Preface

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A. Chapter 3

This chapter is about optimization: doing the best you can, from the main book of the course ‘Principles of Economics and Business’. We will look at how we can choose the best feasible option by using an analysis named the cost-benefit analysis.

Two Kinds of Optimization: a Matter of Focus

The first principle of economics is that according to economists, people tend to make most of their choices by selecting the best feasible option. That is, people tend to optimize. It is assumed by economists that people don’t *always* successfully optimize, but they do try. Thus one could say that people aren’t *perfect* optimizers because this would be quite complex.

We will now look at an example that will be used throughout the chapter. Consider that you have to choose an apartment. There are large cities and a great amount of rental apartments, and all apartments have their own characteristics that need to be taken into account, like location and views. Trade-offs are important in this situation and how one can optimally evaluate suck trade-offs will be discussed.

There are two techniques of cost-benefit analysis that can be used for optimization.

1. **Optimization in levels**: This analysis is based on the *total* net benefit of different alternatives. The best alternative will be chosen;
2. **Optimization in differences**: This analysis is based on the *change* in net benefits in the case one switches from one alternative to the other. The marginal comparisons are used in order to choose the best alternative.

Regardless of which technique is being used, the outcome should be the same. Suppose we have two slightly different bags full of Halloween candy (only one candy differs in the second bag from the first bag). According to the optimization in levels technique, we should choose the bag that offers us the greatest total enjoyment (the best benefit). We analysed both bags in isolation. Now we look at optimization in differences. We can take the two bags of candy and reorder the candy. Since all the candy in the bags is the same except for one candy, it is straightforward that we take a look at those two candy bars. You will choose the bag that has the one that gives you the highest value of the two candy bars. Here we made our choice on the basis of differences between the two bags. This second technique is often faster and easier to use.

Do people really optimize?
Previous research showed that optimization is a good model of economic behavior in most situations, but not in all. **Behavioural economics** identifies the economic and psychological factors that explain human behaviour, so this identifies certain situations in which people fail to optimize.

People tend to fail when they have self-control problems or when they have to carry out a new task. On the other hand, people tend to perform well on optimization when they have a lot of experience.

Optimization in Levels

We return to the example about renting an apartment. We will omit factors like how long it takes to walk to the neighbours or whether there is a park nearby for simplicity reasons. However, in practice they *are* important. We also assume the benefits of each apartment are the same, which makes it easier to compute a cost-benefit analysis as we only have to look for the alternative with the lowest cost.

The search for an apartment has been narrowed to four apartments:

Apartment	Commuting time (hours per month)	Rent ($ per month)
Very close	5 hours	$1,180
Close	10 hours	$1,090
Far	15 hours	$1,030
Very far	20 hours	$1,000

Now we need to sum up the costs for every apartment to find which one is the best to rent. The total cost consists of the *direct* costs of rent and the *indirect* cost of commute time. The commuting time and the rent has to be in a common unit of account, for example in dollars per month. The rent is already given in dollars per month so we only need to convert commuting time.

We assume the opportunity cost of commuting time is equal to $10 per hour. **Opportunity costs** refer to a benefit that a person could have received, but gave up, to take another course of action. In this case, the time spent on commuting cannot be spent on an alternative activity. Suppose the total commute takes 20 hours every month and the opportunity cost of time is still $10 per hour. The dollar cost of that commute can then be calculated as follows:

$$\left(\frac{20\ hours}{month}\right)\left(\frac{\$10}{hour}\right) = \left(\frac{\$200}{month}\right)$$

We can now compute the commuting time for the four apartments by using the same calculations as above but then with different hours per month of commuting time.

Apartment	Commuting time (hours per month)	Commuting cost ($ per month)	Rent ($ per month)	Total cost: Rent + commuting ($ per month)
Very close	5 hours	$50	$1,180	$1,230
Close	10 hours	$100	$1,090	$1,190
Far	*15 hours*	*$150*	*$1,030*	*$1,180*
Very far	20 hours	$200	$1,000	$1,200

The 'total cost' column can be calculated by adding together the commuting cost per month and the rent per month. Apartment 'Far' seems to be the best choice as this apartment has the lowest total cost. This best feasible choice between apartments is the **optimum**, in other words, it is the best optimal choice.

