Principles of Microeconomics : Chapter 2
Supply and Demand as Logical Implications of Net Benefit Maximization

I. The Geometry of Net Benefit Maximizing Choice

A. There are two widely used models of rational choice: (1) the net benefit model and (2) the utility maximizing model.

Both sets of models can be developed geometrically, and both can be used to create surprisingly well integrated general theories of market activity (and of many other activities).

These models allow one **to deduce** a broad range of properties about markets--most of which have been verified with statistical tests of one kind or another.

The models do not work perfectly, but it is amazing how much can be explained about a wide range of market, individual, interest group, and political activities from so few assumptions.

We'll develop the net-benefit maximizing model in this course, because it's a bit easier, and is in some ways it is more important for undergraduate applied micro courses.

(The utility maximizing model is developed in Intermediate Microeconomics courses.)

B. Nearly all partial equilibrium economic models can be developed from the assumption that individuals maximize their private net benefits.

DEF: Net benefits are total benefits less total cost.

Economists often name various net benefits.

- For example, Consumers maximize consumer surplus: the difference between what a thing is worth to them and what they have to pay for it. $CS(Q) = TB(Q) - TC(Q)$
- Firms maximize their profit: the difference in what they receive when they sell their products and what it costs to produce them.

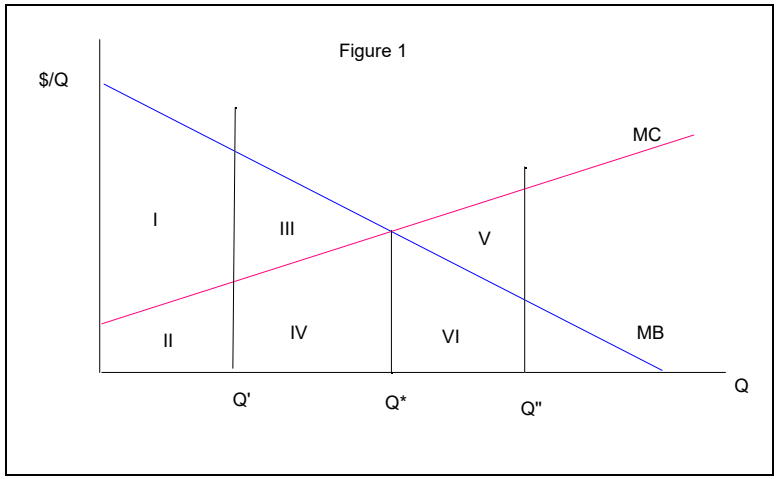
$$\Pi = TR(Q) - TC(Q)$$

Nonetheless, the geometry and logic of net benefits is essentially the same whether one deals with consumers, firms, other roles, or other types of activities.

C. "Marginal" is an adjective and refer to how another unit of a good or service produces additional benefits or costs, etc.

DEF: Marginal "X" is the change in Total "X" caused by a one unit change in quantity. It is the slope of the Total "X" curve. "X" ∈ {cost, benefit, profit, product, utility, revenue, etc.}

- *Important Geometric Property*: Total "X" can be calculated from a Marginal "X" curve by finding the area under the Marginal l "X" curve over the range of interest (usually from 0 to some particular quantity, Q).
- The "area property" allows us to determine consumer surplus and/or profit from a diagram of marginal cost and marginal benefit curves.



D. How to calculate net benefits given MC and MB curves:

Given the marginal cost and marginal benefit curves in Figure 1, it is possible to calculate the total cost of Q' and the total benefit of Q' . These correspond to areas under the curves of interest. TC(Q') = II ; TB(Q') = I + II .

Similarly, one can calculate the net benefits of any output or activity level Q by finding total benefit and total cost for the quantities of interest and subtracting them.

Thus, the net benefit of output Q' is TB(Q') - TC(Q') = [I + II] - [II] = I.

(Labelling the areas works better for many calculations than shading them in or using different colors. It is used in the web notes and initially in class to make it a bit easier to see which areas are being referred to. However, students should feel free to "shade in," color, or crosshatch the relevant areas in straightforward diagrams if that seems easier to them.)

- Use Figure 1 to determine the areas that correspond to the total benefit, cost and net benefit at output Q* and Q".

