Asymmetric Information, Networks and two sided markets

Errol D'Souza

TURIN SCHOOL of DEVELOPMENT

ITC International Training Centre

UNIVERSITÀ DEGLI STUDI DI TORINO

POLITECNICO DI TORINO

With the financial support of Compagnia di San Paolo

Compagnia di San Paolo

Email: errol@iima.ac.in

In a used car market the seller (current owner) has learned over time if the car rarely needs repairs (a good car) or frequently needs them (a "lemon")

A potential buyer knows only the probability of getting a good car.

When buyers cannot distinguish between good and bad used cars the cars sell for the same price.

Suppose consumers believe that

Half of used cars are lemons that they value at Rs. 100

Other half of used cars are good cars that they value at Rs. 200

Suppose consumers believe that

Half of used cars are lemons that they value at Rs. 100

Other half of used cars are good cars that they value at Rs. 200

Consumers are risk neutral

Hence value to a consumer of a randomly selected car is given by

$$\frac{1}{2}(100)+\frac{1}{2}(200)=\text{Rs.}150$$

$$\frac{1}{2}(100)+\frac{1}{2}(200)=\text{Rs.}150$$

Buyer is willing to pay

More than the value of a bad car as 150 > 100 as the car might be good

less than the value of a good car as 150 < 200 as the car might be a lemon

Buyer is willing to pay

More than the value of a bad car as $150 > 100$ as the car might be good

less than the value of a good car as $150 < 200$ as the car might be a lemon

Owner of a bad car is getting more than it is worth and will be delighted to sell the car.

Owner of a good car is getting less than its value and will end up keeping the car rather than selling it.

Only bad cars get sold. Buyers know that they are getting only lemons and will only pay the value of a lemon or Rs. 100. **There is no market for good quality cars.**

Owners of high quality cars would be willing to sell cars at prices that buyers would be willing to pay *if* they (buyers) could be certain of the quality.

As one cannot distinguish high quality cars from lemons before purchasing the price of high quality cars reflects the large fraction of lemons in the market.

Therefore there are buyers and sellers of high quality cars that are unable to strike a deal.

Adverse selection occurs when one party to a transaction (sellers of used cars) takes advantage of knowing more than the other party to the transaction. – Such information problems reduce economic efficiency in the market.

When the costs of obtaining information are relatively low consumers obtain the information and markets function smoothly.

If costs are high the information is not gathered and inefficiency results.

Other ways for consumers to obtain information –

When the costs of obtaining information are relatively low consumers obtain the information and markets function smoothly.

If costs are high the information is not gathered and inefficiency results.

Other ways for consumers to obtain information –

Guarantees or Warranties

By providing credible guarantees or warranties sellers of high quality goods convey information to consumers that their products are of high quality.

Of course, such firms are also able to charge higher prices that reflect the higher quality of their goods.

Typically, a guarantee will only be provided if the life of the product does not depend heavily on how the consumer uses it.

Otherwise buyers have an incentive to use the product relatively carelessly and rely on the seller to fix problems under the warranty. – This is a moral hazard problem.

Typically, a guarantee will only be provided if the life of the product does not depend heavily on how the consumer uses it.

Otherwise buyers have an incentive to use the product relatively carelessly and rely on the seller to fix problems under the warranty. – This is a moral hazard problem.

Liability Laws

These serve the same function as explicit warranties.

If consumers know that contract laws force the manufacturer to make good on defective products the obligation of a warranty need not be offered by the manufacturer.

Problem with legal recourse is that the precise obligations of the manufacturer may be ambiguous

Transactions costs of going to court may be quite high.

Problem with legal recourse is that the precise obligations of the manufacturer may be ambiguous

Transactions costs of going to court may be quite high.

Reputation

A manufacturer may rely on its reputation and signal that its goods are of high quality.

A store that expects repeat purchases has a strong incentive not to provide defective products.

If items are purchased frequently and consumers and firms deal regularly a reputation is easy to establish.

Experts

An expert who is a disinterested party may provide consumers with reliable information.

E.g. a potential purchaser of a used car can take it to the mechanic to get an appraisal.

Consumer groups may publish expert comparisons of different brands.

Experts

An expert who is a disinterested party may provide consumers with reliable information.

E.g. a potential purchaser of a used car can take it to the mechanic to get an appraisal.

Consumer groups may publish expert comparisons of different brands.

Standards and Certification

A standard is a metric or scale for evaluating the quality of a product. For example the "R-value" of insulation tells you how effectively it works.

Industry groups may set their own standards and get an outside group or firm such as Underwriters' Laboratories to certify they meet these standars.

Often standards are set to **guarantee conformity across brands.**

A VHS video-recorder owner is assured that a VHS tape manufactured by another firm works in that machine.

Governments may set and **enforce minimum quality standards** by requiring that professionals be licensed or that drugs be effective or by testing the products directly.

Often standards are set to guarantee conformity across brands.

A VHS video-recorder owner is assured that a VHS tape manufactured by another firm works in that machine.

Governments may set and enforce minimum quality standards by requiring that professionals be licensed or that drugs be effective or by testing the products directly.

Standards can be harmful if their information is degraded.

Although quality varies along a continuous scale often only a high versus low quality rating is used.

In that case products are likely to be made that either they have the lowest possible quality or just barely the high enough quality level to obtain the high quality rating.

In that case products are likely to be made that either they have the lowest possible quality or just barely the high enough quality level to obtain the high quality rating.

Licensing and mandatory standards can be used for anticompetitive purposes and erecting entry barriers.

Many model plumbing and building codes required pipes to be made of copper and have certain dimensions earlier. Due to this manufacturers of plastic faced problems in introducing their products. This impeded the diffusion of innovations in buildings.

Many professions license themselves under government auspices. E.g. doctors, lawyers, etc.

These groups may define standards that prevent entry of professionals from other geographical regions so as to keep the wages of currently licensed professionals high.

Another type of asymmetric information is moral hazard. **Moral hazard** refers to the tendency of people to change their actions because they have insurance.

For example, once a firm has taken out fire insurance policy on a warehouse, it may be a little less careful about avoiding fire hazards.

Someone with medical insurance may visit the doctor for treatment of minor illnesses when he or she would not do so without the insurance.

Insurance companies take steps to reduce moral hazard problems. – They use deductibles and co-payments to reduce moral hazard. A deductible requires the holder of the policy to pay a certain dollar amount of a claim. In a co-payment the insurance company pays only a percentage of any claim.

In **adverse selection** problems, one agent in the economic interaction knows some piece of information or *type*, but the other agent does not.

This *type* (car is a lemon for e.g.) is determined by nature and cannot be affected by either player. Adverse selection problems involve *hidden types*.

In **moral hazard** problems one agent can take an *action* which is not observed by the other agent. Moral hazard problems involve a *hidden action*.

Networks

A **network externality** exists when the value of a good or service to any one customer increases as more and more other customers use it.

Obvious examples are telephones and fax machines. There is little point in owning either device when nobody else does.

A similar force is at work in the case of operating systems. The need for different users to be able to run different programs and to exchange files makes it useful to have a large number of users employing the same operating system.

The more that Microsoft's initial operating system, MS-DOS, came to be used on personal computers, the more others also wanted to use it even at the same price.

In this way network externalities amount to scale economies that work through the demand side.

A fundamental issue in such markets is that the market equilibrium may be difficult to pin down because the purchase of the service by any one consumer depends critically on that consumer's expectation as to how many other consumers will purchase the good.

This raises the possibility that there may either be no equilibrium or many.

Take the case of a monopoly provider of a network service, such as a **monopoly supplier of communications services**.