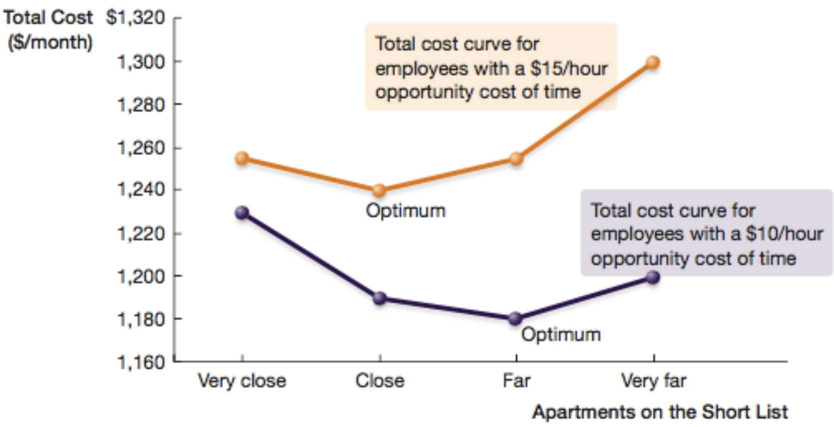
So far, optimization in levels involves taking three steps:
1. Translate all costs and benefits into common units, like dollars per month;
2. Calculate the *total* net benefit of each alternative;
3. Pick the alternative with the highest net benefit.

Comparative statics
Economic models predict how the choices of people change when something in the environment changes. **Comparative statics** is the comparison of economics outcomes before and after some economic variable is changed. We will now conduct a comparative statics analysis for our apartment example, as we want to see what happened when the opportunity cost of time is changed.

Suppose the opportunity cost of time is now $15 per hour instead of $10 per hour. This amount can rise when one's hourly wage would rise, for example. We make the same calculations as in the previous table, but now we use $15 opportunity cost per hour.

Apartment	Commuting time (hours per month)	Commuting cost ($ per month)	Rent ($ per month)	Total cost: Rent + commuting ($ per month)
Very close	5 hours	$75	$1,180	$1,255
Close	*10 hours*	*$150*	*$1,090*	*$1,240*
Far	15 hours	$225	$1,030	$1,255
Very far	20 hours	$300	$1,000	$1,300

Apartment 'Close' is now the best choice. This makes sense because when the opportunity cost of time increases, it becomes more valuable for the commuter to choose an apartment that reduces the amount of time spent commuting, thus the apartment that is closest to his\her job in the city center.



Source: Chapter 3, figure 3.6, p. 81

The purple line in the figure above represents the total cost curve for the commuter with an opportunity cost of $10 per hour and the orange line for an opportunity cost of $15 per hour. There are two important properties visible in the figure:

1. The total cost curve with opportunity cost of $10 per hour lies below the total cost curve of $15 per hour, for every apartment;
2. The optimal apartment switches from 'Far' to 'Close' as the opportunity cost of time rises from $10 per hour to $15 per hour.

Optimization in Differences: Marginal Analysis

Optimization in differences breaks an optimization problem down by looking at how costs and benefits change when one moves hypothetically from one alternative to the other.

Economists use the word *marginal* to point out differences between alternatives. This difference usually represents one 'step' or 'unit' more. A **marginal analysis** is a cost-benefit calculation that focuses on the difference between a feasible alternative and the next feasible alternative. The costs and benefits are compared. Using marginal analysis will never change the final outcome of which (in our example) apartment is best, but it does change the way we think about optimizing in comparison to optimization in levels where we compared apartment by looking at the *total* costs.

Marginal cost
We assume once again that the opportunity cost if time is $10 per hour and we will focus on what will change as we hypothetically 'move' from one apartment to another. The commuting cost in the table below is calculated the same way as before. The 'Marginal commuting cost' column shows that value of the extra monthly commuting that is created when one moves from one apartment to another further away from the cite center.

For 'Close', the marginal commuting cost can be calculated by \$200 – \$150 = \$50 and the marginal rent cost can be calculated by \$1,000 – \$1,030 = –\$30.