Answers:

- TB(Q*) = I + II + III + IV , TC(Q*) = II + IV , so NB(Q*) = I + III
- TB(Q') = I + II + III + IV + VI , TC(Q") = II + IV + V + VI , so NB(Q") = I + III - V
- (It should be clear that a net benefit maximizing individual will prefer Q* over Q' and Q") [**explain why**])

E. If any person or organization attempts to maximize net benefits, it turns out that he, she, or it will normally want to consume or produce at the point where marginal cost equals marginal benefit.

- (This "rule of thumb" reflects the conclusions that we worked out from Figure 1, and it applies to most cases in which Q is very "divisible" and Q* is greater than zero).

Net-benefit maximizing decision makers tend to choose activity levels where **their own marginal costs equal their own marginal benefits**--not because they care about "margins" but because this is how one maximizes net benefits.

We have already developed a nice geometric proof of this above ("D" above implies this) and also have or will shortly do so in class. (See your class notes.)

- This characterization of net benefit maximizing decisions is **quite general**, and it can be used to model the behavior of both firms and consumers.
- Moreover, it can be used to characterize the policies that maximize net benefits for an organization (firm) or even for a society, insofar as "all" relevant costs and benefits can be computed.

F. Economists have found the idea of "the margin" (points around Q*) and the concepts of marginal cost and benefit to be very useful in both explaining individual choices. The implied behavior, in turn, is very helpful in understanding markets and many other activities.

II. Deriving A Consumer's Demand Curve from his or her MB curves using the Net Benefit Maximizing Model

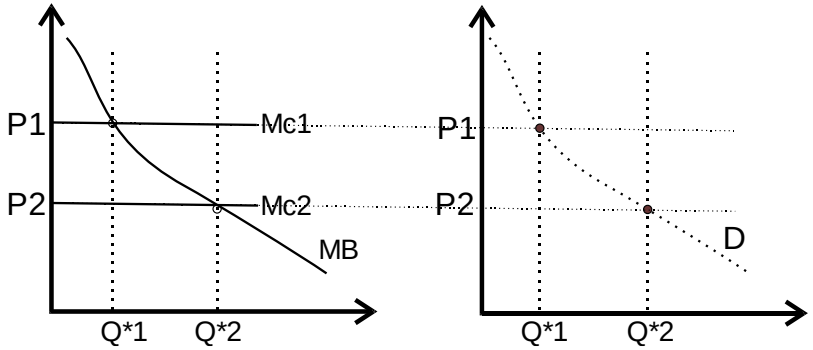
A. If consumers are rational net benefit maximizers, it turns out that both individual and market demand curves are downward sloping.

B. To demonstrate this, we will first determine what net benefit maximizing behavior implies about individual demand curves and then what individual demand curves imply about market demand curves.

- To derive a demand curve from a consumer's MB curve:
- (i) pick a price, Pi
- (ii) find the associated MC curve
- (iii) find the NB maximizing quantity, Q (the amount bought by a rational consumer
- (iv) Plot P and Q
- (v) repeat with another price

The next figure illustrates the geometry of this process. It begins with a marginal benefit curve (MB) and uses two prices, P1 and P2, to find two points on this person's demand curve.

Figure 2.2 Deriving a Demand Curve



- Note that the **price**(s) characterizes a consumer's **marginal cost curve**(s), since he or she has to pay that amount to get each successive unit of this good. The usual MC curve faced by a consumer is simply a horizontal line equal to the price, here P1 or P2.
- Net Benefits are maximized at the quantity where MB(Q)=MC(Q).
- So, the quantity purchased at MC=P1 is the quantity labeled Q1. That gives us a point on the individual's demand curve, (Q1, P1)—at price P1 the consumer buys quantity Q1.
- A similar relationship follows for P2 and every other price that one might try.
- In principle, one should continue varying price and finding each price associated quantity demand to trace out a demand curve, but usually a few prices and quantities are sufficient to trace out a demand curve.
- Note that in cases in which an individual's MB curve is downward sloping (throughout the domain of interest), an individual's demand curve goes through exactly the same points as the demand curve.

C. A demand curve characterizes how a "rational" (net benefit maximizing individual) will alter his or her purchases when prices change—holding other things (all those that affect his or her marginal benefits from the good or serve) constant.

- It is the logic that is general, rather than the particular diagrams.
- Given a consumer's MB curve, we can deduce his or her demand curve!
- THE POINT HERE IS NOT TO MEMORIZE DIAGRAMS, but to understand how to derive a demand curve and what a demand curve explains.

