# Microeconomics with Ethics

by Steven Suranovic (2022) – George Washington University

# Chapter 3

# A Pure Exchange Model of Trade

> *"This division of labour, from which so many advantages are derived, is not originally the effect of any human wisdom, which foresees and intends that general opulence to which it gives occasion. It is the necessary, though very slow and gradual consequence of a certain propensity in human nature which has in view no such extensive utility;* ***the propensity to truck, barter, and exchange*** *one thing for another." (Adam Smith – Wealth of Nations, 1776. Book I, Chapter 2 (emphasis mine))*

This is the opening passage by Adam Smith is his original description of the "invisible hand." The invisible hand is used to describe the natural workings of a market economy, for which there is no grand human design. No one person conceived of, or designed, economic or market activity. Instead it comes from a natural human propensity "to truck, barter and exchange one thing for another." Here "trucking" means to move an object from one location to another, in particular to the market. "Barter" means to discuss with another person how much of one item will be traded for another. "Exchange" means to give some amount of something one possesses to someone else and receive some amount of another item in trade.

Exchange is the most notable characteristic and the fundamental building block of an economy. On every single day and at every single moment, people are trading one thing for another. Most often the trade involves money being given to a merchant in exchange for merchandise. Sometimes though, trade involves exchanging one item for another item; this type of exchange is also referred to as barter. Sometimes trade involves a promise to do something in exchange for money. For example, a person may give money to a bank in exchange for a promise to return the money in the future, together with additional interest payments. Sometimes trade occurs between an individual and a business, sometimes between one business and another business, and sometimes between individuals, businesses, and governments.

Every trade that occurs is an economic event. Virtually every trade is bilateral, bringing two people together for an exchange. Almost all trades are voluntary, which means that if either party didn't want to make the exchange, he or she would have been able to refrain from trade. The purpose of this chapter is to demonstrate that when mutually voluntary exchanges take place, both parties to the trade become better off than they were before. Each trader is happier and has more well-being, or welfare, or satisfaction, or utility. Another way to say it is that each trade generates "surplus value," which is additional value above and beyond the value attainable before trade.

Perhaps a more memorable way to refer to the surplus value created by trade is to call them "happiness bursts." The size of each burst is different for each trader: sometimes they are large, sometimes small. But in all cases the happiness bursts occur.

The implication of this result is profound, especially because every day billions of bilateral trades occur around the world. That means that there are billions of happiness bursts of varying intensities being generated because of economic activity. The result also suggests that one way to increase the world's happiness is to expand the number of mutually voluntary trades. What follows is a more careful exposition of this basic and important result. Included are the assumptions needed to guarantee the outcome and an explanation for why those assumptions are almost invariably met.

## 3.1 A Pure Exchange Model: Preliminaries

### Learning Objective

1. Identify the key assumptions of a simple pure exchange model.

A pure exchange model is a very simple model that demonstrates several important features about trade between two individuals. It is called "pure exchange" because of the assumption that there is no production. Instead we assume there are two individuals, each with an initial endowment of some good. How they acquired the endowment is not considered in the model, thus we say the endowment is exogenous, which means its value is determined outside the model. We also assume that each person is the legitimate owner of his or her endowment.

Suppose the two individuals are named Smith and Jones. Suppose Smith has an endowment of 10 oranges and Jones is endowed with 10 apples. Imagine that all the oranges and apples are homogeneous, each apple and each orange being perceived by both individuals as having identical quality. We will suppose that Smith and Jones each has perfect information, or full knowledge of his own preferences for apples and oranges. By this we mean that each knows the intensity of his utility(happiness) from consuming every potential combination, or basket, of apples and oranges. For example, if Smith or Jones is asked to compare one basket, of, say 3 apples and 5 oranges with another basket of 6 apples and 2 oranges, he will always know which basket is preferable or whether he is indifferent between the two.

### Reality Check

Sometimes economists will say that we assume market participants have "perfect information." This means that the individuals know everything they need to know to make a wise decision. One element of perfect information is the knowledge about one's preferences over all the goods in the marketplace. In many instances this assumption is probably satisfied. For example, I have eaten oranges and apples for most of my life and I have a pretty good idea how much utility they provide. However, during a recent trip to Asia I was offered a variety of new fruits such as pomelo, mangosteen, and durian. Since I had never tasted these before, I had no way of knowing how much utility I would get by consuming them. (Although I had smelled the foul odor of durian from a distance, so I didn't expect to like it much. It turned out not to taste too bad. Just hold your nose!)

A similar story can be told about many items we see in the marketplace. Most items for sale in the grocery store we have never consumed before and hence have little idea how much we might like or dislike them. Indeed, this lack of knowledge about preferences is the reason many businesses offer free samples, or discounted services, to get customers to try their products.

Perfect information is a simplifying assumption that may apply in many familiar situations but is unlikely to be valid in many other realistic settings. If we assumed, more realistically, that Smith and Jones did not know their preferences perfectly for all potential combinations of apples and oranges, then the story of trade becomes much more complicated because Smith and Jones might respond to the uncertainty in different ways. To avoid these complications, simple models of trade assume perfect information about preferences.

**Key Takeaways**

1. A simple pure exchange model consists of two people endowed with two goods who meet together to trade.
2. This model assumes each type of good is homogeneous and that the individuals have perfect information about their preferences for the goods.

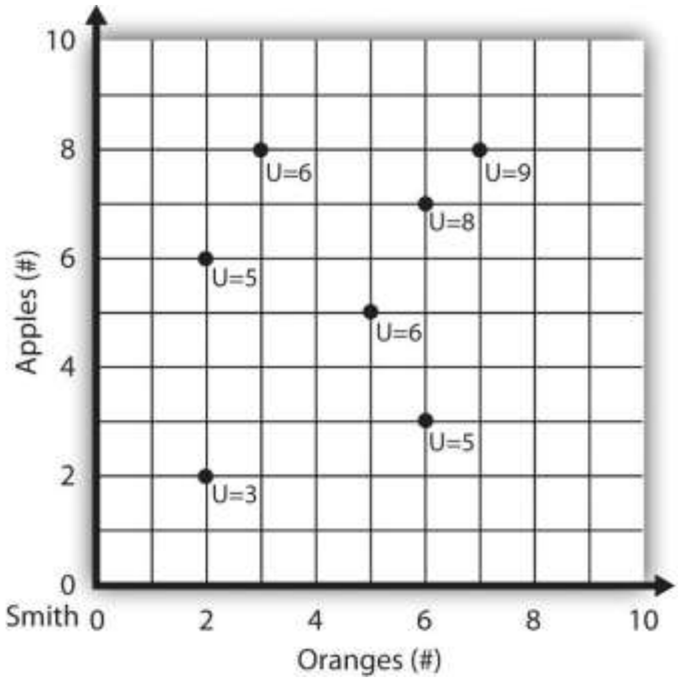
## 3.2 Indifference Curves

**Learning Objectives**

1. Identify the two main assumptions made about an individual's preferences.
2. Learn how to represent an individual's preferences using a set of indifference curves on a two-dimensional diagram.

We can graphically depict an individual's preferences for different baskets of goods by constructing indifference curves. Consider Figure 3.1 depicting all possible combinations of 10 apples and 10 oranges that an individual, like Smith, may consume.

