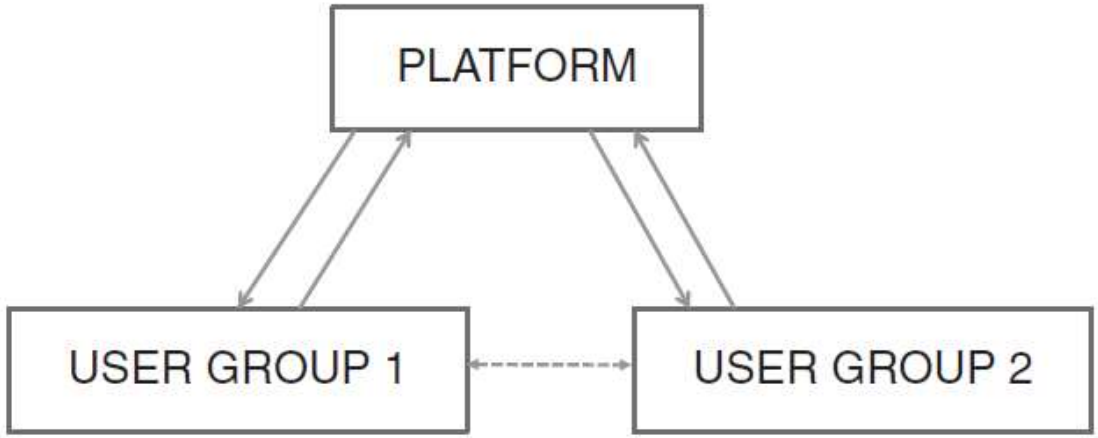
Economic Fundamentals of the Digital Economy:

Basic Features of the Economics of Two Sided Platforms

Two-sided patforms: Definition and examples

- A *two- sided platform* brings together two different types of agents for the purpose of engaging in a transaction. It performs an intermediation role by reducing the transaction costs that agents might incur to find each other and consummate an exchange
- Two-sided platform can be physical and virtual:
  - The auction house Christie's brings together the owner of an item (who is one type of agent) and prospective buyers (who are another type of agent) for the purpose of selling that item
  - eBay offers a virtual counterpart of a physical auction house
- A relevant part of the platforms in the online world is fueled by advertising. They are called "attention" platforms, where advertisers are drawn by the presence (or attention) of consumers, and consumers are drawn by content whether it is:
  - Search information (the platform is a search engine, such as Google)
  - Contact with friends (the platform is a social network, such as Facebook)
  - Videos (the platform is a streaming video website, such as YouTube)


PLATFORM
USER GROUP 1
USER GROUP 2

Examples of Two-Sided Platforms

Market	Platforms	User Group 1	User Group 2
Auctions	eBay, eBid, Christie's	Sellers	Buyers
Search engines	Google, Bing	Advertisers	Consumers
Taxi service	Uber, Lyft	Drivers	Passengers
Operating systems	Windows, Mac	App developers	Consumers
Credit cards	VISA, MasterCard	Retailers	Consumers
Video games	PlayStation, Nintendo	Game developers	Gamers
Employment	Monster.com, Careerbuilder.com	Employers	Job seekers
Dating*	eHarmony, Match.com, Tinder, nightclubs	Women	Men
Dining reservations	Open Table, Reserve	Restaurants	Diners
Accommodations	Airbnb, Wimdu, Booking.com	Property owners	Consumers
Retailing	Shopping malls, Amazon	Stores	Consumers

The fundamental features of two-sided platforms (1)

Several features of two-sided platforms are critical to understanding their performance

1. *The presence of indirect network effects*. The value that a user attaches to the associated service increases with the number of users on the other side of the platform

2. *Congestion.* It is the opposite of network effects: The more users of a service there are, the lower will be the value that a user attaches to it. Congestion effects can arise in association with a user's own side of the platform. Examples:
   - The more buyers there are at eBay, the less attractive eBay will be to a buyer as then there are more buyers with which to compete when bidding on an item

   Anyway, not all two-sided platforms have congestion effects
   - The value to conducting a search at Bing or viewing a video at YouTube is not diminished if many other people are doing so. Moreover, sometimes there are direct network effects (e.g. social networks)

The fundamental features of two-sided platforms (2)

3. *The manner in which services are priced.* In a standard market, a seller selects the price it will charge a buyer. In contrast, the owner of a two-sided platform decides the prices to be charged to the two types of users. Optimal prices can be very different from what the standard model of pricing would predict.