D. This basic process can be used to derive a consumer's demand curve from any sort of MB curve. Although such derivations are

not always as easy as this one, most are. And in cases in which a consumer's marginal benefit curve is downward sloping over its whole range, the consumer's demand curve goes through exactly the same points as the MB curve and is also downward sloping.

- In such cases, one can use estimates of individual demand curves as estimates of MB curves.

However, although they go through the same points, marginal benefit curve and demand curve are not the same. They **have different meanings, and the two function go in opposite directions.** A demand function goes from prices into quantities. A marginal benefit function goes from quantities into marginal benefits in terms of dollars per unit.

- In some cases, the demand curves include only a subset of the point on an individual's MB curve, but the points in common are always from the downward sloping portions of the MB curve.
- Thus, when a demand curve is derived in this way from MB curves, it turns out that **every** individual demand curve slopes downward.

E. Notice that we **already have several predictions** about behavior that follows simply from the net-benefit maximizing model of consumer choice:

- Demand curves generally slope downward. Thus, as prices rise, consumers tend to purchase fewer of the goods produced.
- A change in an individual's marginal benefits from a good or serve will cause his or her demand curves for that good or service to shift up or down as his or her marginal benefit curve shifts up or down.
- Consumer surplus tends to fall as prices rise, other things being equal, and to rise as prices fall.
- IN CLASS, A VARIETY OF SIMILAR DERIVATIONS WILL BE DONE ON FOR VARIOUS MB CURVES, ONE OF WHICH WILL BE ASSIGNED AS A HOMEWORK **PUZZLE**. **(So do show up for class!!!)**

III. Deriving a Firm's Supply Curve from MC Curves

A. In a similar fashion, one can use the **profit maximizing model** (another measure of net benefit) to derive a competitive firm's short run supply curve from its short run marginal cost (MC) curve.

B. The method used to derive a firm's supply curve is very similar to that used to derive a consumer's demand curve:

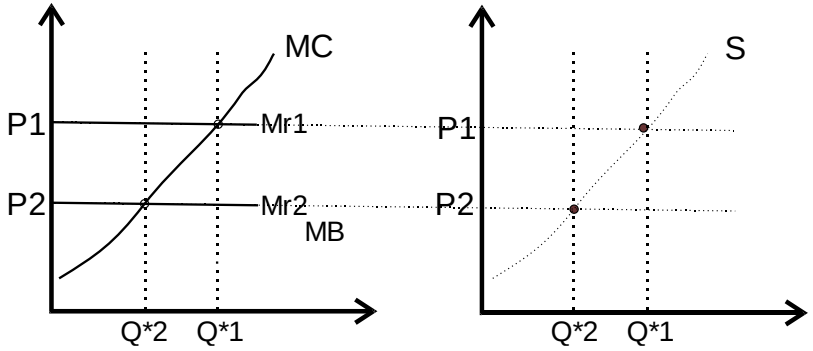
(i) Choose a price
(ii) Find the associated marginal revenue curve (MR)
(iii) Find the profit maximizing quantity of the good or service, given that MR curve.
(iv) Plot the price and the profit-maximizing quantity on another diagram.
(v) Repeat with several other prices to trace out a supply curve.

C. The next figure illustrates these steps for a given marginal cost curve(MC) and two prices, P1 and P2.

- In a competitive market, the market price is every firm's marginal revenue curve, because the firms get "P" new dollars of revenue every time it sells an additional unit at that price.

- So, each of the MR curves that you'll draw when deriving a supply curve is a horizontal line through P1.
- (An exception to this rule is the case of monopoly, where firms produce different products, as we'll see later in the course.)

Figure 2.3 Deriving a Supply Curve



- Given a MR curve, the firm will choose the quantity that maximizes his or her profit (the firm's net benefit), which occurs where MR=MC.
- If the prevailing market price is P1, then the firm's MR curve is a horizontal line through P1, and it will produce Q1 units for sale.
- To derive a supply curve, this price and output combination is plotted on the Supply diagram.
- Next, we try another price, P2. A horizontal line through P2 is the firm's marginal revenue curve, since its revenue now increases by that P2 dollars every time another unit of the good is sold.
- Given that new MR curve, this firm chooses the quantity that maximizes profits, which is again found where MC=MR and is labeled Q2.
- This price output combination is plotted on the Supply diagram.
- In principle, this process of tracing out the firm's supply curve is repeated over and over again until the entire supply curve is traced out. However, usually, three or four points is enough to get the general shape of the supply curve.