Apartment	Commuting cost	Marginal commuting cost	Rent cost	Marginal rent cost	Total cost	Marginal total cost
Very close	\$50		\$1,180		\$1,230	
		\$50		–\$90		–\$40
Close	\$100		\$1,090		\$1,190	
		\$50		–\$60		–\$10
Far	\$150		\$1,030		\$1,180	
		\$50		–\$30		\$20
Very far	\$200		\$1,000		\$1,200	

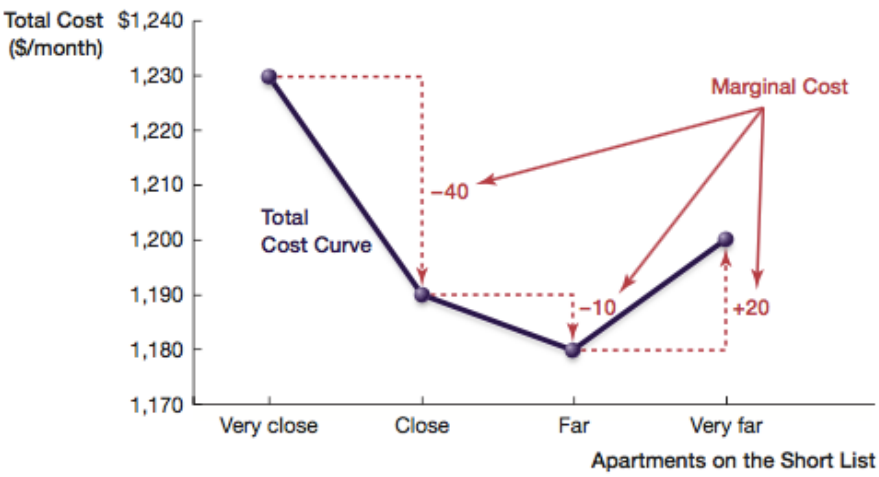
In general, the **marginal cost** is the extra cost that is generated by moving from one feasible alternative to another feasible alternative.

The marginal total cost is calculated by \$50 – \$90 = –\$40, when we look at 'Very close'. There are two methods to get to the value of –\$40, which will always give the exact same results:

$$Marginal\ commuting\ cost + marginal\ rent\ cost = \$50 + -\$90 = -\$40$$
$$Total\ cost\ of\ Close - total\ cost\ of\ Very\ close = \$1{,}190 - \$1{,}230 = -\$40$$

We can use the last column in the table above for optimization. The first move, when we move from 'Very close' to 'Close', has a marginal cost of –\$40 per month. This move is thus reducing costs, so it is worth taking it. The second move has a marginal cost of –\$10 which is thus also worth taking. The move from 'Far' to 'Very far' gives us \$20 extra costs so we will not be taking this step. We can therefore conclude that 'Far' is the optimum, the best feasible choice.

This example illustrates the **principle of optimization at the margin**, which states that an *optimal* feasible alternative has the property that moving to another alternative makes you better off and moving away to another alternative makes you worse off. The graph below shows the total costs and the marginal costs for every apartment. Optimization can be found at the lowest point in the graph (thus 'Far'), representing the lowest total cost.



Source: Chapter 3, figure 3.8, p. 84

To sum up, there are three steps that need to be taken for optimization in differences (also knows as optimization at the margin):

1. Translate all the costs and benefits into common units, like dollars per month (the same as in optimization in levels);
2. Calculate the marginal consequences when you move from one alternative to another;
3. Apply the principle of optimization at the margin by choosing the best alternative with the property that moving to it makes you better off and moving away from it makes you worse off.

B. Chapter 4

This chapter is about demand, supply, and equilibrium, from the main book of the course 'Principles of Economics and Business'. In this chapter we are looking at how buyers and sellers respond when the price of goods and services changes. In particular, we are looking at the gas stations as our leading example.

Markets

A **market** is a group of economic agents who are trading a good or service, and the rules and arrangements for trading. A market can have a specific location but this is not necessary. When we look at the dispersed market for gasoline, we see that there is a gas station on every corner.

We will see how markets use prices to allocate goods and services. Prices act as a device that selects the sellers who can produce goods at the lowest costs and the buyers who have a particular value to the goods.