Assume the monopolist charges an access fee but does not impose a per usage charge, i.e., the consumer is charged a **single price** p for connecting to the network but each individual call is free, perhaps because the marginal cost of a call is zero.

Assume there is some maximum size of the market, say one million, reflecting the largest number of consumers who would willingly buy the product even if the access fee were zero. – By fixing the total amount of potential customers we can talk interchangeably about the actual number served and the fraction f of the market that is served.

Many different consumers agree that the service is more valuable the greater the fraction f that signs up for it.

However, even if everyone acquires the service ($f = 1$), consumers still vary in their valuation or willingness to pay for the service.

v_i : valuation of the i^{th} consumer when $f = 1$.

These valuations are assumed to be **uniformly distributed** between 0 and 100. For e.g., the 1 per cent of consumers who most value the service (10,000 individuals in our case) would willingly pay about $100 for it if all other consumers also acquire it.

As the fraction of the consumers who sign up declines, so does each consumer's willingness to pay.

The easiest way to reflect the assumption is that the i^{th} consumer's **valuation of the service for any value of *f* is given by fv_i** .

The demand by consumer *i* for the communications service is therefore given by

$$q_i^D = \begin{cases} 0 \;\; if \;\; fv_i < p \\ 1 \;\; if \;\; fv_i \geq p \end{cases}$$

For consumer *i* the above equation says that the ultimate willingness to pay for the service fv_i increases with the fraction of potential buyers *f* who have bought into the service.

The marginal consumer is the one who is just indifferent between buying into the service network and not buying into it so that her valuation is $\tilde{v}_i f = p$ or $\tilde{v}_i = \dfrac{p}{f}$.

All consumers with a valuation less than $\tilde{v}_i$ will not subscribe to the service. The remainder will subscribe.

Since v_i is distributed uniformly between 0 and 100, the fraction of consumers with a valuation below $\tilde{v}_i$ is simply $\dfrac{\tilde{v}_i}{100}$.

The marginal consumer is the one who is just indifferent between buying into the service network and not buying into it so that her valuation is $\tilde{v}_i f = p$ or $\tilde{v}_i = \dfrac{p}{f}$.

All consumers with a valuation less than $\tilde{v}_i$ will not subscribe to the service. The remainder will subscribe.

Since v_i is distributed uniformly between 0 and 100, the fraction of consumers with a valuation below $\tilde{v}_i$ is simply $\dfrac{\tilde{v}_i}{100}$.

Hence the fraction of consumers f with valuations greater than $\tilde{v}_i$ who acqure the service is

$$f = 1 - \frac{\tilde{v}_i}{100} = 1 - \frac{p}{100 f}$$

Fraction of consumers f with valuations greater than $\tilde{v}_i$ who acqure the service is

$$f = 1 - \frac{\tilde{v}_i}{100} = 1 - \frac{p}{100f}$$

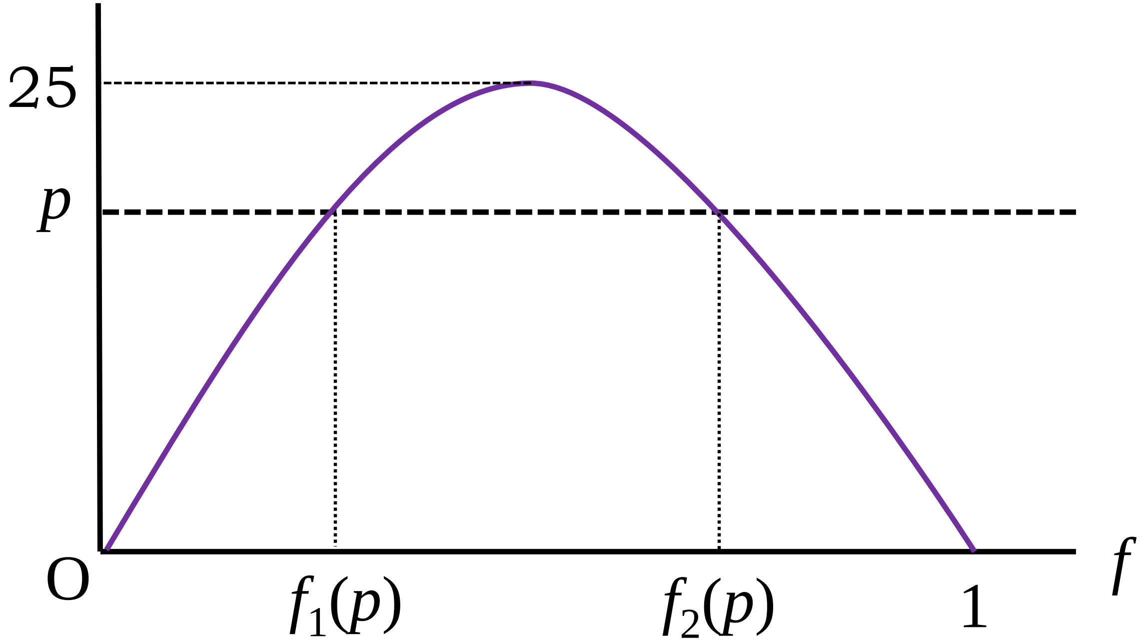
If we solve for p we obtain the demand function in terms of the fraction f of the maximum potential customers who actually buy the service as

