher cost-profit margins and higher market power. Thus, no public intervention is needed.

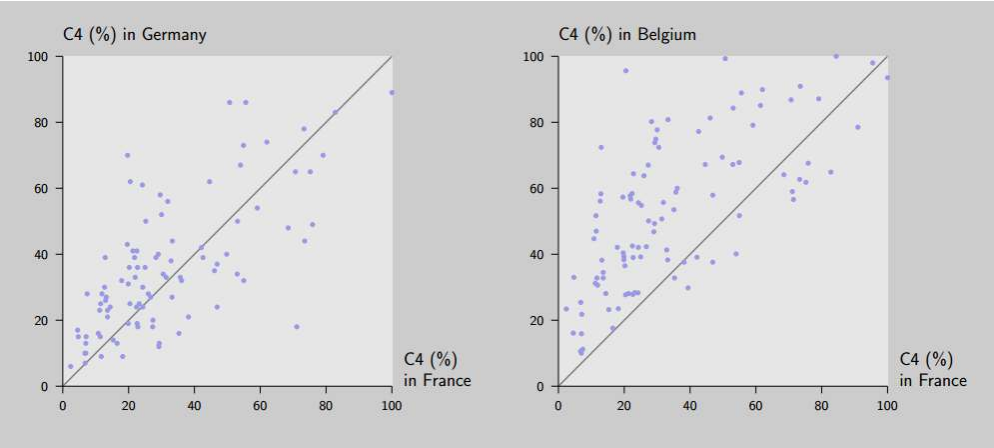
Current industrial organisation tries to explicitly capture conduct of firms and uses firm level rather than industry level data -> firm behaviour added to the structure, performance
Structure -> conduct -> performance

$$L = \vartheta \frac{H}{\varepsilon}$$

1. *Market structure affects firms' conduct* (i.e. lower concentration leads to more competitive firms' behaviour ; higher concentration, higher collusion).
2. *Conduct influences performance* (i.e. more competitive behaviour leads to lower market power and greater social efficiency)
3. Though θ (degree of collusive behaviour between firms ) is difficult to estimate due to lack of reliable (firm level) data

## Entry costs and market structure

So far, we considered the **number of firms** (i.e. market structure) as given (i.e., we hypothesised markets with different *n*). However the *number of firms* that populate an industry and their *size* (i.e. **market structure**) may not be exogenous. In equilibrium they depend on some factors. How does market structure change according to the type of industry, type of product, country size, etc.?




Economies of similar size (i.e. Population, GDP)

Economies of different size

We will see the Optimal number of firms (concentration in symmetric oligopoly) in a Cournot model with free entry, as a function of **S**=size of the market and **F**=set-up costs and the impact of endogenous vs. exogenous entry costs (set-up costs) on the market structure.

Indeed, cross country and cross technology empirical evidence suggests that **market size** and **industry** specific factors are important determinants of *market structure* (i.e. firm size, number of firms and market concentration). Here we examine how:

- market size (number of buyers in a market)
- nature of the technology (cost structure)

Might influence the number of firms and the quantity produced by each firm in the market.

Since we deal with symmetric oligopolies here, this is equivalent to measuring market concentration.

## Symmetric cournot with free entry

*Hypothesis* -> firms are all of the same size, access to the same technology, perfect information, coordinated entry ... thus, changes in **n** (number of firms) measure changes in **industry concentration.**

**Free-entry** (if profits>0, firms enter)

TC= **F** + c $q_i$ where F=set-up cost

D(p) is Q=(a-P)**S** where S=market size (thus P=a-Q/S)

$\Pi_i$=P $q_i$ – F – c $q_i$

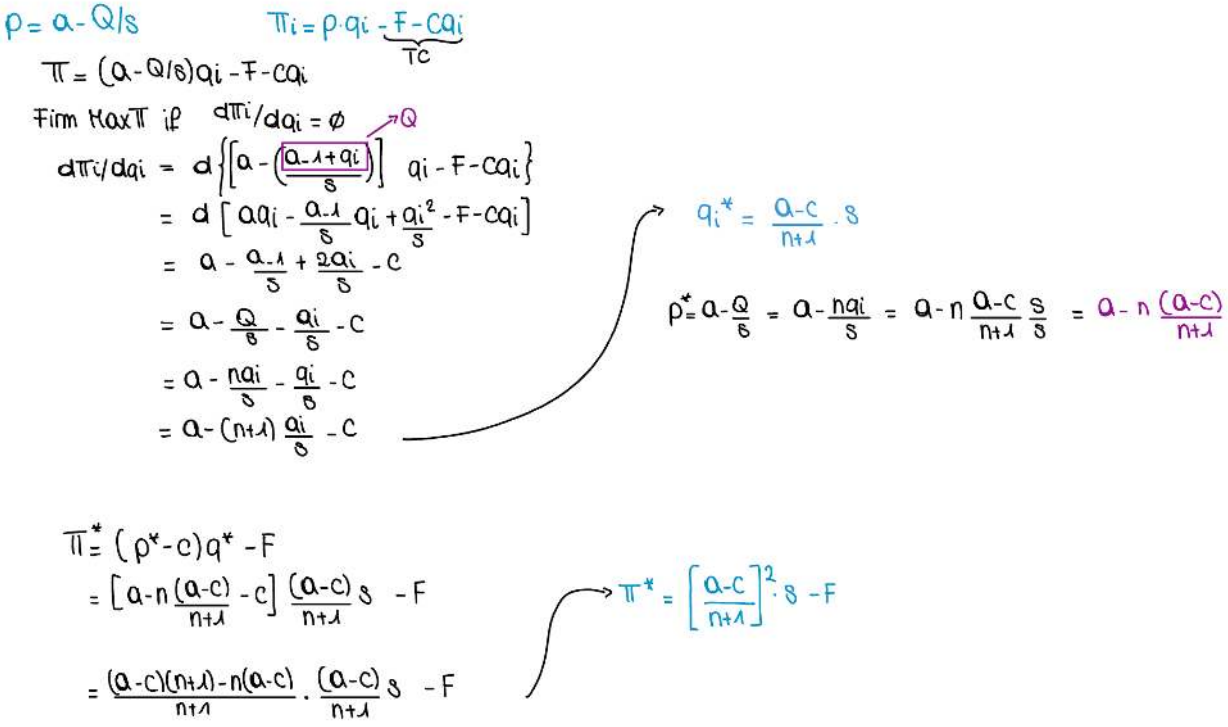
**1) Firm equilibrium: Max $\Pi_I$**
From first order condition: $d\Pi_i/dq_i=0$ derive p*, $q_i$*and $\Pi_i$*

**2) Industry equilibrium (thus n*): $\Pi_I=0$**

Where equilibrium profits $\Pi_i$* are:

$$\Pi_i = \left(\frac{a-c}{n+1}\right)^2 S - F$$

$$\prod_i \uparrow \text{ as } S \uparrow$$
$$\prod_i \uparrow \text{ as } c \downarrow$$
$$\prod_i \uparrow \text{ as } F \downarrow$$
$$\prod_i \uparrow \text{ as } n \downarrow$$



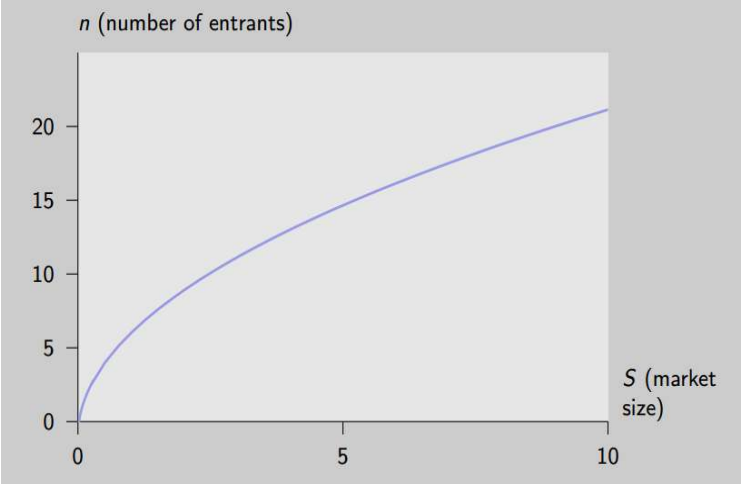

With this situation, no firm will have an incentive to change their prices and quantitates since the firms are in equilibrium and are maximising their profits

Market Equilibrium ($\Pi_i=0$) when: $$n = (a-c)\sqrt{\frac{S}{F}} - 1$$

N is a positive function of S and a negative function of F -> ***n*** increases with market size ***S*** (... thus, higher concentration in smaller markets/countries) and ***n*** increases if fixed and variable costs (***c*** and ***F***) decrease (... thus, higher concentration in industries with higher costs) -> N.B. Symmetric Cournot: concentration is equivalent to number of firms in the market. The larger n, the lower concentration.
We now suppose that S increase, then the number of firms increase and there will be more competition within firms and for that reason n will decrease -> there is a limitation and attenuation of the increase of the number of firms in the market since we need to consider also the effect of competition. Viceversa if S decrease, the number of firms will decrease and also the competition, that will increase the number of firms since the price competition is attenuated (partial compensation of the effects of S and competition). The number of firms in the market in equilibrium, depends on the structure of the market.

1. ***n*** increases with market size ***S*** -> non proportional relation due to increased price competition as n increases (p-mc decreases and so does entry)
2. ***n*** increases if fixed ***c*** and ***F*** decrease due to economies of scale in production [Minimum Efficient Scale (MES)]. Again, non proportional relation between **F** and **n** -> an increase in MES (F) produces a decrease of n that is less than proportional due to lower price competition as n decreases (p-mc increases).

Economies of scale are barriers to entry. ... barriers to entry lead to concentrated industries




We assume that firms are all of the same size, with access to the same best technology, perfect information concerning prices (price-cost margin are known and the firms can see if the profits are positive and if they should enter the market), coordinated entry (firms coordinate their entry in the sense that, if they see that other firms are entering the market, then they will enter the market too, because they know what other firms are doing) … then, from a set of parameters that describe the industry and the market, we can predict ***n*** and therefore industry concentration. However, empirical evidence does not always support the relation. Why?

**Historical details of industry evolution**:

- Not equal access to the same “best” technology (F) by all firms; different “best” technologies to produce the same good
- Imperfect information concerning market size (and therefore π)
- Entry coordination mistakes
- Finally, set-up costs might be endogenous, while here F is exogenous (independent of S)

Set-up costs costs might be **endogenous**: *they increase with market size* (F depends on S). Given F, if S changes, then n changes and viceversa if S is given, changing F, n changes -> in reality we should also consider the relationship between F and S -> Endogenous entry costs (i.e. firms need larger investments to enter larger markets) reduce the increase in ***n*** initiated by an increase in ***S***. In other words, endogenous ***F*** counter-balance the positive effects of higher ***S***

on ***n*** -> if S increase, then n increases but if F increases too, then n decrease (counter-balance). Usually larger market sizes can support higher set-up costs due to the potential for economies of scale and higher revenue, while smaller market sizes often demand a more cautious approach to investment to avoid overextending costs relative to the limited demand.

Example of licenses in wireless telephony -> a country decides to deregulate the wireless telephone sector by allocating **only one license** of the necessary technology ->

- Estimated revenues = **S** (size of the market)
- Necessary condition to get the license -> the firm has to be an established telecommunication company. To do so it has to pay an exogenous set-up cost equal to **F**
- Two ways to allocate the license: **lottery (only F)** and **auction (F + endogenous B).**

**Lottery** -> entry cost F is *exogenous* -> with n potential grantees, the probability to get the license is 1/n. Thus, expected revenues by each potential grantee is S/n. We are assuming no price competition (lottery). Consistently with previous results: if entry costs are exogenous (do not depend on S: they are F whatever the size of the market is), then n is proportional to S.

With the lottery, firms can decide to invest in F in order to enter the lottery, then the authorities randomly decide to which one of them give the licence. In this case, n depends just on F and S (without the squared root)

$$\Pi^E = \frac{S}{n} - F$$

$$\text{n' in eq such that : } \frac{S}{n'} = F$$

$$n' = \frac{S}{F}$$

The number of firms is proportional to the size of the market

**Auction** -> entry cost is *endogenous*: F+B. Each firm has to bid (B) for the right to exploit the license -> With the auction, the firms decide, depending on the revenues and the profit-margin that they predict to make, to make a bid (the higher the bid, the higher the probability to get the licence) -> they don't invest immediately in F since they know that they might not get the licence if there are higher bid

If **n=1**, for the contender, the expected revenues is S minus the minimum bid admissible

If **n>1** there will be a Bertrand competition. The max price that each firm is willing to pay for the license (including **B**) is F=S. Thus, the firm that wins the bid gets payoffs S-S=0. The firm that looses the bid gets payoffs=0.

If firms predict this outcome, no-one will be willing to enter if there is another potential entrant, regardless of market size!

**Thus, S does not affect n. Equilibrium entry is for n=1.**

**The value of being in the market does not change as S changes.**

**Many sources (auctions, advertising, R&D ... ): any situation in which firms engage in an "escalation war" for winning the market**

In general, if set-up costs are endogenous to market size, the relationship between S and market concentration (n) is weaker. If S increase, also F increase. Advertising as an endogenous set-up cost

## Horizontal mergers

A **merger** is a legal consolidation of two companies (of similar size) into one entity. In economics and business, mergers are a key way for companies to grow, consolidate, or gain market power. They can take various forms depending on the relationship between the companies involved. The two primary types of mergers are horizontal mergers and vertical mergers. A merger happens when two firms get together and form another indipendent company (new entity)

An **acquisition** occurs when one company takes over the control of the target firm and establishes itself as the new owner (no new entity)

- *horizontal mergers* -> mergers within the same industry -> A horizontal merger occurs when two companies that operate in the same industry and at the same stage of the production process merge. These companies are usually direct competitors, offering similar products or services.
- *Vertical mergers* -> entities that work at different stages of the value chain decide to merge -> A vertical merger occurs when two companies that operate at different stages of the supply chain for a specific product or service merge. These companies typically have a buyer-supplier relationship, meaning one company is a supplier of goods or services required for the other company's production process.
- *Conglomerate* (between industry-unrelated firms) -> large corporation or business entity that consists of a diverse group of companies operating in various industries or sectors. These companies are typically unrelated or loosely related in terms of products and services. The conglomerate structure allows the parent company to diversify its risks by having multiple revenue streams from different markets

*Why do firms engage in merger and acquisitions?*

- to increase synergies in production (e.g.,related products) -> higher economies of scale (Lower fix costs)
- To become larger -> higher market power
- To enter new product markets (domestic or international) -> lower cost to get to know the industry/competitors…
- To increase bargaining power with respect to buyers or sellers -> bigger market share -> monopsony situation
- To increase efficiencies and synergies between distribution and production -> especially in vertical mergers since they are across different stages of the value chain
- For financial purposes (e.g.,to create a diversified portfolio of activities -> reduce risks)

- Killer acquisitions with the aim of elimination potential competitors in areas/technologies of interest -> a larger firm acquires a potential competitor because it wants to kill the potential competition -> blocking firms

*What are the the implications of horizontal mergers?* Consider an industry with ***n* firms**, competing a la Cournot. Firms are **symmetric** (same marginal (**c**) and fixed (**F**) costs). What happens when 2 of the n firms (Firm 1 and Firm 2) merge? Suppose that, after the merge, the merged firm (Firm1&2) has marginal cost **c** and common fixed cost F. In addition, the market is now composed of **n-1** firms instead of **n** and we know that the **equilibrium price** with Cournot competition decreases w.r.t. the number of firms in the market (p -> c as n very large) -> thus, as n decreases (concentration increases), p increases

Thus, market price increases as n reduces to n-1 as a result of the merger. However, if n is very large (e.g., perfect competition), each firm's profit with n is similar to profit with n-1 firms. In this case the *merger would be unprofitable to the merged firms*: before merging the two firms made *π(n)*2* ; after merging the two firms together make *π(n-1)*. Since π(n-1) is slightly higher than π(n), then:

**π(n-1)<π(n)*2**

In other words, from Cournot with n firms: $q^N = \frac{(a-c)}{b(n+1)}$

Thus, the quantity produced by each firm in case there are, for example, either **3 (=n)** or **2 (=n-1)** firms (after the merge) in the market would be:

Total output would be:

$$Q^N = \frac{n}{(n+1)}\frac{(a-c)}{b}$$

$$Q^N(3) = \frac{3}{4}\frac{(a-c)}{b} > Q^N(2) = \frac{2}{3}\frac{(a-c)}{b}$$

Thus, total output smaller with fewer firms

$$q^N(3) = \frac{(a-c)}{b*4} < q^N(2) = \frac{(a-c)}{b*3}$$

$$\pi_i^N = \frac{(a-c)^2}{(n+1)^2 b} \qquad \pi_i^N(3) = \frac{(a-c)^2}{16*b} < \pi_i^N(2) = \frac{(a-c)^2}{9*b}$$

But, for the merged firms, total profits smaller than the sum of the profits of the two firms before the merger:

$$2*\pi_i^N(3) = \frac{(a-c)^2}{8*b} > \pi_i^N(2) = \frac{(a-c)^2}{9*b}$$

2 X profits of unmerged firms (before merging) > profits of the merged firm (after merging)

Profits earned by each firm:

While profits of the non merged firm (Firm3) are higher after the merge of Firm 1 and 2 (than before).

$$\pi_i^N(3) = \frac{(a-c)^2}{16*b} < \pi_i^N(2) = \frac{(a-c)^2}{9*b}$$

Why should firms merge if they earn lower profits by doing so? The answer is that, typically, the assumption that the costs (c or F) are the same before and after the merger is not realistic. Horizontal mergers are typically undertaken for the expected **synergies that firms enjoy**, or, in other words, **cost efficiencies** -> (e.g., they avoid duplication of fixed costs, eliminate overlapping R&D projects, reduce back-office costs, enjoy economies of scope, economies of scale, etc.) -> if the TC changes, then the cost that will enter the profit functions of the merger

firms changes and it might be convenient to merge in order to have lower costs and higher profits.
On the one hand, mergers generally imply an increase in prices because of higher concentration -> may make collusion easier. The merged firms typically achieve cost reductions through the merger -> this trade-off between higher prices (and collusion) and higher efficiency is what policy makers evaluate when facing mergers proposals -> the merger firms will benefict from lower TC, higher price and higher quantity; the non-mergin firms will just benefict from higher profits (due to higher price); consumer will only benefit from the merger if the reduction in the total cost is at least high enough to let (p-c)/p remain the same.
When firms merge together, the quantity produced by the two firms merged might be lower than the quantity that the two firms could produced by themself and the higher price is not enough to justify the merge if the marginal cost remains the same -> lower profits than without the merger
In general, if there are efficiency gains (not captured by the simple Cournot model seen earlier) the **merged firms** gain from the merger. Moreover, **social welfare** could also increase if the decrease in c is large enough to lead prices down (think of Cournot when c decreases -> Q increases, p decreases).

***Mergers often occur in waves***-> periods of intense merger activity alternate with periods of relative stability. Why do mergers occur "together"? It seems that this is because of "exogenous shocks" that trigger mergers in some periods (e.g., industry deregulation, market scale expansion) or "endogenous forces" (e.g., if the initial merge between large firms spurs follow up mergers between other firms in the market...)

## Public policy toward Mergers

*Endogenous forces* -> internal factors that arise from within the economic system itself. They are determined by the interactions between economic agents and evolve based on decisions made by individuals, businesses, or governments within the system.

*Exogenous forces* -> external factors or shocks that come from outside the economic system and impact it without being influenced by the economy itself. These are often unpredictable and uncontrollable by the internal agents of the economy.