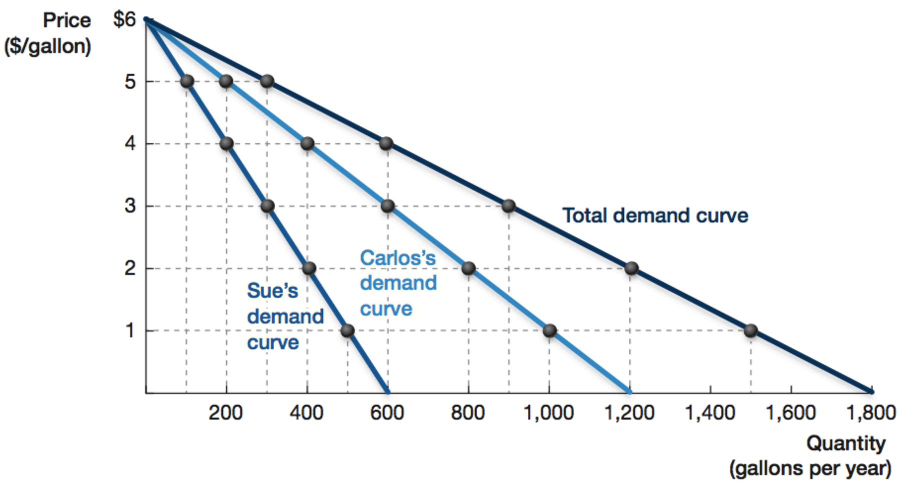
Competitive markets
When all sellers and buyers deal with the same price, this price is known as the **market price**. The features of a **perfectly competitive market** are the following:

1. All sellers sell an identical good or service;
2. Any individual buyer or seller does not have enough power individually to affect the market price.

We can thus say that in a perfectly competitive market, everyone accepts the market price and no one can bargain to get a better price. These kind of markets are very rare, if they even exist. Many markets are nearly perfectly competitive though (like the markets for gasoline), which is why they are very interesting.

How do Buyers behave?

We make the assumption that buyers are price-takers. This means that they take the price of a product or service as a given and treats it as a take-it-or-leave-it offer. The **quantity demanded** is the amount of a good that buyers are willing to purchase at a given price. When we look at the gasoline market, we might expect that consumers will buy less gasoline when the price for gasoline increases. The table underneath represents the quantity Sue and Carlos demand at different prices for gasoline, holding all else equal. This table is called a **demand schedule**. '**Holding all else equal**' implies that everything else in the economy is held constant, except for the price of gasoline.



Source: Chapter 4, figure 4.2, p. 98

Demand curves
When we plot a demand schedule, we create a **demand curve**. In other words, the demand curve plots the demand schedule. Notice what the x-axis and the y-axis represent: the quantity and the price respectively, like how it is most often represented. The price and the quantity of gasoline are **negatively related**, which means that these two variables are moving in opposite direction. When one goes up, the other goes down, and vice versa. We often see that demand curves have a negative relationship: quantity demanded rises when the price falls. This is called the **Law of Demand**.

Willingness to pay
Willingness to pay is the highest price that a buyer is willing to pay for an extra unit of a good, in this case, a gallon of gasoline. One extra gallon of gasoline can also be called a marginal gallon. When we look at figure 4.2, Sue is willing to pay $2 for her 400th gallon of gasoline. Since the demand functions are downward sloping, the more gasoline someone has, the less this person is willing to pay for an extra gallon of gasoline. This is called **diminishing marginal benefit**: as one consumes more of a good, their willingness to pay for an additional unit declines.

From individual demand curves to aggregated demand curves
To obtain the worldwide demand for gasoline, all the individual demand curves need to be added together. The process of adding these demand curves together is called the **aggregation** of individual demand curves. When we take another look at figure 4.2, we see that at a price of $4, Sue has a quantity demanded of 200 gallons per year and Carlos 400 gallons per year. Together, this adds up to 600 (as can be seen at the 'total demand curve'). Remember that we are putting the quantities together, not the prices.