$$100f^2 = 100f - p$$

Or,

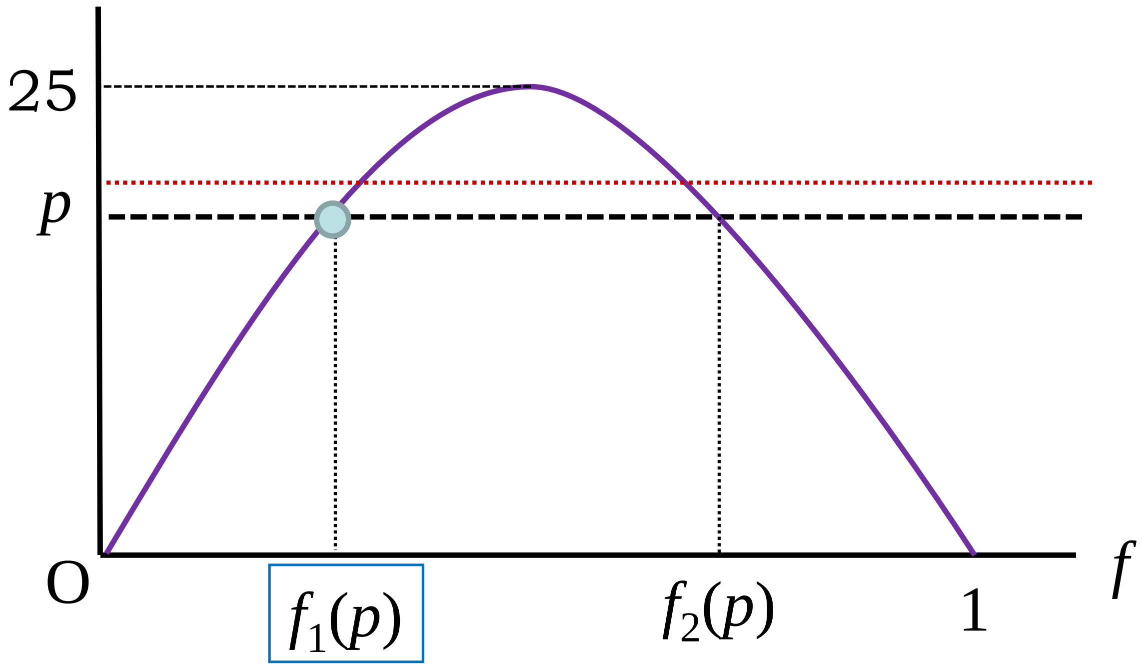
$$p = 100f(1 - f)$$

This is illustrated in the following figure ⟹



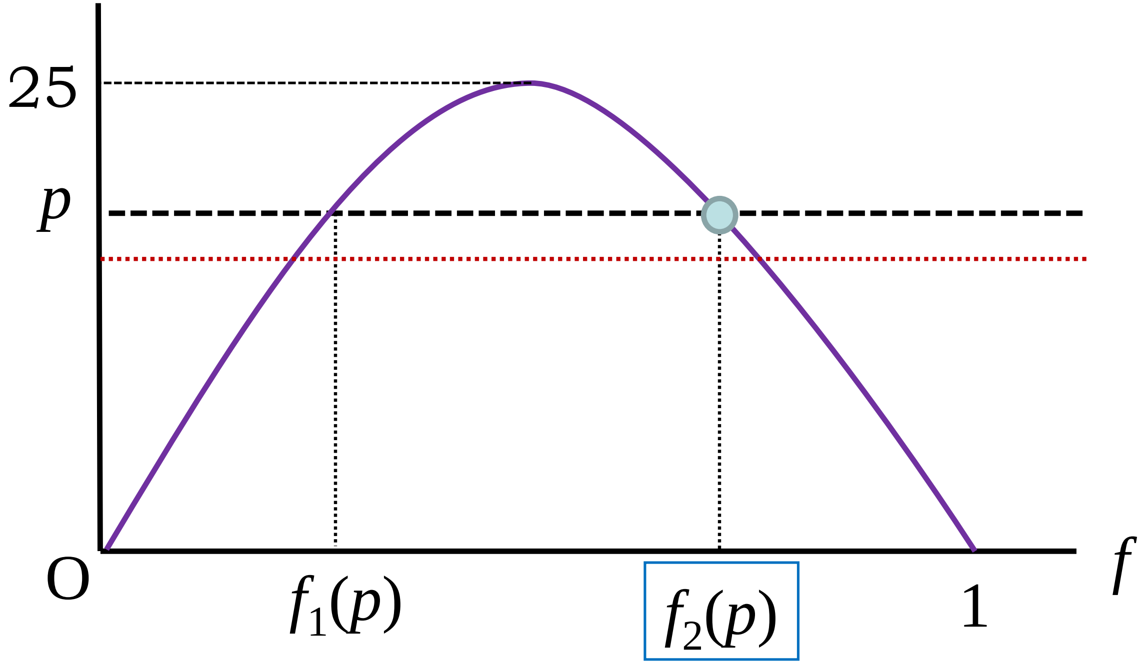
- For all prices greater than $25 no equilibrium with a positive value of f exists. If the monopolist charges a price greater than $25 the network will simply fail.

- For prices less than or equal to $25 there is actually more than one equilibrium value of f. For instance when the price is p both $f_1(p)$ and $f_2(p)$ are possible values.



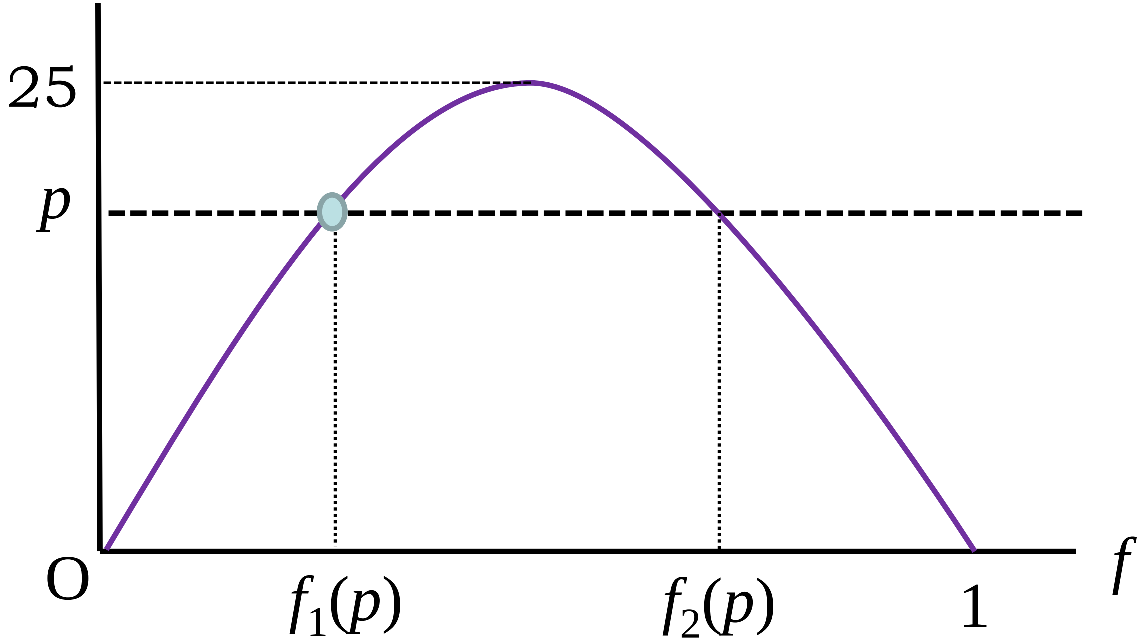
Suppose the equilibrium is at $f_1(p)$ and the price increases slightly to the dotted horizontal red line. At $f_1(p)$ now the price is higher and there is a loss of those consumers who are willing to pay less than the current new price of the service. The market will contract.

Repeating this logic the eventual outcome will be that all consumers leave which will bring the process to O.



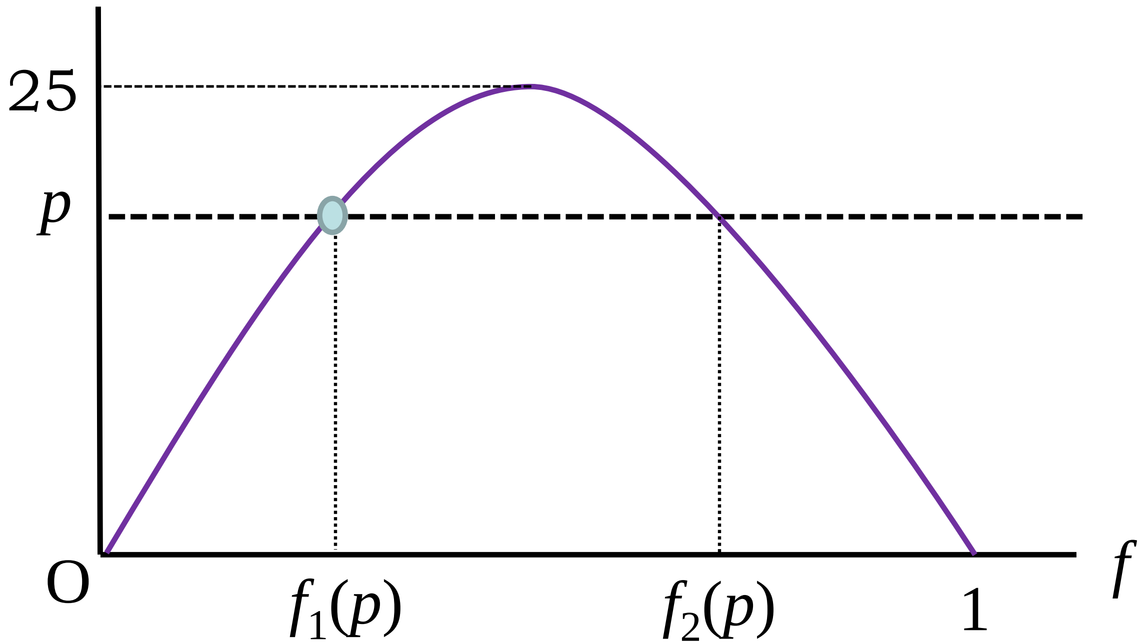
Similarly, if the price is slightly reduced the demand curve is now above the red dotted price curve. Consumers are willing to pay more than the cost of the product and the market will expand till it reaches $f_2(p)$.