Three parties involved in mergers: merging firms, non-merging firms, consumers:

- In general, consumers lose from the merger (i.e. higher prices) -> unless the efficiency savings are large enough to maintain the price as the one before the merger (c decreases enough)
- Non-merging firms may gain (if p increases) or lose (if c of the merged firms decreases and p does not increase) from mergers
- Merging firms gain from cost efficiencies, otherwise they would not merge

**Public authorities** therefore need to evaluate relative losses and gains... main challenge: obtain all the information (e.g., firms' costs) needed to evaluate the effects of the mergers on the different parties. Firms cannot just merge in the market, they cannot create conglomerate that are too large without public authorisation.
A general rule for merger policy: the greater the price increase, the less desirable the merger is. We know indeed that the greater the market **concentration**, the higher the price, suggesting that a **merger between two large firms** (compared to a merger between two small firms) implies a greater increase in price, and therefore greater (consumers') losses. -> Note: increase in price is the sum of two effects: the "**unilateral effect**" (i.e. increase in price due to higher concentration) + "**collusion effect**" (i.e., increase in price due to distribution of market shares)

### *Antitrust legislation*

1. **USA**: first country to adopt antitrust policies in case of mergers (Sherman Act 1890; Clayton Act 1914; Celler-Kefauver Act 1950)

| | Post-merger HHI | | | |
|---|---|---|---|---|
| ΔHHI | | <1500 | ∈[1500,2500] | >2500 |
| | <100 | Approved | Approved | Approved |
| | [100,200] | Approved | Approved | Scrutinized |
| | >200 | Approved | Scrutinized | Scrutinized |

2. **EU**: Treaty of Rome, 1957 -> however, issues when public authorities have to define the "*relevant market*" in which firms compete (and create dominant positions) ... geographical markets? Product markets? Degree of concentration and price-cost margins before and after the merger -> there is not a define way to decide the boundaries of the relevant market and for that reason it's difficult to control mergers

## Strategic behavior, entry and exit

So far we studied structures with n as a function of S and F; entry decision based on anticipation of profits and market competition but we had no consideration for strategic behavior of competitors. However, entry and exit can be affected by incumbents' behavior, especially in industries with a small number of players:

- *Potential entrants* may run into retaliation by incumbents
- Symmetrically *incumbents* can act strategically in order to prevent entry or induce exit

Now we have to look at entry and exit with strategic behavior -> when a firm is considering if entering a market, it should take into account the strategic forces between firms that want to get a higher market power and market share and that, in order to do so, try to prevent the enter

of new firms into the market (reduce the possibility of new competitors that might steal the benefits that the firm could derived from the market -> higher profits…). Given the demand, if prices decreases, the profits of the firms that are present in the market will decrease too and they won't accomodate the entering of other firms in the same market -> price-cost margin and quantity produced will go down -> firms will try to do everything possible (and also legal) to try to stop the potential competitors that might enter the market. Even if we should consider only barriers that are legal, it's not uncommon to see firms do something illegal in order to stop the other firms that want to enter their market. It's important to study those behaviours because those can change the market structure (concentration, number of firms…)

There are different things that firms can do:

- **Entry deterrence** (overproduction and the problem of credible commitment) -> strategies used by established firms to prevent or discourage potential competitors from entering their market. These strategies can be either *legal*, like lowering prices temporarily or increasing production, or in some cases, *illegal or anti-competitive*, like predatory pricing. The aim is to maintain market dominance by making entry *unattractive, costly, or less profitable for new players* -> Overproduction as an entry deterrence strategy is a tactic where an incumbent firm deliberately produces more than the market demand requires, even to the point of creating excess supply. The goal of overproduction is to signal potential entrants that the market is oversaturated and unprofitable, discouraging them from entering -> they produce the optimal quantity + x (more than the optimal quantity) such as the price is lower -> the potential entrant that sees the demand quantity left, might understand that this quantity and the price are not enough to cover the fix-cost -> This strategy can have several economic effects that benefit the incumbent firm while preventing new competitors from gaining a foothold -> this tactics decrease market competition and increase the profit-margin for the firms active in the market

- **Predatory behavior** (predatory prices) -> aggressive tactics that a firm or individual uses to eliminate or weaken competition, often by driving rivals out of the market or deterring potential competitors from entering. While predatory behavior can take various forms, it generally involves actions that may *not be sustainable in the long run* but are used strategically to gain or maintain market dominance. Many forms of predatory behavior are viewed as anti-competitive and may violate antitrust or competition laws.

These are **exclusionary practices** carried out by a dominant firm with the aim of *deterring entry* or *inducing exit* in their own or related markets (goal: reduce competition -> increase market power). In general we can say that there are different types of barriers:

- **Innocent barriers** (non strategic) -> Economies of scale and scope; patents; cost advantages; network externalities; product differentiation, brand and reputation, etc. -> market conditions or business practices that naturally make it difficult for new competitors to

enter an industry, without the incumbent firms intentionally engaging in anti-competitive or predatory behavior. These barriers often arise from the *inherent structure or dynamics of the industry*, rather than as a result of strategic actions taken by incumbent firms to prevent competition. In contrast to artificial or predatory barriers, innocent barriers are typically *legal* and often seen as part of a well-functioning economy

- **Administrative barriers** -> Market regulations (environmental, legal/natural monopolies, tariffs, quotas etc) -> refer to regulations, policies, and bureaucratic procedures imposed by governments or other regulatory bodies that can make it difficult for new firms to enter a market. These barriers often include licensing requirements, permits, compliance with standards, and other legal or regulatory hurdles that businesses must clear before operating in a particular sector. Unlike market-based barriers (such as economies of scale or brand loyalty), administrative barriers are created by government intervention. They can either be intentional to ensure quality and safety or unintentional, creating unnecessary complexity or delays. In some cases, they may serve a protective purpose for consumers or the environment, but in others, they may stifle competition and innovation.

- **Strategic barriers** -> Over-investment in capacity or R&D, product proliferation, exclusive dealings, bundling, predatory pricing, etc -> more generally, any long-term profitable strategy that deters the entry of a new competitor or it forces an existing competitor out of the market. Short term: strategy might be non profitable -> they are deliberately created by incumbent firms to prevent or discourage new competitors from entering a market. These barriers are often designed to protect the market position and profitability of established firms, making it harder for potential entrants to compete effectively. Unlike natural or administrative barriers, strategic barriers are the result of business decisions aimed at influencing market structure and competition -> it's difficult for the outsiders of the market to understand which are the possible reasons for lower prices of a market (efficiency or strategic barriers…)

Is difficult for anti-trust to distinguish exclusionary practices from fair competition.

### *Article 82 of the EU treaty*

Any abuse by one or more undertakings of a dominant position within the common market or in a substantial part of it shall be prohibited as incompatible with the common market insofar as it may affect trade between Member States. Such abuse may, in particular, consist in:

1. Directly or indirectly imposing unfair purchase or selling prices or other unfair trading conditions
2. limiting production, markets or technical development to the prejudice of consumers
3. applying dissimilar conditions to equivalent transactions with other trading parties, thereby placing them at a competitive disadvantage

4. making the conclusion of contracts subject to acceptance by the other parties of supplementary obligations which, by their nature or according to commercial usage, have no connection with the subject of such contracts.

As we said, there are different **Exclusionary practices** but they have some common (time) patterns:

- *Short-run sacrifice of profits* due to initial aggressive strategy to reduce (current or expected) profitability of (current or expected) competitors
- *Higher profits in the long run* once (current or potential) competition is eliminated/limited, firm(s) enjoy higher market power.

When we are talking about exclusionary practices, we refer to two main practices:

- **Non-price based abuses** -> Commitment to aggressive behaviour in the case of entry -> Over-investment in capacity
- **Price-based abuses** -> A dominant firm sets low prices to force a rival out of the industry or to pre-empt a potential entrant -> Predatory pricing

Consider a market where an **incumbent** (I, monopolist) faces the threat of a **potential entrant** (E, in a **non-cooperative, sequential game**):

- *At time t0* : incumbent chooses output qI
- *At time t1* : after having observed the incumbent choice, the entrant decides whether to enter (E) or not (NE) and the output qE to produce

The incumbent has already paid a sunk costs F to produce for this market. Assume incumbent has **MCI=0**. If entrant decides to enter, it pays a sunk cost **F>0** and **MCE=0.** Goods are homogeneous with inverse demand ***p=1-Q*** where *Q* is total output. The intuition that we can get is that the incumbent could keep the entrant out (entry deterrence) by producing a quantity such that if the entrant (E) produces one extra unit, the price drops under the average cost, and E gets negative profits. The limit price (PL) is the maximum price the Incumbent can charge (associated to the corresponding quantity needed to deter entry) for not having E entering the market. *A barrier is profitable when its implementation cost is lower than the future excess profits*.

**Limit pricing cost** -> difference between monopoly profits (when Incumbent does not have to deter entry) and profits resulting from entry deterrence and limit pricing strategy.

In general, with potential entrants and possibility of incumbent's strategic behavior, there are three possibilities:

- **Accommodated entry** -> Duopoly -> strategy where an incumbent firm decides not to aggressively prevent or block new competitors from entering the market but instead allows entry and competes with them in a more cooperative or non-confrontational manner. This

approach contrasts with entry deterrence, where the incumbent firm takes active steps to discourage new entrants through pricing strategies, capacity expansion, or other tactics.

- **Entry Deterrence** -> Deterrence quantity and limit pricing (short term losses; long term monopoly gains)
- **Blockaded entry** -> Monopoly -> situation where potential competitors are entirely unable to enter a market due to overwhelming natural barriers or market conditions, without any need for deliberate strategic actions by the incumbent firms. In other words, the market's structure itself makes it impossible or highly impractical for new firms to enter, even if incumbent firms do nothing actively to deter entry -> fixed cost so large that the incumbent doesn't even need to produce quantity over the monopoly quantity since this is already enough in order to deter the entrance of potential competitors.

What is the optimal output of the entrant if it decides to enter (duopoly)? Need to start from profit maximization problem (profits = pqE - TC)

$$\pi_E = (1 - \bar{q}_I - q_E)q_E - F$$

$$\frac{\partial \pi_E}{\partial q_E} = 1 - \bar{q}_I - 2q_E = 0 \rightarrow q_E = \frac{1 - \bar{q}_I}{2}$$

Best response function of Firm E

Plugging this into the profit function, we obtain the profits made by the entrant if it enters the market (as a function of qI decided in the first stage and observed by firm E).

$$\pi_E = \left(1 - \bar{q}_I - \frac{1 - \bar{q}_I}{2}\right)\frac{1 - \bar{q}_I}{2} - F = \frac{(1 - \bar{q}_I)^2}{4} - F$$

Note that profits of the entrant depends on the choice of the incumbent in the first stage (it is a duopoly)!!

Therefore **the incumbent can anticipate E's behaviour, and keep the entrant out (deter entry) by producing a "large" quantity, such that the entrant's perspective profits are zero or negative**.

$$q_I^D: \quad \pi_E = \frac{(1 - \bar{q}_I)^2}{4} - F \leq \mathbf{0}$$

From $(1-qi)^2=4F$
$1-qi=sq(4F)$
$qi=1-2sqF$

$$\Rightarrow \quad q_I^D = 1 - 2\sqrt{F}$$

This is the quantity that deters entry, as the entrant would make profits=0 if incombent produces this quantity

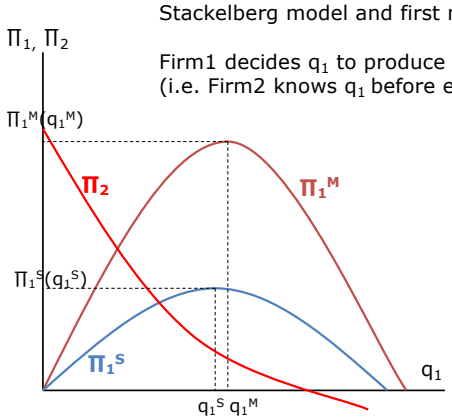
In particular, if qI > 1-2 sqF, profits of entrant <0, the entrant makes strictly negative profits and prefers to stay out ($q_E$=0). In this case the profit of the incumbent is given by [**p*q**$_I$ as MC=0 and F is sunk cost already paid; **p comes from the D function is 1-q, and it is the Limit Price**]:

$$\pi_I^D = (1 - q_I^D)q_I^D = \left(1 - 1 + 2\sqrt{F}\right)\left(1 - 2\sqrt{F}\right)$$
$$= 2\sqrt{F} - 4F$$

## Graphically: entry decision and profits

Firm1: incumbent
Firm2: potential entrant
Stackelberg model and first mover advantage

Firm1 decides $q_1$ to produce before Firm2 enters (i.e. Firm2 knows $q_1$ before entry)

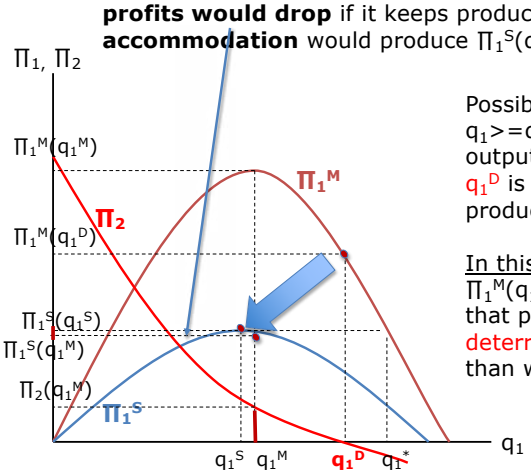



Optimal level (MaxΠ) of $q_1$ and $q_2$? **$\Pi_1$ curves** describe profits of firm1 as a function of q1.
Optimal $q_1$ would be:

$q_1^M$ with Monopoly profits $\Pi_1^M(q_1^M)$, if firm 2 does not enter
Or,
$q_1^S$ (with accommodation) Duopoly profits $\Pi_1^S(q_1^S)$

**$\Pi_2$** curve describes the profit of firm 2 as a function of q1 produced by Firm1 (larger q1, lower $\Pi_2$)

However, **if Firm1 sets $q_1^M$**, Firm2 earns positive profits $\Pi_2(q_1^M)$ → **Firm2 would enter** → as a consequence, **Firm1 profits would drop** if it keeps producing **$q_1^M$**. In this case, **accommodation** would produce $\Pi_1^S(q_1^M) < \Pi_1^M(q_1^M)$



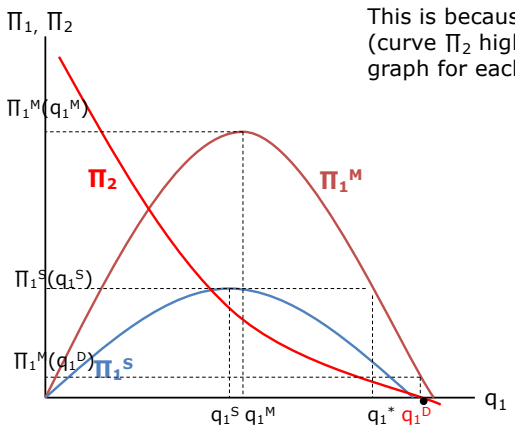

Possible strategy: Firm1 sets $q_1 >= q_1^D$ larger than monopoly output $q_1^M$, so that $\Pi_2 =< 0$.
$q_1^D$ is the level of the output to produce in order to deter entry!

In this case:
$\Pi_1^M(q_1^D) > \Pi_1^S(q_1^S)$ meaning that profits by Firm1 with entry deterrence strategy are higher than with entry accommodation.

Note: $\Pi_1^M(q_1^D) > \Pi_1^S(q_1^S) > \Pi_1^S(q_1^M)$, thus, even if firm1 must deter every period, better to produce $q^D$ than $q^M$ (which would make Firm2 enter)

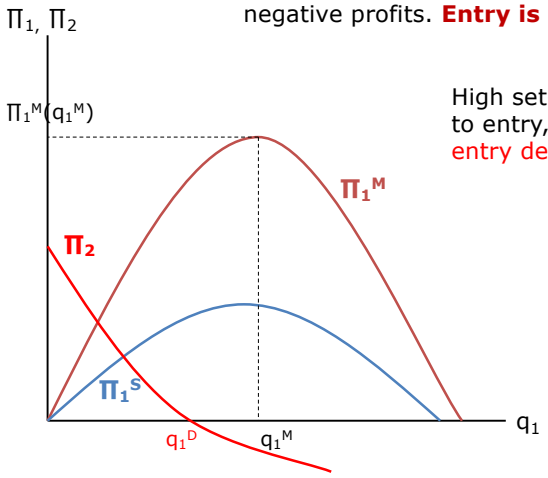
Entry deterrence is an optimal strategy only if profits of the incumbent are higher than with entry accommodation -> this is when q1d < q*

Differently, in the following case, entry deterrence is not an optimal strategy -> Entry accommodation allows the incumber to earn higher profits




This is because **entry costs are low** (curve $\Pi_2$ higher than in the previous graph for each level of the output).

If instead **entry costs are high** (curve $\Pi_2$ lower than before for each level of the output), monopoly output is the best strategy. Firm1 would produce $q_1^M$ and Firm2 would make negative profits. **Entry is blockaded**.



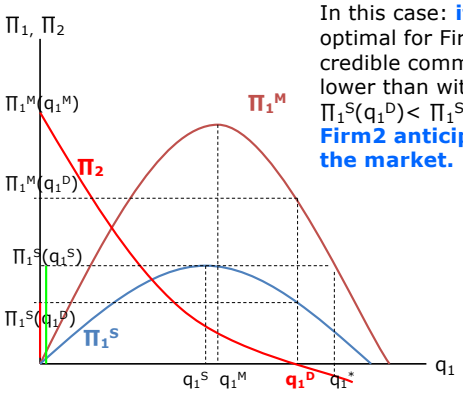

High set-up costs are a barrier to entry, and no strategy of entry deterrence is needed.

However, even when overcapacity is an effective strategy to deter entry, the simple *threat* to over-produce is not, per sé, a credible strategy. **Threat of overcapacity must be credible**, otherwise firm 2 will enter. If so, it will be convenient for firm 1 to accommodate the entry! Imagine the threat: "if the entrant enters the market, I will deter it by producing the quantity qD". This strategy is not credible if it is not convenient for the incumbent to implement it when entrant enters: e.g., threat of overcapacity by Firms 1 -> Firm 2 enters -> not convenient for Firm1 to overproduce (profits higher if it accommodates) .

Thus, the threat is not credible if the action that the incumbent announces is not in her best interest when she has to implement that action. It is credible only if it is costly for the incumbent not to make the action she committed to (i.e., that action becomes beneficial to the incumbent).

When is the announcement by Firm1 to produce $q_1^D$ **credible**?

… an announcement is credible if the strategy that the firm announces is beneficial when it has to be implemented




In this case: **if Firm2 enters**, it is not optimal for Firm1 to produce $q_1^D$ (no credible commitment). Profits would be lower than with accommodation: $\Pi_1^S(q_1^D) < \Pi_1^S(q_1^S)$
**Firm2 anticipates this and enters the market.**

Only if (before Firm2 enters) Firm1 pays a **HIGH and SUNK costs** to install a large output capacity $q_1^D$, then the commitment to produce $q_1^D$ is credible, and Firm2 will not enter ($\Pi_2$ would be <= 0)

Thus, for a strategy to be credible, the agent has to make a commitment to implement it, that is:

- ***Observable*** -> the entrant must observe it and understand that the incumbent has no other option than fighting in case of entry.
- ***Irreversible*** -> changing the commitment choices is costly and investment cannot be recovered.

Analytically, this is when a strategy is profitable, that is, when it is in the best interest of the incumbent to keep the entrant out than to *accommodate* entry. How does the incumbent decide whether to accommodate or deter E's entry?

By **deterring entry** and producing more than $q_I^D$ , the incumbent keeps entrant out and makes profits equal to:

$$\pi_I^D = 2\sqrt{F} - 4F$$

Alternative strategy could be to let the competitor enter the market -- **accommodate entry** -- (remember that incumbent chooses output *before* the entrant and can anticipate its reaction. She is a **Stackelberg** leader).

In case of accommodated entry, incumbent profits are:
$pq_I$-TC → $(1-Q)q_I$ -> $(1-q_I-q_E)q_I$

$$\pi_I^A = \left(1 - q_I - \frac{1 - q_I}{2}\right) q_I$$

Best reply of entrant

With **accommodation**:
**Incumbent output**:

$$\frac{\partial \pi_I^A}{\partial q_I} = 0 \rightarrow \frac{1 - 2q_I}{2} = 0 \quad \rightarrow q_I^A = \frac{1}{2}$$

If incumbent produces $q_I^A$, **the entrant** will produce:

$$q_E^A = \frac{1 - q_I^A}{2} = \frac{1}{4}$$

Market price is then equal to:

$$p^A = 1 - q_I^A - q_E^A = \frac{1}{4}$$

Companies' profits with entry accommodation:

$$\pi_I^A = \frac{1}{4}\frac{1}{2} = \mathbf{\frac{1}{8}} \qquad \pi_E^A = \frac{1}{4}\frac{1}{4} - F = \mathbf{\frac{1}{16}} - \boldsymbol{F}$$

What is then the most profitable strategy for the incumbent: entry deterrence or accommodation?

Deterrence profits: $\pi_I^D = 2\sqrt{F} - 4F$

Accommodation profits: $\pi_I^A = \frac{1}{8}$

*Thus, the most profitable strategy depends on the level of entry costs F.*

There are therefore three possible cases:

1. **Accommodated entry** (F such that profits with deterrence are lower than profits with accommodation):

$$\pi_I^D = 2\sqrt{F} - 4F < \pi_I^A = \frac{1}{8}$$

Find F such that for the incumbent it is convenient to accommodate entry. This F will be sufficiently low, such that for the incumbent it is more profitable to accommodate entry.

2. **Deterrence** (F such that profits with deterrence are higher than profits with accommodation):

$$\pi_I^D = 2\sqrt{F} - 4F > \pi_I^A = \frac{1}{8}$$

F entry costs are sufficiently large to make entry deterrence more profitable for the incumbent, even if, to deter entry, the incumbent should produce a quantity larger than monopoly quantity

3. **Blockaded entry** (F such that quantity with deterrence is lower than monopoly quantity -> entrant stays out):

$$q_I^D = 1 - 2\sqrt{F} < q_I^M = \frac{1}{16}$$

Entry costs are so large that the entrant stays out even if the incumbent produces monopoly quantity.

## Predatory pricing

**Predatory pricing** -> is a form of predation -> firms set price below average costs in order to induce exist. After competitors have abandoned the market, price is brought back to higher level. -> difficult to distinguish from competitive behavior where price is set close to MinAC=MC.

**Chicago School of thought** on predatory pricing: rational players should never exit the market if there is predation, and therefore, rational predators should never engage in predatory practices (they are not effective!) -> Thus, if firms are rational, no predatory behavior should be observed. If prices are low, this must be the result of competition! Why should predatory pricing exist?

- Banks are not always willing to lend money to firms who suffer losses in the short run. Banks do not want to run the risk of not being paid back. In this case, the predated firm might have to exit the market and the predator succeeds with predatory strategy.
- Low prices signal low costs (and p=MC) -> no room for other firms in the market (signal of zero profits)
- Reputation for toughness -> by setting predatory prices, the incumbent is seen as being tough, leading to *higher credibility* of commitment to predation in following periods
- Growing markets where large initial market share leads to future success -> snowball effect -> This concept is key in industries or markets where early dominance or rapid scaling creates advantages that compound over time, making it harder for competitors to catch up.