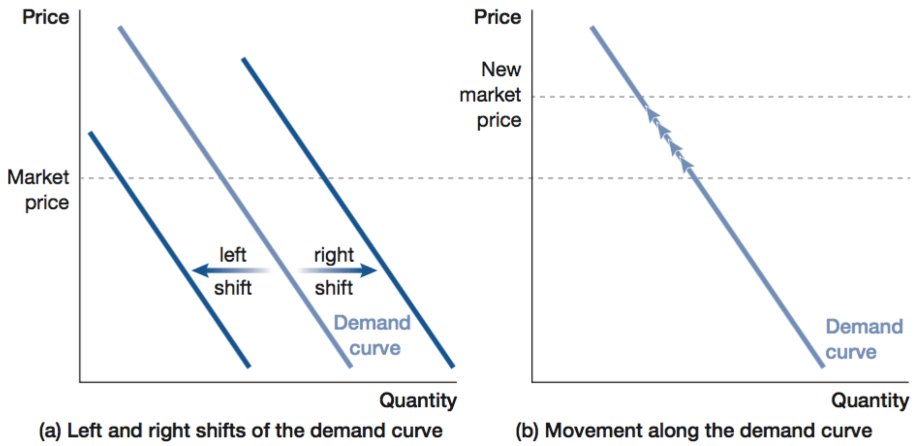
Building the market demand curve
Economists call the total demand curve the **market demand curve**, which is the sum of the individual demand curves of all the potential buyers and it plots the relationship between the total quantity demanded and the market price, holding all else equal.

Shifting the demand curve
There are a couple of things that influences the demand curve:
1. Tastes and preferences;
2. Income and wealth;
3. Availability and prices of related goods;
4. Number and scale of buyers;
5. Buyers' beliefs about the future.

When one of these factors change, the demand curve shifts.

1. When someone's preference changes, for example global warming becomes really important to you, your willingness to buy gasoline declines. This results in a left shift in the demand curve because a lower quantity is demanded by the same prices as before. We can see this in figure 4.4 on the next page. Someone's taste can also change. Imagine that you start dating someone who lives in another town and the most convenient way of traveling is by car. This increases your transportation needs and the demand curve will shift to the right.

Important to remember:
- The **demand curve shifts** only when the quantity demanded changes at a given price level (figure 4.4 panel a);
- If the price of a good changes and its demand curve has not shifted, a **movement along the demand curve** will be the result (figure 4.4 panel b).



Source: Chapter 4, figure 4.4, p. 100

2. When someone gets a higher salary, he or she will be able to buy more/more expensive goods, resulting in a higher willingness to buy gasoline for example. When we talk about a **normal good**, an increase in income will cause the demand curve to shift to the right. But consider a product like Spam, which is canned, precooked meat. When one's income rises, they will buy less of these products. This is called an **inferior good**, as rising incomes shifts the demand curve to the left.

3. When a city decides to lower the price of public transportation, there might be more people using public transportation instead of their own cars. This results in a shift to the left in the demand curve for gasoline. Public transportation and gasoline are **substitutes**, the fall in the price of one leads to a left shift in the demand curve of the other. On the other hand, imagine lift ticket prices in a ski resort decreases. This leads to more visitors and to a higher demand curve for gas. These goods are **complements**, the fall in the price of one leads to a right shift in the demand curve for the other.

4. The demand curve shifts to the right when the total number of buyers increases, and the opposite happens when the number of buyers decreases.

5. Imagine that your neighbours are losing their jobs at the beginning of an economy-wide slowdown. This might cause others to get worried and start to cut their spending back. This results in a left shift of the demand curve for gasoline.

How do Sellers behave?

Quantity supplied is the amount of a good or service that sellers are willing to sell at a given price. When the price of gasoline increases, suppliers increase their willingness to supply gasoline as they can make a bigger profit.

Supply curves
A **supply curve** is a table that reports the quantity supplied at different prices, holding all else equal. An example of a supply curve is given in figure 4.7 on the next page. In contradiction to demand curves, are supply curves upward sloping. The price of gasoline and the quantity supplied are **positively related** because the two variables move in the same direction. The quantity supplied and the prices are almost always positively related, which is called the **Law of Supply**.