Thus once the network reaches size $f_1(p)$ it is virtually certain that it will reach $f_2(p)$. We then refer to to $\boldsymbol{f_1(p)}$ as the **critical mass** of the network.



So long as a fraction of subscribers just a bit greater than this critical mass $f_1(p)$ can be established the network will grow to contain the high fraction $f_2(p)$ of the population.

Values of f below the critical mass tend to unravel. At these prices no individual consumer will wish to sign up for the service unless others do. Each consumer holds back from joining until they see some others joining.



It is important therefore for an entrepreneur to get the net-work started and grow to a critical mass.

One possibility is to provide the service free for a limited period of time.

Another option is to lease the equipment to potential users with a guarantee that if the service does not achieve critical mass, the lease agreement can be canceled without any penalty.

A further possibility that was employed when fax machines were first marketed is to target groups of large users. Multinational companies or government agencies are the obvious examples of users that might want to operate their own internal networks.

Note that competition between two or more firms to establish the network can be particularly fierce. If only one network can survive – because there are only enough consumers for one network to reach critical mass – the market has a ***winner take all*** feature.

The winning network claims the entire served population and the loser gets nothing. In such a setting survival is on the line and competition is intense.

Complements and two-sided networks

Jobs introduced the iPhone in 2007 – a phone that had plenty of doubters prior to its release, including Microsoft cofounded Steve Ballmer who said,:

"$ 500? Fully subsidized? With a plan? I said that is the most expensive phone in the world. And it doesn't appeal to business customers because it doesn't have a keyboard. Which makes it not a very good email machine."

From the beginning the iPhone was intended to be as much a computer as a phone; it had a processor, memory, storage, an operating system, a user interface, and other familiar attributes of computers.

The iPhone also had applications which came to be called "apps" to distinguish them from software found on full-sized desktops and laptops.

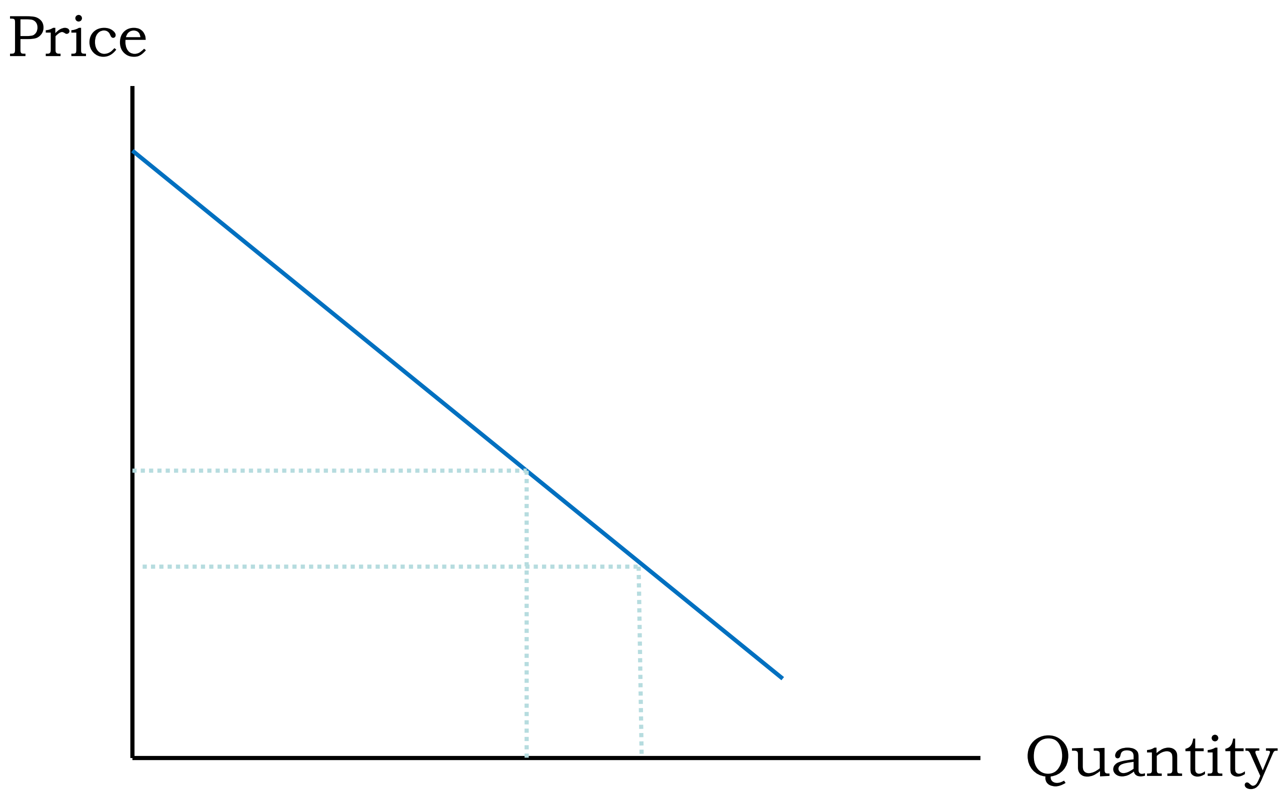
When the iPhone first came out there were no apps you could buy from outside developers, and Jobs initially resisted allowing them. He didn't want outsiders to create applications that could mess it up, infect it with viruses, or pollute its integrity.

Jobs eventually changed his mind – and it was a good decision. It is hard to imagine a successful smartphone today without a large constellation of apps from independent developers.

Imagine that the iPhone has tons of great free apps available, but they are all games. The device would be highly attractive to gamers, but other consumers wouldn't be too interested in it.

Now imagine that it has lots of apps of all kinds but each costs \$100 or more. Such an iPhone would be the must-have gadget for plutocrats, but the rest of us wouldn't have much use for it.

These two hypothetical examples highlight the intuit-tion that there's something about **the variety of apps combined with a range of prices, that help make the iPhone popular**.



The iPhone has a demand curve like that above but so does each available app for the phone. – However it does not make sense to think about the iPhone and the app curve separately, as **iPhones and apps** are not independent of each other – they are **complementary goods**. – Which means their demand curves interact closely.

There are many examples of complements – crop seeds and fertilizers, cars and tyres, bottles and bottle caps, etc.