*Figure 3.1 Consumption Bundle Utility Values*



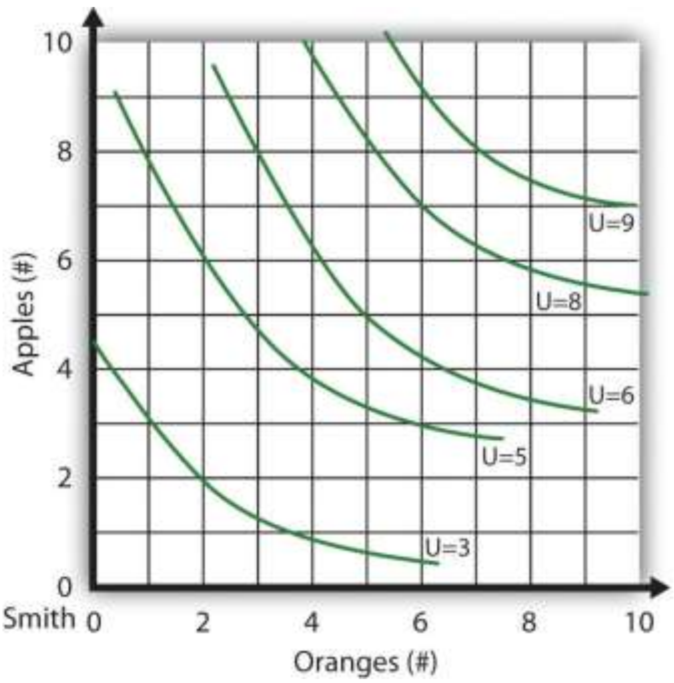

Imagine further that we can assign a number representing the utility value, or happiness level, that Smith attains by consuming each combination of apples and oranges. For example, as shown, suppose Smith gets 3 units of utility (U=3) when he consumes 2 oranges and 2 apples. Likewise, he gets 5 utility units with 6 oranges and 3 apples and with 2 oranges and 6 apples. Several other values are shown in Figure 3.1, but we imagine that every conceivable combination of oranges and apples has a utility value attached to it. Thus, at a point like 3 oranges and 7 apples, the utility value might be 5.5.

A useful way to represent the utility values Smith obtains with different combinations is by drawing indifference curves on the diagram. An indifference curve is a line drawn through all combinations of oranges and apples (points on the graph) that give the same utility value. Examples of indifference curves are provided in Figure 3.2.

Combinations of oranges and apples that lie on the same indifference curve would generate the same level of utility to Smith. Consequently, Smith would be indifferent in choosing between them and wouldn't care which bundle he got. For example, in Figure 3.2 Smith would be indifferent toward the following (orange, apple) combinations: (1,8), (2,6), (~4, ~4), and (6,3). We can also assign a number to each indifference curve representing the level of utility attained for any orange-apple combination on the curve, with larger numbers representing higher utility levels.

Indifference curves have the shape shown because of two basic assumptions. First, we assume an individual gets greater utility from having more of either good (i.e. "**More is Better**"). This is why the combination (6,7) has a higher utility number (U=8) than (5,5;U=6); more oranges and more apples makes Smith happier. This is also why the indifference curves are negatively sloped and why utility is higher on a curve to the northeast of another. (Note that indifference curves also allow us to compare bundles that have more of one good and less of another. Thus we know that for Smith, 3 oranges and 8 apples is preferred to 6 oranges and 3 apples because the first point lies on a higher indifference curve.)

*Figure 3.2 An Indifference Curve Map*

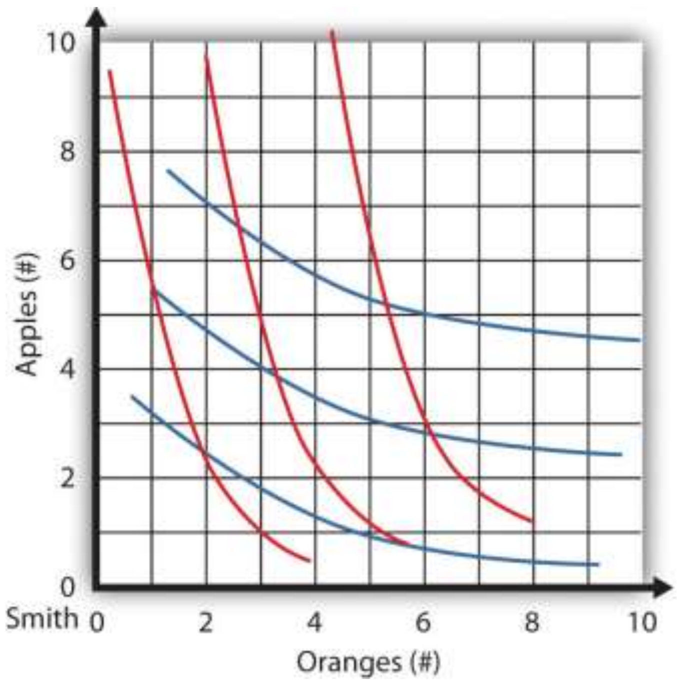



Second, we assume that consumption of each good exhibits **diminishing marginal utility**. That means that successive units of a good provide a smaller and smaller increment of added utility. For example, while the first unit in consumption might provide, say 10 units of utility, the second unit consumed might add only 8 more utility units, while the third unit consumed might add only 6 utility units. Diminishing marginal utility causes the indifference curves to curve inward toward the origin (i.e., the (0.0) point). (Mathematically we can say the indifference curves are concave functions, or convex with respect to the origin.

To illustrate diminishing marginal utility in the diagram, consider the indifference curve U=3. The bundle, 1 orange and 3 apples, is about equal in utility for Smith as the bundle of 2 oranges and 2 apples. Suppose Smith's bundle is adjusted from the first to the second. In this transition, in consuming one more orange, Smith gives up one apple and maintains the same utility. In other words, Smith's second orange can be said to be worth one apple to Smith. However, now suppose Smith wishes to consume one more orange, starting from the bundle (2,2). In this situation, he would need to give up less than one apple to reach the same level of utility. That means that for Smith, the second orange is worth one apple, but the third orange is worth less than one apple. This implies that orange consumption exhibits diminishing marginal utility for Smith.

In general, it is likely that different people have different preferences over the same two goods. For example, one person might love apples and dislike oranges. Another might love oranges but dislike apples. In Figure 3.3, we depict two different sets of indifference curves for two different people. (Note that one person's indifference curves can never cross or intersect with each other because it would imply that a person gets the same utility from a bundle that has more of both goods. This would violate the assumption that more is better.) One set is colored red, the other blue. Both sets are negatively sloped and bowed inward toward the origin, but the red set is steeper than the blue set. These shapes imply that the person with the red set of indifference curves has a stronger preference for oranges and weaker preference for apples compared to the person with the blue indifference curves. Steep indifference curves for the red person means she would have to give up a lot of apples in exchange for one orange to be left indifferent. In other words, one orange is equivalent to many apples and thus is valued more highly. The opposite is true for the blue person; adding apples one by one to the blue person will raise utility by more than adding oranges one by one.

*Figure 3.3 Two Sets of Indifference Curves Reflecting Different Preferences*




### Reality Check

One of the most important concerns of economics is the well-being of individuals as realized through the consumption of goods and services. It is rather curious though, that the well-being that is generated by consumption, what economists call utility, is something that we have no direct way to measure. There are no utility monitors that can be hooked up to a person to measure how much utility he or she attains by eating an ice cream cone, or by eating spaghetti at a restaurant. There aren't even any accepted units of measurement of utility. Utility has no weight, no length, and no voltage. When we do talk about utility units, economists often refer to them as "utils," which is nothing more than a fabricated measurement unit derived from the word itself.