   The *price structure* matters:

   - Profit maximization could mean charging one type of user a price below cost or even a negative price (that is, paying them to use the platform). What matters is not just the total price charged to a pair of user types when they conduct a transaction, but how that total price is distributed between the two user types.

4. *Platforms can compete.* Competition across platforms can happen:
   - *eBay vs. Amazon*
   - *Google vs. Yahoo*
   - *Netflix vs. Prime Video*

Prices at a two-sided platform

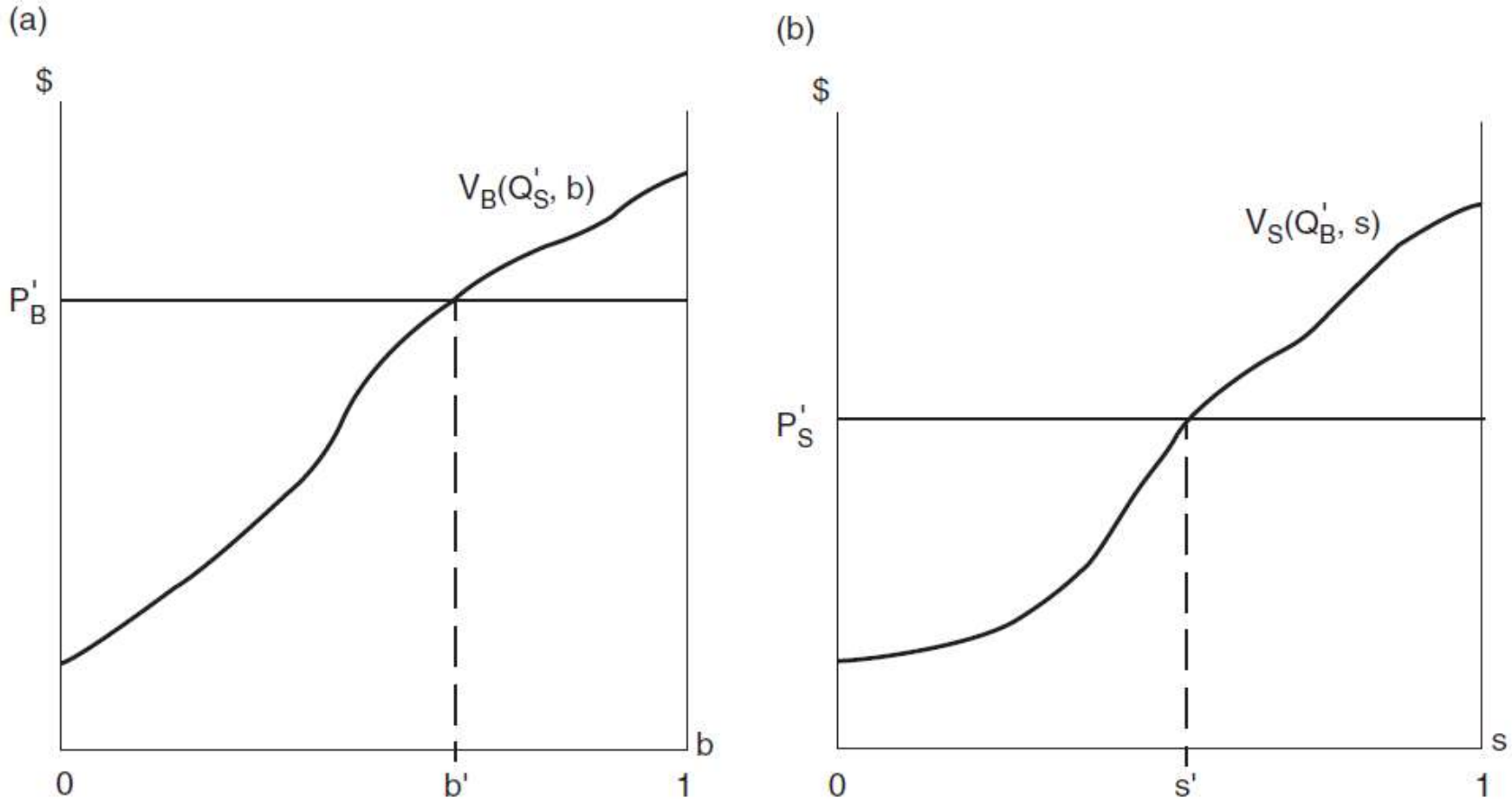
- The owner of the platform has two decisions to make:
- How to collect revenues. E.g.:
    - It can charge a fee to users to access the platform
    - It can charge a fee when users from two sides of the platform are matched
- How to price the different sides of the market. E.g.:
    - eBay has a positive price for sellers but a zero price for buyers (who access and transact at eBay at no charge)
- The problem can be analysed in three steps:
    1. Determine which prospective users participate at the platform (that is, the equilibrium quantity of users), given prices for the two user types. That gives us user demand
    2. Solve for the prices that maximize profits when there is a monopoly platform
    3. Discuss what additional forces come into play when there are competing platforms