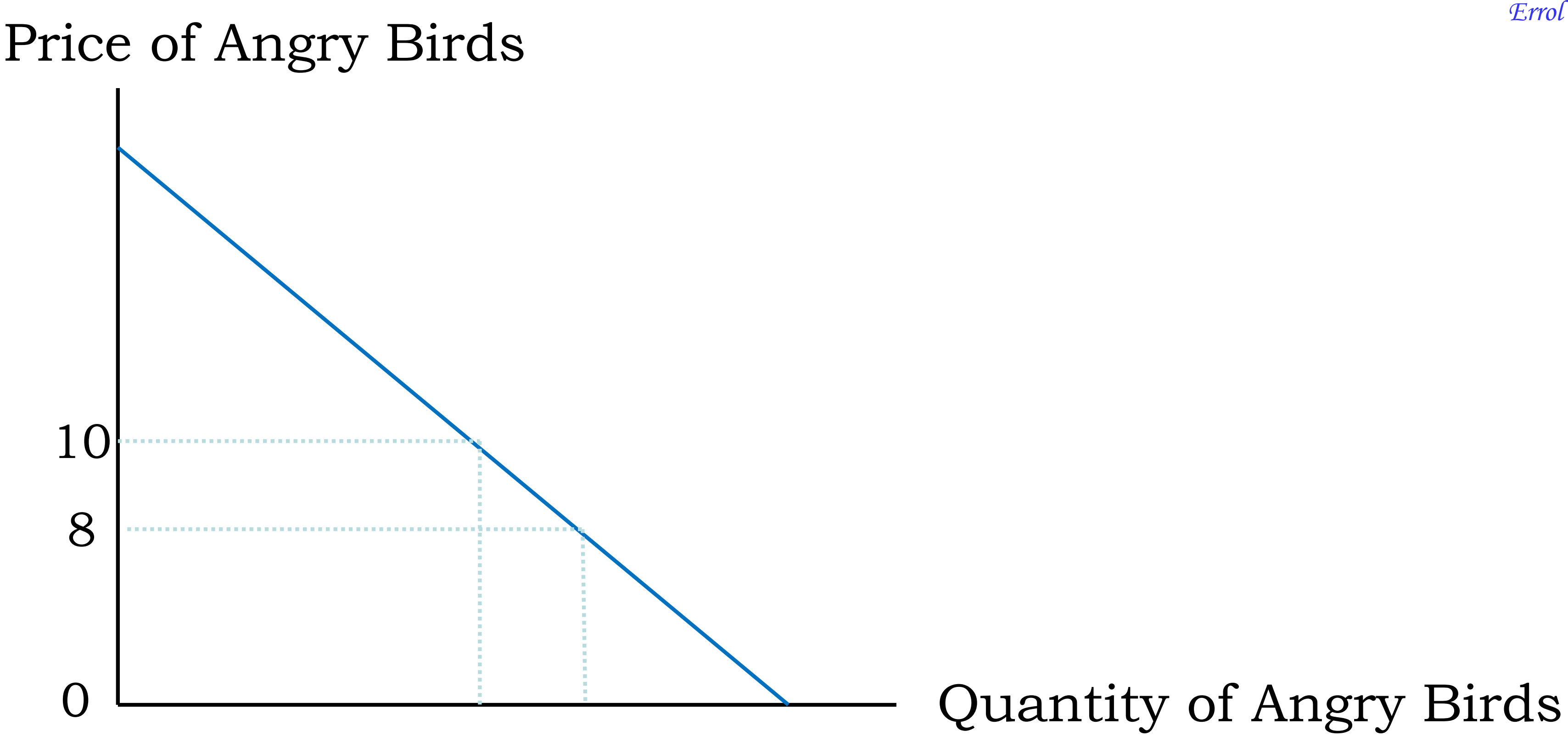
Complements are a pair of goods where when the price of good A goes down, the demand for good B shifts out to the right. – This means a higher quantity of good B will be in demand even though its price did not change at all.

Some iPhone customers want games, some want business tools, some want to stream music, some want to use social media, and so on. The best way to discover these preferences is to turn the App Store into something closer to an open marketplace than a store with a single owner.

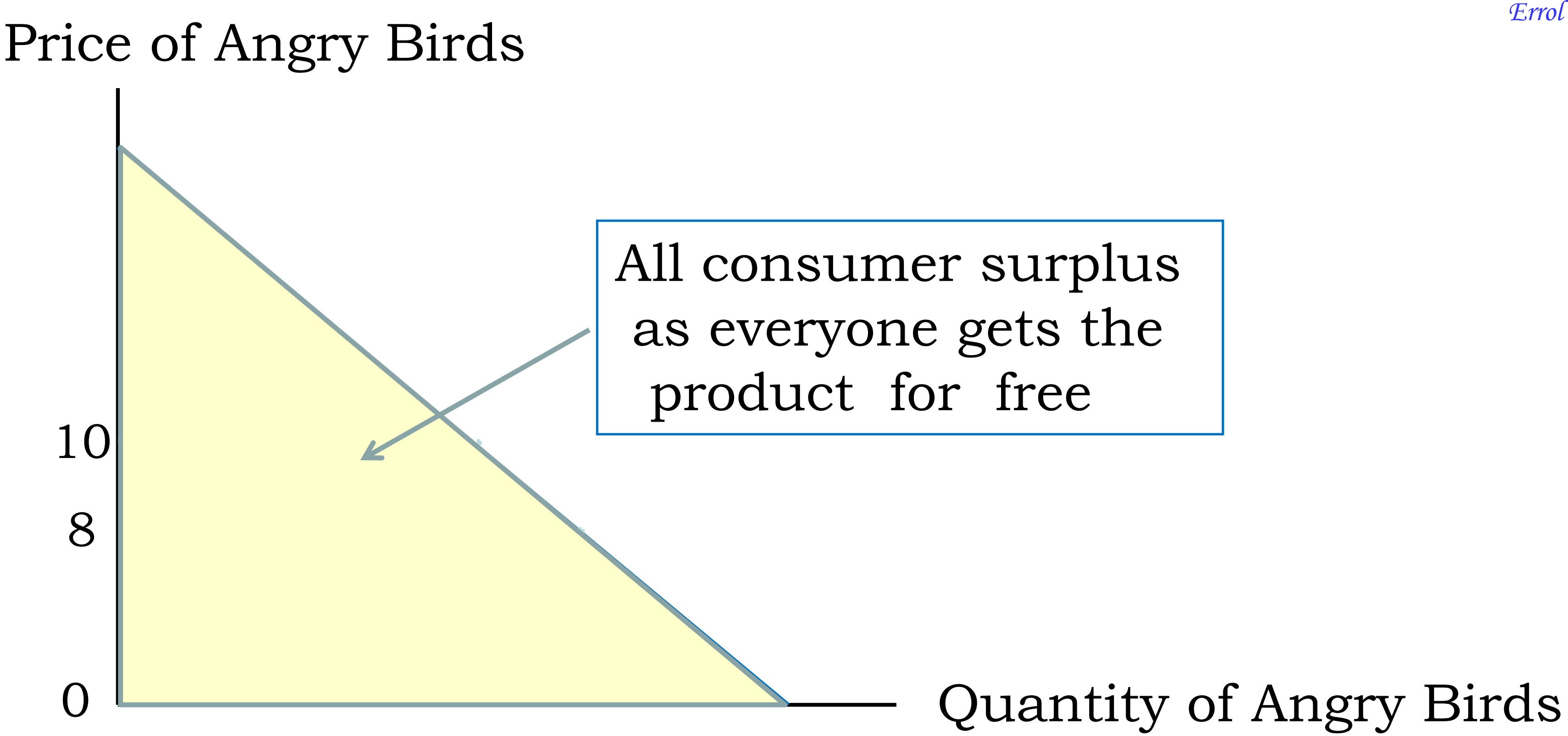
No single company, not even one as innovative as Apple could have come up with both Shazam – an app that listens to the music in your room and tells you the name of the song that's playing – and Angry Birds, a game in which you help angry birds get their eggs back from the pigs that have stolen them.

Angry Birds was released in late 2009 and became one of the most downloaded games of all time.