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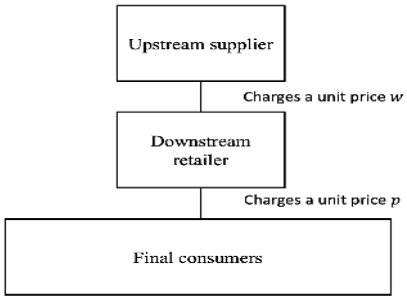
## Vertical relations

So far we have assumed that all the markets where B2C -> there was a producer and there were consumers. What is the difference between B2B and B2C? Many transactions take place between two firms (B2B), rather than between a firm and “final” consumers (B2C). So far we talked about B2C relation but now we’re going to talk about B2B, considering the same final demand-> we look at vertical relations as those relationships between two firms active in different stages along the same value chain.

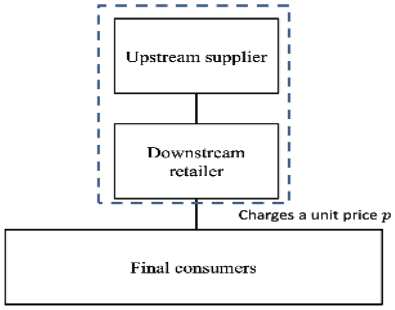
The relationship between a manufacturer and a retailer is different from the relation between a firm and a final consumer:

- Demand for an intermediate good being sold by an upstream company (M) to a downstream company (R) is derived from the demand curve faced by the downstream company in the final market -> the retailer is the one that serve the final demand, while the manufacturer serve the retailer
- There is (or can be) competition among downstream companies (no competition, instead, among consumers) -> there are not many retailers -> there might be competition -> mark-up
- M does not directly control crucial factors related to the final market -> retail prices, sales service, advertising -> adv is done by retailers but this might impact also the manufacturers (if retailers sell more, then the manufacturers sell more too)
- The number of intermediate firms (Rs) is typically small, whereas the number of final consumers is large

Vertically separated firms




Vertically integrated firms




A possibility for firms in B2B is to **vertically integrate** -> a firm is vertically integrated when it controls several or all the production steps (along the value chain) involved in the production of the good/service it sells -> Example: in the oil industry, a company can carry out in house one or more of the following activities along the value chain: Exploration, Drilling, Refining, Distribution

*Why does a firm integrate vertically instead of keeping vertical relationships with external buyers (suppliers)?*

**Upstream firms (U; or manufacturers M)** -> manufacturers of consumer goods, producers of intermediate goods, …

**Downstream firms (R)** -> distributors, retailers, …

The market between upstream firms and downstream firms is called the **intermediary market** (or **wholesale market**), while the market between downstream firms and final consumers is called the **final market** (or the **retail market**).

**Double marginalisation problem** -> Known also as the *problem of vertical externality* (Spengler 1950) -> we consider **M**= upstream firm, the manufacturer (produce the good), **R**= downstream firm that sells the product as a retailer and **D**= final demand = a - bQ —> the general idea is that, if M and R both have market power, each of them will set a price higher than the cost (strictly positive margin), which will lead to set high (total) price in the value chain -> In other words, what is worse than a monopoly? A chain of monopolies!

The assumptions are:

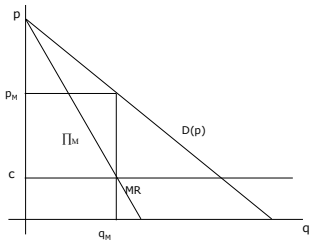
- retailer R has no costs of production -> it's a distributor (he buys and retails) -> it has the cost of buying the product (w) from M (**TCr = wq**)
- The marginal cost of M to produce the product is constant (c) (**TCm = cq**)

- Consumer demand for the product (faced by R) is **p=a-bq** (with c<a)

*CASE 1* -> equilibrium with vertical integration -> If, M and R are vertically integrated, they behave as an integrated company (a monopolist) and produce q* that Max profits (MR=MC) with the final market D function.

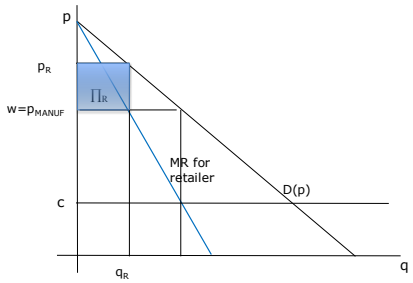
***MR=a-2bq*** (from TR) (remember demand function ***p=a-bq)***
→ a-2bq = c
→ q* = (a-c)/2b
→ p*= a-b(a-c)/2b = (a+c)/2
→ ∏*= [(a+c)/2 - c ]*(a-c)/2b = $(a-c)^2/4b$

We call them $q_M$ and $p_M$ in the graph.




*CASE 2* -> suppose instead M and R are two separate companies > vertical separation/ specialisation—> The Retailer pays w to the manufacturer. Thus, w is the Retailer's MC. We start backward, from R -> To maximise profit, the retailer sets MR=MC, but MC=w now, with w>c (by assumption because the manufacturer will sell for w higher than MC). Thus, if w>c, in equilibrium (max profits), q ↓ p ↑ -> lower profits

**The Retailer problem**:
→ MR=MC → a-2bq=w → q*=(a-w)/2b → lower q* than before because w>c
→ p*=a-b(a-w)/2b = (a+w)/2 → higher p*
→ ∏=[(a+w)/2-w]*(a-w)/2b = $(a-w)^2/4b$ → lower profits




For the upstream firm M:

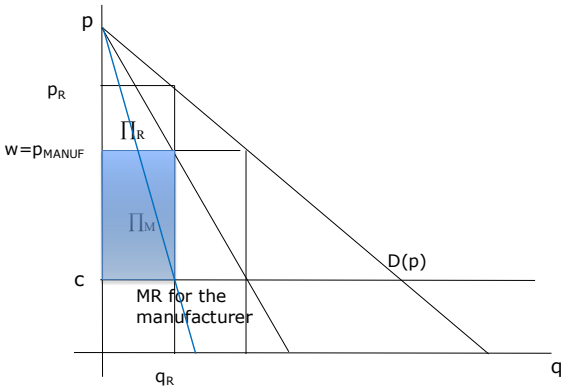
**w=a-2bq** is the **D(p) for M** (w is the price M receives from R. M faces the Retailer's demand)

Thus, $TR_M$=wq=**(a-2bq)q**

To Max profits, MR=MC
Thus: $MR_M$**=a-4bq**
MC=c
→ **a-4bq=c → q*=(a-c)/4b**

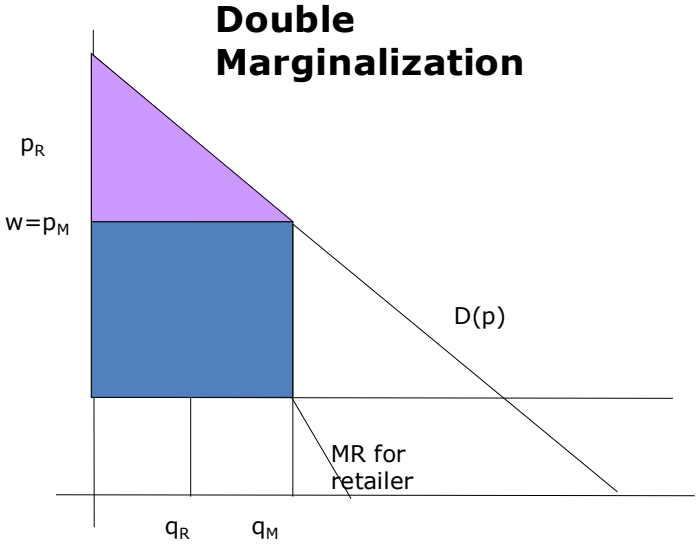
**p*(=w*)=a-2bq*=a-2b ((a-c)/4b)=(a+c)/2**

**∏*= (p*-c)q***
**= [((a+c)/2)-c] (a-c)/4b = $(a-c)^2/8b$**




With double marginalisation and the equilibrium with vertical separation:

- the final price to consumers is higher than the price that would be set by a monopolist
- The final price is determined by a double mark-up on marginal costs -> double marginalisation
- Consequence of this is lower profits for both M and R, and lower consumer surplus




Vertical integration represents a solution to this problem. Both consumers and firms are better off if the two firms vertically integrate to maximise joint profits.(**integration is privately and socially efficient**)

There are other efficiency reasons for vertical integration:

-limit problem of R's underinvestment in activities (e.g., services to customers) that benefit M -> For example, R's advertising efforts that increase demand of the product and generates spillovers on M -> In a non-integrated setting, R (the supplier or service provider) may not have sufficient incentives to invest in activities that indirectly benefit M (the manufacturer or downstream firm) -> why should R (separate firm) do something that might have positive impacts on M (separate firm)?

- Avoid opportunistic behaviour (e.g., renegotiation in case of specific investments) and promote specific investments -> When firms invest in relationship-specific assets (e.g., specialised equipment or processes tailored to a particular partner), they become vulnerable to **hold-up problems**. This occurs when one party tries to renegotiate terms after the investment has been made, exploiting the other's sunk costs. For example, after R has made a specific investment to meet M's needs, M could demand lower prices or better terms, knowing that R can't easily switch to another partner without incurring large costs

Some investments are tailored and dedicated to a particular buyer. The danger that the relationship is discontinued may lead to under-investment (problem of hold-up of the commitment made).

If vertical integration solves the double marginalisation problem and the inefficient provision of downstream services, why in real world markets we observe both vertically integrated firms and vertically separated firms? The fact is that the problem is not related to vertical relations per se, but:

1. To the type of contract governing the relation between firms -> **vertical restraints**
2. To the type of **competition upstream or downstream** that affect the outcome of vertical relations -> types of markets in which they operate (i.e. retailer is not a monopoly anymore as we assumed before)

**Vertical restraints** are contractual terms between firms in a client-supplier relationship, which go beyond simple pricing rules and restraint what the other can do in the relationship ->

"Vertical restraints are agreements or concerted practices entered into between two or more companies each of which operates, for the purposes of the agreement, at a different level of the production or distribution chain, and relating to the conditions under which the parties may purchase, sell or resell certain goods or services. There are different types of vertical restraints:

1. Vertical restraints in pricing -> Franchise fees (franchising) or Resale price maintenance (RPM)
2. Other (non-tariff based) vertical restraints -> Exclusive territory, Exclusive dealing

Why do firms use vertical restraints?

- **For efficiency issues** -> to address the problem of double marginalisation, to avoid free-riding problems from downstream firms, to price discriminate
- **For anti-competitive incentives** -> to control competition, to establish entry barriers

**Franchising** -> Suppose the case of one upstream manufacturer and one downstream retailer. No competition in the M market (which we call also U for upstream) and R (D for downstream) market. Under a franchising contract, the retailer pays the manufacturer a two-part tariff made of a fixed sum F plus a variable component w per unit bought, i.e. its total costs are: **wq + F** -> In a franchising contract in which the variable component w=c (where c is the marginal cost of the manufacturer), the downstream retailer's profit is:

$$\Pi_f^D = (p-c)(a-p) - F$$

*If the market D(p) function is Q=a-p (with b=1)*

From profit maximisation:

$$q^D = \frac{a-c}{2} \qquad p^D = p^{iv} = \frac{a+c}{2}$$

$$\pi_f^D = \frac{(a-c)^2}{4} - F \qquad \pi_f^U = F$$

Price, quantity and total profits are exactly the same as with Vertical Integration, with only difference of F: -F for the Retailer; +F for the Manufacturer. Thus: the indication of F (fixed fee in the Franchising contract) determines the distribution of profits between upstream and downstream firms, i.e. *F depends on the relative bargaining power*
Suppose that a there is competition among Rs -> the extent of downstream competition affects the terms of the franchising contract. Suppose 1 upstream firm M and n downstream retailers: R1,R2, ...RN and a franchising contract wq + F . If n>1, price competition (e.g., Bertrand) among retailers (to sell to final consumers) pushes them to set a low price: *What is the optimal franchising contract in this case?*
As in the standard set up, suppose:

- MC incurred by M is c (and there is no capacity constraint).
- All Rs pay w (no other production costs) and F to the manufacturer -> wq+F

Suppose M set w=c. Suppose also that price price competition among Rs leads them to set a price p1=p2=c -> Rs and M's ∏=0 (as also w=c) -> thus, the best solution for M is to set w=pm (monopoly price). Then, p1 =p2= pm. Retailers' ∏=0, but M's ∏=monopoly profits -> thus, the

stronger the competition downstream, the higher the variable part of the franchising fee w (and the lower the fixed fee F) -> With price competition: w=pm and F=0

**Resale price maintenance** -> there are contracts that impose retailers to set a certain price.M and R can agree on a minimum price pmin=pm that the retailer sets in the market, together with w=c. The fact that pm >w provides. R the incentive to invest in services (R will capture benefits from increasing demand).Yet, RPM raises problems of collusion -> prohibited by EU antitrust laws (only recommended prices are tolerated)

**Exclusive territories** -> The upstream firm grants the right to sell its product to just one dealer within a specific region (intra-brand competition). As the retailer gets all the benefits from the service provided, it will provide an optimal level of services -> territorial restrictions are prohibited under the EU competition laws

**Exclusive dealing** -> Contract that commits a firm to deal exclusively with some vertically related firms but not with others (inter-brand competition, i.e. competition among manufacturers) -> Example: the dealer is not allowed to sell brands that may compete with the manufacturer's brand (e.g.: Coke and Pepsi). There are different advantages:

- Protect and encourage relation-specific investments
- Promote retailer loyalty
- Maintain the value of the product

We need to consider that this increases market power by limiting sales of other brands. May be used to deter entry or induce exit from the market (**foreclosure**: Exclusive dealings may deter entry into a market by an efficient competitor)

## Price discrimination

**Price discrimination** -> practice of setting different prices for different consumers (or groups of consumers, or same consumer) of the same good -> there are three different degree of price discrimination.

So far we saw that the **ability to set the price** of a good (and specifically, to be price- maker and set p>MC) depends on firms' market power (... monopoly, oligopoly ... no perfect competition). Once the firm sets a price, this is **uniform** across all consumers in the market (one price only for the product). The **Total Surplus** is the largest under perfect competition; the smallest under monopoly ("efficiency loss"). **Consumers' Surplus** is the largest under perfect competition; it is the smallest under monopoly.
Now, with price discrimination, a firm can set different prices for different (groups of) consumers and monopoly produces high total surplus, but this surplus is appropriated by the producer. The goal is to increase profits by appropriating consumers' surplus (by reducing

difference between price and consumers' willingness to pay): consumers with higher willingness to pay will pay more; those with lower willingness to pay, will pay less.

Examples:

- subsubscription plans for mobile telephones/wifi
- airplane fares
- utilities (gas, electricity) contracts
- tickets and prices for movie theatres, sport facilities, etc. - on demand video and music subscriptions
- pay 2 and get 3 at supermarkets

Prices – Odeon Movie-Theater

| | Mon. | Tue. | Wed. | Thur. | Fri. | Sat. | Sunday |
|---|---|---|---|---|---|---|---|
| 2.00 p.m. | 4,50 | 4,50 | 4,50 | 4,50 | 4,50 | 5,50 | 7,50 |
| 4.30 p.m. | 4,50 | 4,50 | 4,50 | 4,50 | 4,50 | 7,50 | 7,50 |
| 8.30 p.m. | 7,50 | 7,50 | 5,50 | 7,50 | 7,50 | 7,50 | 7,50 |
| 2.00 p.m. * | 4,00 | 4,00 | 4,00 | 4,00 | 4,00 | 4,00 | 5,50 |
| 4.30 p.m. * | 4,00 | 4,00 | 4,00 | 4,00 | 4,00 | 4,00 | 5,50 |

**People over 65***
**Under 14**: 5,50 Euros instead of 7.50

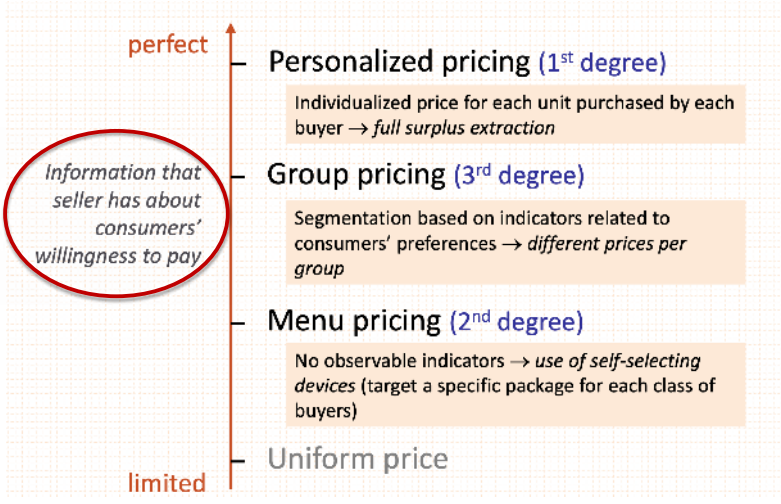
When is price discrimination possible? We need to consider three conditions:

1. The supplier can set the price ((i.e., price-maker, some degree of **market power**).
2. Firm needs to be able to **distinguish/classify** different types of consumers (or groups)
3. there is no arbitrage (**no resale**)

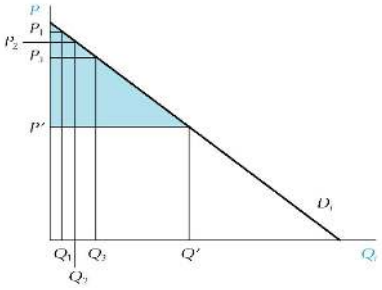
Moreover, there is discrimination when price differences are not explained by cost differences that arise from producing the same good for different groups of consumers (ratio p1/p2 > MC1/MC2).

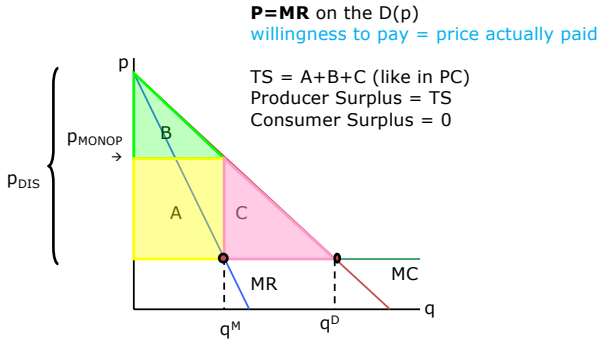
Types of price discrimination

**Classification based on information that firms have about customers**



**First degree price discrimination** (perfect price discrimination) -> It is possible when the seller knows the individual willingness to pay of each customer -> Seller then sets a specific price for each consumer and for each unit of the good, equal to the consumer's specific reservation price -> price is not uniform but there are as many prices as there are consumers in the market






Perfect discrimination hard to implement in real markets, mostly because it is hard to obtain information about each consumer willingness to pay for a good/service, and for each unit by each consumer. -> However, the **higher the number (or ranges) of prices** a monopolist is able to set in a market (targeted to specific consumers or group of consumers), the higher the **appropriation of consumers' surplus** that a monopolist will make -> the producer appropriates all the surplus.

**Third degree price discrimination** (selection by indicators) -> it is the most frequent form of discrimination -> Customers' characteristics are observable and correlated with consumers preferences, and willingness to pay. Firms' **look at those characteristics to predict willingness to pay** -> Then firms set different prices for the same good for different groups of buyers, according to group characteristics (e.g.: over-65 and under-14 prices, membership discounts, academic prices for software, country-specific prices).

**Market segmentation** -> customers are divided into groups (by indicators such as age, income correlates (e.g., student status), geographical area) and then a different price is set for each group.

A monopolist selling the same good in two separate markets/groups of consumers considers revenues in the two markets:

$\prod=TR_1+TR_2-CT$

$= p_1q_1+p_2q_2-CT$

To Maximize profits, **$MR_1=MC$** and **$MR_2=MC$**
Thus:

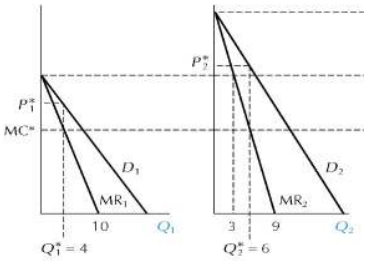
Given that p is a function of q (from the demand function):
→ $d\prod_i/dq_i=d(f(q_i).g(q_i))-c$

$d(p(q_i)*q_i)$

$$\frac{\partial \pi}{\partial q_1} = 0 \Leftrightarrow \underbrace{p_1 + q_1 \frac{\partial p_1}{\partial q_1}}_{MR_1} - \frac{\partial C(q)}{\partial q_1} = 0$$

$$\frac{\partial \pi}{\partial q_2} = 0 \Leftrightarrow \underbrace{p_2 + q_2 \frac{\partial p_2}{\partial q_2}}_{MR_2} - \frac{\partial C(q)}{\partial q_2} = 0$$

Thus: **$MR_1=MR_2=MC$**




Note that:

$$p_1 + q_1 \frac{\partial p_1}{\partial q_1} = p_1 \left[1 + \frac{q_1}{p_1} \frac{\partial p_1}{\partial q_1}\right]$$

$$\varepsilon_1 = \frac{p_1}{q_1} \frac{\partial q_1}{\partial p_1} \quad = \frac{1}{\varepsilon_1}$$

Thus:

$$p_1\left(1 - \frac{1}{\varepsilon_1}\right) = p_2\left(1 - \frac{1}{\varepsilon_2}\right) = MC$$

Under third degree price Discrimination, firms set a lower price in market segments with higher price elasticity -> i.e. lower prices for consumers who presumably have lower income (thus, higher elasticity, such as people under 26, students, people above 65 years old)

**Second degree price discrimination** -> The characteristics of the buyers are not directly observable. Firms only know that consumers **differ in their willingness to pay for the good, but they cannot associate this willingness to their identity** -> the objective is to extract the maximum consumers' surplus. Thus:

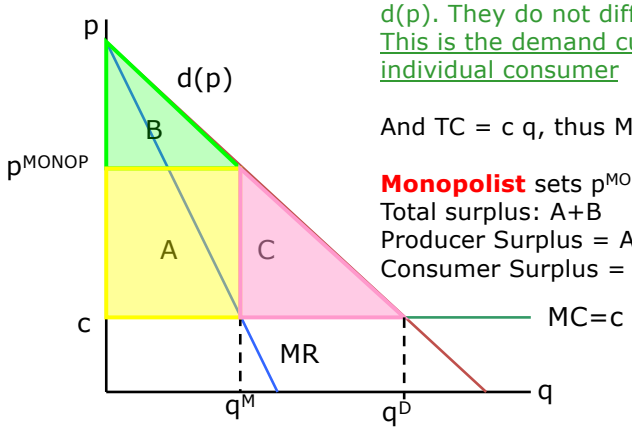
1. Firms differentiate prices according to the quantity of the good bought by customers: **non-linear pricing.** The suppliers set different tariff plans with different combinations of fixed fee + unit price for the good (average price decreases as q increases). By choosing a tariff plan, consumers **self-select themselves** into different categories.
2. Sellers set different prices for different "versions" of the good (e.g.: airplane fares). -> versioning -> By choosing the combination version/price, customers **self-select themselves** into groups -> this induce consumer to self select into combination of good and prices that its better for them

## Non-linear pricing: general idea (A)

(Second Degree Price Discrimination)

Price changes according to quantity bought by the consumer.