The equilibrium quantity of users (1)

- Consider a two-sided platform that is an auction or retailing site, such as eBay or Amazon (in its capacity as a platform for other online stores to post their wares)
- The two user groups are *buyers* and *sellers*
- A buyer's value to using the platform is given by $V_B(Q_S, b)$, where Q_S is the quantity of sellers using the platform and b is a buyer's type. $V_B(Q_S, b)$ is increasing with Q_S because of network effects
- Assume that there are many buyers and they differ in the value attached to using the platform. A higher value for b indicates the buyer finds using the platform more valuable (one can think of a buyer's type as a trait - for example, income - that positively infuences the buyer's desire to buy some item, in which case the value of going to eBay is higher when b is higher)
- $V_S(Q_B, s)$ is the value that a seller of type s assigns to using the platform, where Q_B is the quantity of buyers at the platform, and $V_S(Q_B, s)$ increases with Q_B. A higher value for s corresponds to a seller who finds it more valuable to participate at the platform (perhaps because its inventory is large or it has low cost)
- For simplicity, congestion effects are assumed to be negligible: V_B does not depend on Q_B, and V_S does not depend on Q_S

The equilibrium quantity of users (2)

- If a buyer of type b believes there will be Q'_s sellers at the platform, then $V_B(Q'_s, b)$ is her maximum willingness to pay to access the platform
- Let P_B and P_S denote the price charged to a buyer and a seller, respectively, for joining the platform (note that these are the prices charged by the platform owner and are not the prices involved in any exchange between a buyer and a seller)
- A buyer joins the platform if and only if she values it at least as much as it costs her: $V_B(Q'_s, b) - P_B \geq 0$. If $P_B = P'_B$, then only buyers with $b \geq b'$ will pay the price and participate at the platform. If we let $N_B(b')$ denote the number of buyers whose type is at least b', then $N_B(b')$ is how many buyers participate at the platform



(a) Buyer's Value from the Platform (b) Seller's Value from the Platform

The equilibrium quantity of users (3)

- While one may be inclined to think that $N_B(b')$ is buyers' demand for the platform, remember that $N_B(b')$ depends on how many sellers participate, and we have not yet solved for it. We simply stated it was Q'_S but, in fact, how many sellers participate depends on how many buyers participate
- Suppose sellers expect Q'_B buyers to be at the platform, and the price charged to a seller for participating is P'_S. If we go through a similar analysis as we did for buyers, sellers whose type is at least s' will join. If $N_S(s')$ is the number of sellers with a type at least as great as s', then $N_S(s')$ is how many sellers will be at the platform when they believe there will be Q'_B buyers, and the price for a seller to access the platform is P'_S.