It is curious, then, that one assumption economists make about individual consumers is that they have a well-known set of preferences that can be represented with a family of indifference curves. If we can't even measure utility, how can we assume that consumers know the utility value they would get from every combination of goods and services they might conceivably purchase? To some critics of economics, this is a serious flaw.

Economists have worried about this problem for a long time. Studies have shown, though, that assignment of a value for utility (what is called cardinal utility) is not needed to demonstrate many economic principles. Instead, we must merely assume that consumers can rank-order their bundles of goods and decide what is more preferred, less preferred, or equally preferred. This is called ordinal utility. Under this less stringent assumption we can still derive and use indifference curves.

However, even with the assumption that people can rank order baskets of goods, it still means that individuals know fully and completely how to compare every combination of goods they are potentially faced with. But perhaps this is too much to expect from people. Shouldn't we try to make more realistic assumptions?

A more complete answer is provided at the end of this section. However, the assumption we are making here is a simplification that helps us to formalize the analysis and work with the issue mathematically and graphically. With these simplifying assumptions, we can display some important results in a simple way. Afterward, we'll reflect on how important the assumptions are to the results.

### Key Takeaways

1. The utility achieved is identical for every combination of goods along any one indifference curve.
2. An indifference curve is a line connecting all bundles of goods that generate the same level of utility for a person.
3. The standard assumptions about preferences are (a) that more goods are better than fewer, and (b) that consumption exhibits diminishing marginal utility.
4. Indifference curves are negatively sloped curves and convex to the origin under the standard assumptions about individual preferences.
5. Indifference curves that are in a "northeast" position have higher utility values compared to indifference curves that lie to the "southwest" (assuming the origin is in the lower left).
6. There is a unique indifference curve for every utility value.
7. Steeper indifference curves imply a stronger individual preference for the good on the horizontal axis compared to flatter indifference curves.

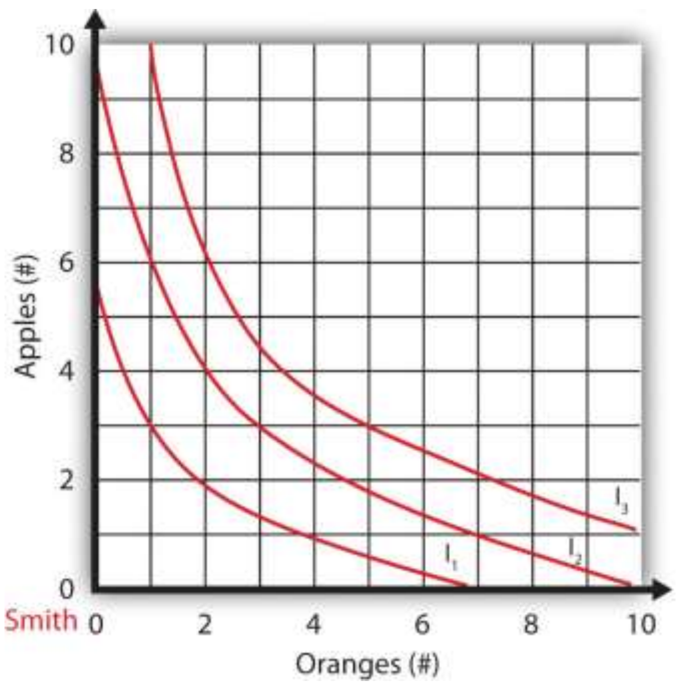
## 3.3 The Edgeworth Box

### Learning Objectives

1. Learn how to construct an Edgeworth box by superimposing the endowment points and the utility maps of two individual traders.
2. Learn how each point in an Edgeworth box diagram represents a potential allocation of oranges and apples between the two individuals.
3. Learn that trade from the endowment allocation to some points in the Edgeworth box would raise utility for both and thus motivate the individuals to trade.
4. Learn that a movement from the endowment allocation to some points in the Edgeworth box would not raise utility for both and could only be achieved involuntarily or by coercion.

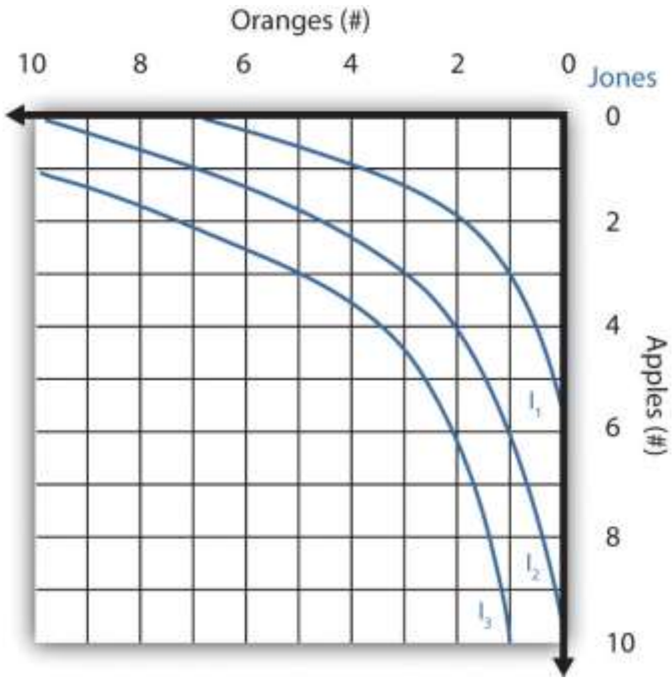
Imagine that Smith and Jones each with well-defined and known preferences over all combinations of oranges and apples, come together in a market to discuss the possibility of a trade. Imagine that Smith's preferences are represented in Figure 3.4. Three representative indifference curves are drawn. Note that the middle indifference curve, $I_2$, shows that he is indifferent between the bundle of 10 oranges and 0 apples and the bundle of 0 oranges and 10 apples. Note further that he has a strong desire for variety because he finds 3 oranges and 3 apples to be equally appealing to (10,0) and (0,10). Another way to see the intensely diminishing marginal utility is to note that beginning with 10 apples and 0 oranges, Smith is willing to give up 4 apples to acquire 1 orange, but to acquire the second orange, Smith is only willing to give up 2 apples.

*Figure 3.4 Smith's Indifference Map*




Suppose that Jones tends to look at everything upside down. (Perhaps he is a child of circus performers and does handstands all day long!) Let his preferences be depicted in Figure 3.5. With the upside-down diagram, the origin is in the upper right, and oranges increase to the left while apples increase downward. Notice that Jones has the same preferences as Smith; his indifference curves pass through the same points, relative to his origin, as Smith's indifference curves.