**Two-part tariff**: ***f*** (fixed fee) + ***p*** (variable part on Q)= f+pQ



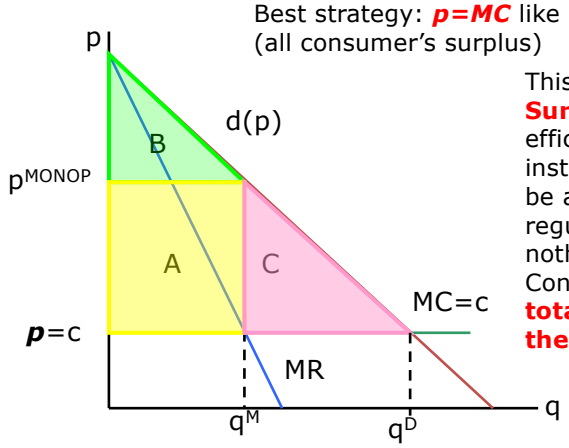

Suppose all consumers have the same d(p). They do not differ.
This is the demand curve for the individual consumer

And TC = c q, thus MC=c

**Monopolist** sets $p^{MONOP}$ and sells $q^M$
Total surplus: A+B
Producer Surplus = A
Consumer Surplus = B

With a **two-part tariff**, the monopolist can appropriate consumers' surplus B. What are the optimal ***f*** and ***p*** so that the monopolist maximizes its own surplus?

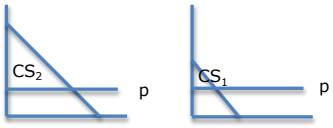
Max ***f*** = ***Consumer's Surplus***.




Best strategy: ***p=MC*** like in PC, and ***f=A+B+C*** (all consumer's surplus)

This **maximizes Total Surplus** (high efficiency): A+B+C instead of A+B that can be achieved under regular Monopoly but nothing goes to Consumers: surplus **totally appropriated by the Producer**

Now we assume that consumers differ -> there are two types of consumers: Consumer2 and Consumer1. Consumer2 is a heavy user of the good for any level of the price. Thus, for a given level p set by the seller, CS2>CS1. If the supplier could determine who's who" (type of consumer and his willingness to pay), he would set:




- **p=c=MC**
- **f1=CS1** and **f2=CS2**

But **the seller cannot observe consumers' type**! How to induce different types of consumers to choose their ***f*** (so to appropriate their surplus)? The seller can offer the consumers the choice of different two part- tariffs: if the two tariff plans were set as follows:

- p1=c and f1 for Consumer1
- p2=c and f2>f1 for Consumer2

This strategy would not sort out different consumers' types in the two tariff plans. Both types of consumers would go for 1).

There are two conditions that must hold when maximizing profits.

- satisfy the **participation constraint**, i.e. both consumers prefer to buy q>0 rather than q=0 (i.e., they prefer to buy rather than not to buy) – consumers' utility is positive
- be **incentive-compatible**, i.e. Consumer2 chooses tariff plan option 2, while Consumer1 chooses tariff plan option 1 -> each consumer is better off when choosing the tariff plan designed for her type

**Participation constraint** -> (or individual-rationality IR constraint) -> both types of consumers, giving the offer, should by something (they must participate in the market) -> (total) price package for each group lower than willingness to pay -> the fix-fee can't be higher than the consumer surplus

$$P_1 \leq WTP_1$$
$$P_2 \leq WTP_2$$

Or:

$$F_1 \leq CS_1$$
$$F_2 \leq CS_2$$

**Incentive-compatibility (IC)** -> each group should derive higher surplus from paying the tariff specifically designed for them:

$$CS_1(buying\ option\ 1) \geq CS_1(buying\ option\ 2)$$
$$CS_2(buying\ option\ 2) \geq CS_2(buying\ option\ 1)$$

*Which can be rewritten as:*

$$WTP_1 - P_1 \geq WTP_1 - P_2$$
$$WTP_2 - P_2 \geq WTP_2 - P_1$$

*Or:*

$$CS_1(P_2) - F_2 \leq CS_1(P_1) - F_1$$
$$CS_2(P_1) - F_1 \leq CS_2(P_2) - F_2$$

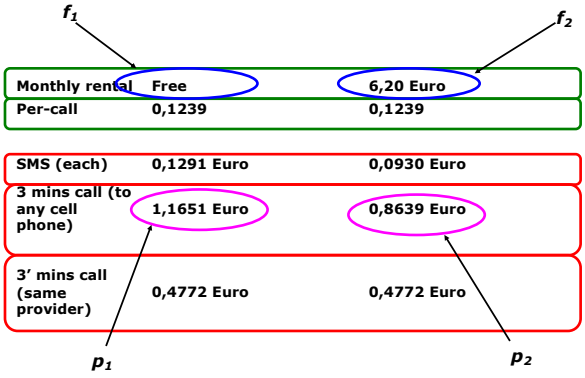
Consumer2 will select F2 is this choice will let him have more CS left, so if the quantity is high enough to have a higher fix cost but a lower price on the single quantity (we pay more for the fix cost but we have a benefict from paying less on the price depending on the quantity since the quantity is high). On the other hand, Consumer1 will select F1 is this choice will let him have more CS left, so if the quantity is low, it's better to have a lower fix cost but a higher price on the single quantity. Then, optimal strategy is:

- F2 = CS2 > F1 = CS1

- P2 < P1

Thus we have self-selection since :

- **T1 = F1 + p1Q** -> light users chose lower fix fee and higher per unit price
- **T2 = F2 + p2Q** -> heavy users chose higher fix fee (can also be lower than CS) and lower price




Heavy users prefer lower p!

**Versioning** -> second degree discrimination -> The seller knows that consumers have different willingness to pay, but cannot identify groups directly. To sort consumers by group, the seller sets different prices for different "deals" or "versions" of the good -> **different combinations of quality and price**. Consumers will buy the combination that reflects their preferences and willingness to pay -> self-selection (e.g. Amazon books; flight fares; software versions; etc.) -> N.B. Price Discrimination (different p) is based on different quality and not on different costs.

| Flights characteristics | Fares |
|---|---|
| 10/10 (Wed) – 15/10 (Sun) | 183 Euros Malpensa<br>203 Euros Linate<br>263 Euros Malpensa (changes allowed)<br>283 Euros Linate (changes allowed) |
| 13/10 (Fry) – 16/10 (Mon) | 124 Euros Malpensa at 6 a.m. or 9 p.m.<br>161 Euros Malpensa at 3 p.m. or 6 p.m.<br>183 Euros Malpensa at 9 a.m. or 1 p.m. (changes allowed) |
| 24/12 (Sun) – 26/12 (Thu) (Christmas!) | 58 euro Malpensa - Heathrow<br>78 euro Linate – Heathrow - Malpensa<br>98 euro Linate - Heathrow |

Firms may reduce the quality of part of their goods in order to discriminate p (*damaged goods*) -> the difference with product differentiation is that we are considering the same good with different versions and not different products -> and example of versioning might be the different seats on the plane (you pay more if you want a better seat, even if seats are all the same but with different positions)

New technologies make it easy to design and produce many variations of the same good. However, risk of **cannibalisation** -> low-price products might attract also consumers with high willingness to pay

**Social benefit** -> many consumers are served, also those with a low willingness to pay.

**Social cost** -> quality reduction to induce self-selection (and to avoid cannibalization) and surplus to producers.

**Bundling** -> different version of versioning -> another strategy to sort consumers and discriminate price among them. The seller offers different packages of related products/ services at different prices (Microsoft hardware + software; combos at fast food). Consumers

will self-select themselves by buying the combination package/price that better reflects their preferences and willingness to pay. It can be pure or mixed bundling.

*Pure bundling* -> is a type of bundling where the individual components that make up the bundle are only available when purchased as a bundle – they are not available for purchase separately. One example would be the cable company – you can choose different bundles of services and channels, but you can't select the individual channels that make up those bundles. Pure bundling is sometimes favored because it is seen as a way to increase sales – to get the channel you really want you also have to pay for a lot of channels you really don't care about. Because pure bundling also limits the choices available to the consumer it can come under scrutiny and even be subject to litigation.

*Mixed bundling* -> an approach to bundling where the individual components that make up the bundle are also available for purchase individually. Movie theater snacks and fast food combos are examples of mixed bundling – you can purchase each item individually, or together as part of the combo for a single price.

Other reasons for bundling:
- Compatibility and interoperability of the products in the package (software)
- Economies of scale and scope in production and/or distribution of the products in the package
- A new product is introduced in the market and the seller wants to gain market share

There are two effects of bundling:

1. **Reduction of price dispersion**

Two products (Newspaper N; Magazine M)

Two consumers (A; C): C is willing to pay 1,20 for N and 1,00 for M; A is willing to pay 1,00 for N and 1,20 for M

*a)* If N and M are sold separately, p max that the seller can set to capture both consumers is 1,00 for both products. Thus, TR= 2,00 for N + 2,00 for M = 4,00

b) With bundling the seller can set 2.20 for the two products together, thus TR= 2,20 (for M+N) *2 = 4,40

**NB** Firms revenues increase while consumers surplus decreases (… willingness to pay=price actually paid)

2. **Higher barriers to entry** -> Consumers differ in their willingness to pay for the products/ services that compose the package (N and M) -> by bundling the goods together, the seller can reach also those consumers with a low willingness to pay for one of the goods in the package. This implies that a *potential entrant* in the market of one of the goods (either N or M) will *not enter* because it has low or no market for its good. Bundling deters entry. It also increases market share of firms bundling the goods together.

**Time dependent prices** (intertemporal price discrimination) -> unit price depends on the time at which purchase is made -> products are introduced on the market at successive dates and at declining prices -> the objective is to discriminate between patient and impatient consumers -> the price changes during time (if consumer is impatient, he's willing to pay more at the exact moment the good enters the market , if consumer is patient, he's willing to wait until the price decrease) -> examples can be books first in hardcover and later in paperback, movies first in theatres and next on dvd or TV, flight tickets with last-minute sales

**Durable goods** -> a good that does not quickly wear out or, more specifically, one that yields utility over time rather than being completely consumed in one use. Items like bricks could be considered perfectly durable goods because they should theoretically never wear out. Highly durable goods such as refrigerators or cars usually continue to be useful for several years of use, so durable goods are typically characterised by long periods between successive purchases

There are two main features that we need to take into consideration:

- firms offer the same product in different periods
- Consumers buy only 1 item over the whole horizon.
  - Benefits are derived over a number of periods.
  - Consumers can decide on the timing of their purchase (e.g., car, washing machine, computer, telephone) and can order the good in advance compared to consumption time (e.g., holiday package, plane ticket, concert ticket)

*The possibility of selling at different points in time allows for **intertemporal price discrimination** (i.e., High price "today" to consumers with high WTP, low price "tomorrow" to consumers with low WTP). Is it a **profitable strategy for firms**?*

The IPhone case

- June 29, 2007: Iphone release
  - $599 for 8GB , $499 for 4GB
- September 5, 2007: Apple announces discounts
  - From $599 to $399 for 8GB model
- Discontent among early buyers who felt cheated

https://www.youtube.com/watch?v=eF-qX72om5w

- Apple offers a $100 store credit to early buyers and Jobs publish an open letter of apologies:

*"(…) we need to do a better job taking care of our early iPhone customers as we aggressively go after new ones with a lower price. Our early customers trusted us, and we must live up to that trust with our actions in moments like these."*

Suppose that we have two types of customers:

- Ta with high WTP -> **Va** -> more impatient
- Tb with low WTP -> **Vb** -> more patient

- **Va > Vb**
- Equal number of consumers of each type N = 1 million
- Discount factor δ < 1 -> the smaller is δ, the lower is the current amount of money that I get
- Production cost c = 0

- With no inter-temporal price discrimination
  - $p(today) = p(tomorrow) = V_A$
    $\pi = V_A\ (millions)$ → Because only $T_A$ buys for price higher than $WTP_B$
  - $p(today) = p(tomorrow) = V_B$
    $\pi = 2V_B\ (millions)$ → Because both types of consumers buy for a lower price
  - Assume that $V_A > 2V_B \rightarrow p^* = V_A$

- With inter-temporal price discrimination
  - $p(today) = V_A$
  - $p(tomorrow) = V_B$
  - $V_A > V_B \rightarrow \pi = V_A + \partial V_B > V_A > V_B$

Inter-temporal Price discrimination is apparently profitable, but is it **feasible**? -> the problem is that the situation described is not an equilibrium -> Consumer Ta knows that the price tomorrow will be lower -> the price today that leaves her indifferent between buying today (at the price of today) and buying tomorrow (at the price of tomorrow) is the one satisfying:

$$\underbrace{V_A - p(today)}_{\text{Surplus if buying today}} = \underbrace{\partial[V_A - p(tomorrow)]}_{\text{Surplus if buying tomorrow}}$$

Since: $p(tomorrow) = V_B$

→ $p(today) = V_A(1-\partial) + \partial V_B < V_A$

- Profits are thus given by

$$\pi = \{V_A(1-\partial) + \partial V_B\} + \partial V_B$$

If $\partial \rightarrow 1$ (i.e. consumers are patient enough)

$$\pi = 2V_B < V_A$$

Profits with inter-temporal discrimination are thus lower than those obtained with a uniform price. The trap of durable goos is that:

- Rational consumers understand that seller will lower price over time
- Even high-WTP consumers prefer to wait and buy at low prices tomorrow, rather than buying at high prices today

The solutions to the trap of durable goods could be:

- commitment not to lower prices in the future (i.e. Porsche, Miele, Apple)
- Do not sell good, rent it -> it turns the good from a durable one to a good whose services last for a short period of time (Xerox)

## Innovation

Innovation is a very broad topic and it's one of the main ways through which market structure change. We'll study the impact of innovation on those changes in the structure of the markets.

The importance of innovation goes beyond those changes: innovation provided changes in cities, way of living and everything we can think about in life. At a macro level, we can say that "Innovation is responsible for as much as 80% of the growth in per capita income in advanced economies." 80% of the growth in our per capita income derives from the fact that there are technical innovations. The remaining 20% is due population increase, capital goods (investments in cars, hospitals…) -> there is more capital for more people so the per capita income increase too.
When it comes to companies, the reason why we study innovation is that innovation distinguishes between a leader and a follower (Steve Jobs) -> if you are innovate you grow, otherwise you probably fail because you don't grow enough -> it's important for the survival of the companies.
Our focus in these two classes is on the interplay between innovation and industry structure.

## Measuring innovation

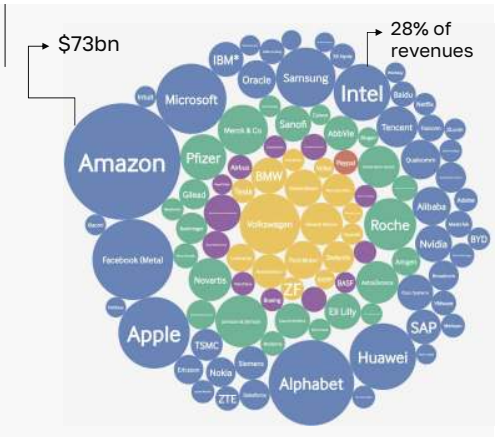
Innovation is very important but it's not easy to measure: not everything that can be counted counts; not everything that counts can be counted. It's difficult to what's innovation and how some innovations are different from others in terms of importance. By innovation we typically consider two different types of innovations product innovations or process innovations.

- **Product innovations** -> easy to observe and understand -> we usually think about those kind of innovations when we are asked about innovations
- **Process innovations** -> increase productive (IA doesn't sleep so the productivity will be higher because we are not wasting time) and might be good for earth too (some innovations can make process more sustainable)-> those innovations are important to increase productivity and to lower the costs if we use robots, the costs will be lower because we don't have to pay wages…)

Those kind of innovations are both important are they are connected sometimes: we might have a situation in which some products are not feasible unless there is some kind of process innovation.
In general, innovation and technical change are a cumulative process: something, some products, are possible only if there are previous advance in other things (smart-watches are now a real product only because there were previous innovation i.e. crystallisation for the screen…).
What things can a company do to improve its competitiveness other than product/process innovation? Information collection, marketing innovations, management type, business model innovation, company structure innovation (outsourcing instead or producing), "just-in-time production" (production based on the demand) -> changes that might reduce costs and increase profits. Sometimes innovation has positive aspects (more competitive companies) but also negative aspects for the society (i.e. pollution).

## Top 100 R&D spenders

Collectively, these big firms spent $720bn in research and development in 2022 to develop and improve products, services and processes




Most innovations come from investments in R&D -> the companies in the picture, collectively, spend 720 billion dollars every year in research and development. They spend a lot in innovation. Those companies are systematically engaged in developing and introducing new things (general innovations -> products, processes, companies structures…)

It's quite easy to find data about R&D (you can find them on Statista) but those are input measured: I can count the resources invested in this but I don't know the output, so I don't know if those investment are effective or not.
There are some product and process that don't need so many resources in R&D, for example food, fashion, in Italy (the guy that invented apericena was a genius!!! You wouldn't pay for a regular dinner 40€ but you are willing to pay 15€ for drinks and food) -> you don't need many resources but creativity.

## Fitbit patent

Wearable device to determine mental health based on physiological and environmental data


US011872041B1

(12) **United States Patent**
**Heneghan et al.**

(10) **Patent No.: US 11,872,041 B1**
(45) **Date of Patent: Jan. 16, 2024**

(54) **DETERMINING MENTAL HEALTH AND COGNITIVE STATE THROUGH PHYSIOLOGICAL AND OTHER NON-INVASIVELY OBTAINED DATA**

(71) Applicant: **Fitbit, Inc.**, San Francisco, CA (US)

(72) Inventors: **Conor Joseph Heneghan**, Campbell, CA (US); **Alexander Seaton**, Cosford, CA (US); **Jonathan David Charlesworth**, San Francisco, CA (US)

(73) Assignee: **FITBIT, INC.**, San Francisco, CA (US)

( * ) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **17/542,774**

(22) Filed: **Dec. 6, 2021**

(58) **Field of Classification Search**
CPC ... A61B 5/165; A61B 5/02055; A61B 5/1118; A61B 5/14551; A61B 5/162; A61B 5/4815; A61B 5/7257; A61B 5/742; A61B 5/02416; G16H 50/30
USPC ..... 600/301
See application file for complete search history.

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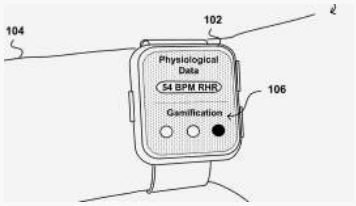
*Primary Examiner* — Carl H Layno




The Fitbit is not already out but there is a patent so the firm can only produce this but this a "just in case" thing since its not a product already and we don't know if we'll ever see it on the market or no -> patents covers something that actually might not be counted -> we don't know if the product will be available in the market

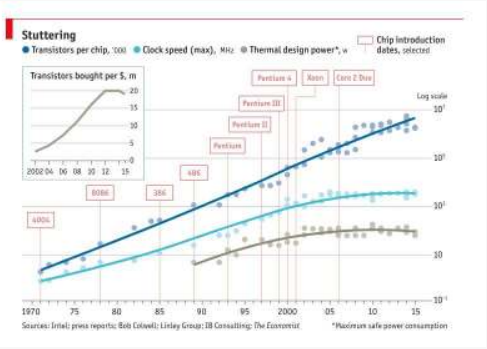
**Patent** -> legal right granted by a government authority to an inventor or assignee, giving them the exclusive right to make, use, sell, or distribute their invention for a certain period, typically

20 years from the filing date. In exchange for this protection, the inventor must publicly disclose the details of the invention -> Patents typically cover inventions, processes, or technological improvements and encourage innovation by rewarding inventors with temporary monopolies, which can help them recoup research and development costs. After the patent expires, the invention enters the public domain, allowing others to use it freely.