Chevron's Supply Schedule

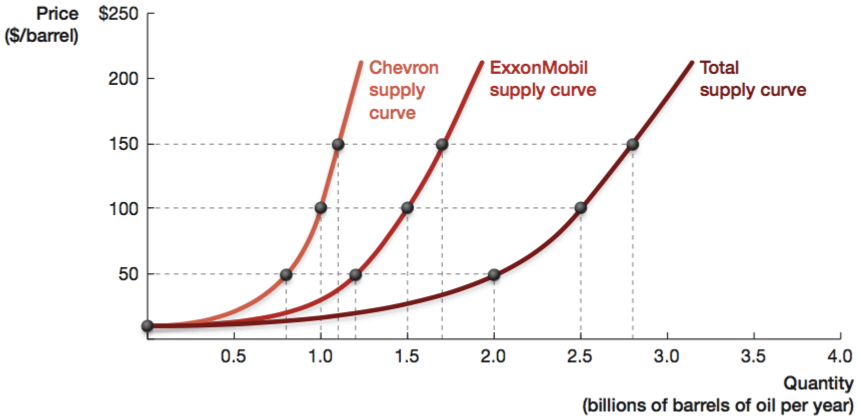
Price ($/barrel)	Quantity supplied (billions of barrels of oil per year)
$10	0.0
50	0.8
100	1.0
150	1.1

ExxonMobil's Supply Schedule

Price ($/barrel)	Quantity supplied (billions of barrels of oil per year)
$10	0.0
50	1.2
100	1.5
150	1.7

Total Supply Schedule

Price ($/barrel)	Quantity supplied (billions of barrels of oil per year)
$10	0.0
50	2.0
100	2.5
150	2.8



Source: Chapter 4, figure 4.7, p. 103

Willingness to accept
When we look at figure 4.7, we see that ExxonMobil's is willing to accept $100 to produce its 1.5 billionth barrel of oil. This is exactly what the supply curve tells us, which is called the **willingness to accept**. It is the lowest price that a seller is willing to get paid to sell an extra unit of a good. Willingness to accept is the same as the marginal cost of production.

From the individual supply curve to the market supply curve
This works the same as we did when we added up the quantity demanded. When we add up the quantity supplied, we create the **market supply curve**. This is the sum of the individual supply curves of all the potential sellers. It plots the relationship between the total quantity supplied and the market price, holding all else equal.

At a price of $100, the quantity supplied by Chevron is 1 billion barrels and the quantity supplied by ExxonMobil is 1.5 billion barrels. Together they add up to 2.5 billion barrels, which can be seen when we look at the total supply curve if we have a price of $100.

Shifting the supply curve
There are four major variables that influence the supply curve:
1. Prices of inputs used to product the good;
2. Technology used to produce the good;
3. Number and scale of sellers;
4. Seller's beliefs about the future.

1. An **input** is a good or service used to produce another good or service. When the prices of inputs increase, some products might not be profitable to produce anymore. This results a shift to the left of the supply curve.

Again, important to remember:
- The **supply curve shifts** only when the quantity supplied changes at a given price;
- If a good's own price changes and its supply curve did not shift, a **movement along the supply curve** will be the result.

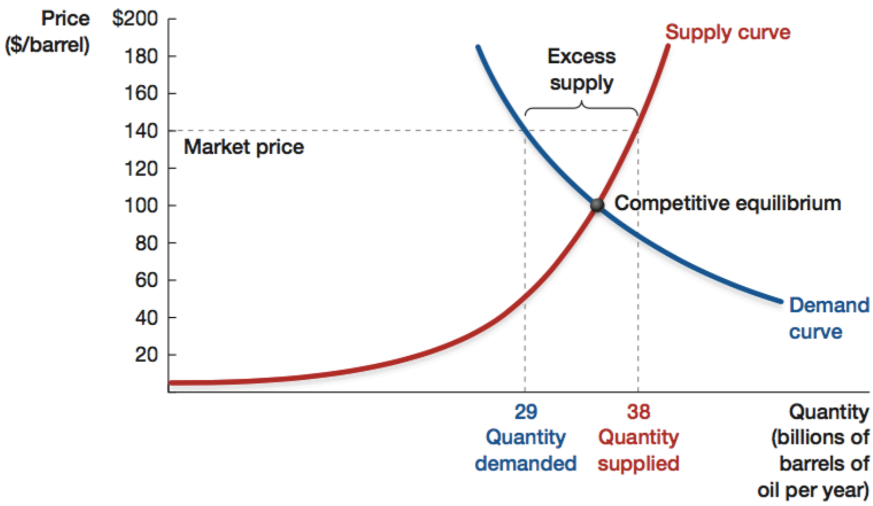
2. When an innovation causes the production of a good to be cheaper, the supply curve will shift to the right.