*Figure 3.5 Jones' Indifference Map*



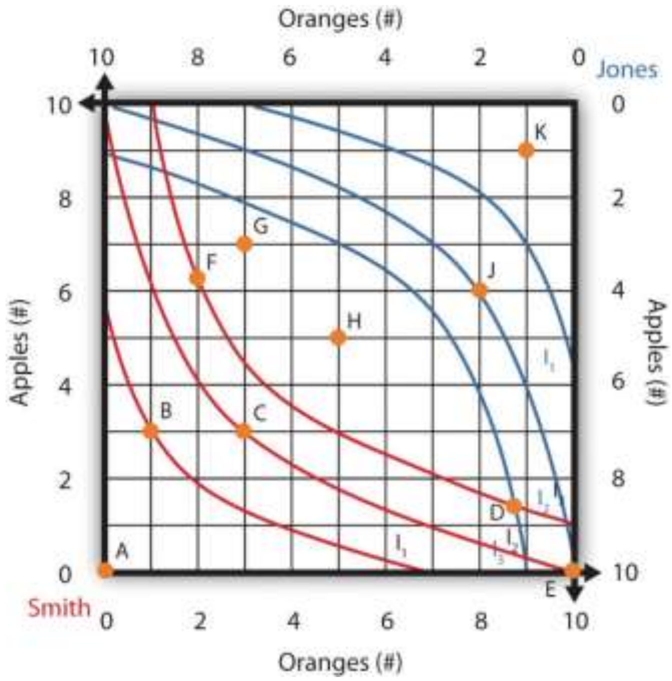

An Edgeworth box is formed by superimposing the endowment points of two individuals, as shown in Figure 3.6. We will assume there are 10 oranges and 10 apples available, and thus the Edgeworth box will have dimensions that are 10 x 10. It is used to show the benefits that can arise from voluntary exchange.

In Figure 3.6, we assume that Smith measures the goods from the traditional origin in the lower left-hand corner, but Jones stands on his head and measures the goods from his origin in the upper right-hand corner. For example, at point B in Figure 3.6, Smith would have 1 orange and 3 apples as measured from the usual origin. However, Jones measures from the upper-right origin and would have 9 oranges and 7 apples at point B.

The endowment of 10 oranges for Smith and 10 apples for Jones corresponds to point E in the lower right corner of Figure 3.6. Notice that point E is on both Smith's and Jones's middle indifference curve labeled $I_2$.

Suppose Smith and Jones meet together in a market and discuss the possibility of trade. With knowledge of their own preferences, they would quickly discover that there are many potential trades that would serve to increase utility for both of them. For example, if Smith were to give one orange to Jones in exchange for one apple, then they would move to point D in the Figure 3.6. At D, Smith is on a higher indifference curve, $I_3$, and Jones is on a higher indifference curve, $I_3$. Therefore both Smith and Jones are better off after trade than before trade. We can say trade is mutually advantageous or that there are gains from trade for both Smith and Jones.

*Figure 3.6 An Edgeworth Box with Smith and Jones*




Intuitively, the reason a one-for-one trade is beneficial for both Smith and Jones is because of diminishing marginal utility. Smith gets more utility from every additional apple and orange consumed, but he gets much more utility from his first orange than from his tenth orange consumed. The same is true for apples. Therefore, Smith is very happy to give away about one orange in trade to receive about one apple because the orange given away is his tenth (with low added value) but the apple received is his first (with high added value). The same is true for Jones. He is very happy to give away one apple in trade to receive one orange because the apple given away is his tenth (with low added value) but the orange received is his first (with high added value).

Notice that point D is not the only point that achieves mutual gains. In fact, both Smith and Jones could do much better. For example, consider Point H in Figure 3.6. At H, Smith would reach a higher indifference curve (not drawn) AND Jones would reach a higher indifference curve too (not drawn). Thus both would be better off than at either point D or point E.

Indeed trade that moves Smith and Jones from point E to any point that lies within the lens formed by the two indifference curves that pass through point E will generate gains from trade for them both. Points F and G are two additional labeled points that would satisfy the condition.

Many of the potential trades are not beneficial for both individuals though. For example, if Smith trades 9 oranges for 3 apples with Jones, then they would move to point B in Figure 3.6. Although B would put Jones on a higher indifference curve (not drawn), Smith would move to a lower indifference curve ($I_1$ vs. $I_2$). Since we assume Smith knows his preferences perfectly, he would never voluntarily trade to point B. Thus, since point B lies outside the lens formed by the two indifference curves that pass through point E, such a trade would not generate mutual benefits. The same can be said for trades to points A and K.

Note that a movement to point A could occur with one possible scenario. Suppose Jones pulls out a gun and demands that Smith hand over all of his oranges. Afterward Jones would have 10 oranges and 10 apples and Smith would have nothing. Such a “transaction” is more commonly referred to as theft, and theft, by definition, is never mutually voluntary.

## Key Takeaways

1. An Edgeworth box is constructed by superimposing the endowment points for two individuals drawn in the quantity space of two goods. One diagram must have the quantity origin in the lower left corner, while the other one is rotated with the origin in the upper right corner.
2. Each point in an Edgeworth box represents an allocation of the two goods between the two traders such that the sum of the apples and oranges between the two equals the total initial endowment of apples and oranges.
3. By drawing indifference curves through the endowment allocation in an Edgeworth box, one can identify the set of bundles of goods, formed by the lens between the two indifference curves, which if achieved via trade, will make both individuals better off.
4. Points in the Edgeworth box that are external to the lens formed by the two indifference curves drawn through the endowment allocation, if realized, would make one trader better off and the other worse off relative to the endowment and thus could only be achieved involuntarily or by coercion.

## 3.4 The Terms of Trade

### Learning Objectives

1. Learn the definition of the terms of trade in the cases where two goods are being traded.
2. Learn that the terms of trade can be represented and derived as the ratio of prices of the two goods being traded.

The terms of trade is defined as the amount of one good that trades for another. It is typically presented as a ratio between the two goods. Thus, in the Edgeworth box example, if Smith and Jones were to trade 5 apples for 5 oranges and move from point E to point H in the diagram, the terms of trade would be 5 apples for 5 oranges, or to simplify, 1 apple/orange. This also corresponds to the slope of the line between points E and H from the perspective of both Smith and Jones. (Note that one could also express the terms of trade as oranges/apple, in which case the value here would still be 1 orange/apple.) In contrast, if Smith were to exchange 8 oranges for 7 apples, then the terms of trade would be 7/8 = .875 apples/orange (or equivalently, 8/7 = 1.14 oranges/apple).

There is one additional relationship we will need later. The terms of trade measured as apples per orange also corresponds to the ratio of dollar prices between oranges and apples. In other words, we can write the terms of trade as $P_O/P_A$, where $P_O$ is the price of oranges measured as $/orange and $P_A$ is the price of apples measured as $/apple. Note that if we take the ratio of the units we get,

$$\frac{\frac{\$}{oranges}}{\frac{\$}{apples}} = \left(\frac{\$}{oranges}\right) x \left(\frac{apples}{\$}\right) = (\frac{apples}{orange})$$

In other words, $P_O/P_A$ has units of apple/orange, precisely as we have defined the terms of trade.

### Key Takeaways

1. The terms of trade is defined as the amount of apples that a person trades for an amount of oranges. It can be measured either as a quantity of apples per a quantity of oranges or as a quantity of oranges per a quantity of apples.
2. The term of trade between two goods is determined as the ratio of the prices of the two goods.

## 3.5 Evaluating the Gains from Trade

### Learning Objectives

1. Learn how every transaction everywhere creates surplus value, or happiness bursts.
2. Recognize that the distribution of the surplus value created out of voluntary trade can vary substantially across different potential trade outcomes.

The extra utility that Smith and Jones achieve after trade is sometimes referred to as surplus value. These gains arise because of trade and accrue to both parties in the trade. But don't lose sight that this "surplus" or these "gains" are real increases in happiness. Smith and Jones are both happier after trade than they were before. This is why I like to refer to the surplus value as extra "bursts of happiness." What's more, there is a simple way to convince ourselves that both Smith and Jones must achieve greater happiness via trade. Why? Because the trade is voluntary. If Smith or Jones thought they were getting a bad deal, if either one thought he would become worse off after trade, then he could just walk away and not trade. Voluntary participation in trade implies that both parties to the trade are made happier. Every trade must increase both individual and overall happiness.