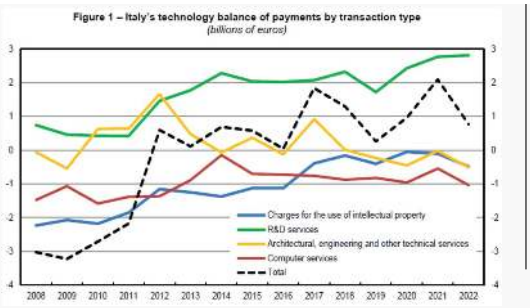
## Measuring innovation

| Measure | Advantages | Disadvantages |
|---|---|---|
| **R&D expenditures** | —Readily available<br>—Long time series | —Input measure<br>—Innovations not from R&D |
| **Patents** | —Readily available<br>—Detailed tech info | —Not all firms/sectors patent<br>—Variance in economic value |

## Other measures




Transistors per chip




Technological balance of payments (Bank of Italy)


Number of scientific publications

**Market structure and innovation**

Do we expect innovation to be higher in market situations of higher market power or lower market power? Is innovation effort higher in fragmented and highly competitive industries; or, rather in concentrated and monopolistic industries?

There is a different between static efficient and dynamic efficiency: talking about static efficiency,  market power implies allocative inefficiency. Perfect competition ideal market structure to maximise static social value. From the point of view of dynamic efficiency we need to ask ourselves: Is the rate of technical change and progress higher in industries where firms enjoy market power? Is there a trade-off between static and dynamic efficiency?

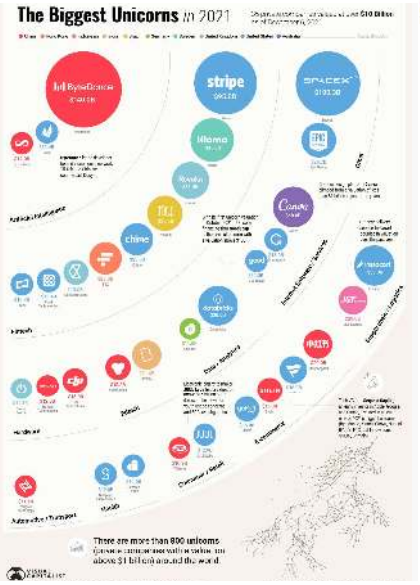
## Schumpeter Mark I

*[Entrepreneurship] replaces today's Pareto optimum with tomorrow's different new things … carrying out innovation is the only function which is fundamental in history.*

Theory of economic development (1912)

Startups as engines of innovation

Creative destruction



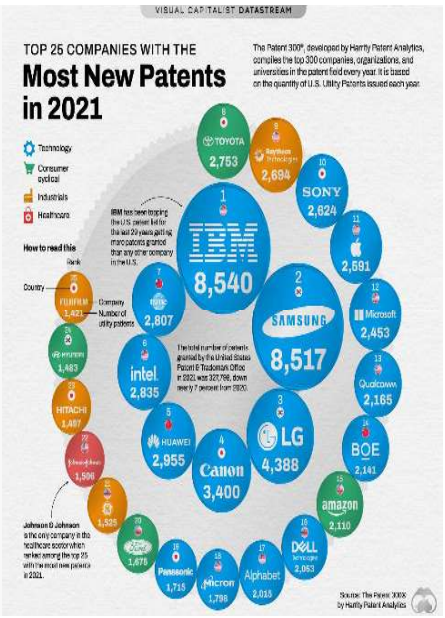

## Schumpeter Mark II

*As soon as we go into details and inquire into the individual items in which progress was most conspicuous, the trail leads not to the doors of those firms that work under conditions of comparatively free competition but precisely to the door of the large concerns … perfect competition is not only impossible, but inferior, and has no title to being set up as a model of ideal efficiency.*

Capitalism, socialism and democracy (1942)

Large firms as engines of innovation

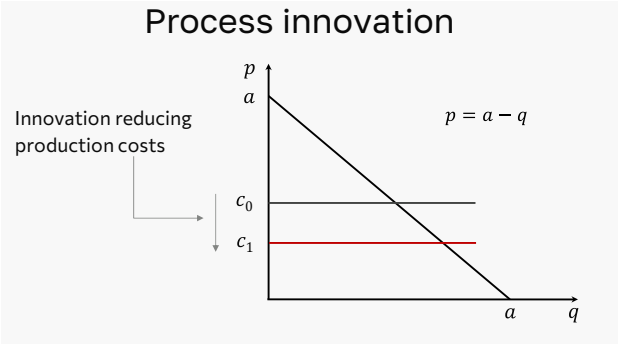
Creative accumulation




The genes of innovations are in the entrepreneurs, the start-uppers -> the biggest unicorns (start-up) are companies with innovative ideas.

Significant progress and innovation often emerge from large companies rather than smaller firms operating in conditions of free competition. It challenges the idea that perfect competition is both achievable and desirable. Instead, the argument is that not only is perfect competition unrealistic, but it is also less efficient compared to the contributions made by large enterprises in driving advancements. Therefore, perfect competition should not be viewed as an ideal model for economic efficiency.

What changes from 1912 and 1942? The rise of R&D -> up to 1942, innovation wasn't organised in laboratories, but it was the activities of the genius -> now companies spend a lot of money to get innovative ideas



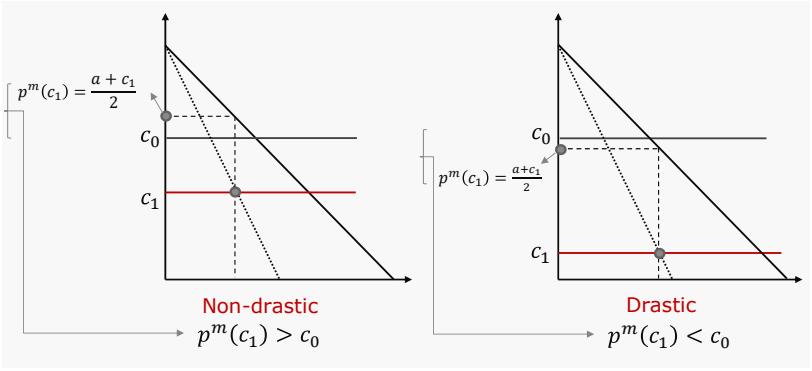

**Arrow model** -> Small firms in fragmented and competitive markets have a greater incentive to invest in (process) innovation, than large firms in concentrated and monopolistic markets.

Process innovations -> innovation in the way we produce a product for which the inverse demand is p = a - q

**Drastic innovation** -> A drastic innovation is one that is so significant or transformative that it allows the innovating firm to fully capture the market, potentially becoming a monopolist. After a drastic innovation, the cost reduction or improvement in product quality is so large that competitors cannot profitably produce or compete at the new lower prices set by the innovator. The monopoly price with the new cost is less than the original marginal cost. The innovating firm can set the price at the level of their new cost structure, making other firms irrelevant because they cannot match the new efficiency -> Example: A breakthrough in a new technology that cuts production costs drastically, like the invention of the assembly line by Ford, which significantly reduced automobile prices.

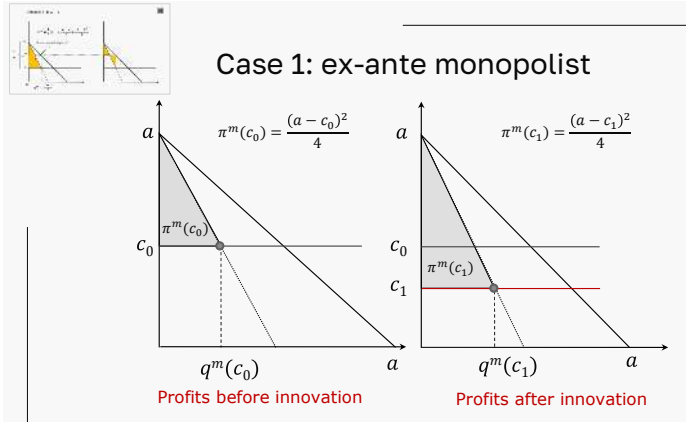
**Non-drastic innovation** -> A non-drastic innovation improves the product or reduces costs, but not enough to allow the innovating firm to dominate the market entirely or eliminate competition. The reduction in costs, driven by the innovation, is not that big (in the sense that the monopoly price with the new cost is greater than the original marginal cost). In this case, while the innovator can reduce prices or improve product offerings, competitors can still adjust and remain in the market, possibly by lowering their own prices or making incremental improvements. Non-drastic innovations often lead to competitive markets where innovation improves overall efficiency but doesn't grant a monopoly to any one firm -> Example: An improvement in battery life in smartphones, which offers an advantage but doesn't eliminate competition from other brands.

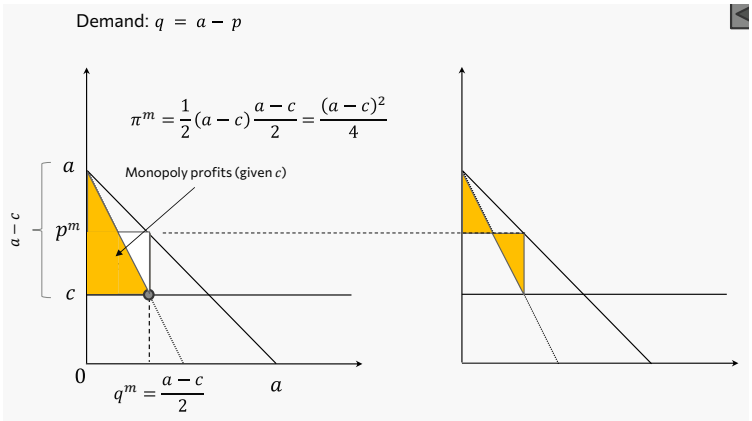
We can say that drastic innovation can potentially change market dynamics by leading to monopolistic outcomes, while non-drastic innovation fosters continued competition.




- Market demand: $p = a - q$
- An R&D lab is selling a patent for a **non-drastic** process innovation → reducing costs from $c_0$ to $c_1$
- The firm that obtains the patent has the exclusive right over the use of the innovation → ex-post, the firm that obtains the patent is a monopolist over the invention

*What is the maximum amount a firm would be willing to pay (invest) to purchase the patent?*

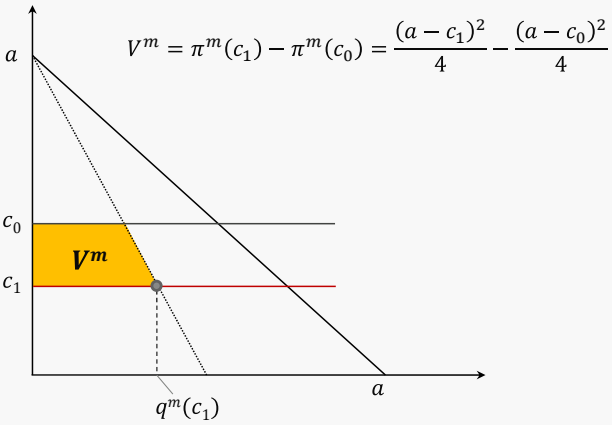


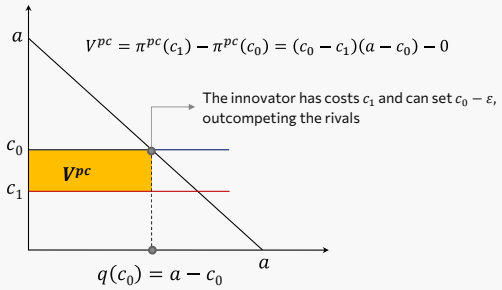

Profits = TR - TC = the area below the MR curve - the area below the MC curve

Before the patent, the firm is working with costs equal to c0, after the acquisition of the patent (with innovation), the firm can have lower costs equal to c1 (higher profits with higher quantity produced)

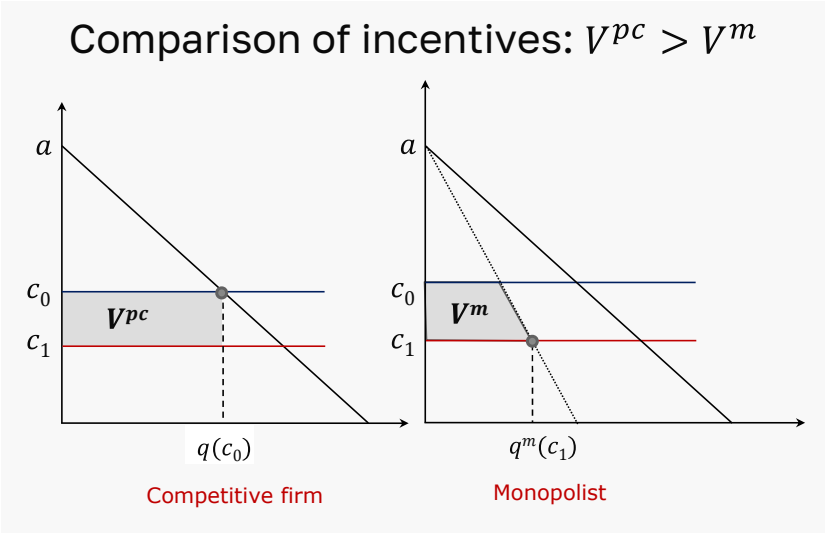
**Incentive to invest in innovation** -> the maximum amount the firm is willing to offer to the innovator (R&D, the one that sells the patent), will be the difference between the profits with the innovation and the profits without innovation.
If we are in a situation of PC and R&D say




Case 2: ex-ante perfectly competitive firm

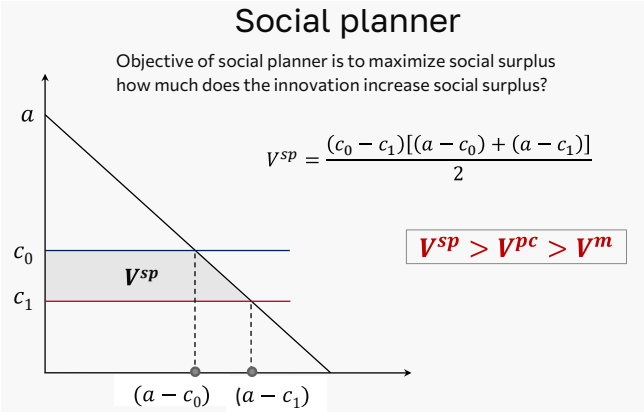


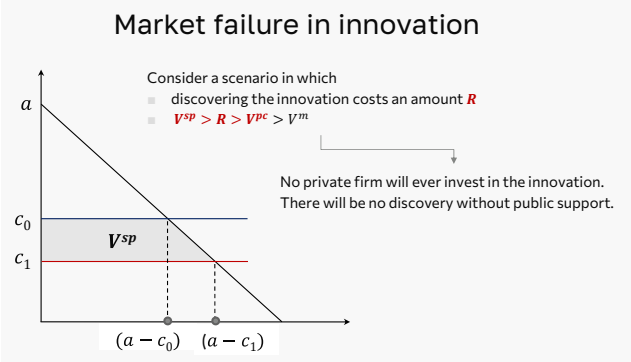

that there is a new patent that will be sell just to one firm that will be the exclusive producer of the innovated product -> the incentive to innovate will be higher because the firm with the patent will become a monopolist in the market (not with monopoly price but with a price lower), leaving the other firms with zero profits. We need to consider the difference between the profits with innovation and the profits without innovation (equal to zero since we are considering a situation similar to PC and to a Bertrand equilibrium)




We can expect the more competitive firms to have a higher incentive than the monopolist firms to innovate their products.

**Social planner** (should be the government with policies, antitrust laws…) -> hypothetical decision-maker or entity responsible for making choices that maximize the overall well-being or social welfare of a society. This concept is used in theoretical models to analyze how resources should be allocated for the greatest good, balancing efficiency and equity, as well as addressing market failures -> want to maximise the social welfare (maximise the TS)




In this situation, no private companies will invest in innovations (but this a theoretical situation that is not real) because they don't see many returns to make it worth for them. For the government is worth because they might discover something that is socially useful (i.e. new sources of energies …

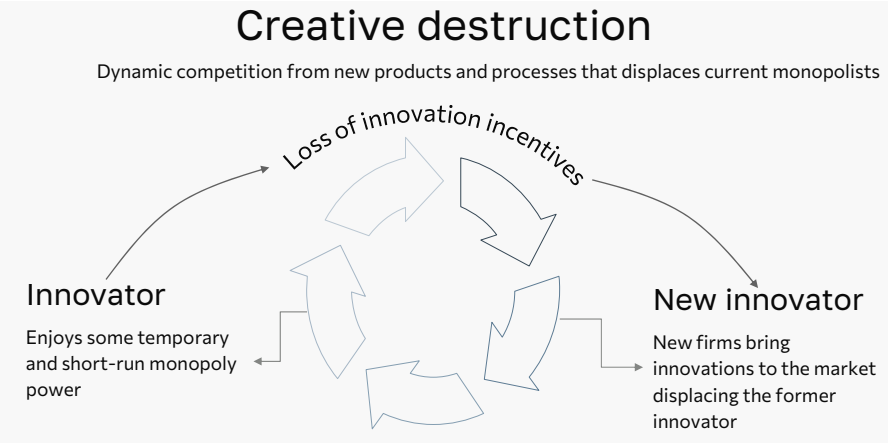
Existing companies refused to innovate or they did it late and for that reason they failed. Market failure in innovation is theoretically (and also practically) possible

Examples can be:

- **Kodak** -> Chose not to invest in digital photography fearing it would have cannibalised its film core business)
- **Microsoft** -> Initially, did not invest in cloud computing fearing that this would have undermined its one-time purchase of software business)
- **Blockbusters** -> Slow to invest in streaming services fearing that this would have cannibalized its revenues from rental of movies

**Conclusions on the arrow's model** -> A monopolist not threatened by any competitor will invest less in innovation than a firm operating in a perfectly competitive market. Intuition:

- Ex-ante, perfect competitive firm makes zero profit -> innovating means going from zero to positive profits
- Ex-ante, monopolist firm already makes positive profits -> the pre-invention monopoly power acts as a disincentive to further innovation (replacement effect



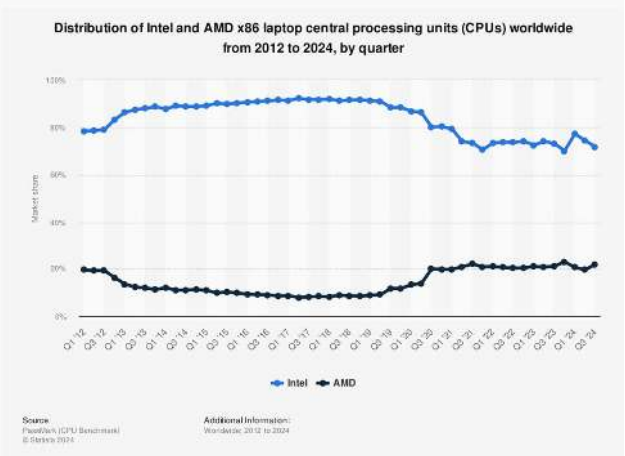

**Creative destruction** -> economic concept introduced by Joseph Schumpeter, referring to the process by which new innovations and technologies replace outdated ones, leading to economic growth and transformation. While this process can foster progress and efficiency, it also results in the obsolescence of certain industries and jobs, which can create social and economic challenges -> For example, the rise of digital photography led to the decline of traditional film photography, affecting jobs and companies in that sector. The concept emphasises the importance of innovation in driving capitalism forward, even if it means disrupting established practices and economic structures.

### Innovation strategy

Which firms have more incentives to innovate? How do startups profit from their ideas?

## Intel

Intel maintained its market dominance through continuous innovation in chip design and manufacturing technology. Innovations such as the development of the x86 microarchitecture and advancements in manufacturing processes (e.g., moving to smaller transistor sizes like 14nm and 10nm) allowed Intel to deliver faster, more power-efficient processors.




Does innovation level the field, or does it contribute to maintain or increase the dominance of technological leaders?

- Consider a market with
  - (1) an incumbent monopolist ($I$)
  - (2) a potential entrant ($E$)
  - (3) a research laboratory which has developed a non-drastic process innovation
- The R&D laboratory licenses the patent to the firm that offers the highest amount
- $E$ can enter only by innovating $\rightarrow p^m(c_0) < c_E$ where $c_E$ current costs of $E$
  - If $E$ gets the license, its costs become $c_1$ with $c_1 < c_0 < c_E$
- If $E$ enters then price competition between $I$ and $E$

## Incentives of the incumbent ($I$)

- $I$ offers the highest amount and gets the license, it remains monopolist, making monopoly profits

$$\pi^m(c_1)$$

- $E$ offers the highest amount and gets the license, $I$ becomes a duopolist, making duopoly profits

$$\pi^d(c_0, c_1)$$

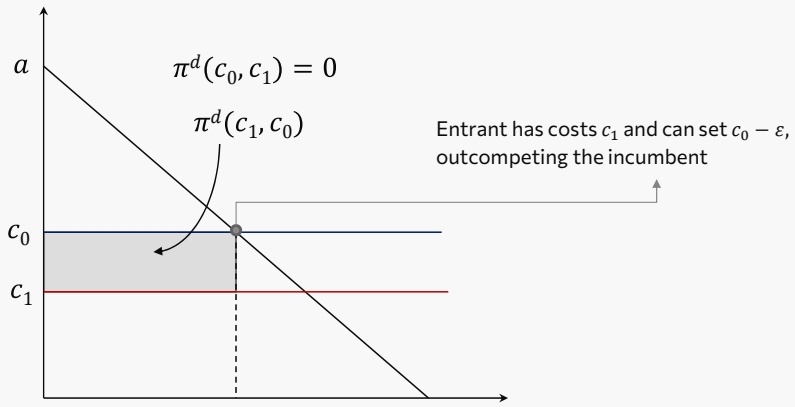
## Incentives of the entrant ($E$)

- $I$ offers the highest amount and gets the license, $E$ remains out of the market making zero profits
- $E$ offers the highest amount and gets the license, $E$ enters, and makes duopoly profits having costs $c_1$

$$\pi^d(c_1, c_0)$$

The only way for the Entrant to enter the market is to acquire the patent -> lower costs for the entrant (c1 < c0) -> it E enters, there is price competition between I and E
If the incumbent offers the highest amount, if I is able to acquire the licence, it will have cost c1 and the entrant will stay out -> I will make monopoly profits with costs c1 -> if I wins the auction, the entrant stay out and make zero profit
If the incumbent lose the patent, the entrant will win it and enters the market making duopoly profits with lower costs than the incumbent.