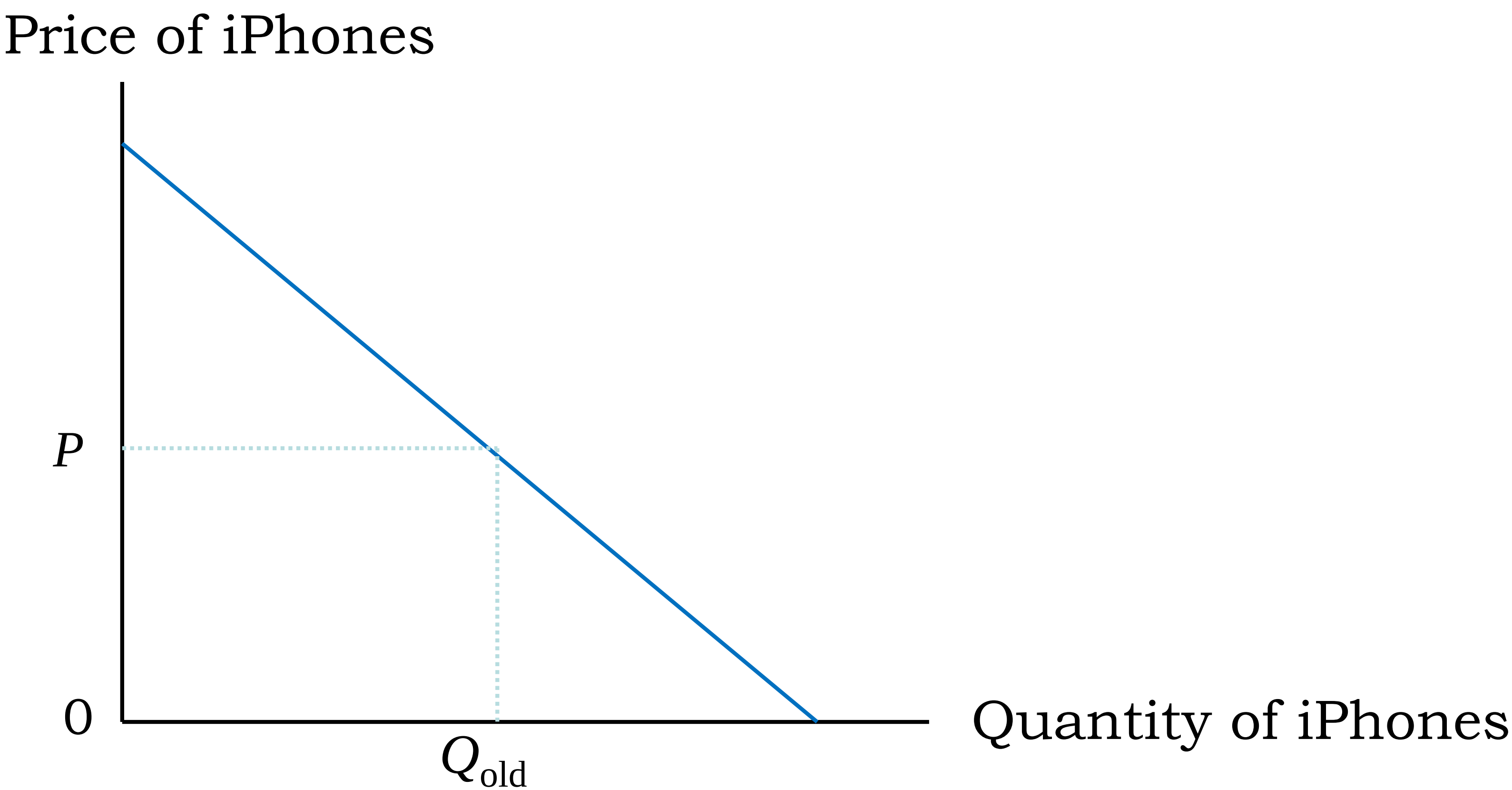
- It was also free, which is a very interesting property for one member of a pair of complementary goods to have.



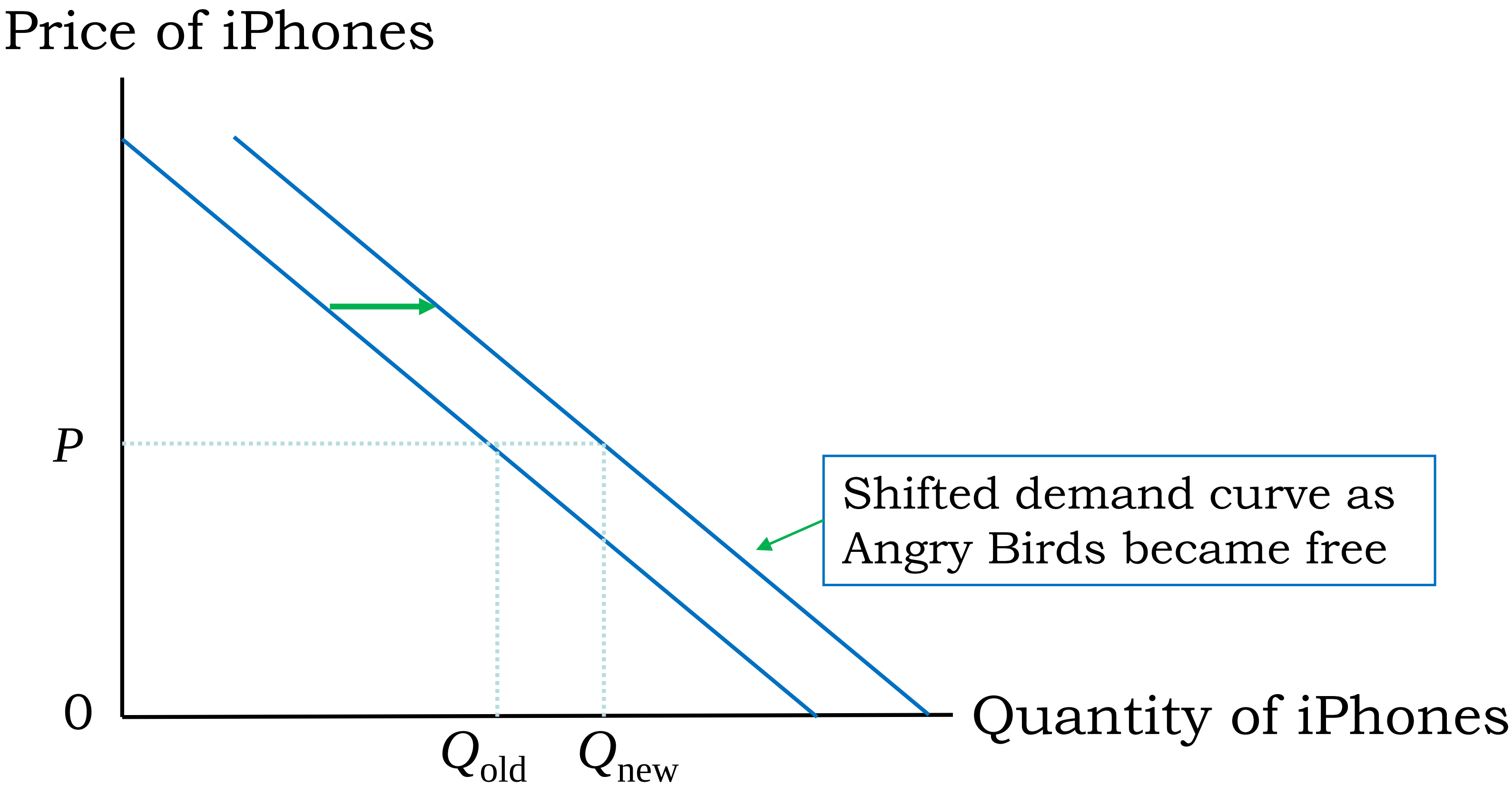
If we price Angry Birds at $10 its demand curve tells us the total quantity that will be demanded – how many downloads it will get. If we price the game at $8 it will obviously have greater demand. – If we price it at zero, there will be even greater demand for it. More interestingly, a huge consumer surplus will be generated as well.