A skeptic might say, "OK sure, this is all well and good, but how often do two people come together and trade apples for oranges?" Maybe it happens in a high school cafeteria occasionally but never anywhere else. Even if we extend this discussion to any exchange between two goods, barter such as this almost never occurs anymore.

However, this critique misses an important generalization. Gains from trade occur anytime mutually voluntary exchange occurs, no matter what the two traded items are. More common everyday trades involve the trade of money for goods or services. For example, suppose I have $20 in my wallet. One could say I am currently endowed with $20. Suppose I walk into a department store and see a shirt with a $20 price tag. We could say the store is currently endowed with a shirt. The price tag indicates that the store is willing to give me the shirt if I am willing to give the sales clerk $20. I am free to take that deal or leave it. If I take it, then it must be true that the shirt is currently more valuable to me than $20 in my wallet. Likewise, the store owners must believe that $20 in their cash register is more valuable than the shirt. After the exchange occurs, the store owners are happier and I am happier. There are happiness bursts all around.

But where did I get the $20? Suppose I earned the $20 in my current job. In that case I agreed to exchange my labor services (i.e. my time) to perform the tasks asked of me by my employer. In exchange, the employer agreed to pay me a wage. For me, a weekly paycheck giving me money is more valuable than my time spent working for the firm. If I don't think so, I am free to quit my job. Similarly, my labor services are more valuable to my employer than the money he holds in his bank account. After the exchange occurs, my employer is happier and I am happier. There are happiness bursts all around.

This process of voluntary exchange occurs every minute of every day in every city and town everywhere in the world. There may be billions or trillions of these occurring every day. And in every case, happiness bursts are created for both parties of the exchange. It is a simple truth then that if the average value of the happiness bursts in every transaction is fixed, then the greater the number of transactions that occur, the greater the overall surplus value that is generated. Quite simply, more trade means more happiness.

But what about the distribution of the happiness bursts? Is it true that both Smith and Jones benefit equally from trade? Here it depends on what sort of outcome arises. In Figure 3.6, if Smith and Jones trade from the endowment point E to point H, then it looks as though both will share about equally from the trade. However, even this seemingly simple conclusion could be wrong. The reason is that we do not have any knowledge about how Smith's and Jones's utilities compare with each other. Maybe by trading to point H, Smith gets 100 extra units of utility while Jones gets only 10 extra units. We can't know unless we could measure utility in some way that allows us to compare the intensity of happiness experienced by Smith and Jones.

Economists have long recognized and accepted that so-called interpersonal comparisons of utility simply cannot be made. This means that we can never be sure whether the distribution of the gains from trade was equal or unequal. Instead we can only know that voluntary trade led to some degree of improvement for both.

Nonetheless we can use Figure 3.6 to demonstrate that some mutually beneficial trades are preferred by the traders over others. For example, consider points F and G in the diagram. Since both points lie inside the lens formed by the indifference curves through point E, trade to either point would make Smith and Jones better off than at E. However, G is clearly preferred by Smith to F since it would give him about one extra orange and one extra apple. Likewise, Jones would prefer the reverse because trade to F would give him about one extra orange and apple.

In the best of circumstances, Jones would like it best if he could induce Smith to trade to point C. Trading to point C would leave Smith indifferent to his original endowment. If Jones could suggest such a trade to Smith and if Smith says, "sure, why not, it doesn't matter," then Jones would obtain all of the available surplus value and Smith would obtain none. Similarly, Smith would obtain all of the available surplus value if he could induce Jones to trade to point J.

Note also that the terms of trade between the endowment point E and point C is 3/7 apples/orange, whereas the terms of trade from E to J is 3 apples/orange. This terms of trade also represents the price of oranges over apples $P_O/P_A$. As noted above, Smith prefers trading to point J with $P_O/P_A$ = 3 than trading to point C with $P_O/P_A$= 3/7. In other words, Smith prefers the terms of trade with the higher price for oranges. This makes sense because Smith is a seller of oranges on the market, thus he profits more when the price of his item is higher.

A similar story can be told for Jones. Jones prefers trading to point C with a terms of trade given by $P_A/P_O$ = 7/3 oranges/ apple, than trading to point J with a terms of trade of $P_A/P_O$= 1/3 orange/apple. In other words, he profits more when the price of apples is higher in the market.

### Key Takeaways

1. More trade means more happiness.
2. Every voluntary transaction in the world generates extra happiness for both parties to the trade.
3. Billions of transactions occur every day around the world, and each one generates mutual happiness.
4. Some mutually beneficial trades can result in one trader becoming substantially more happy while the second trader is only slightly happier. The distribution of the surplus value depends on the terms of trade that are agreed to.

## 3.6 Achieving a Unique Solution

### Learning Objectives

1. Learn why the assumption that both traders maximize utility assures that the final trade allocation is unique.
2. Learn the equilibrium conditions that must be satisfied when both individuals are simultaneously maximizing utility.
3. Identify the set of Pareto optimal allocations in an Edgeworth box.
4. Identify the utility maximizing allocation in an Edgeworth box diagram.

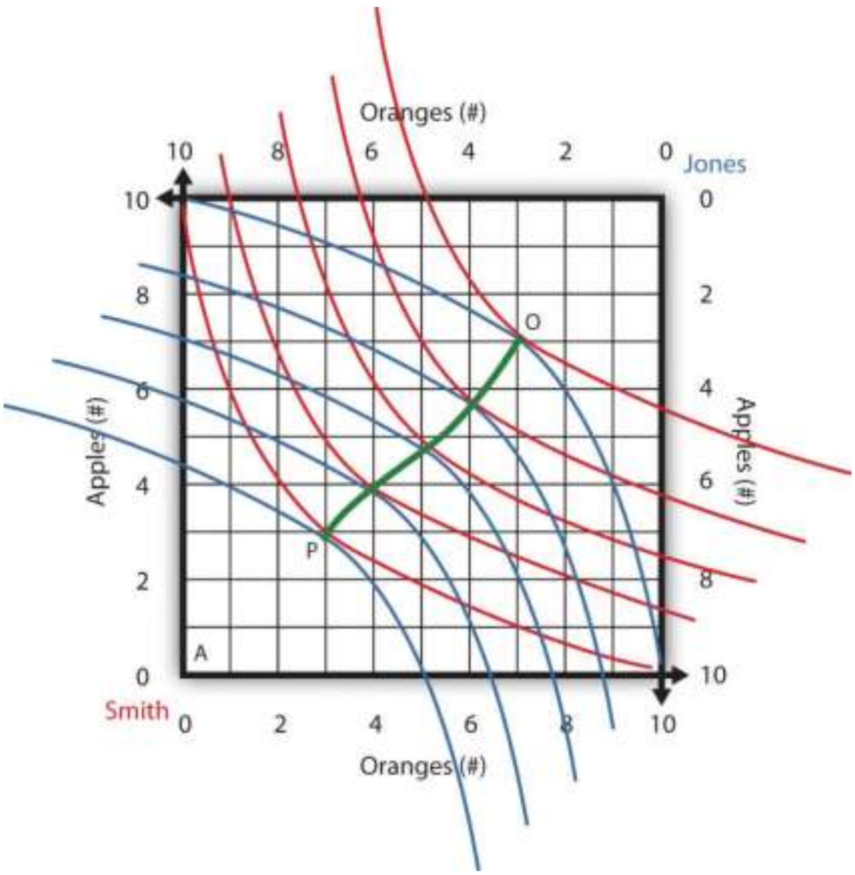
So far the analysis has demonstrated that there are numerous trades that could arise between Smith and Jones that would generate surplus value, or happiness bursts, for them both. But we might want to know precisely which trade pattern they are likely to pick. Indeed economists are often uncomfortable with multiple outcomes. Economists don't just want to know what could happen, they want to be able to predict what **will** happen.