The equilibrium quantity of users (4)

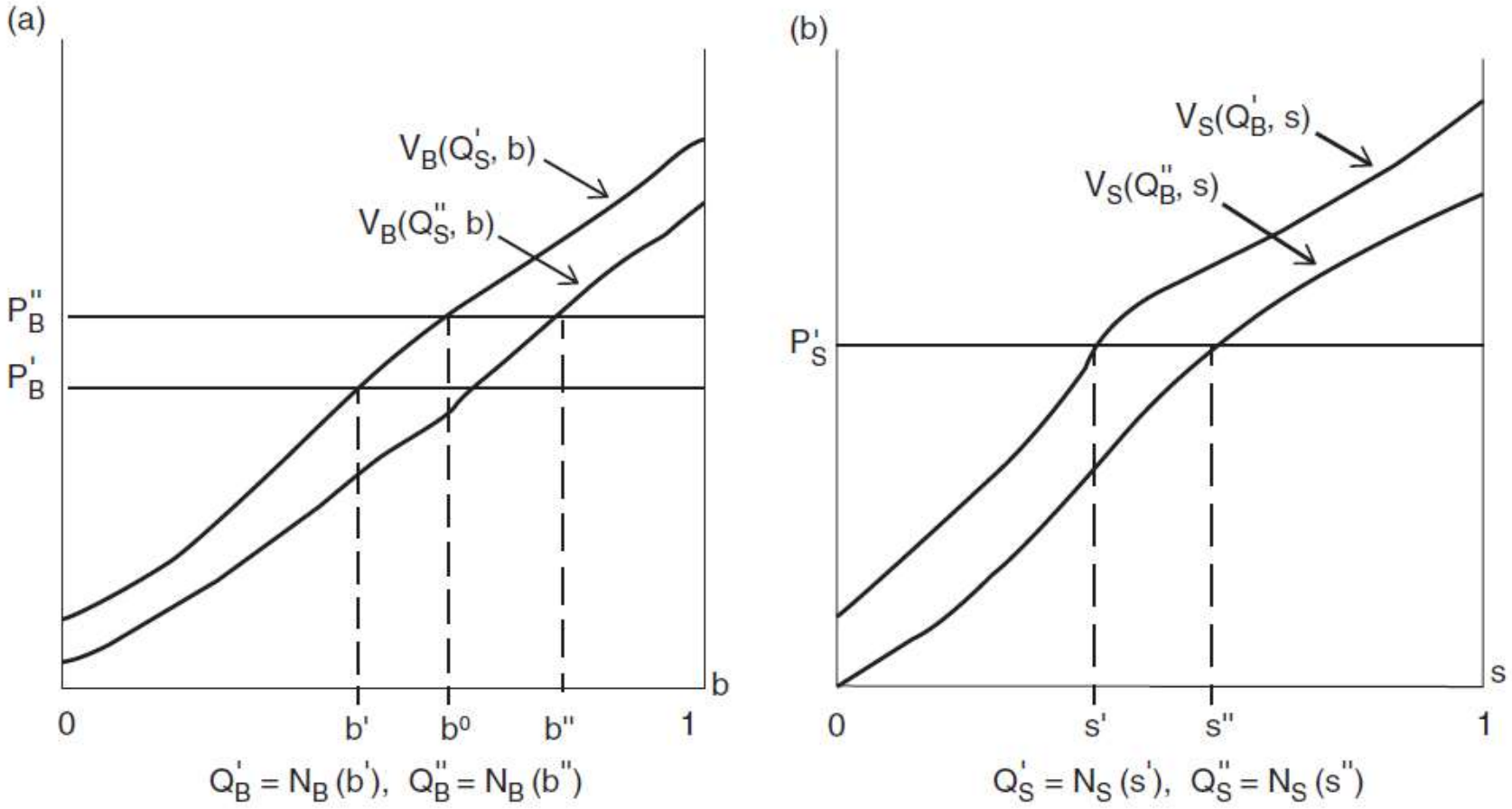
- Given prices, a *user equilibrium* is a quantity for each side of the platform, Q_B^* and Q_S^*, such that if sellers believe Q_B^* buyers will join the platform, then Q_S^* sellers will find it optimal to join, and if buyers believe Q_S^* sellers will join the platform, then Q_B^* buyers will find it optimal to join. In other words, the beliefs of each side are fulfilled. If that were not the case, then the situation would not persist. For example, if fewer sellers were there then expected by buyers, it would cause fewer buyers to join.
- The conditions defining a user equilibrium can be cast in terms of the types of buyer and seller who are just indifferent to joining:

$$V_B(Q_S^*, b^*) - P_B = 0, \qquad Q_B^* = N_B(b^*)$$
$$V_S(Q_B^*, s^*) - P_S = 0, \qquad Q_S^* = N_S(s^*)$$

- The first equation tells us that if buyers believe Q_S^* sellers will join the platform, then the net surplus to a type b^* from paying P_B and joining is zero, which implies that all those of a higher type will have a positive net surplus. Hence, $N_B(b^*)$ (or Q_B^*) buyers will join
- The second equation tells us that if sellers believe Q_B^* buyers will join, then sellers of type s^* and higher will join, which results in $N_S(s^*)$ (or Q_S^*) sellers on the platform
- Given prices P_B and P_S, a platform can then expect of Q_B^* on one side (buyers) and Q_S^* on the other side (sellers). $Q_B^*(P_B, P_S)$ and $Q_S^*(P_B, P_S)$ are the demand functions of the platform

The equilibrium quantity of users (4)

- The demand from each side depends on the prices charged to both sides. The higher is P_B, the fewer buyers will join by the usual logic of downward sloping demand. Given that there are fewer buyers, fewer sellers will then join; hence, seller demand is also lower. The quantity of a user group is decreasing with both the price charged to that user group and the price charged to the other user group
- Suppose that the initial user equilibrium is based on prices P_B' and P_S', which results in Q_B' buyers and Q_S' sellers joining the platform. Now suppose that the price for buyers rises to P_B''. If buyers continued to believe there will be Q_S' sellers, then buyers whose type lies between b' and b^o will no longer join, and the quantity of buyers will fall to $N_B(b^o)$
- Now that there are fewer buyers, fewer sellers will join, which is reflected in the value for sellers shifting down
- The new equilibrium has Q_B'' buyers and Q_S'' sellers joining the platform
- The value that a buyer attaches to the platform has shifted down to $V_B(Q_S'', b)$, in which case only buyers with $b \geq b''$ join
- Given that the number of buyers is Q_B'', the value of a seller shifts down to $V_S(Q_B'', s)$, in which case only sellers with $s \geq s''$ join



