Supply and Demand

We now turn to the most important model in all of economics, supply and demand in a perfectly competitive market. A market is a collection of agents, firms and households in this case (policy makers are an important part in many markets) whose decisions cause the allocation of a certain good or service. Perfect competition means that any single household or firm is too small to affect the market price. We will use the hokey example of the market for soda.

We begin with demand. For most goods and services, households are the demanders. In the labor market, however, households are the suppliers of labor, and firms are the demanders. The demand curve is the relationship among different prices, and the amount of the product that demanders are willing to purchase at each price. We now explicitly make some assumptions about these households:

1. They are rational and make choices to maximize their *utility*, the total benefit to them provided by the soda. Furthermore, they understand the correct relationship between soda consumption and utility. This latter assumption is not always valid. Economists often study the impact of incorrect or incomplete information.

2. There are a large number of households and each of them is only a small part of the market. Once again, this assumption is not always true. For some goods, there may be only a few buyers. If there is only one, it is known as *monopsony*.

3. Because they are each a small part of the market, households have no ability to affect the price. This is known as *price taking*. By assumption, an individual consumer cannot effectively demand that soda companies lower their prices. Again, this assumption is not always applicable. If there are only a few demanders of the good, then they may be able to influence its price. This is known as *market power*.

4. They are able to observe all market conditions (price, utility, cost, etc.)

These assumptions offer a starting point for analyzing demand. They are not offered as a perfect representation of most markets. Issues like incomplete information, market power, etc.

Table 1: Utility of Soda

Units	Marginal Utility	Total Utility
1	\$100	\$100
2	\$90	\$190
3	\$80	\$270
4	\$70	\$340
5	\$60	\$400
6	\$50	\$450
7	\$40	\$490
8	\$30	\$520
9	\$20	\$540
10	\$10	\$550

are important features of many real world markets. Studying these issues is, however, best done by building off of the basic model presented here. This is a common tactic in economic theory. Start with a simple model that admittedly omits many relevant features of actual markets, and then extend it to examine these features.

Table 1 assumes a specific utility from soda:

We will now derive the demand curve. To graph it, we choose to put the price on the vertical axis and the quantity demanded on the horizontal.

Graph: Supply and Demand

As we derive the demand curve for soda, notice that it is marginal (additional) utility, not total utility, that matters at each step in the process. This is true for most examples in economics.

Suppose that the price per unit of soda is $10. Households will choose to buy a first unit of soda because the marginal benefit is greater than the price. Likewise, households will buy a second unit because the $90 marginal benefit (again, marginal matters, not total) is greater than the price. This remain true thorough the ninth unit. The tenth unit provides just as much marginal utility as it costs. The household is therefore indifferent to buying it. To make things easy, we will assume that households do buy the soda. Households thus demand 10 units of soda at a price of $10. We can make this the first point on the demand curve.

Now suppose that the price is $20. Repeating the previous exercise, households will purchase soda until its marginal benefit equals the price which occurs at 9 units. If the price is $30, marginal utility equals the price at 8 units. As we continue this process, we see a pattern where marginal utility is demand.

In this example, the demand curve is downward sloping: households demand more soda as the price falls. While we believe that this is usually true, it results from a previously unstated assumption from the previous table. The demand curve is downward sloping because we assumed

that marginal utility is decreasing. As households consume more of a good, they get more total utility, but less marginal utility. In this example, the first unit of soda is more valuable than the second which is more valuable than the third, etc. While this usually a good assumption, there are cases where it does not apply. Demand curves are thus not universally downward sloping.

To reiterate, demand is equal to marginal (not total) utility in our model of perfect competition.

Supply

We now turn our attention to the firms who supply the soda. We make the following assumptions:

1. They are rational and make choices to maximize their profits. Furthermore, they know how much of their product they will sell at each price. Once again, this assumption of complete information is not always applicable to markets.

2. There are a large number of firms and each of them is only a small part of the market. Each produces a homogenous good, that is each firm' product is indistinguishable.

These assumptions are even stronger than those made about demand. Many goods are provided by only a few suppliers. When there is just one, it is known as a *monopoly*. Likewise, there are very few markets where suppliers produce genuinely identical goods. This set of assumptions is thus presented as a baseline and microeconomics spends a great deal of time considering the implications of alternate assumptions.

3. Because they are each a small part of the market, they have no ability to affect the price and they are price takers, like households. If a firm tries to charge a price above the market price, they will lose all their business. If they charge a price below market, they will capture the entire market.

4. They are able to observe all market conditions (price, utility, costs, etc.)

Firms must, of course, pay production costs (labor, capital, etc.) to produce its product. Table 2 assumes a specific cost function.

Table 2: Cost of Soda

Units	Marginal Cost	Total Cost
1	\$20	\$20
2	\$30	\$50
3	\$40	\$90
4	\$50	\$140
5	\$60	\$200
6	\$70	\$270
7	\$80	\$350
8	\$90	\$440
9	\$100	\$540
10	\$110	\$650

As with utility, marginal, not total matters when solving a firm's problem.