F. It turns out that if the firm's marginal cost curve is upward sloping over its entire range, then every point on the firm's marginal cost curve is also a point on its supply curve.

- However, as with the relationship between a consumer's marginal benefit curve and his or her demand curve, the curves have different meanings, and their associated functions go in different directions.
- The MC curve goes from quantities into marginal costs. The supply curve goes from prices into quantities produced for sale.
- In cases in which a firm's supply function is not upward sloping throughout, only a subset of the points on a firm's MC curve will be on its supply curve, but those will all be from the upward sloping parts of its MC curve. So, it turns up that a firm's supply curve is always upward sloping.
- Thus, firms will always supply more of its product as prices rise.

D. Again, the assumption of purposeful net-benefit maximizing behavior has clear implications—in this case implications about how firms behave (when they are "price takers").

- Every firm's supply curves tend to be upward sloping.
- As prices rise, other things being equal, firms produce and sell more units of their products.
- Any change in market conditions that affects a firm's marginal cost curve will also affect its supply curve.
- For example, an increase in input prices tends to cause the marginal cost of production to increase.
- If MC rises, the supply curve shifts back to the left.
- If market prices rise, MR shift upward, and a firm's profits will increase—other things being equal.
- If a firm's MC rises and prices do not, then profits will fall, other things being equal.

E. If MC rises, the supply curve shifts back to the left. Keep in mind that in this chapter, both our theory and derivation of supply curves assumes that rms are "price takers." that is that take the market price as given and simply adjust their output in response to it. This is a standard assumption when modelling competitive market models. Exactly the same method can be used to derive a firms Long Run Supply curve given its Long Run Marginal Cost Curve.

- And the same conclusions will follow.

IV. Deriving Market Demand and Supply Curves

What is "a market"?

A. A market is composed of a group of firms producing similar goods and consumers demanding those goods, which therefore conduct "business" with each other.

- Markets exist for a huge range of specific types of goods in today's commercial society. There are markets for apples, bazookas, cell phones, doughnuts, electric cars, Ferris wheels, geothermal heating systems, hats, ice cream, jet airplanes, kangaroos, lights, mangos, nuts, octopi, pizza, and so on…
- These are local markets, as the market for freshly made pizzas and doughnuts tend to be. There are regional markets as markets for milk tends to be. And there are international markets as markets for automobiles, cell phones, robots, and wheat tend to be.
- When one models supply, demand, and equilibrium prices in a market is it important to keep in mind whether the market is local, regional, or international. The basic logic is the same for each of these, but the number of consumers and firms and consumers that one needs to include in one's market supply or demand curves varies with the type of market one is thinking about. (International markets and some regional markets may also vary a bit because of differences in currency, tariffs, and various regulations on trade.)
- Some markets involve only a handful of buyers and sellers, others involve millions of consumers and thousands of firms.
- Market networks emerge from connections among individual markets such as those that arise from transportation services, intermediate goods, and other input markets.
- We'll initially focus on markets for final goods—which are the markets that ordinary consumers like you participate in when shopping for food, clothing, cell phones, cars, streaming services, textbooks and so on.

B. The markets for which the demand and supply approach works best is one where there are lots of buyers and sellers for the product of interest (the type of product or service whose price (or average price) is being modeled. Such markets are referred to as "competitive markets" by economists.

- It is the large number of buyers and sellers that induces individual buyers and sellers to behave as "price takers."
- In such cases, no single seller or buyer or small group of sellers and buyers determines price. Rather price emerge from the buying and selling decisions of all the buyers and sellers in the market.