The total triangle area under the demand curve will be all consumer surplus – since everyone who is willing to pay any amount of money for the game will be getting what is, in their eyes, a bargain.



The app and the phone are complements – the price drop of Angry Birds from any potential consumers' previous expectations to the price of zero – has the effect of shifting the iPhone's demand curve outward, increasing the no. of people who are willing to pay the iPhone's price. →



Hence existence of free apps has 2 effects: it generates consumer surplus & it nudges the iPhone's demand curve outward. (Note that the price of the phone has not changed and the demand for phones goes up because the app {Angry Birds} became free.)

Each app probably shifts the phone's demand curve outward only a small amount; after all how many people are going to be willing to pay a high price for an iPhone just because they can play a game on it?

But the effect of complements are cumulative. Each free app adds some consumer surplus to the total bundle offered by the iPhone and also pushes its demand curve that much farther out in the direction desired by Apple.

With a huge collection of apps that would yield a lot of consumer surplus the demand curve for the phone would be pushed out a long way.

But who is going to write all those free apps? Many organizations are willing to make their apps available for free:

- Freemium businesses – Cloud based storage provider Dropbox has a business model where they offer customers a basic level of service for free and then charge for extra capacity on top of this base. Free goods are complements for more expensive versions and increase demand for paid versions. (Jobs offered a nine digit acquisition offer for Dropbox in 2009).

But who is going to write all those free apps? Many organizations are willing to make their apps available for free:

- Freemium businesses – Cloud based storage provider Dropbox has a business model where they offer customers a basic level of service for free and then charge for extra capacity on top of this base. Free goods are complements for more expensive versions and increase demand for paid versions. (Jobs offered a nine digit acquisition offer for Dropbox in 2009).

- Ad revenue – Free apps make money for their creator by showing ads to users. Google's iPhone search engine, the driving direction app Waze, and many others include ads, and the revenue from them is large. Facebook's app on the iPhone is free but mobile advertising represented 84% of total revenue for Facebook in the 3rd quarter of 2016.

- Customer service – In Oct 2010, Amazon rolled out a feature that let iPhone users take a picture of a bar code of a product they had found in a store; the app would immediately tell them if they could get it more cheaply from Amazon. Chase's free consumer banking app lets users deposit checks simply by taking pictures of them. This leap forward in consumer surplus was soon copied by other banks.

- Customer service – In Oct 2010, Amazon rolled out a feature that let iPhone users take a picture of a bar code of a product they had found in a store; the app would immediately tell them if they could get it more cheaply from Amazon. Chase's free consumer banking app lets users deposit checks simply by taking pictures of them. This leap forward in consumer surplus was soon copied by other banks.

- Public service – Many government agencies and not-for-profits makes apps available for free as part of their mission. For those obsessed with economic data, the FRED app of the Federal Reserve Bank of St. Louis makes data easily accessible. – Code for America, is a not for profit that lets geeks take sabbaticals from their jobs at leading tech firms in order to develop apps and public facing software for city governments.

- Pairing with products – Health and fitness devices like the Fitbit and Nike+ FuelBand, Sonos music speakers, and a lot of other gear can be controlled via apps. After installing gear from Viper and other companies, you can even unlock and start your car via smartphone.

Jobs realized that allowing a platform to be too open could lead to malware, phishing, identity thefts, etc.

To keep out the bad and encourage the good, the platform owner uses curation.

Jobs permitted outsiders to write apps, but they would have to meet strict standards, be tested and approved by Apple, and be sold only through the iTunes store.

It was a way to reap the advantage of having thousands of software developers while retaining enough control to protect the integrity of the iPhone and the simplicity of the customer experience.

O2O or Online to Offline platforms –

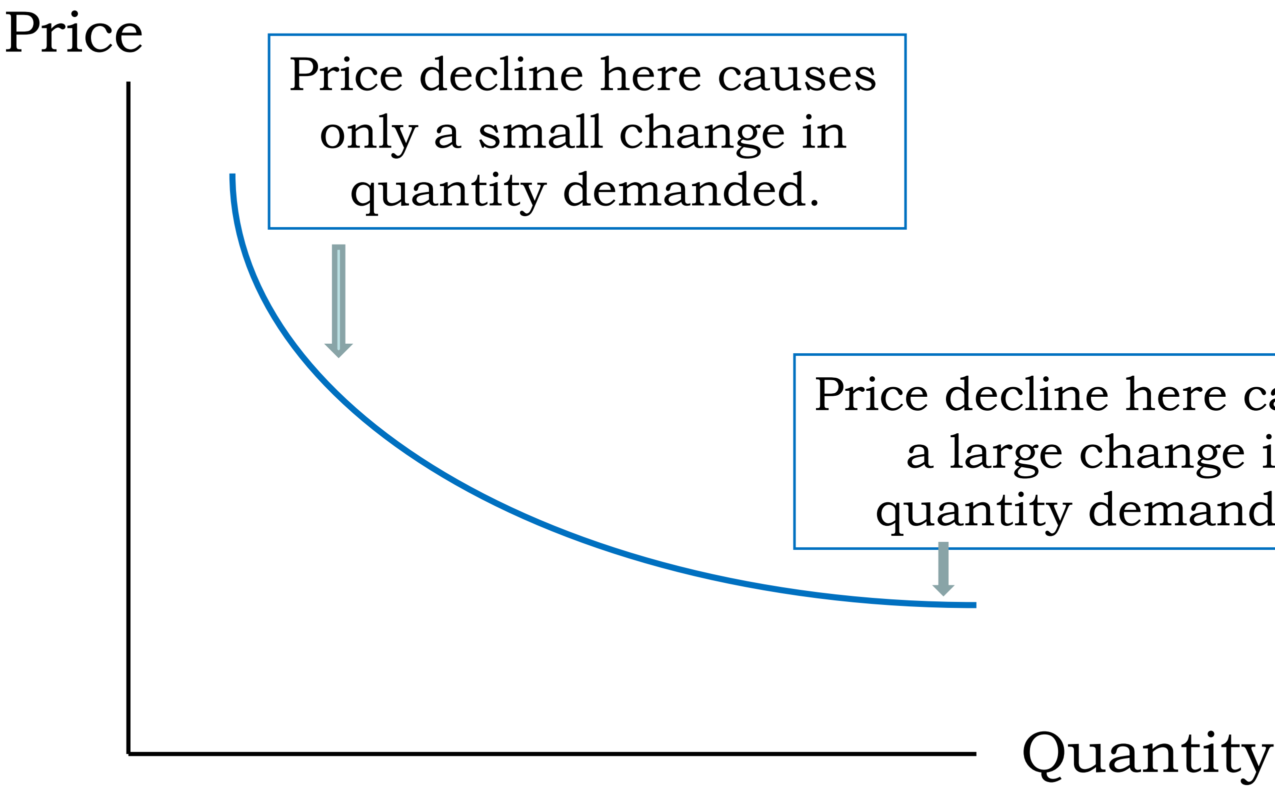
Most of today's better known platforms are consumer facing:
Lyft and Uber for urban transportation, Airbnb for lodging, Grubhub and Caviar for food delivery, Honor for in-home health care, etc.

All of these companies are working to bring together the economics of bits (online) with those of atoms (offline).