## Duopoly profits in case of entry




## Persistence of dominance

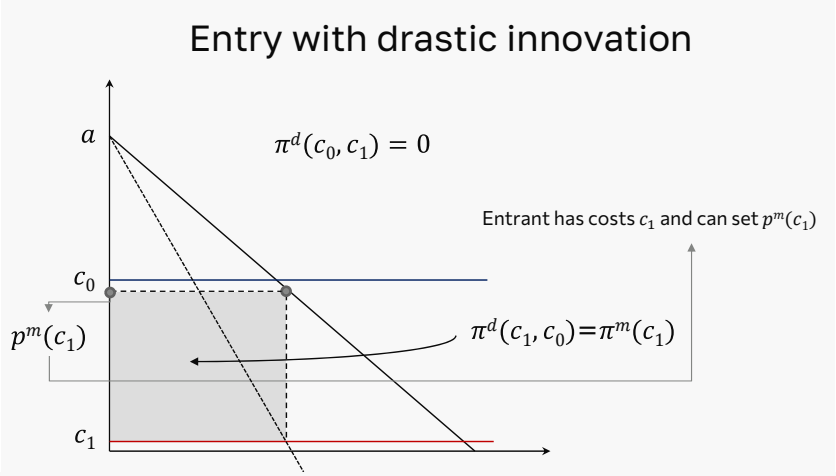
- Compare incentives

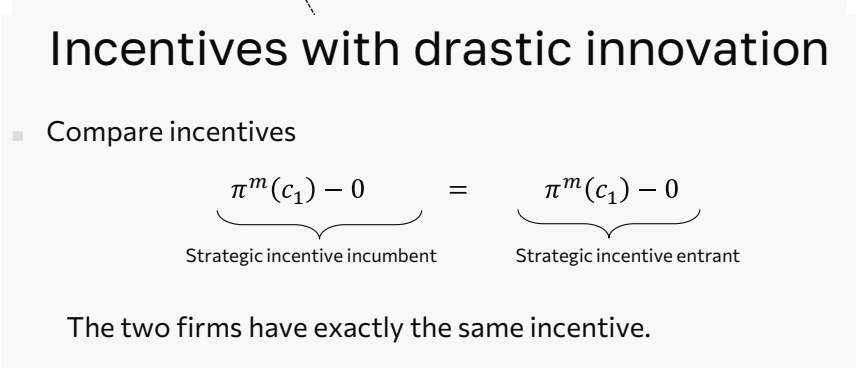
$$\underbrace{\pi^m(c_1) - \pi^d(c_0, c_1)}_{\text{Strategic incentive incumbent}} > \underbrace{\pi^d(c_1, c_0) - 0}_{\text{Strategic incentive entrant}}$$

$\pi^m(c_1) > \pi^d(c_0, c_1) + \pi^d(c_1, c_0)$ A monopolist will always do greater profits than two competing firms

With a non-drastic innovation, the incumbent has a higher incentive, will offer more, get the innovation, and remain monopolist → persistence of monopoly

In case of entry of E, the profits will be different for E and I -> the entrant will have lower costs and for that reason can lower the price by a slight measure and get the whole demand. The price is different from the monopoly price since the innovation is not drastic and it can't be charged a monopoly price otherwise the I firm can undercut E. In this case I can't compete because it will get zero profits.
To compare the incentives, we need to calculate the difference between the profits made with the win of the auction and without the patent. We get that the incumbent has a higher incentive to innovate because in this way it can remain a monopolist in the market -> maintain dominance -> Incumbent has much more to lose and for that reason it must innovate.
If innovation is more radical things change a little bit -> the incentive to innovate change.
Uncertainty can have an impact on the incentive to innovate.

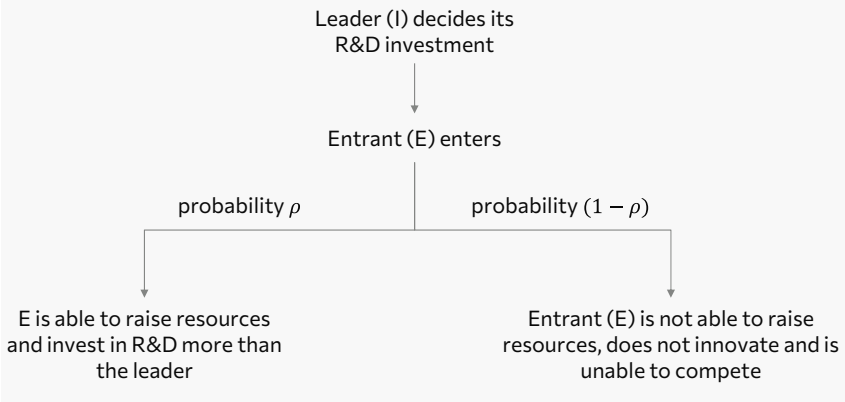



With drastic innovation, the Entrant and the Incumbent will have the same incentive to innovate because both will behave as a monopolist (they can set monopoly prices since the change in the product is drastic) and kick the other firm out of the market. With a drastic innovation is not

true anymore that the incumbent has higher incentive to innovate ad with non-drastic innovation: E and I have the same incentive.

Now we consider the model with uncertainty -> In the previous models, there is no uncertainty: innovation has been already produced and the agent offering the highest amount obtains it. However, innovation is inherently uncertain -> there is no guarantee to discover a successful new product or process by investing in R&D. We can try to understand the role of uncertainty by modifying the previous models as illustrated in the following chart. We consider again the case of a drastic innovation and we incorporate uncertainty.




## Incentives for the leader

Profits with innovation: $\pi^m(c_1)$ — Expected profits without innovation: $[\rho \cdot 0 + (1-\rho)\pi^m(c_0)]$

With probability $\rho$, entry and zero profits

With probability $(1-\rho)$, no entry and monopoly profits with costs $c_0$

- Rearranging

$$\pi^m(c_1) - (1-\rho)\pi^m(c_0)$$

## Incentives for the entrant

Profits with innovation: $\pi^m(c_1)$ — Profits without innovation: $0$

- Hence, the incentive for the entrant (if able to find resources) is simply

$$\pi^m(c_1)$$

**Expected profit** -> weighed profit with the probabilities as weights -> estimating potential future profits while accounting for the risks and variability associated with different scenarios -> the higher the probability for the entrant not to find the money to invest in innovation, the lower the incentive for the incumbent to invest in innovation

## Comparison of incentives

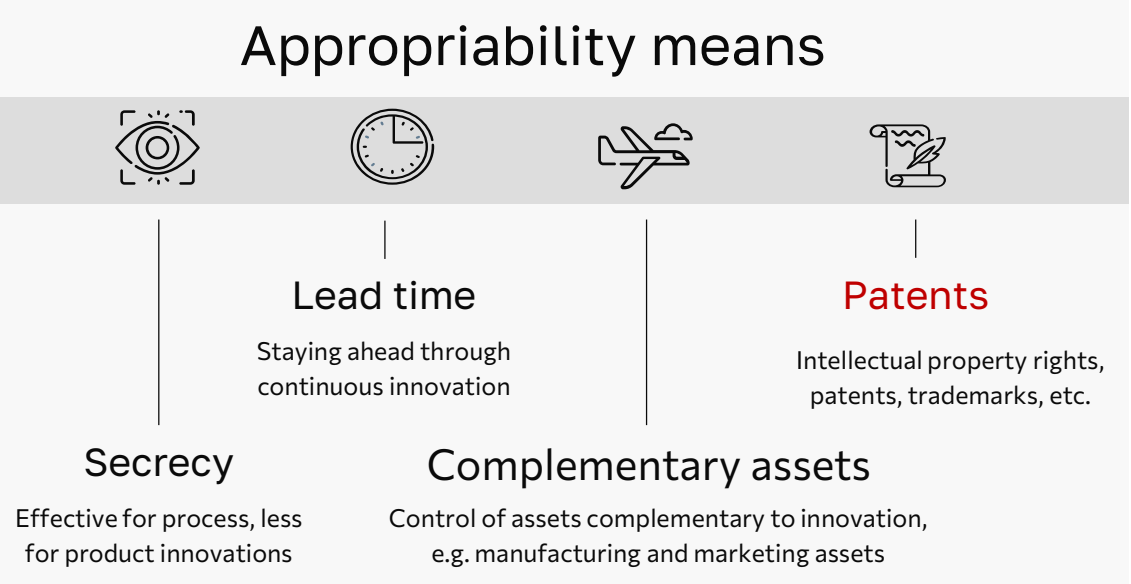
$$V^M = \pi^m(c_1) - (1-\rho)\pi^m(c_0) < \pi^m(c_1) = V^E$$

Entrant has higher incentives to invest in innovation if the innovation is drastic (radical) and there is uncertainty.

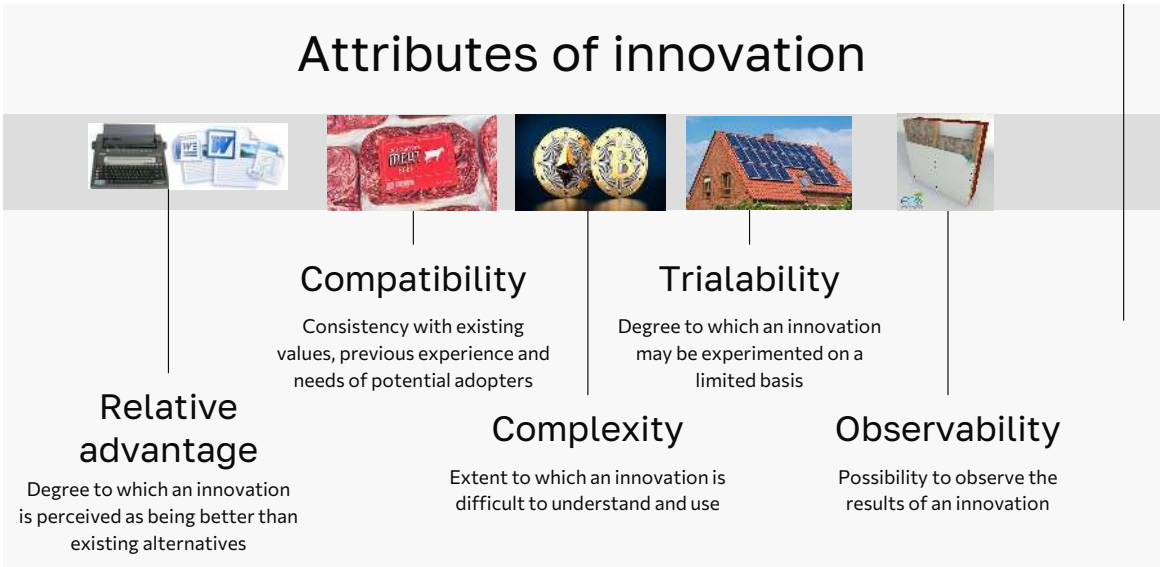
In summary, we can say that we can find creative destruction when the uncertainty is high -> startup engines of innovation in environments with high technological opportunities, uncertainty, radical and disruptive innovations
We have creative accumulation where innovation is more incremental -> Leading incumbents are more likely to be the innovators in industries where innovations is more incremental, cumulative, and sustaining -> less uncertainty

**Idea factories** -> In some industries, symbiotic relation between established leaders and innovative startups -> Start-ups generate ideas protected by patents, which they do not directly commercialise. Established leaders own the complementary assets needed to commercialise the innovations -> Strat-ups sell the patents or the whole company to bigger firms that have higher power and more resources to make the idea real.

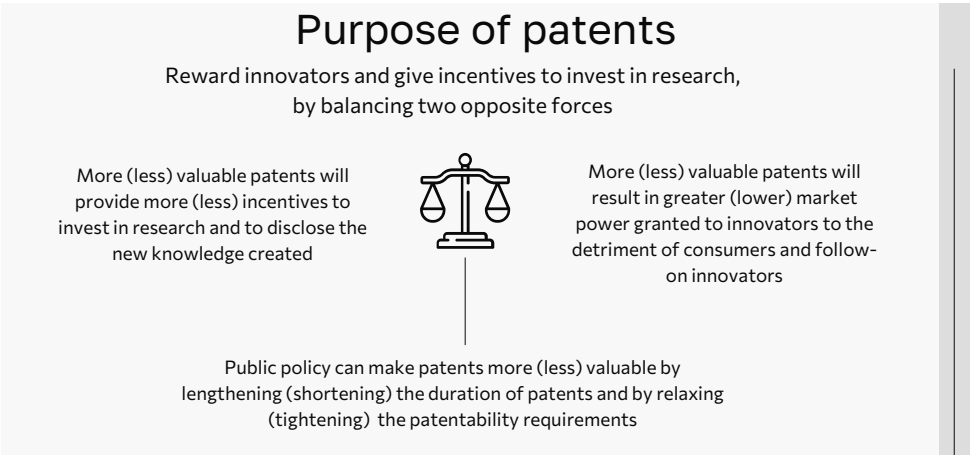
**Public policy**
How do firms appropriate the value (profits) created by their innovations? How do they prevent other firms from imitating and thus benefiting from their creative efforts?




**Patents** -> Right granted by a government for 20 years (introduced by the republic of Venice) , to exclude others from manufacturing, using or selling a patented product or from utilising a patented method or process -> Patents are legal protections that grant inventors exclusive rights to their inventions for up to 20 years. There are three main types: utility patents (for new processes or products), design patents (for ornamental designs), and plant patents (for new plant varieties). To be patentable, an invention must be novel, non-obvious, and useful. The patent process involves submitting an application to a patent office, undergoing examination, and potentially obtaining approval. Benefits of patents include monopoly rights that prevent competition, the ability to generate revenue through licensing, and encouragement of innovation. However,



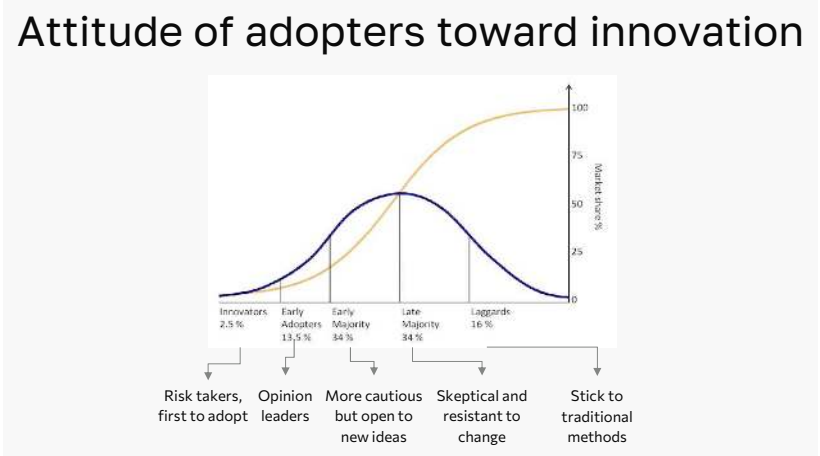

obtaining and enforcing patents can be costly and time-consuming. Developing a patent strategy is crucial for businesses, including early filing, conducting patent searches, and building a portfolio. Current trends highlight the focus on software and biotech patents and the importance of securing patents in global markets.




The major requirements for an innovation to be patentable are

- **Novelty** -> it must be new to the world (no previous public notice)
- **Non-obviousness** -> it must contain an inventive step - something that would not be obvious to someone with a good knowledge of the subject

Patent examiners and courts, indirectly inspired by policy, decide in a discretionary way upon these



requirements.

There is also a “dark-side” of patents:

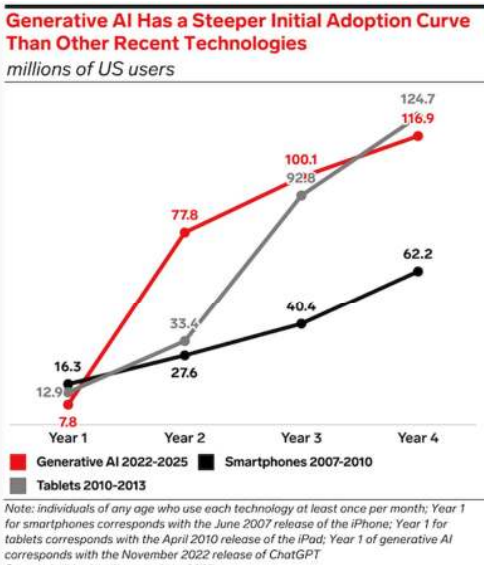
- **Non-practicing entities** whose primary business model is to own a patent portfolio and generate revenues by licensing. Some of these NPEs are known as patent trolls: their business is to sue patent infringers and extort royalty damages
- **Patent thickets** -> commercialisation of new products may require obtaining the license for thousands of patents -> total cost increases -> Patent pools as partial remedy to the problem -> arrangement where multiple patent holders agree to license their patents to one another or to third parties as a single package. This can streamline the process of obtaining licenses, reduce litigation risks, and promote innovation by making it easier for companies to access essential technologies. Patent pools are often formed in industries where multiple patents are necessary to create a product, such as telecommunications or biotechnology. They can help prevent patent thickets, where overlapping patents complicate the landscape for developers, and they can foster collaboration among companies that might otherwise compete.

## Inter-firm R&D agreements

- Rivals often co-operate by forming R&D strategic alliances
- These collaborations help restore incentives to innovate by internalizing knowledge spillovers, and reducing the risks and costs associated with R&D
- From a social perspective, these agreements raise the risk of intra-industry collusion
  - — Most anti-trust laws, however, are tolerant towards them (see, for example, the EU Regulation No 418/85 of 19 December 1984)

## Diffusion of innovation

Generative AI adoption climbed faster than smartphone and tablets




In the graph we can see that it takes time to introduce a new innovation -> the rate of adoption of AI is higher than other technologies (faster diffusion) -> even If there is a higher rate of diffusion, there aren’t many people that actually pay for those platforms (not many people subscribed at chatgpt)

We study diffusion of innovation for two reasons:

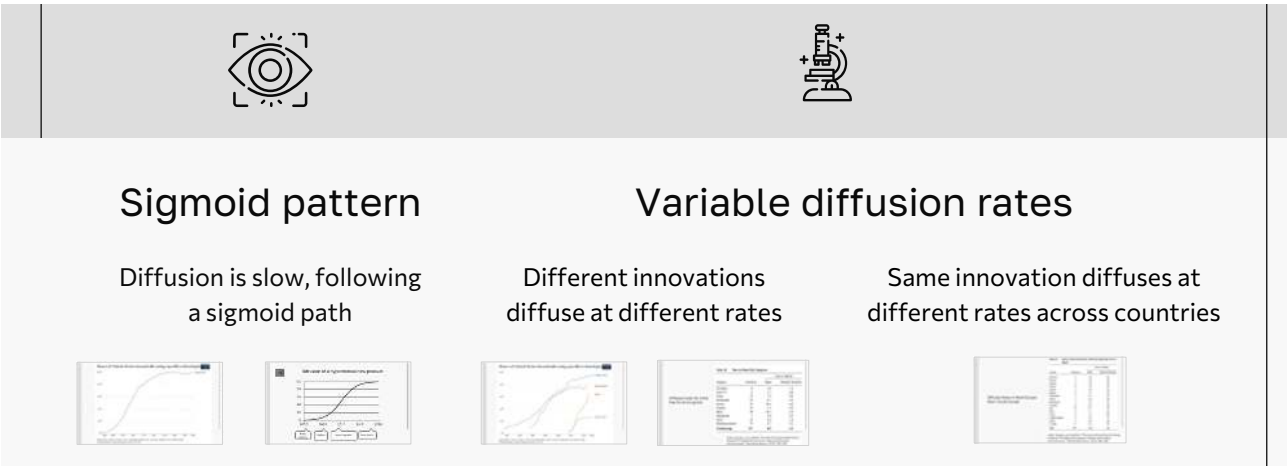
- **Welfare** -> innovations have an impact on welfare

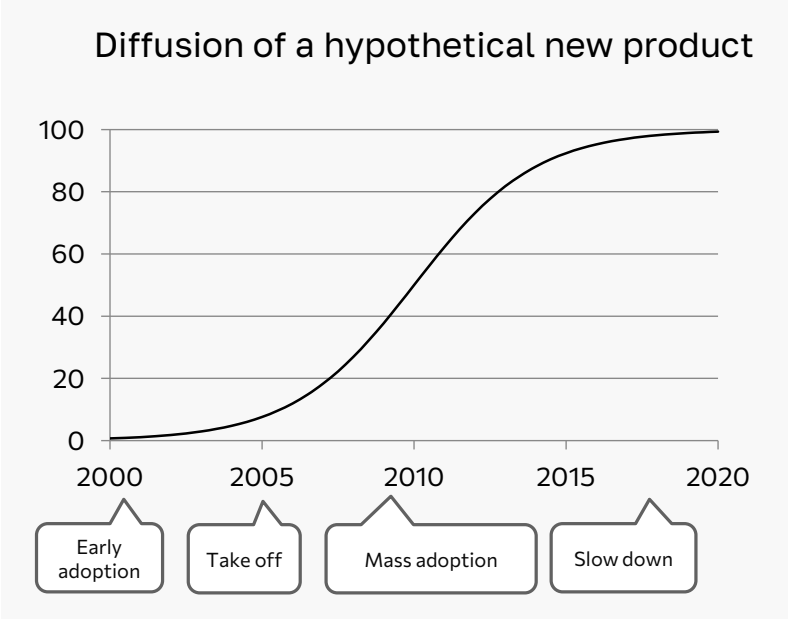
only through their diffusion -> welfare can also mean profits, but this is only considered if the innovation is diffused -> if the innovations are not adopted, they don't have an impact obviously