Deriving a Market Demand Curve

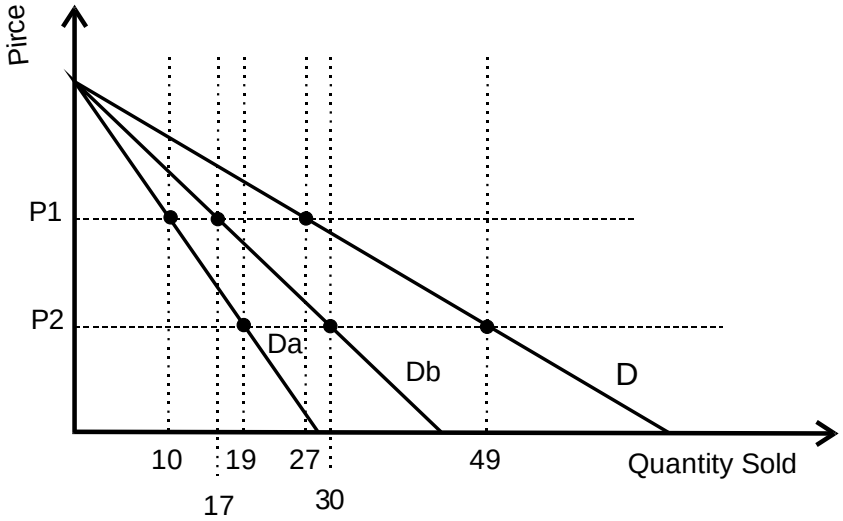
A. Market demand curves characterize the sum of all the quantities of a particular type of good or service that consumers in that market are willing and able to buy at given prices.

- **Geometrically, Market Demand** curves for ordinary private goods are "horizontal" sums of individual demand curves.

C. A market demand curve is derived by (i) choosing a price, (2) adding up the total purchases of all consumers (in the market of interest) at that price, and (3) plotting the price chosen and the total amount purchase. A market demand curve is developed by repeating that process with other prices, which will gradually trace out the entire market demand curve.

- In the figure below, there are just two consumers in the market to make the diagram easier to understand.
- Two prices have been chosen (P1 and P2).
- The prices are used one a time to determine the purchases of each person (a and b, or al and bob).
- The quantities purchased at P1 were (10+17=27)
- The point (P1, 27) was plotted along what would become the graph of the market demand curve.
- The quantities purchased at P2 were (19+27=46)
- The point (P2, 46) was plotted along what would become the graph of the market demand curve.
- When all the individual demand curves are straight lines, two prices and their associated sums are sufficient to determine the market demand curve. When the individual demand curves are "curves" or "kinked" rather than straight lines, more prices will be necessary to determine the general shape of the market demand curve.

Figure 2.4: Derriving a Market Demand Curve



[As a practice exercise, draw two other demand curves, vary prices and trace out the market demand for these two new persons.]

Deriving Market Supply Curves

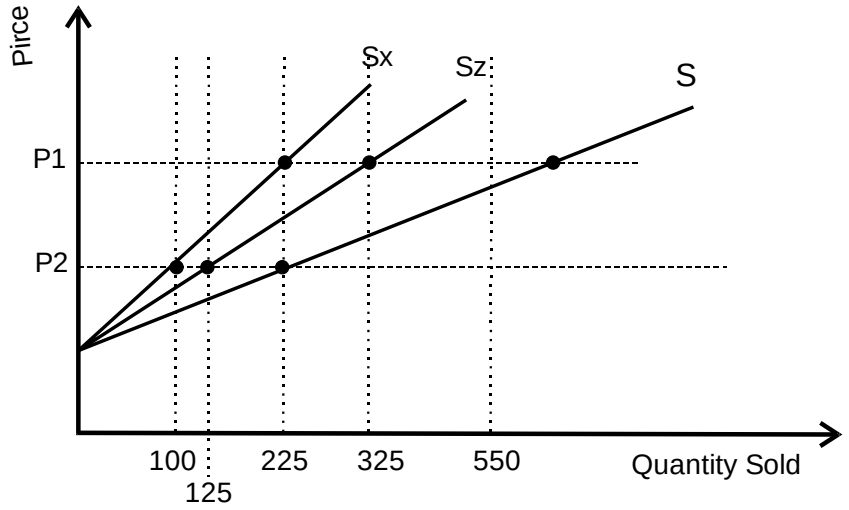
D. Market supply curves characterize the sum of all the quantities of a particular type of good or service that sellers/producers in that market are willing and able to sell at given prices.

- **Geometrically, Market Supply** curves for ordinary private goods are "horizontal" sums of individual firm supply curves.

E. A market supply curve is derived by (i) choosing a price, (ii) adding up the amounts that all the firms in the market of interest will produce to sell by every firm in the market, and (iii) plotting the chosen price and the total output of the industry. To trace out the entire market supply curve, repeat these steps for a series of different prices.