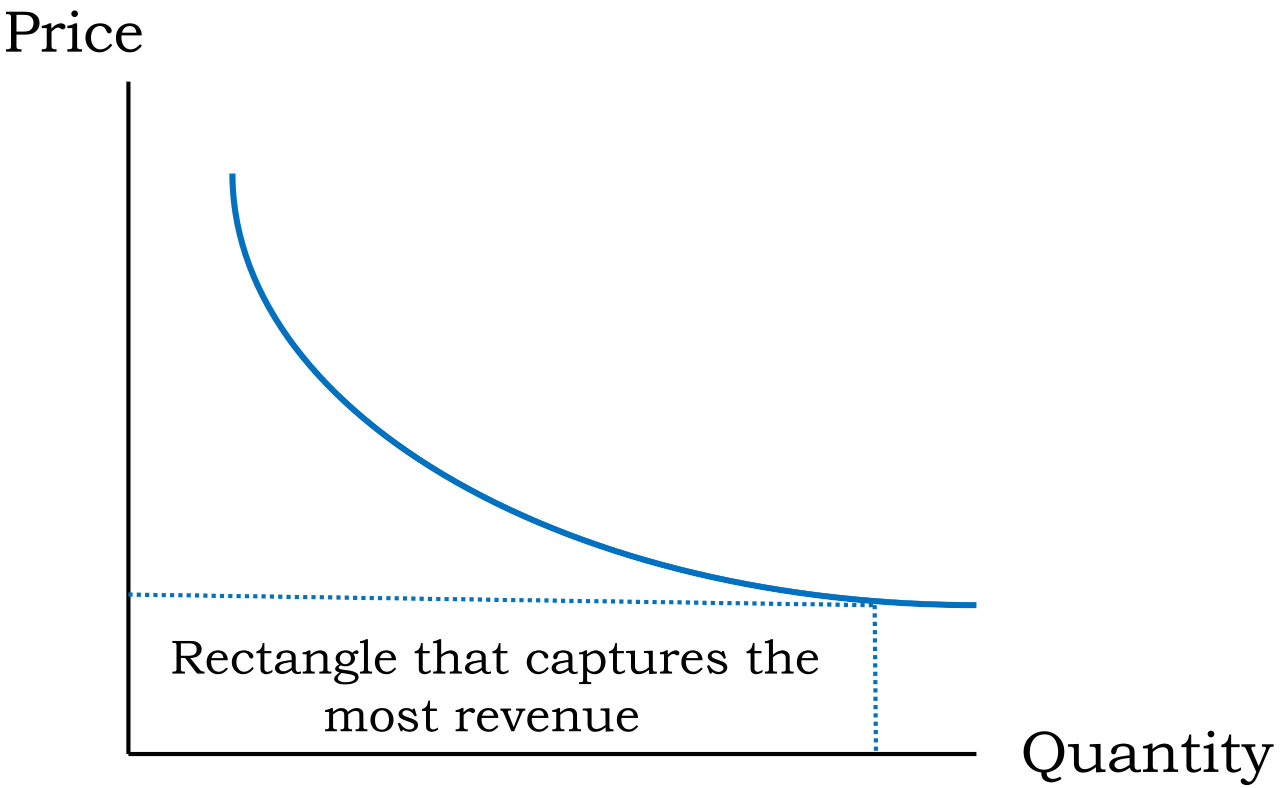
The question we want to investigate is: Why are platform prices so low?

For many products, elasticities are different at different price points. The demand increase that would result from lowering the price of milk from INR 35 to INR 25, for e.g., is smaller than it would be if the price dropped from INR 10 to INR 7.

The demand curves for such products have a particular shape: they flatten out as they move down and to the right as shown in the figure on the next slide.



As a supplier if your cost of each additional unit sold is zero, what price should you charge? – The product should be priced to maximize revenues. That means picking the place where the $p \times q$ rectangle has the largest area.



For the above demand curve the $p \times q$ **rectangle turns out to be a long, low one**. That is, the revenue maximizing price is surprisingly low.

This appears to be the case for rides in cars within cities. Uber will therefore want to satisfy this demand by charging very low prices since doing so will maximize revenue.

In two-sided markets, however, **working your way down the demand curve is only a part of the story**.

Uber is a **two-sided network**. It actually provides two separate apps. The company has one app for riders, which lets them hail drivers, and a separate app for drivers, which lets them find riders.

What ride hailers care about is to have more drivers on the ride finding app as that increases the chances that an available car will be nearby. Such a phenomenon makes the service more attractive to people using the ride hailing app and it shifts out the apps' demand curve.

Similarly drivers benefit from more users of the ride-hailing app.

Lowering prices increases the number of riders on the network as Uber moves down the demand curve.

An important second effect is that it makes the platform more attractive to Uber drivers as well, who will see all the new riders and flock to them.

Lowering the price on one side of the network increases the demand on both sides of the network, creating an extra benefit for each price cut.

So why are consumers typically subsidized and the sellers side of the market made to bear the cost rather than vice versa?

A **key consideration** is the **elasticity of demand** – how many extra users would you gain by lowering the price a little bit, and conversely, how many would you lose by increasing the price?

The smart strategy is to lower the price on the side of the market with the greater elasticity and raise it on the side with less price elasticity.

A **key consideration** is the **elasticity of demand** – how many extra users would you gain by lowering the price a little bit, and conversely, how many would you lose by increasing the price?

The smart strategy is to lower the price on the side of the market with the greater elasticity and raise it on the side with less price elasticity.

A **second factor** is the **cross elasticity**. – That is, what happens to the other side of the market when you lower the price on the first side? The greater the cross elasticity, the more you can influence the other side of the market. – The increase in demand by riders will increase the demand for drivers and each driver will have less downtime and make more money per hour.

A third factor is important in two sided networks: **switching costs**.

If it is easy to switch from one network to another, there is much less incentive to invest heavily in getting users on board. They may pocket your incentive and then just switch to another network the next day. – However, if it is costly to switch, then once they join your network, a bandwagon effect is much more likely to take off. Other users will also join and even if eventually the initial incentive disappears, the users will still find it unattractive to go elsewhere not only because of the switching costs, but also because of all the other users on the network. These **users** will be **locked in**.

In order to lock in consumers platform owners can't just focus on pricing. They have to manage a variety of other things including

- the user interface and user experience,
- reputation systems,
- marketing budgets, and
- core network technology.

The most successful platform owners carefully curate the value that each side of the market gets from participating and aren't too greedy.

Uber thus has to invest heavily in growing the network in the early stages of adoption to bring in more users and riders.

Uber's investors are making the bet that the two sided network effects and switching costs are large enough to make it worthwhile investing billions of dollars to encourage adoption of the platform by both riders and drivers.

Uber has two advantages:

First is a set of deep-pocketed and patient investors, who are willing to cover Uber's costs while it scales. These initial costs – for technology development, marketing, driver recruiting, staffing – are substantial and Uber was estimated to raise more than $ 15 billion in loans and investments by July 2016 for this.

Investors are willing to supply the money because they see the second advantage –

> If and when the company activates network effects and achieves scale, its marginal cost of arranging a ride somewhere in the world will be extraordinarily low. – Uber will eventually be able to profitably charge the very low prices that maximize total revenue.

For taxis the marginal cost of taking someone across town is clearly not zero since petrol and the driver both must be paid for. Thus most companies operate higher on the demand curve where prices are greater.

Two forces push prices downward:

First is **consumers** who obviously want to pay as little as possible and side with platform builders who seek to rapidly grow their networks.

Second is that many suppliers compete for business and many potential suppliers are waiting in the wings. **Platforms** enhance this competition by **reducing barriers to entry** and they often **commoditize the suppliers**, making them interchangeable to the customers.

Competition and commoditization tend to drive down the price and to deliver the business to the companies willing to supply products more cheaply while maintaining acceptable quality.

Thus platform builders and consumers both want low prices, and competition among suppliers tends to result in them.