- **Speed of adoption** -> Diffusion takes time and there is no guarantee it will be successful (we don't know if the innovation will be successful or not) -> implications for policy and firm strategies (different nations can have different perspective on the implications that an innovation can have, different nations can decide if they want to produce something or not depending on the impact that this can have on the nation in general in terms of welfare)

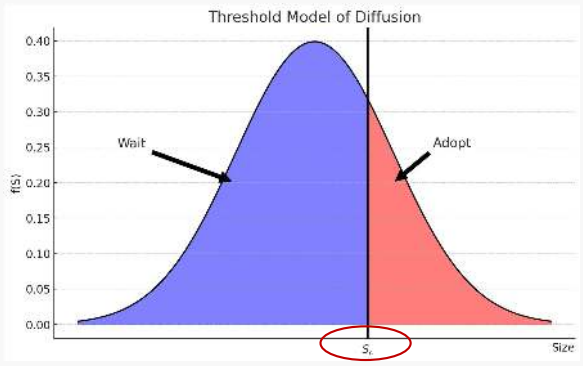
**Empirical facts**

We are gonna talk about empirical regularities (i.e., observed across many innovations) in diffusion

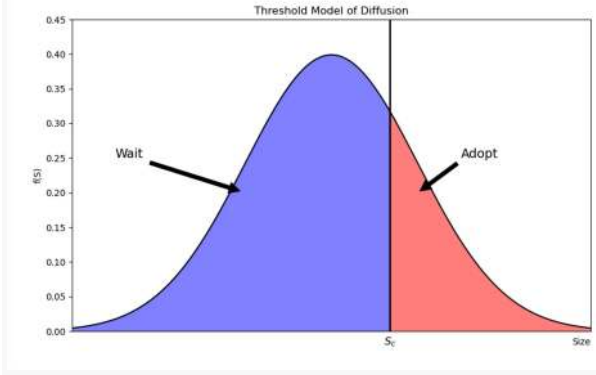



**Sigmoid pattern** -> characteristic S-shaped curve. The sigmoid pattern is often used to model processes that exhibit slow initial growth, followed by rapid expansion, and then a takes off as the market matures or reaches saturation -> The sigmoid pattern is frequently used to describe the adoption of new technologies or products. Initially, only a few early adopters use the product. As it gains popularity, adoption



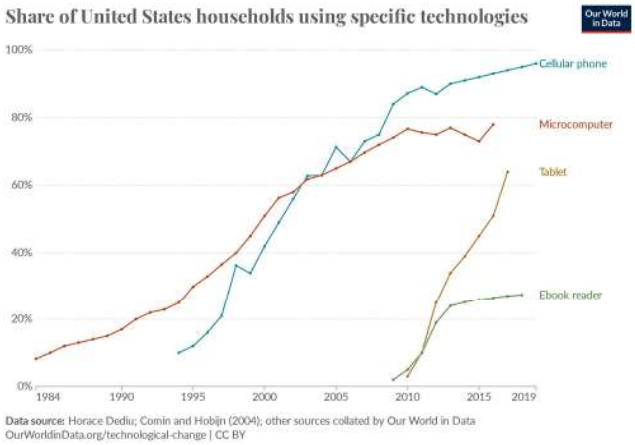

Assuming firms are normally distributed in terms of size, firms with a size greater than $S_c$ adopt the innovation, while the others wait




As the critical threshold reduces over time, more and more firms adopt the innovation

accelerates rapidly until most potential users have adopted it, after which growth slows as the market saturates.

We can observe how different products can have very different diffusion rates, different time to diffuse and be used by many people




An other case can be found in the situation in which the same product needs different time to be diffused in different regions or countries

**Epidemic model**

Word-of-mouth and social interactions drive the spread of innovations much like a disease. The diffusion of innovation model, when applied to epidemics, analyses how new ideas, technologies, or practices spread within populations, similar to how diseases spread. This model has been proposed to explain the slow diffusion of innovation.

**The epidemic model**:

- When a new product is first introduced, few people (early adopters) are fully informed about the product's benefits
- These early adopters communicate their experiences or benefits of the innovation to others within their social networks diffusion but since they are few, is slow at the beginning
- As the number of adopters increases, so does the number of "mouths" that voice in favour of the innovation -> diffusion accelerates
- As most people have

- It can be shown that the number of adopters over time follow this equation:

$$x_t = \frac{N}{1 + \phi e^{-kt}}$$

$N$ = number of potential adopters
$x_0$ = number of adopters at time $t_0$
$k = \beta N$
$\beta$ = speed of diffusion
$\phi = [N - x_0]/x_0$

- Try to implement in Excel, and check that the higher the value of $\beta$, the steeper the diffusion curve and the faster the adoption

adopted the innovation, there remain few “ears” to hear the benefits from the innovation -> diffusion decelerates

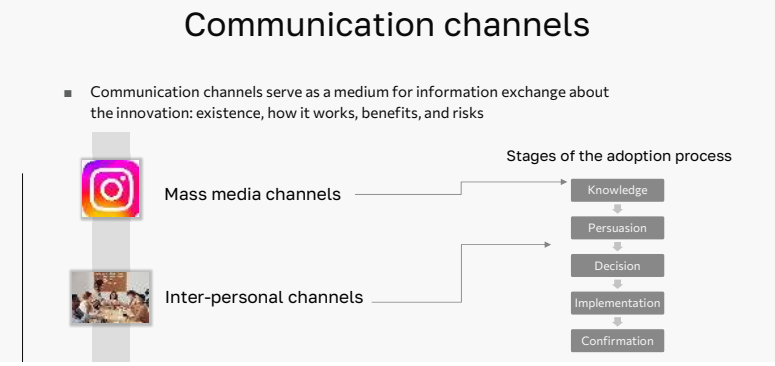
**Determinants of speed**

What are the factors that affect the rate of adoption (i.e. β,  in the logistic equation)?
The rate of adoption depend on attributes of innovation, resistance to novelty of adopters, cultural values, communication channels

The attitude of adopters toward innovation significantly influences the rate and extent of its adoption. Various factors contribute to how individuals or groups perceive and respond to new ideas or technologies:

**Key Attitudes**:

- **Perceived Benefits** -> Adopters are more likely to embrace innovations if they believe the benefits outweigh the costs. Clear communication of advantages (e.g., health improvements, cost savings) is crucial
- **Compatibility** -> Innovations that align with existing values, beliefs, and practices are generally adopted more readily. If an innovation feels relevant to the adopter’s lifestyle, acceptance is higher
- **Complexity** -> The easier an innovation is to understand and use, the more likely it will be adopted. If an innovation seems complicated, potential adopters may hesitate.
- **Trialability** -> The opportunity to experiment with an innovation on a limited basis can positively influence attitudes. If individuals can test a new product or practice without significant risk, they are more likely to adopt it.
- **Observability** ->  When the results of an innovation are visible to others, it can enhance its attractiveness. Seeing peers benefit from an innovation can encourage others to adopt it.
- **Social Influence** -> Norms and opinions within social networks play a vital role. Individuals are often influenced by the attitudes of friends, family, and community leaders.
- **Personal Experience** -> Previous experiences with similar innovations can shape attitudes. Positive experiences can lead to a greater willingness to adopt new technologies or practices.
- **Trust and Credibility** -> Trust in the source of the innovation (e.g., healthcare providers, government agencies) can significantly impact attitudes. Clear, credible communication can build this trust.




The adopters are not the same:

- Risk takers -> very few and pro-risk -> they are the first to buy a innovative product -> individuals who are more willing to embrace uncertainty and take chances on new ideas or technologies, even if they may not yet be proven.
- Opinion leaders / early adopters -> open to new ideas -> these individuals are typically the first to adopt an innovation after the innovators. They are crucial in the diffusion process as they help bridge the gap between early innovators and the larger population.
- Late majority -> skeptical and resistant to change -> Individuals in this category adopt an innovation after the average member of a society. They are typically skeptical and cautious about change
- Laggards -> they stick to tradition and are anti-change -> The last group to adopt an innovation, laggards are typically resistant to change and may hold on to traditional methods or technologies.

It's not necessary that the population is normally distributed -> we can have a more innovative (left skewed) or more conservative (right skewed) population -> same speed of diffusion but for more conservative population's attitude it takes more time to diffuse.

There are many different factors that can have an impact on the speed of diffusion. For example, Cultural factors play a crucial role in explaining how innovations diffuse at a different speed across countries, regions, or segments of society -> Example: Use of cache in transactions

**Cultural dimensions** -> Individualism vs. Collectivism , Tradition vs. Change Orientation, Power Distance

**Opinion leaders** -> In some cultures, influential figures (community leaders, religious figures) must endorse innovations for broader adoption

Social media are really important to rise awareness of innovation in a fast way (through influencers usually) while it's usually a slower process if we consider inter-personal channels (even if sometimes those are more trustable)

**Adopters' heterogeneity**

Potential adopters are heterogeneous. The cost-benefit of innovation adoption differs across them. if we consider innovations used by business, we can observe the labor-saving innovation, that has a different kind of diffusion.

## Threshold model of diffusion

- A labor-saving innovation (e.g., GPS guided tractors)

$$a = \frac{L}{S}$$

$L$ = number of workers
$S$ = firms size (sales)

- Old technique (conventional tractors): $a_0$
- New technique (GPS guided tractors): $a_1$

$$a_1 < a_0$$

## Benefits from innovation

- Given a wage rate $w$, savings per unit of sale:

$$w(a_0 - a_1)$$

- Savings (per year) for a firm of size $S_i$

$$w(a_0 - a_1)S_i$$

## Costs of innovation

- Adoption cost (per year):

$$rp$$

where

$$w(a_0 - a_1)S_i$$

  - $r$ = annual interest rate
  - $p$ = price of the good (i.e. GPS guided tractor)

## Adoption decision

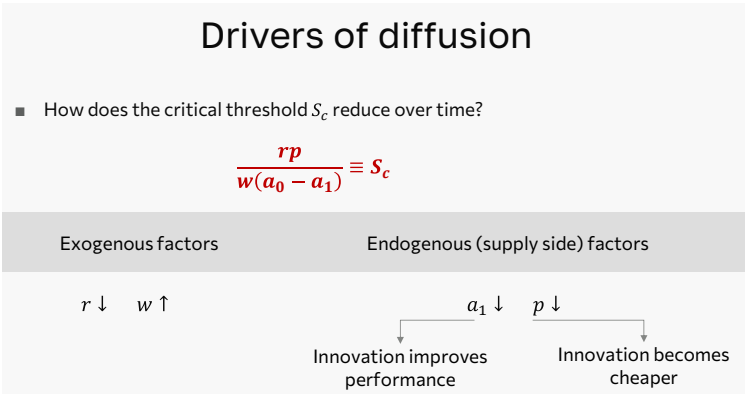
- A firm of size $S_i$ adopts as soon as benefits are greater than costs

$$\boldsymbol{w(a_0 - a_1)S_i > rp}$$

- **Critical threshold**

$$\boldsymbol{S_i > \frac{rp}{w(a_0 - a_1)} \equiv S_c}$$

The bigger companies (bigger size) innovate before the others -> the size must be higher than the threshold otherwise the companies wait for the threshold to become smaller (innovation

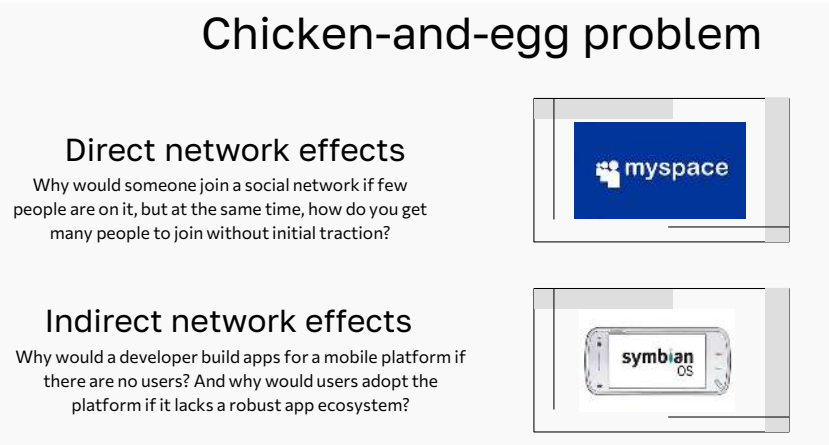



more accessible) -> the faster Sc moves, the faster is the diffusion of the innovation.

## Network effects

The benefit a user derives from a product increases when the number of other consumers increases. There are two main types of network effects:

- **Direct network effect** -> Means of communication -> Benefit of using one product is enhanced by the possibility to communicate with others -> Direct network effects occur when the value of a product or service increases directly as more people use it. A classic example is a social media platform: the more users it has, the more valuable it becomes for each individual user because they have more potential connections and interaction
- **Indirect network effect** -> Platforms -> Benefit of using one product is enhanced by the availability of a complementary product or service -> i.e. playstation -> Indirect network effects arise when the value of a product or service increases due to the growth of complementary goods or services. For example, consider a gaming console: as more consoles are sold, more game developers are incentivised to create games for that console, which in turn increases its value to consumers.




### Expectations

Since the value of a network good depends on the number of other users, users' expectations on adoption play a crucial role.

Chicken-and-egg problem -> dilemma used to describe situations where it's unclear which of two events or

phenomena should occur first, as each one seems to depend on the other. This concept is often applied in various fields, including economics, technology, and social sciences.

The challenge for start-ups is to build a user base and create a viable product or service simultaneously. This dilemma is particularly common in businesses that rely on network effects, where the value of the product increases as more users join. This problem arises when two interdependent elements are needed to create value, but each depends on the other for success. For example, a platform needs users to attract more users, but it also needs a sufficient number of users to be attractive in the first place. The chicken-and-egg problem highlights the initial challenges in establishing a network effect. Startups often struggle to kickstart both user bases simultaneously. Without initial users, the network effect can't take hold, making it hard to attract additional users. **Breaking the Cycle** -> Once a startup successfully overcomes the chicken-and-egg problem and gains initial traction, network effects can amplify growth. Early adopters can provide testimonials, create content, or engage in ways that attract further users. The interplay between the chicken-and-egg problem and network effects is critical for startups aiming to build successful platforms. Understanding and addressing the challenges of both concepts can lead to sustainable growth and a thriving user ecosystem.

## Fulfilled expectations equilibria

If consumers **expect** that no one is interested in purchasing the network good, then no one will adopt and the good will not take off

*«Nobody wants to go there because it is always empty»*

If consumers **expect** the good will be popular, each will have a high valuation and thus will adopt it, thereby determining its actual success

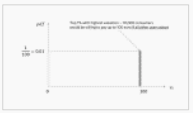
*«Everybody wants to go there because it is always full of people»*

In both scenarios, expectations are correct ex-post (i.e. they are fulfilled)!!
Success or failure depend on users' expectations.

Managing expectations -> a proper management of consumer expectations is vital for the success of network goods -> announcements in network economies have a big impact (if someone say something wrong, people start leaving the network and this can make a company fail)

# Critical mass

- Assume a network service owned by a monopolist: $p$ = price
- $N = 1$ (million) potential adopters
- $f$ = fraction of the market currently served
- $v_i$ = valuation of consumer $i$ when $f = 1$
- $v_i$ uniformly distributed between 0 and 100



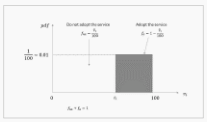
- Demand of consumer $i$ $\rightarrow$ $q_i^D = \begin{cases} 0 & if \quad fv_i < p \\ 1 & if \quad fv_i \geq p \end{cases}$

Willingness to pay increases with the fraction $f$ of adopters using the service (network effect)

# Critical mass

- Demand curve = fraction of adopters that adopt the service at any given $p$
- $\tilde{v}_i$ = valuation of the consumer indifferent between adopting/not adopting

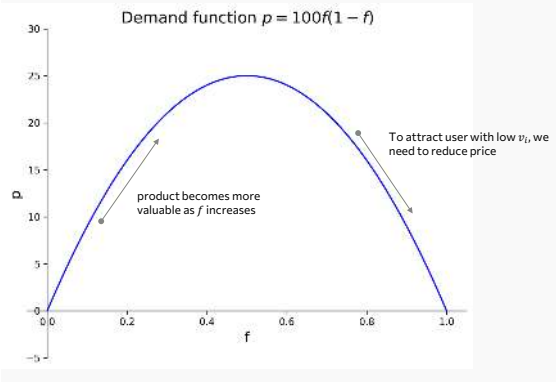
$\tilde{v}_i$: $fv_i = p \quad \Leftrightarrow \quad \tilde{v}_i = {}^{p}/_{f}$

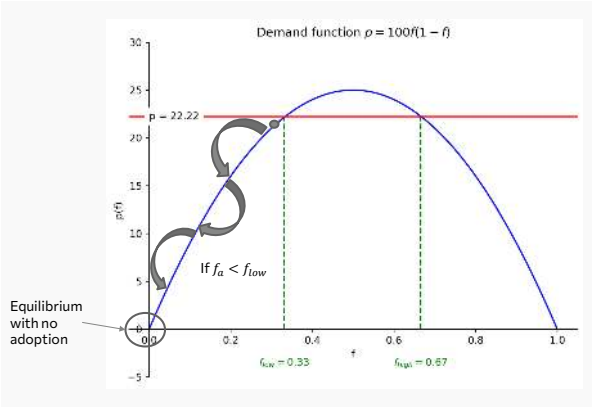


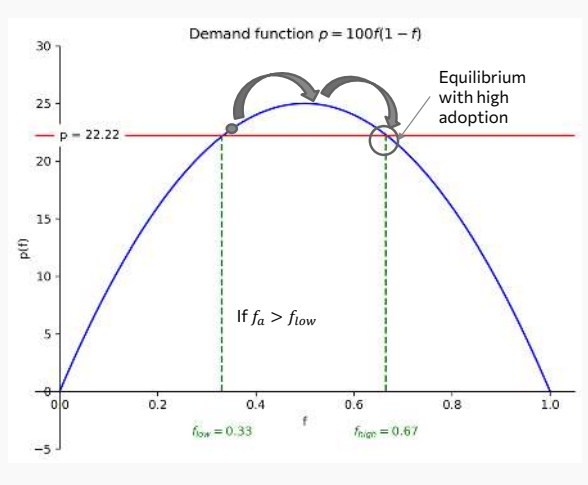
$$f = 1 - \frac{\tilde{v}_i}{100} = 1 - \frac{p}{100f} \quad \Leftrightarrow \quad p = 100f(1-f)$$

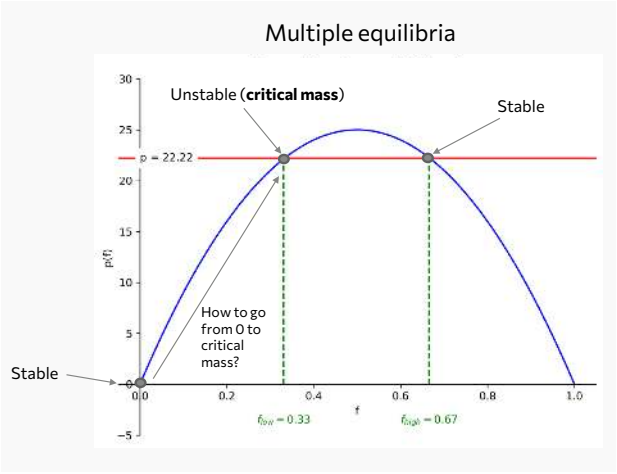
inverse demand function

The critical mass problem in the context of network externalities refers to the challenge of reaching a sufficient level of adoption of a product or service so that it becomes valuable to users. This concept is particularly relevant in markets that rely on network effects, where the value of a product increases as more people use it.





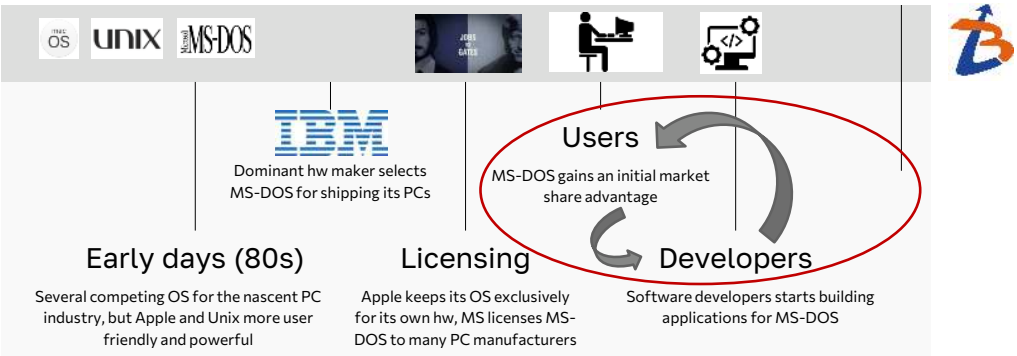

With network externalities, a piece of the demand function can have a positive slope -> if the number of users increase, the greater the price since the WTP is increasing due to the increase of the number of people using the good -> product becomes more value as more people buy it. For some costumers, even the increase of the number of users is not enough to convince them to buy the product, the only way is to lower the price. If the number of users decrease because of something happened (as with Twitter), the number of people leaving the network will increase and the number of actual users will decrease, decreasing the price.
When we have rational expectations, we may have multiple equilibria, some stable and some unstable in which little shocks can change the demand drastically. The critical mass is a "make-or-break" point -> we need at least a number of users to reach a point that is valuable for the producer of the good.