- In the figure below, there are just two price-taking firms in the market to make the diagram easier to understand.
- Two prices have been chosen (P1 and P2).
- The prices are used one a time to determine the production of each firm (x and z, or Xeno and Zemo).
- The quantities produced at price P1 were (100+125=225).
- The point (P1, 27) was plotted along what would become the graph of the market supply curve.
- The quantities purchased at P2 were (225+325=550).
- The point (P2, 46) was plotted along what would become the graph of the supply demand curve.
- When all the individual firm supply curves are straight lines, two prices and their associated sums are sufficient to determine the market supply curve. When the individual supply curves are "curves" or "kinked" rather than straight lines, more prices will be necessary to determine the general shape of the market supply curve.

Figure 2.5: Derriving a Market Supply Curve



V. Equilibrium Prices in Competitive Final Goods Markets

A. Economists use market supply and demand curves to model the determination of market prices in "competitive markets."

- A competitive market exists when a reasonably "large" number of producers (firms) sell very similar products to relatively large numbers of consumers.
- Their large numbers tend to make both sides of the market "price takers" similar to those assumed when we derived

the individual consumer demand curves and individual firm supply curves.

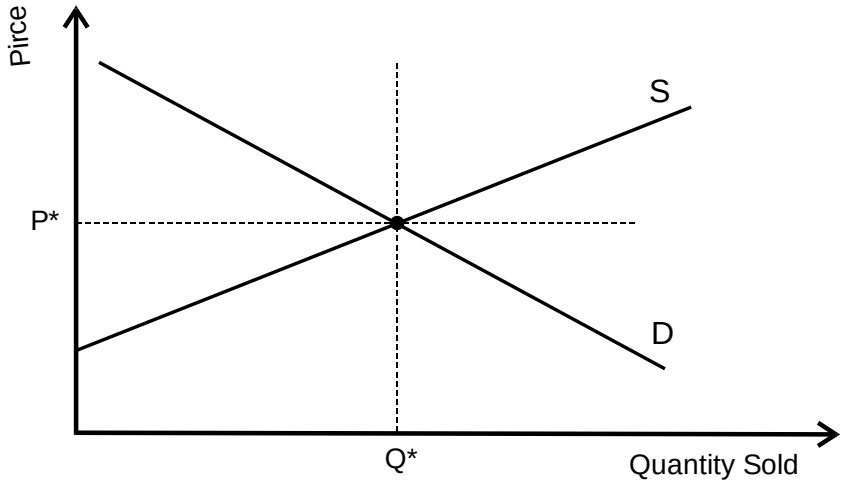
- Large numbers make it very difficult, if not impossible, for firms or consumers to coordinate their behavior and thus somehow have a major impact on prevailing market prices.

B. A market is said to "clear" when the quantity supplied by all firms selling a particular type of good or service provide the total amount of those goods or services demanded by all the purchasers (consumers) of those goods or services.

- A market clearing price, P*, is one that induces the firms in a particular market to supply quantity of a good or service equal to the amount that consumer's demand at that price in that market.

C. Market prices tend to move to levels where the total quantity supplied by all firms equals the total amount demanded by consumers. (This defines P*, and Q*)

Figure 2.6: A Market Clearing Price



D. The "market clearing" model of price determination predicts that output and prices tend to move toward P* and Q* as prices adjust to "ration" the quantities produced to consumers.

- Equilibrium prices cause all markets to "clear" at which market supply = market demand.
- Note that this adjustment process is, in principle, an entirely decentralized process requiring governments to do nothing more than enforce property rights and contracts.
- If there is a shortage, prices tend to rise, causing consumers to buy less and firms to produce more, until a price emerges that sets demand equal to supply.
- If there is a surplus, prices tend to fall, causing consumers to buy more and firms to produce less until a price emerges that sets demand equal to supply.

E. Changes to consumer that affect the marginal benefits of consumers or that changes the marginal costs of firms imply that preexisting prices are no longer market clearing prices. In the next chapter we'll explore how changes in the choice settings of firms or consumers

VI. Using Net Benefit Maximizing Models of Rationality to Show Market Efficiency [Normative Analysis]

A. Having derived the individual market demand and supply curves using the net benefit maximizing model, it turns out that:

- A market demand curve is (approximately) the horizontal sum of the **marginal benefit curves of the individual consumers**. So, a demand curve can be used to estimate

the MB curve for all the consumers in the market of interest. w

- It also turns out that a market supply curve is approximately the horizontal sum of the marginal cost curves of individual firms in the market. So, a supply curve can be used to estimate the industry's MC curve.
- [An **exception** is the case in which Marshallian assumptions are used, in which case, S_{LR} is the industry's ATC curve, we'll discuss that case in the next chapter.]