We can guarantee a unique outcome by making one additional assumption. We assume that both Smith and Jones *maximize* their individual utility. One problem this immediately raises is the trade that is best for Smith will not be the same trade that is best for Jones. For example, in Figure 3.6, among the mutually advantageous trades, Smith will get close to his maximum utility if they trade to a point like J. This is the point in which Smith attains all of the surplus value. However, Jones would maximize his utility by trading to a point near C, in which he would receive all the surplus value. Clearly then, neither Smith nor Jones can be most happy simultaneously.

In order to narrow our search for the best trade for them both, we can define the set of Pareto optimum outcomes (named for the economist Wilfried Pareto). A Pareto optimum is any allocation of goods (i.e., any point in an Edgeworth box) for which it is impossible via additional trade to raise, and/or maintain, the utility of both individuals. If a trade away from a Pareto optimum point does raise, or maintain, one person's utility, then it must lower the utility of the other person. The original endowment point is an example of a non-Pareto optimum point, since by trading into the lens formed by their indifference curves, both Smith's and Jones's utility can be raised. We would say that starting from the endowment point E, a Pareto improvement is possible because there is a possible trade that can raise the utility of one person without lowering the utility of the other. This also implies that a Pareto optimum point must allow for no Pareto improvements and that no lens can be formed from the two traders' indifference curves.

A depiction of the set of points that satisfies this condition is shown as the line PO in Figure 3.7. The line PO is formed by the tangencies between the indifference curves of Smith and Jones inside the lens created by the indifference curve passing through the initial endowment point. Notice that at every point along PO, there is no way to move away from the line in any direction without lowering the utility of either Smith or Jones.

Figure 3.7 Mutually Beneficial Pareto Optimums




By assuming utility maximization, we have narrowed the trading choices for Smith and Jones from anything in the original lens to any Pareto optimal point along the line PO. However, we have still not determined a unique trading outcome. Which point along PO would Smith and Jones choose?

The unique point chosen that will maximize both Smith's and Jones's utility also depends on the terms of trade. In other words, it depends on how the prices relate to the traders' marginal utilities. When economists set this problem up as a formal mathematical exercise and then solve to determine the utility maximizing solution, an equilibrium condition is identified. (Derivation of this condition is covered in more advanced economics courses.) The equilibrium condition that must be fulfilled for each trader when maximizing utility is $MU_O/P_O = MU_A/P_A$, where $MU_O$ and $MU_A$ represent marginal utilities at the final goods allocation and $P_O$ and $P_A$ represent the dollar prices. When we form the ratio of these two, as with $MU_O/P_O$, it represents the additional utility received for one additional dollar spent on oranges (measured in utils/$). Similarly, $MU_A/P_A$ represents the additional utility received for one additional dollar spent on apples. When these two are equal to each other, it means that a person is indifferent between spending more on oranges or apples. It also implies the person is maximizing his utility given those particular prices.

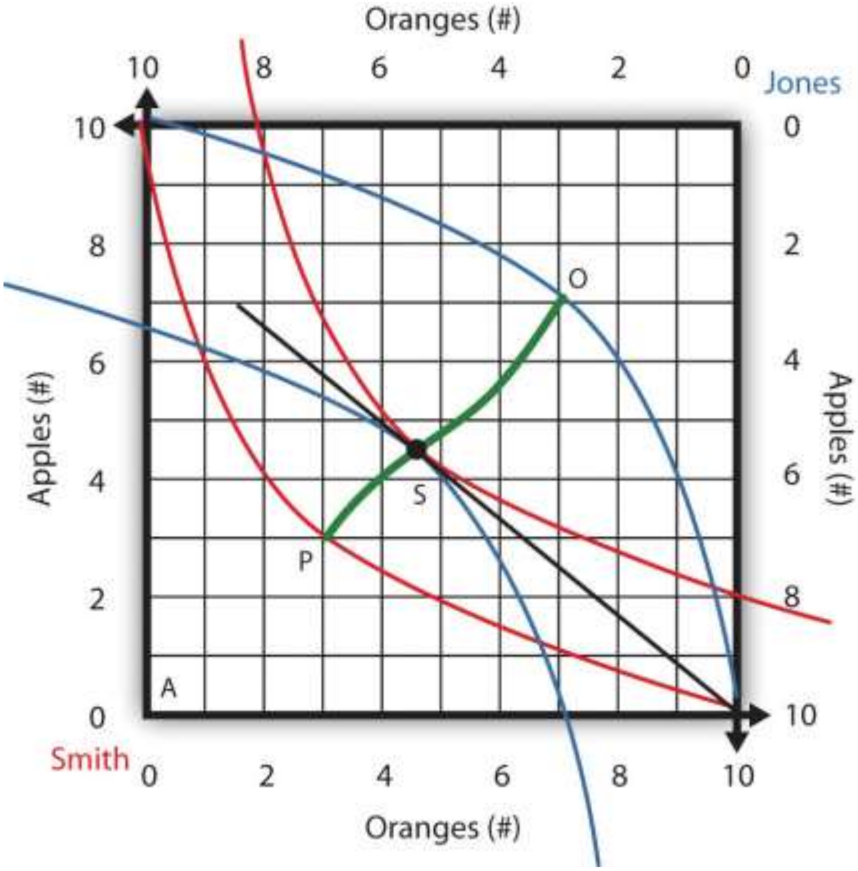
Rearranging and rewriting the expression yields the following:

$$\left(\frac{P_O}{P_A}\right) = \left(\frac{MU_O}{MU_A}\right)$$

The left-hand side of the expression was defined earlier as a terms of trade. It represents the amount of apples traded per orange and corresponds to the slope of the line drawn from the endowment point to the final allocation after trade. The right-hand side of the expression is the ratio of marginal utilities and is also known as the marginal rate of substitution (MRS). Without explaining the details (except to say that this is easily derived using basic calculus), the MRS corresponds to the slope of an individual's indifference curve at the consumption point that is finally chosen. Thus, the expression implies that when an individual is maximizing his utility, the terms of trade must equal the slope of his indifference curve. Since there are two traders and both are assumed to be maximizing utility, the condition must be true for both simultaneously. Under some additional assumptions about the nature of the trader's preferences (not to be discussed here), these conditions are satisfied only at one point.

The utility maximizing equilibrium point is shown at point S in Figure 3.8. To achieve the outcome at S from the original endowment point in which Smith has 10 oranges and Jones 10 apples, the two would have to trade about 5.5 oranges for about 4.5 apples. The terms of trade would be $P_O/P_A = 4.5/5.5 = .818$ apples per orange. At this price ratio, both Smith and Jones achieve maximum utility: point S is also a point within the set of Pareto optimum points. And finally, point S satisfies both Smith's and Jones's optimization conditions that $MU_O/P_O = MU_A/P_A$. Point S is also unique: it is the only point that satisfies all of these conditions.