Suppose that the market price is \$30. Firms will choose to produce a first unit because they are able to sell it for more than the \$20 it costs to produce it. The second unit costs just as much to produce, \$30, as it costs to produce. Firms are indifferent, lets assume that they produce when indifferent. So supply at \$30 is 2 units of soda.

Now suppose the price is \$50. Units 1-3 are all cheaper to produce than what they sell for and firms are indifferent as to producing the fourth unit. Supply is 4 units.

Note that supply is marginal cost in this model of perfect competition.

This supply curve is upward sloping because we assumed that marginal cost is increasing. This is usually, but not always, a good assumption. Suppose that a firm has a given amount of physical capital (*e.g.* machinery used in production). Perhaps it takes one worker, along with this capital, to produce one unit. Now suppose that the firm hires a second worker. The two workers must now share the capital, each has half has much to work with as when there was only one worker. They

will be less productive. The firm will therefore have to hire more than one additional worker to produce a second unit of output.

There are exceptions. There are industries where marginal cost is decreasing or constant. Upward sloping supply curves are therefore not universal. They are an assumption that fits most, but not all, real world markets. We will leave discussion of downward sloping supply curves (and upward sloping demand curves) for a microeconomics class.

Equilibrium

We now introduce the concept of an economic equilibrium. This is a stable point where agents (firms and households) have no incentive to change their behavior. Here, this occurs where supply equals demand, on the graph where the two curve cross.

We have thus solved for the equilibrium quantity and price of soda. The quantity is 5 units and the price is $60.

Here we have solved the model using graphs. There is a set of *exogenous* factors, those that are determined outside the model. This includes the demand and supply curves. Put another way, we are not saying anything about why demand is what it is, or why costs are what they are. They are taken as given. This is in contrast to *endogenous* variables, which are those that are solved for by the model. Here, they include price and quantity. Solving the model means taking the exogenous factors and figuring out what the endogenous variables equal.

Using the Model

Having solved the model, we can now make predictions. Let's start by assuming that something happens that causes households to demand more soda at any price. Instead of demanding 4 units of soda at $50, perhaps they now demand 6 unit. We can show this on a graph as a demand curving shifting upward.

Graph: Supply and Demand

Now, the equilibrium quantity has increased, as has the equilibrium price. An increase in demand has these effects when demand is downward sloping and supply is upward sloping. There are several factors that might cause such an increase in demand:

1. It could be the result of changing tastes. Suppose that some new health benefit of soda was discovered. People would then demand more of it.

2. Two goods are compliments if the use of one increases the utility that one obtains from the other. Suppose that the quantity of pizza increased. This would increase the marginal utility of soda because the two are compliments. Demand for soda would increase.

3. Two goods are substitutes if the use of one decreases the utility that one obtains from the other. Suppose that the quantity of beer decreased. People would wish to substitute toward soda, increasing its demand.

4. Suppose that incomes increase. For some goods, such as sports cars, we would expect demand to increase. We call these *normal goods*, and they include most luxury good and many other goods and services For other goods, such as Ramen Noodles and Natural Light Beer, demand typically decreases as incomes rise. We call these *inferior goods*. I have no idea which type soda is.

The previous examples discuss an increase in demand. What about supply? The language here confuses many students. Because the supply curve is in the same place, we do not say that supply has changed. We have, however, moved along the same demand curve. This is refereed to as a "change in the quantity supplied" rather than a change in supply itself.

The model is also symmetric. If soda is instead found to have previously unknown links to serious illnesses, then demand will decrease, as will the equilibrium price and quantity.

Change in Supply

Now suppose that it becomes less expensive for a firm to supply soda. If the marginal cost of producing any amount of soda is less, then the supply curve moves down (also to the right). Here the equilibrium quantity increases, but the equilibrium price decreases.

Graph: Supply and Demand

An increase in supply comes from a reduction in marginal cost. There are multiple potential causes.

1. The price of an input may have declined. Perhaps the wages that firms pay to labor has decreased, or the rental rate of capital or land have declined, or energy prices may have declined. Or, sugar, an input to soda, could have become cheaper.

2. Something could have happened that allows firms to use fewer inputs in order to produce output. This often take the form of a technological innovation.

An Example

Consider the market for sweatpants. Suppose that, at the same time, fabric prices decline and the average household's income increases. What happens?

Graph: Supply and Demand

In this previous example, there is an increase in supply and an increase in demand if sweatpants are a normal good. If this is the case, quantity increases, but the effect on price may be positive, zero, or negative. We cannot say for sure, the answer is ambiguous, we need more information. Theoretical models yield ambiguous result all the time, it isn't a bad thing. I have found that students desperately want to say that the effect on price is zero, but there is no reason to think the effect of increased supply on price perfectly offsets that of increased demand.

If sweatpants are an inferior good, however, then demand decreases. Now price falls for sure and the effect on quantity is ambiguous.

It does not seem obvious whether sweatpants are an inferior or normal good. This is a case where we may turn to the data, in the form of empirical microeconomics, to estimate the effect of

income on sweatpants demand. Empirical work is a good way of addressing theoretical ambiguity.