3. When there are less suppliers in a particular industry, the supply curve will shift to the left.

4. The demand for natural gas during winters is very high, as natural gas is used for home heating. Natural gas producers use much of their summer natural gas production as a supply for the winter. This creates a shift of the supply curve to the left in the summer.

Supply and Demand in Equilibrium

A competitive market is a market that is perfectly competitive. In these markets, a price will be formed right where the quantity supplied and quantity demanded are the same. To find this point, we need to put the demand curve and the supply curve in one graph.

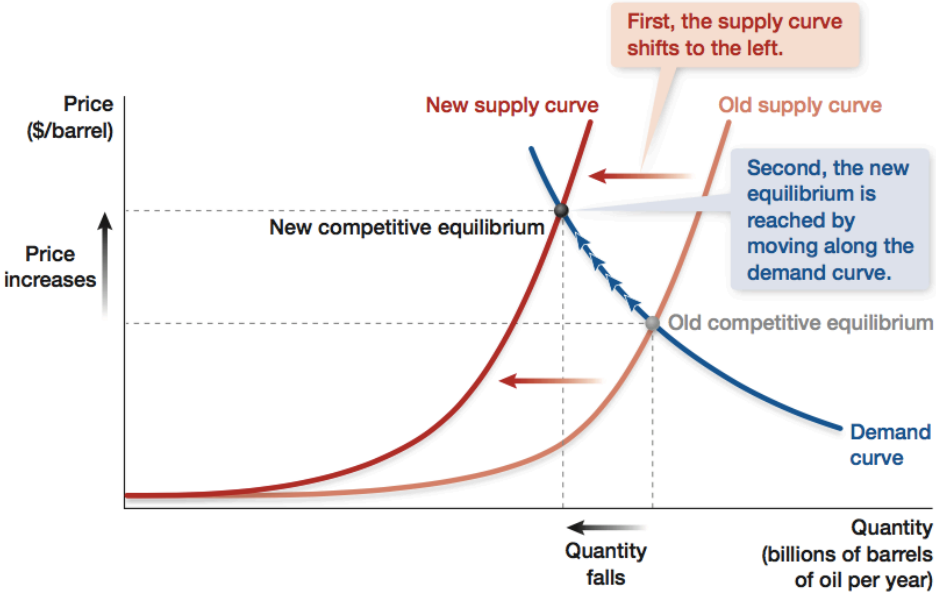


Source: Chapter 4, figure 4.11, p. 108

The **competitive equilibrium** is the crossing point of the supply curve and the demand curve. The **competitive equilibrium price** equates quantity supplied and quantity demanded, and amounts $100 in this example. The **competitive equilibrium quantity** is the quantity that corresponds to the competitive equilibrium price. In this case, this is at 35 billion barrels.

Figure 4.11 illustrates a market that is not in equilibrium because the price is at $140 instead of at $100. Since the market price is above the competitive equilibrium price, there is more quantity supplied than quantity demanded. So we have **excess supply** in this situation. When the price would be $60, we have the opposite situation: there is more quantity demanded than quantity supplied, creating **excess demand**.

Curve shifting in competitive equilibrium
Suppose a very big oil exporter suddenly stopped producing oil. This leads to a shift of the supply curve to the left (step 1), as can be seen in figure 4.13 on the next page. Oil has now become scarcer and as a result, the price of oil needs to increase (step 2). We can also see that the price has increased because the new intersection of the two curves lies at a higher price level and at a lower quantity level.



Source: Chapter 4, figure 4.13, p. 109

It might also be the case that both curves will shift, depending on the situation, creating a new equilibrium quantity and equilibrium price.

What would happen if the Government tried to Dictate the Price of Gasoline?

We have seen that in competitive markets, the outcome will be the competitive equilibrium, but only as long as prices are allowed to respond to situations. Laws, regulations or social norms, however, restrict some markets. In these cases, the price or quantity cannot take on every value.

For example, the US government had capped the price of gasoline during the oil crisis of 1973-74. This means that quantity demanded exceeded quantity supplied, creating excess demand. Long lines were created at gasoline stations and the stations frequently ran out of gasoline. Consumers tried to find a way beyond the rules to get more gasoline because, for example, they did not have enough to go to their work everyday.

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