There are two ways through which we can reach the critical mass:

- **Penetration pricing** -> Very low prices (below MC) may help reaching the critical mass … but have an impact on profitability -> we can consider also the situation in which a producer gives away for free a good
- **Target large users** -> Once a large corporation starts using the service, so will do users, suppliers, and other agents doing business with it

### Path dependence

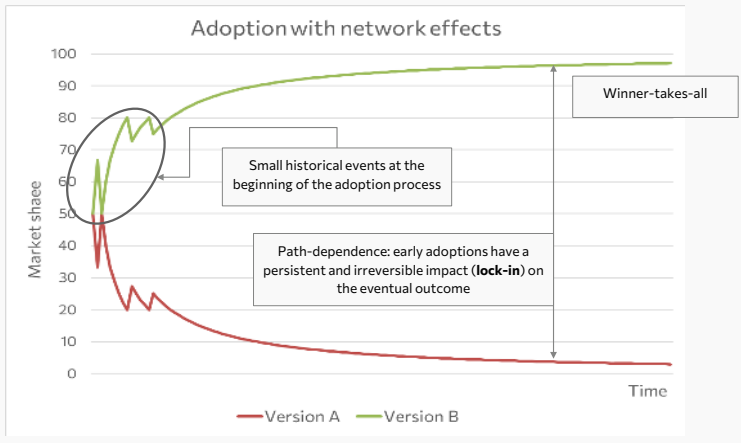
Competition among alternative network goods is characterised by a winner-takes-all tendency and path-dependent dynamics.

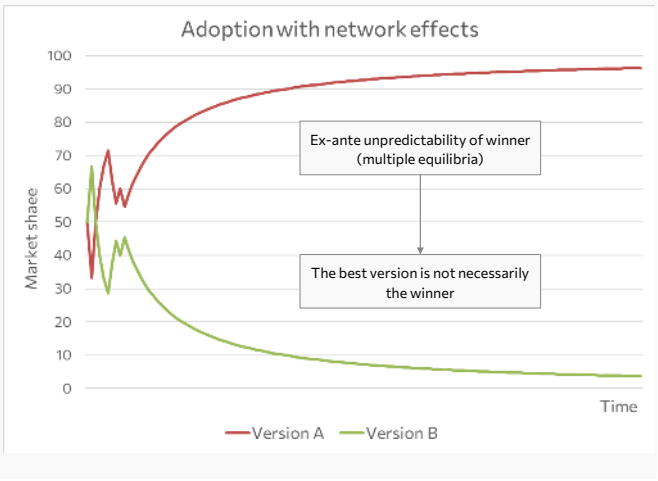



Path dependence -> decisions and outcomes of a system at one point in time are heavily influenced by the historical context and previous choices made in that system. Essentially, it suggests that the course of development in a given context is shaped by the specific decisions and events that preceded it, often making it difficult to alter the trajectory of that path.

# A simple model

- Two versions of a new technology, A and B
  — incompatible with each other → network benefits only if using the same version
- The prices of the two versions are the same
- In each period, a new consumer must choose between A and B
- Each new consumer polls at random 3 past adopters and follows what the majority does
  — if 3 or 2 of past adopters have adopted X, she adopts X as well




This model suggest that there is not always just a winner -> even if the strong get stronger and the weak get weaker, it's not always true because we can have:

- **Love for variety** -> Each version is addressing a different niche of users (ps4, Wii…)
- **Weak network effects** -> Network benefits exhaust at low levels of adoption (social networks, Dropbox, OneDrive…)
- **Low multihoming costs** -> Cost of adopting multiple platforms is low (social media)

There might be market failure in the adoption process due to two reasons:

- **Lock-in** -> market may select the wrong standard (need of public intervention?) and then it could be difficult to go back and change the decision
- **Excess momentum** -> Consumers switch to the new technology even though the old technology is still socially more desirable
- **Excess inertia** -> Consumers stick to an old network technology, while switching to the new one would be more efficient

## Excess inertia

A co-ordination problem

- Old (O) and new (N) network technology
- Two users ($i = 1, 2$) currently using O
- Simultaneous choice: switching / not switching to N
- Any technology useless unless other agent uses the same technology
- Utility (value)
  - Old (O): $a_i$
  - New (N): $b_i$
- Cost of switching: $c_i$
- Switching socially desirable: $b_i - c_i > a_i$ with $b_i = 2\,c_i$

## Payoff matrix

Equilibrium of game

| | | User 2: Old | User 2: New |
|---|---|---|---|
| User1 | Old | $a_1, a_2$ | $0, -c_2$ |
| User1 | New | $-c_1, 0$ | $b_1 - c_1$, $b_2 - c_2$ |

Pareto optimal equilibrium

Expected utility from switching = 0 $\begin{cases} -c_i \\ 2c_i - c_i = +c_i \end{cases}$ if other user does not switch / if other user switches

### Firm strategy

How to choose the best strategy when network goods compete for adoption?

**Compatibility** -> Consumers benefit from compatibility -> greater network value … for firms the situation is different

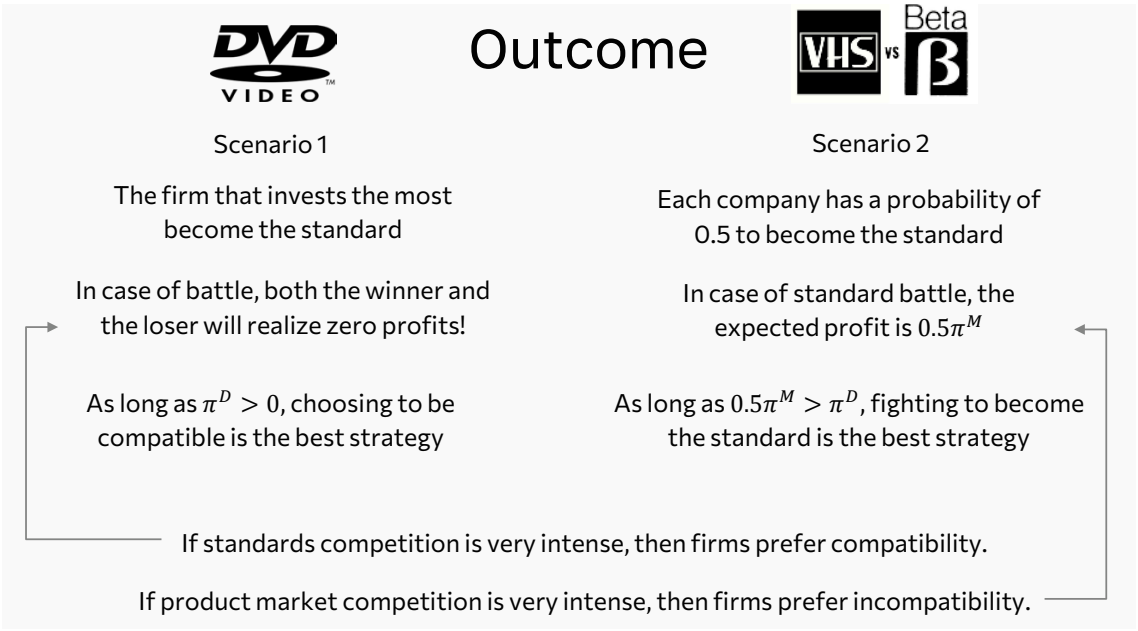
## A two-stage game

- 1st stage: two firms decide whether to make technologies *compatible*
  - If no agreement, then "standardization battle" → one winner
- 2° stage: product market competition
- Profits
  - If agreement, duopoly profits: $\pi^D$
  - If no agreement: $\pi^M$ for winner, 0 for loser

**Q**: are firms better off with or without compatibility?

### Public policy

Externalities often imply market suboptimal outcomes. Should governments intervene in standard-setting? There are both benefits (greater network value, less resource wasted in




standard battles) and costs (Less product market competition, more variety) of standardisation. Public policy, when it comes to technology, is much more tolerant because agreements about standardisation make life easier for people and for that reason there are benefits for all consumers (i.e. universal charger -> buyers just need one for all the dispositive)

**Information-Timing trade-off**:

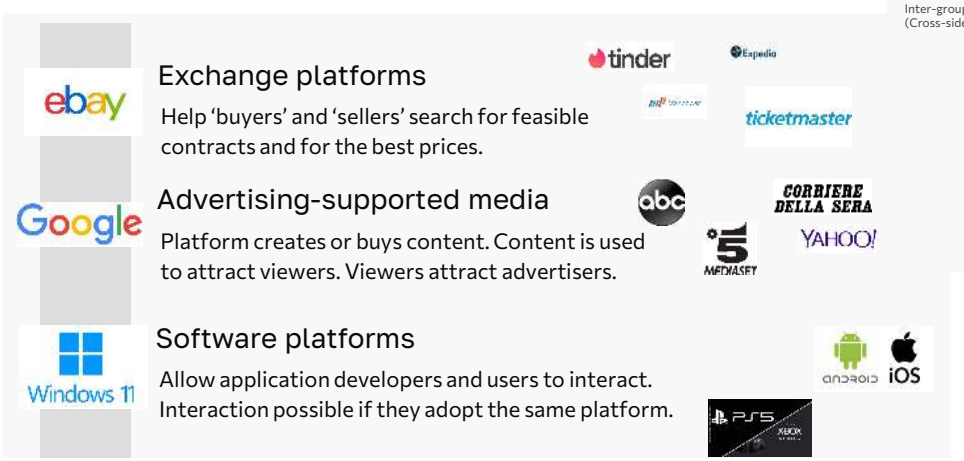
- Acting too early -> too few information on the merits of alternative standards
- Waiting too long -> difficult or extremely cost to revert to a different standard

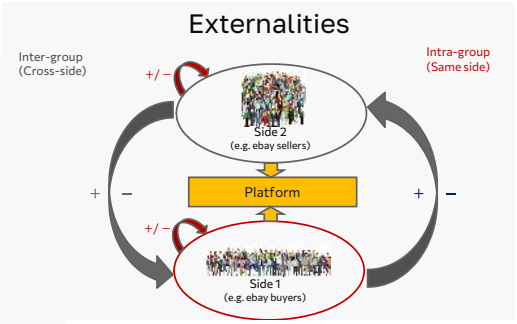
## Platforms

**Endowment effect** -> you attach much higher value to the things you have -> cognitive bias where people assign higher value to items merely because they own them. This phenomenon suggests that ownership increases the perceived value of an item, leading individuals to overestimate its worth compared to how much they would pay for it if they didn't own it. For example, if someone is given a mug, they may value it at $10, but if they were looking to buy it, they might only be willing to pay $5. This bias can influence decision-making in various contexts, such as consumer behavior, negotiations, and even personal relationships. The endowment effect highlights how emotional attachments and ownership can distort rational assessments of value.

**Platform** -> intermediary that facilitates interactions, transactions, or exchanges between two or more distinct groups, usually producers and consumers, by providing an infrastructure or a digital space for them to connect. -> Platforms create value by enabling these groups to engage in mutually beneficial activities, such as buying and selling, sharing, or communicating -> platforms facilitate transactions in terms of costs and time and that's their value

## Types of platforms



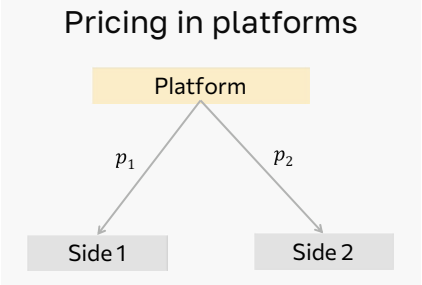

Platforms feature within same side and across side network externalities. Platforms differ by type of intermediation.

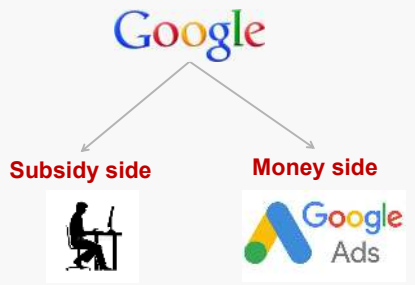
**Cross-side network effects** -> A higher activity level in one group makes it more attractive for the other group's members to increase their activity level and vice versa -> if one or more user join group A, that increase the value for group B.
If we consider E-bay case: the more seller, the more valuable is for buyers to go on the website (cross-side). On the other side, the more buyers there are, the better for the seller (cross-side).
If we consider the point of you of the same side: the more seller, the less valuable if for a seller to be on the platform (more competition). The more buyers, the less valuable if for a buyer to be on the platform (higher prices for the demand effect).

Platforms face the typical «chicken-and-egg» problem, i.e., "getting both sides on board" -> Side 1 is willing to participate only if side 2 participates and vice versa How to solve the problem? Design correctly the structure of prices -> the aim is to internalise the various externalities across and within the sides of the platform. The structure is prices is key in this case

### Logic of platforms

A platform engages in transactions with two (or more) sides. How to set the prices to each side?



Total transactions (T) = $(n_b \times n_s)$ With $P_b = 6 \rightarrow n_b = 6$ $n_s$?

$U_s(n_b) = (i - 3 - P_s) \times n_b$ With $P_s = 0, n_s = 4$ sellers participate, $(4 \times 6) = 24$ transactions

| | Sellers ($i$ = 1 to 6) utility | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| $P_s$ | 1 | 2 | 3 | 4 | 5 | 6 | Transactions | Profits on sellers side |
| 0 | -2 | -1 | 0 | 1 | 2 | 3 | $4 \times 6 = 24$ | $0 \times 24 = 0$ |
| 1 | -3 | -2 | -1 | 0 | 1 | 2 | $3 \times 6 = 18$ | $1 \times 18 = 18$ |
| 2 | -4 | -3 | -2 | -1 | 0 | 1 | $2 \times 6 = 12$ | $2 \times 12 = 24$ |
| 3 | -5 | -4 | -3 | -2 | -1 | 0 | $1 \times 6 = 6$ | $3 \times 6 = 18$ |
| 4 | -6 | -5 | -4 | -3 | -2 | -1 | $0 \times 6 = 6$ | 0 |

Optimal price on sellers side, $P_s = 2$

Most of the platforms follow this structure: one side is subsidy (gets paid, in the sense that the service is given for free) and one is charged.

Subsidy users are attracted in large numbers -> **Cross-side network externalities** -> A large number of subsidy users attracts and increases the willingness to pay of the money side users -> The losses made on the subsidy side are more than compensated by the profits realised on the money side

- Assume a monopolistic platform (zero costs)
- 6 buyers ($b$) and 6 sellers ($s$)
- Each buyer makes one transaction with each seller: T = $(n_b \times n_s)$
- Net surplus if $n_b$ buyers and $n_s$ sellers are on platform

Buyers: $U_b(n_s) = (6 - P_b) \times n_s$

Sellers: $U_s(n_b) = (i - 3 - P_s) \times n_b$ for seller $i = 1,2,3,4,5,6$

where $P_{b(s)}$ = price paid by buyer (seller) for making a transaction

Case 1: Platform ignores the interdependence between the two sides

- Monopoly price on buyers side: $P_b = 6$
- Monopoly price on sellers side (if all buyers participate): $P_s = 2$
- Total profits:

$$\pi_1 = (12 \times 6) + (12 \times 2) = 96$$

- Yet, this structure of prices does not maximize overall profits!

Total transactions (T) = $(n_b \times n_s)$

Platform makes a loss of 1 for each transaction with sellers

$U_s(n_b) = (i - 3 - P_s) \times n_b$

| | Sellers ($i$ = 1 to 6) utility | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| $P_s$ | 1 | 2 | 3 | 4 | 5 | 6 | Transactions | Total profits |
| -1 | -1 | 0 | 1 | 2 | 3 | 4 | $5 \times 6 = 30$ | $(-1 \times 30) + (6 \times 30) = 150$ |
| 0 | -2 | -1 | 0 | 1 | 2 | 3 | $4 \times 6 = 24$ | $(0 \times 24) + (6 \times 24) = 144$ |
| 1 | -3 | -2 | -1 | 0 | 1 | 2 | $3 \times 6 = 18$ | $(1 \times 18) + (6 \times 18) = 126$ |
| 2 | -4 | -3 | -2 | -1 | 0 | 1 | $2 \times 6 = 12$ | $(2 \times 12) + (6 \times 12) = 96$ |
| 3 | -5 | -4 | -3 | -2 | -1 | 0 | $1 \times 6 = 6$ | $(3 \times 6) + (6 \times 6) = 54$ |
| 4 | -6 | -5 | -4 | -3 | -2 | -1 | $0 \times 6 = 6$ | 0 |

Case 2: Platform sets prices accounting for the interdependence between the two sides

- Logic

if $P_s \downarrow \rightarrow n_s \uparrow \rightarrow$ more transactions $\rightarrow$ more revenues on buyers side

- Optimal pricing

$\boldsymbol{P_b = 6, P_s = -1 \rightarrow n_s = 5} \rightarrow$ 30 transactions

- Profits of platform: $\boldsymbol{\pi = (30 \times 6) + (30 \times -1) = 150}$

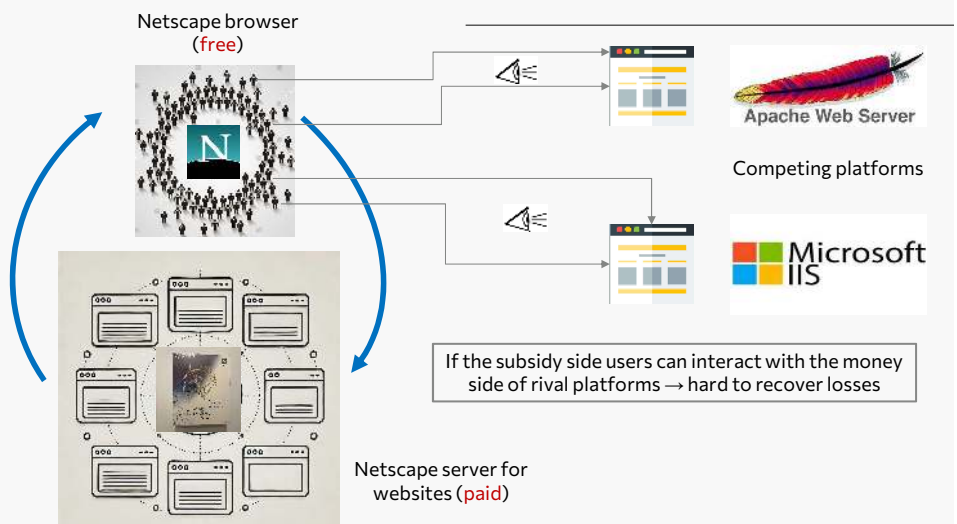
In the real world is difficult to have a platform that gives you money. In the real world the subsidy means that you pay less than you are suppose to (usually you get it for free).

**Strategies**

There are several strategic implications:

- Subsidising one side of the market entails a 'loss' for the platform owner

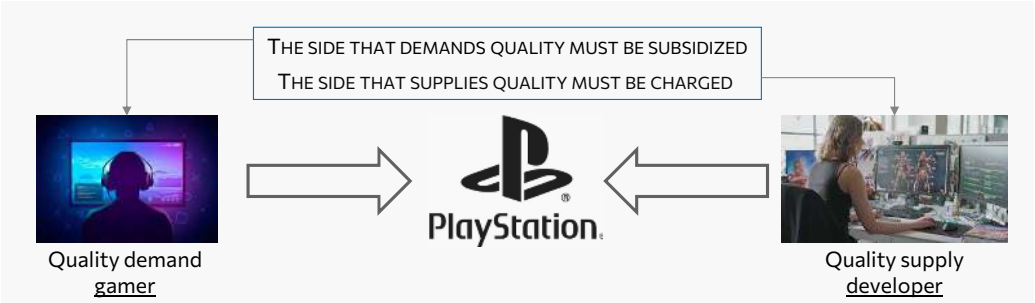
- The loss is acceptable if there is the prospect to offset it by charging the money-side
- Competition on the money-side reduces the possibility for a platform to capture cross-side network effects and recover the losses ->competition can significantly impact a platform's ability to harness cross-side network effects. When multiple platforms vie for the same user base, they often engage in price wars or offer incentives to attract users. This can undermine a platform's pricing power and make it challenging to recover initial investments or losses. -> Cross-side network effects occur when the value of a platform increases as more users join on one side, benefiting users on the opposite side. For instance, in a marketplace, more sellers attract more buyers, and vice versa. However, if competitors undercut prices or offer superior features, it can fragment the user base and diminish the potential benefits of these network effects -> In such a competitive landscape, platforms may need to find innovative ways to differentiate themselves, build user loyalty, and create sustainable revenue models that can weather the competitive pressure. This might involve focusing on enhancing user experience, offering unique services, or leveraging data to better serve their users.




Something that is important to consider, is the **sensitivity to price** -> one side of the market generally is more reactive to price than the other -> Another side instead is more sensitive to the growth of the other side


On the other side we need to consider the sensitivity to quality -> In some cases, platform users demand high-quality products/services -> Supplying quality entails high fixed costs ->

large user base to amortize




**Variable costs** of expanding the user-base may be negligible (software) or substantial (tangible goods, services) -> If users on the money-side do not have a sufficiently high WTP, revenues may not cover costs


**Same-side competition** -> negative same-side effect -> Growth on sellers side may come with increasing competition (i.e., negative same-side effect) -> Hence, sellers may leave the network therefore reducing the platform value for users


**Heterogeneity of users**

- lead users -> big spenders or high willingness-to-pay
- Marquee users -> attract other users because of brand, quality, etc.
- Platform should secure the exclusive participation of those users, i.e., commitment not to join rival platforms

**Conflicts** -> Attracting marquee users may be expensive and it may generate conflicts over the division of value generated by the platform ->

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