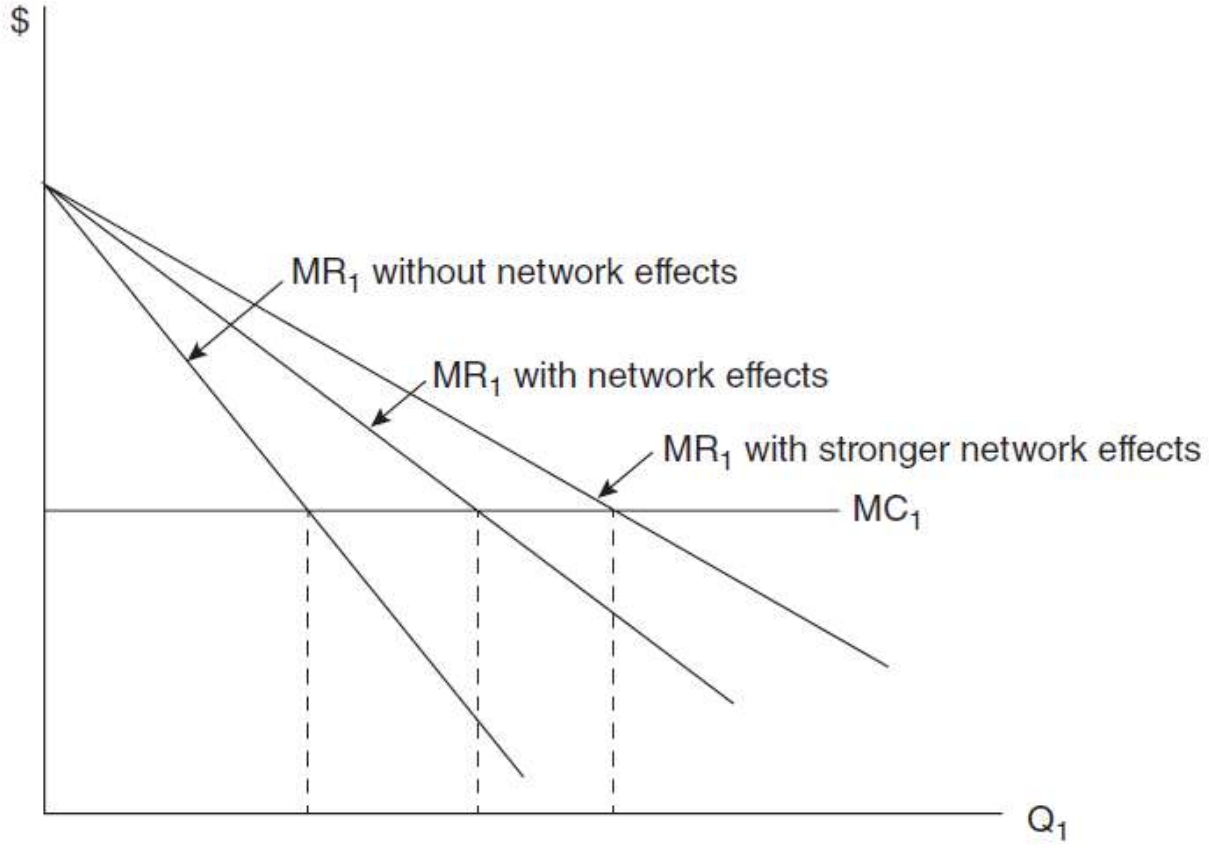
(a) Change in Buyer's Value from the Platform (b) Change in Seller's Value from the Platform

Monopoly prices in two-sided markets (1)

- Given demand functions $Q_1^*(P_1, P_2)$ and $Q_2^*(P_1, P_2)$, the platform owner will choose prices for the two user groups that maximize total profit
- Let MC_1 and MC_2 denote the (constant) marginal cost of having someone from user group 1 and 2, respectively, access the platform
- The monopoly platform profit maximization problem can be presented as:
  - choose P_1 and P_2 to maximize $(P_1 - MC_1)Q_1^*(P_1, P_2) + (P_2 - MC_2)Q_2^*(P_1, P_2)$

Monopoly prices in two-sided markets (2)

- In the standard monopoly model, the marginal revenue from another user group 1 agent should be $P_1 + Q_1\Delta P_1$, where $\Delta P_1 < 0$ is the reduction in price required to get that additional user
- With a two-sided platform, an additional term must be added to that marginal revenue expression. By inducing one more user group 1 agent to join the platform, the platform becomes more attractive to user group 2, so more of them join
- Let ΔQ_2 be the rise in user group 2 for each additional user group 1 agent. From each of those user group 2 agents, the platform is earning profit of $P_2 - MC_2$. Hence, if, by lowering the user group 1 price, another user group 1 agent accesses the platform, the profit from user group 2 rises by $(P_2 - MC_2)\,\Delta Q_2$. The marginal revenue from selling to one more user group 1 member is then $MR_1 = P_1 + Q_1\Delta P_1 + (P_2 - MC_2)\,\Delta Q_2$.
- As the term $(P_2 - MC_2)\,\Delta Q_2$ raises marginal revenue, it causes the profit-maximizing value of Q_1 to rise, and this implies a lower price P_1
- ΔQ_2 measures how much user group 2 demand rises in response to a unit rise in user group 1. This effect is driven by how much value user group 2 gets out of user group 1. Therefore, the stronger are the indirect network effects generated by user group 1 for user group 2, the lower the profit-maximizing price will be for user group 1.