Figure 3.8 A Unique Trade Equilibrium




So now economists can say that if Smith and Jones have well defined preferences, if utility rises at a diminishing rate with increases in consumption, if they know their preferences fully and completely, and if they both trade so as to maximize their individual utility, then we can predict precisely what prices will prevail for the apples relative to oranges (i.e., we will know the terms of trade) and we can predict the trade pattern and the final consumption bundles for the two traders.

Furthermore we will know that after trade occurs, both Smith and Jones will be happier than before trade. Trade will generate surplus value that will be shared between the two. Thus, trade is a happiness generator.

### Reality Check

Let's now reconsider the importance of the assumptions and the likelihood that they are satisfied in the real world. We have assumed that individuals have well-defined preferences, that utility rises at a diminishing rate with increases in consumption, that they know their preferences fully and completely, and they both trade so as to maximize their individual utility. The first assumption is about the nature and form of preferences (utility increases at a diminishing rate). The second assumption is about information (people have perfect information about their preferences). The third assumption is about behavior (individuals seek and achieve maximum utility).

To the critic, these assumptions may seem very strong. That utility rises at a decreasing rate is probably valid for most people and for most goods and services. Perfect information about one's preferences is probably true for commonly purchased items, but most consumers are often unaware and uninformed about a vast range of products available for sale in the marketplace. For example, student preferences for fast food meals and sports drinks are probably well known because students have purchased many of these products.

Therefore, they know their likes and dislikes and how much they are willing to pay for various products. However, student preferences over home mortgages or life insurance policies is probably imperfect because most students have not purchased these services. On the other hand, the advent of the Internet does mean that information about new products can be obtained relatively quickly, so quite possibly, people can be assumed to have better information available now compared to the pre-Internet era.

Finally, with respect to utility maximization, it seems unlikely that individuals know enough about all of the potential trade outcomes and what one's own utility will be at each of those combinations to guarantee that one will maximize utility. Perhaps with products one purchases frequently, a person gets close to maximum utility. Or alternatively, we might say that with respect to the products one has good information about, a person may get close to maximum utility. However, with respect to all goods a person might purchase, lack of information probably means that many people come up short in their attempts to maximize utility.

This lack of information both about product availability and one's own preferences is the reason there are academic fields in business schools covering advertising and marketing. Businesses advertise both to inform consumers about their products and to change the preferences of individuals in favor of their products over competitors. If consumers really did know their preferences perfectly and if those preferences were unchangeable, then there would be little need for advertising or marketing.

Finally, if the assumptions we make are not valid in the real world with real individuals, then how valid are the results that we predict? In this case, we should break down the result into two categories, the first being the mutual benefits that arise from trade and the second being the equilibrium outcome that arises when utility maximization occurs.

The result of mutual gains from trade must almost certainly be valid in almost all circumstances. People engage in market exchanges every day and they invariably can choose to buy or not buy products for which they have sufficient money to purchase. Because both sides of an exchange are free to walk away, if they engage in trade, it must be because both sides benefit.

Occasionally people do make poor trades. Sometimes a consumer is made worse off after trade. For example, a person may pay $12 to see a new movie at the theater only to discover the movie is terrible. In the end, this person is made worse off by purchasing the ticket. However, this represents another case of imperfect information. The consumer certainly "expected" the movie to be worth $12 or she wouldn't have purchased the ticket. Only afterward does she learn that her expectation was not fulfilled. Indeed the lack of perfect information in this example is a reason there exists a market for movie reviews. People seek out reviews to help decide which movies are worth the money for a ticket.

The strong likelihood that information is imperfect may mean that people do not always achieve the maximization of utility or the particular trade pattern and prices predicted by this economic model. Nonetheless, failure to achieve the maximum does not mean that trade does not result in mutual benefits. Surplus value will still be created and shared in some way between the traders regardless of whether consumers achieve the maximum.

Lastly, it is worth noting that even if consumers do not achieve the maximum utility, it can be very useful to assume that they do. By doing so, we can identify a final equilibrium outcome and can build more complex models to address other issues. If we don't make this assumption then we will be left in a muddle, unable to progress much further, or at least not without greatly complicating the mechanics of the model by introducing much more complex behaviors.

### Key Takeaways

1. A unique equilibrium allocation of goods and a unique terms of trade can be derived by including the assumption that both traders act to maximize their individual utility.
2. The utility maximizing equilibrium condition that must hold at the final allocation for each person is either (a) $MU_O/P_O = MU_A/P_A$ , or (b) $\left(\frac{P_O}{P_A}\right) = \left(\frac{MU_O}{MU_A}\right)$.
3. A Pareto optimum is any allocation of goods for which it is impossible via additional trade to raise, and/or maintain, the utility of both individuals.
4. Graphically, the equilibrium allocation is depicted as the point in an Edgeworth box where both traders' indifference curves are tangent to the line drawn between the allocation and the original endowment point.
5. A utility maximizing allocation is always Pareto optimal.
6. A Pareto optimum does not necessarily satisfy the utility maximizing conditions for both individuals.
7. In most cases, mutually voluntary exchange assures utility rises for both traders, even when utility is not strictly maximized by both traders.

## 3.7 The Role of Market Intermediaries

### Learning Objectives

1. Learn what is a market intermediary business (a middleman) and why they exist.
2. Learn that intermediaries exist because market information is not perfectly known and it is costly to acquire that information.
3. Learn how processes and institutions arise to solve the problem of imperfect information.

The Edgeworth box model can be useful in understanding the role and the effects of market intermediaries. We begin by highlighting the role of a market intermediary and the reasons behind their presence in markets. There are several types of market intermediaries, also known as middlemen, including agents and brokers, wholesalers and resellers, distributors, and traditional retailers.

Consider the movement of a product, such as a toaster, from the manufacturing firm to the final consumer. Normally the product will pass through several companies before being sold to the final customer. First, the toaster manufacturer is likely to sell a large number to a wholesale company. The wholesaler is a firm that might deal in many different types of consumer appliances and maintains warehouses where the products can be received and stored. They might enter into a contract with the manufacturer to purchase a fixed number of toasters, say 10,000, every month for a negotiated price. The manufacturer gains some advantage in that they do not need to identify specific customers interested in buying individual toasters but instead can sell a large amount of their production in bulk to a reliable purchaser on a regular basis. The wholesalers task is to distribute these toasters and sell them to a variety of retail stores. Thus, they might sell 3000 toasters to Walmart and 1500 to Target, etc. Of course, to make money they will sell each toaster at a slightly higher price than they paid from the manufacturer. The retailer's task is to put these items on display so that consumers who might desire the products can find them, evaluate their features, and purchase them for their home. The retailer will also mark-up the price so that they can cover their costs of displaying the product and to make a profit.

But we might ask why these middlemen businesses are necessary. Why doesn't the toaster manufacturer sell directly to the final consumer and avoid all the costs associated with the middlemen? The simple reason is **imperfect information**. In the real world, the manufacturer of toasters simply doesn't know how to find all of its potential customers while its customer don't know where to find toaster manufacturers. Imagine the relief a manufacturer would feel if a wholesaler comes along and is willing to make bulk purchases on a regular basis. Now the manufacturer can focus all its attention on making good toasters and leave the distribution of the product to others. The wholesalers, in turn, can concentrate on purchasing many different types of products in bulk, and finding retailers willing to display the products to potential customers. The retailers can concentrate on providing a convenient space to display items for sale and attract customers to its location. Finally, the customers need only learn which local retail establishments have the products they might wish to buy. The entire process involves identifying matches between sellers and buyers and transporting the goods between the two.