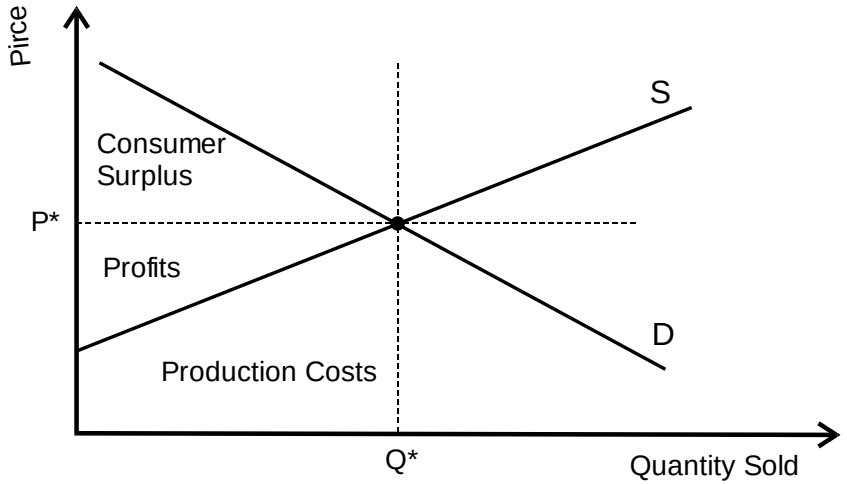
B. The supply curve represents the industry's marginal cost of production, which is approximately the marginal opportunity cost of the resources used to produce the good being analyzed.

C. The demand curve represents the marginal benefit of producing the goods, which is ultimately the benefits received by consumers.

- This allows us to identify both the consumer surplus (the net benefits realized by each consumer in the market) and the industry profits (the total profits realized by firms in the market) at the market equilibrium.
- Figure 2.7 labels the relevant areas.
- Notice the equilibrium price is the marginal costs for all the consumers in the market and it is the marginal revenue for all the firms in the market.
- To calculate consumer surplus, we take the area under the demand curve (consumer marginal benefit curve) and subtract the area under the price line (marginal cost curve) from 0 to Q*. The result is the area labeled as consumer surplus.
- To calculate profit, we take the area under the price line (the industry's marginal revenue curve) and subtract the area under the market supply curve (the industry marginal cost curve). The result is labeled profit in the diagram.
- The area under the supply curve (industry marginal cost curve) from 0 to Q* is the cost of producing the good sold in the market of interest.

D. The net benefits of production, sale, and use are normally (but not always) shared between firms and consumers, with the firms share of net benefits called profits and the consumers share of net benefits called consumer surplus.

Figure 2.7: Net Benefits at a Market Equilibrium



E. Note that the geometry of "market clearing" price implies that markets to produce the output levels that set marginal social benefits (demand) equal to marginal social costs (supply).

- Consequently, competitive markets tend to produce the social net benefit maximizing level of output, the output that maximizes the sum of consumer surplus and profits.

- This conclusion is one very widely used **normative** argument in support of competitive markets as an "efficient" welfare maximizing form of social organization.
- It is sometimes called the first theorem of welfare economics: competitive markets produce (Pareto) efficient outcome.
- Market do so because firms have incentives to minimize the resources used to produce their products. This minimizes their production costs.
- They also do it because firms have incentives have incentives to produce what consumers want, because otherwise their products will not sell, and they will not realize any profits from their efforts...

F. As **Adam Smith** wrote in classic text, the Wealth of Nations, in 1776, "**It is not from the benevolence of the butcher, the brewer, or the baker, that we expect our dinner, but from their regard to their own interest. We address ourselves, not to their humanity, but to their self-love, and never talk to them of our own necessities, but of their advantages**. Nobody but a beggar chooses to depend chiefly upon the benevolence of his fellow-citizens. Even a beggar does not depend upon it entirely. The charity of well-disposed people, indeed, supplies him with the whole fund of his subsistence. But though this principle ultimately provides him with all the necessaries of life which he has occasion for, it neither does nor can provide him with them as he has occasion for them."