Higher Marginal Revenue for User Group 1 from Network Effects on User Group 2

Monopoly prices in two-sided markets (2)

- A general conclusion:
  - Suppose there are no indirect network effects—so the demand by a user group is independent of how many users are on the other side— and both user groups have the same demand and marginal cost. In that case, the profit-maximizing prices will be identical
  - Suppose user group 2 attaches value to user group 1 but the reverse is not true. As explained above, the marginal revenue from selling to user group 1 is higher, which causes the monopolist to lower the price to user group 1 in order to expand how many of them participate on the platform, for more of user group 1 increases user 2 group's demand. With more user group 1 agents, user group 2 attaches higher value to the platform, so the monopolist will then probably want to raise the price on user group 2. Compared to when neither group cared about the other, the price of user group 1 is lower and the price of user group 2 is higher
  - Suppose that user group 2 attaches more value to user group 1 being on the platform than user group 1 attaches to user group 2 being on the platform. In that case the platform owner will do more to encourage user group 1 participation in order to enhance demand by user group 2. It does that by setting a low price for user group 1
- The principle is that, *ceteris paribus*, a monopolist will optimally set price lower (higher) for the user group that attaches relatively less (more) value to the other user group that is on the platform, or *the user group that generates more network effects (for the other user group) will have a lower price*

Monopoly prices in two-sided markets (2)

Some examples:

- For eBay, buyers face a zero price, while the basic commission rate for sellers is 10% of the amount of the sale up to a maximum of $750 (and there is a fee to list the good)
- Many advertiser-funded platforms charge a zero price to one side of the platform and a positive price to the other side. At Google, the user groups are consumers and advertisers. Consumers attach far less value to advertisers than advertisers do to consumers; consumers generate large network effects for advertisers. As profit maximization would predict, consumers pay a lower price than advertisers. In fact, the official price for someone to use the Google search engine is zero. In contrast, advertisers pay a positive price every time a consumer clicks a sponsored link. While consumers would come to Google even without advertisers (and, in fact, did so before sponsored links were launched), advertisers would not join the Google platform unless there were consumers. This relationship between consumers and advertisers in terms of network effects and prices holds as well for social networks sites, such as Facebook

Prices for competing two- sided platforms

When different platforms compete, additional considerations should be kept in mind

- The more similar are platforms, the more intense price competition will be
- When product differentiation varies between the two sides of the platform, all other things being the same, price-cost margins will be lower for the side of the platform for which the competing platforms are less differentiated
- Network effects may prove more important than the extent of platform differentiation
- *Multihoming* (a user participates in two or more platforms for the same service) can be relevant. Platforms will tend to compete more aggressively for the user group that is more inclined to single home
  - Suppose platforms A and B compete, where user group 1 multihomes and user group 2 single homes. If platform A lowers its user group 2 price, it will attract more of those users, which will include drawing them from platform B, because these users only single home. Thus, the network effects generated by user group 2 for user group 1 have gone up for platform A and down for platform B. Platform A is then looking relatively. more attractive for user group 1 compared to platform B. That effect would be weaker, however, if platform A would have lowered the price for user group 1. The price reduction will attract more user group 1 agents, but some will continue to be on platform B, because they multihome. While platform A's network effects for user group 2 have gone up (because it has more user group 1 agents), platform B's network effects may have not fallen by much (because of multihoming). Hence, the increase in the relative appeal of platform A is not as strong when it lowered the price for the multihoming users compared to when it lowered the price for the single-homing users