Let's consider a simplified version of this process in the context of an Edgeworth box. Figure 3.9 below depicts a market consisting of Sam and Jon trading bread and butter. (it could just as easily be trading money for toasters though) Suppose their endowment is at point A implying that Sam has 12 sticks of butter and desires to buy bread, while Jon has 16 loaves of bread and wishes to buy butter.

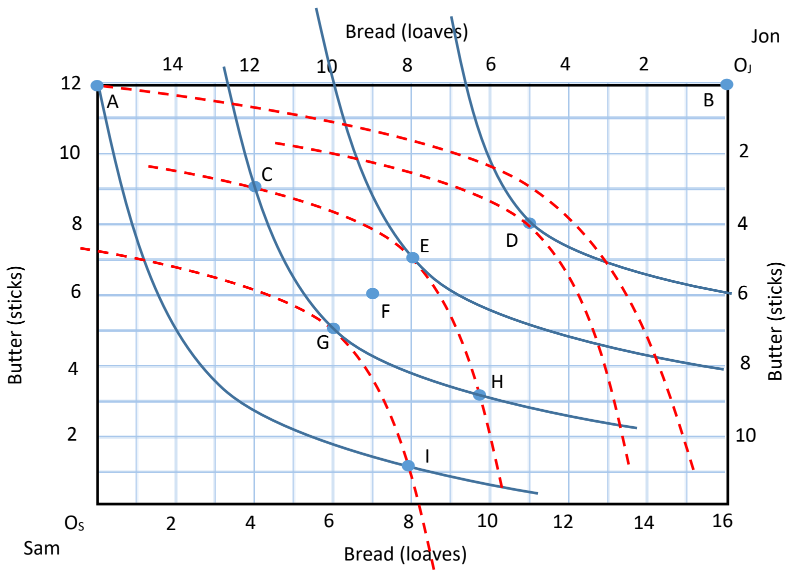
Suppose Jon and Sam would like to trade with each other but do not know how to find each other. In other words, Sam doesn't know where to go to find someone who wants to exchange their bread for his butter.

Now, suppose a third individual, named Axel, enters the market to serve as an intermediary, or a middleman. Axel is familiar with Sam's desire to sell butter for bread and Jon's desire to sell bread for butter so he tells Sam and Jon that he can satisfy both their desires by making a market. In addition Axel tells each that they will not even need to leave their homes or businesses because he will transport the goods between the two.

After having conversations with each trader Axel learns that Sam is endowed with 12 sticks of butter and is willing to trade to points E, F or G. (in the price range 1.6 to .86 loaves/stick) Axel also learns that Jon is endowed with 16 loaves of bread and is also willing to trade to points E, F or G.

Axel then does the following, he goes to Sam first and offers him 6 loaves of bread for 7 sticks of butter. Thus Sam will trade with Axel from point A to point G in the Figure. He tells Sam this is the best offer available that day and he will pay him the bread later that day. He then goes to Jon and says that the best deal that day is 8 loaves of bread for 5 sticks of butter. Thus Jon trades with Axel from point A to point E. He makes the trade with Jon immediately, giving him 5 of the 7 sticks of butter he received earlier from Sam. Finally, he returns to Sam and pays him the 6 loaves of bread, as promised.

Figure 3.9 Intermediation in an Edgeworth Box




Because Axel trades at different terms of trade with the two sellers, he is able to extract 2 loaves of bread and two sticks of butter as a payment for his services. Despite the fee though, all three individuals are better-off after trade. How do we know that?

First, Sam and Jon trade to points G and E, respectively, and these points are both above their original indifference curves passing through point A. Thus, Sam and Jon are better-off with trade. Axel receives a payment for his services and his willingness to engage in these trades must mean that it is sufficient to cover his costs of arranging the trade and transporting the goods and to give him a small profit or surplus in addition, so he too is better-off.

In this case, Axel is providing a valuable service to Sam and Jon and he is getting paid a fee to do so. That service is to relieve them of the costs associated with finding each other and transporting the goods to a market. Instead, the producers can now concentrate on acquiring more bread and butter. Axel is also gathering info about the endowments available each day, deciding upon an appropriate terms of trade and transporting the goods between the two sellers. For these services, Axel deserves reasonable compensation and is receiving two loaves of bread and two sticks of butter for his time and effort.

Now, Axel could have conducted his business slightly differently. He could have announced instead a terms of trade for both Sam and Jon to the midpoint value at F, seven loaves of bread for six sticks of butter. However, for his services he could have explicitly charged both Sam and John one stick of butter and one loaf of bread each. In this case, it would be more obvious that Axel is providing this service and receiving a direct payment for it. The final results are equivalent though.

Finally, let's highlight the role of imperfect information and transportation costs. In the original pure exchange model, Sam and Jon are assumed (implicitly) to know where to go to find another willing trader and incur no transportation costs to move their products to the market. These are simplifying assumptions that allow us to focus attention on the gains from trade that they will realize when they exchange their products mutually voluntarily. However, in the real world information is not perfect and it is costly to move products to the market. This opens up opportunities for businesses to fill that gap. If an intermediary business can gather the needed information (to match buyers and sellers) and transport the goods between the parties, and can do so at a low enough cost, then they can receive some of the surplus value that otherwise would have accrued to Sam and Jon.

It is worth emphasizing that the money to pay Axel comes from the surplus that accrues to both Sam and Jon. The terms of trade offered by Axel are slightly worse for both Sam and Jon relative to what they might have achieved in a perfect information economy (i.e., both trading directly to point F without Axel). However, both Sam and Jon are willing to give up a portion of their surplus because Axel is solving an information and transportation problem for them. If information were perfect, then the traders wouldn't need Axel. But, because in the real world information is not perfect, it opens up more possibilities for businesses who can provide that information cheaply enough.

**Reality Check**

It is worth noting how distribution networks have changed since the advent of the internet. One thing the internet provides is better information about products for consumers and better info of where the consumers are for the businesses. For example, today when someone wants to purchase sports shoes, she can go online and search for shoes that match her desired characteristics. That search could lead one directly to a shoe manufacturer who could take the order and ship the shoes directly to the customer. In this way, many of the costs associated with the middlemen could be eliminated, the exception being the transportation costs which are now covered via the package delivery service. In this new world there may be little need for a retail showroom to display the goods for customers, and no need to sell large quantities to wholesalers for distribution. The costs associated with intermediaries could be reduced significantly because information about products and customers is more readily obtainable by the sellers and buyers of goods. In other words, it becomes easier to match buyers directly with sellers.

Of course intermediary services have not disappeared but they have changed in character. For example, one major new intermediary is Amazon, which provides businesses and customers with a platform to communicate information to each other and arrange for sales directly between producers and consumers. Since the computer network can handle millions of products and consumers, it can offer these services for a very low cost, thereby significantly reducing the traditional costs of intermediary services. This is one reason Amazon has been so successful. It is offering a cheaper way to connect businesses with their final customers.

## Key Takeaways

1. A market intermediary, also called a middleman, provides services that assist companies in locating customers and transporting products from the manufacturer to the consumer.
2. An intermediary firm helps solve problems associated with imperfect information and transportation costs, which are frequently assumed away in simple economic models.
3. Intermediaries earn money that arises from the surplus value associated with trade.

4. The internet has significantly changed the availability of market information and is inducing important changes in the way in which products are marketed and sold.