Chapter 1

The first step is a big one. Economics is aimed being able to account for why people behave the way that they do. People behave in lots of different ways; indeed, the set of possible actions is enormous. To narrow the set a little, we begin with an observation: people trade with each other.[1] This seems like an important observation. Because trades lie at the heart of so many economic interactions, we start by trying to explain why people trade with one another.

As we will see in later chapters, economics is an experimental science. Both laboratory experiments and models are used to develop insight into the factors that can account for people's behavior. In this chapter, we develop a model economy that can account for why people trade.

The Environment

There is an island on which two people live, named Robinson and Friday. There are only two goods on this island: apples and fish. Both apples and fish are perishable. To illustrate this point, apples are only good to eat on the day they ripen. Similarly, fish are only good to eat on the day they are caught. There is no way to store fish or fruit.

Let the time period be one day. It takes time out of each day to acquire apples and fish. Apples grow on trees. Even with hundreds of apples ripening each day, a person must harvest them from the tree and harvesting takes time. In addition, there are large schools of fish swimming in the ocean nearby. Time is required to catch fish. Because time and effort are required and because a day fixes a particular quantity of time, there is a physical limit on how many fish can be caught and how many apples can be harvested.

Regarding preferences, we make only one assumption right now. Robinson prefers more fish and more apples. If given the choice between ten apples and nine apples, Robinson will always prefer ten apples. Similarly, Robinson would always prefer one more fish if given the opportunity. Friday has the exact same preferences; more is preferred to less.

Robinson and Friday are capable of working ten hours per day. Thus, time is the scarce resource that limits what Robinson and Friday can acquire. Assume that each will work the entire ten hours. Moreover, Robinson and Friday are endowed with different abilities. For example, suppose that Robinson can catch fish and harvest apples. Robinson's fish trap takes twenty minutes to setup and then catches one fish the instant it is setup. It takes Robinson ten minutes to climb an apple tree and fetch one apple. With this information, it is straightforward to compute Robinson's production bundle in which case he wishes to maximize the number of fish caught in one day: 3 fish per hour x 10 hours per day = 30 fish. In this case, his production bundle would consist of 30 fish and zero apples, or (30F, 0A). Alternatively, Robinson's maximum apple harvest is represented by 6 apples per hour x 10 hours per day = 60 apples. Robinson can switch from fish catching to apple harvesting without losing any time. Hence, Robinson could harvest 60 apples and no fish, 30 fish and no apples, or some combination of the two. Robinson spends four hours fishing and six hours harvesting apples, his production bundle would be (12F, 36A).

Friday is also capable of catching fish and harvesting apples. Friday has a fish trap that can catch one fish in thirty minutes while Friday can climb an apple tree and fetch one apple every five minutes. With this information, it is straightforward to compute Friday's production bundle in which case he wishes to maximize the number of fish caught in one day: 2 fish per hour x 10 hours per day = 20 fish. In this case, his production bundle would consist of 20 fish and zero apples, or (20F, 0A). Alternatively, Friday's maximum apple harvest is represented by 12 apples per hour x 10 hours per day = 120 apples. Friday can switch from fish catching to apple harvesting without losing any time. Hence, Friday could harvest 120 apples and no fish, 20 fish and no apples, or some combination of the two.

The easiest way to represent Robinson's set of production bundles is with a graph called a production possibilities curve. To make things easy, we assume that Robinson can divide his time so that we can treat him as being able to capture fractions of a fish and harvest fractions of an apple. The points on the line represent all the (infinite) variety of combinations of fish and apples that Robinson could produce in one day. The horizontal axis measures the quantity of fish caught in one day whereas the vertical axis measures the quantity of apples harvested in one day. The maximum number of fish is represented by a point on the horizontal axis in which 30 fish are caught and no apples are harvested. Conversely, the point on the vertical axis represents the maximum number of apples harvested, which we derived as being 60 apples and no fish. (Here, we follow the convention of listing the value on the x-axis first, followed by the value on the y-axis.)

Figure 1

A Production Possibilities Curve

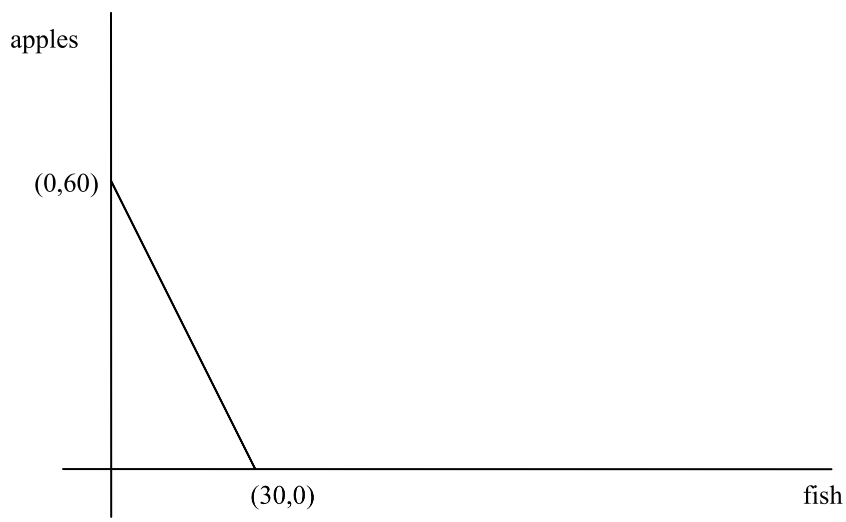


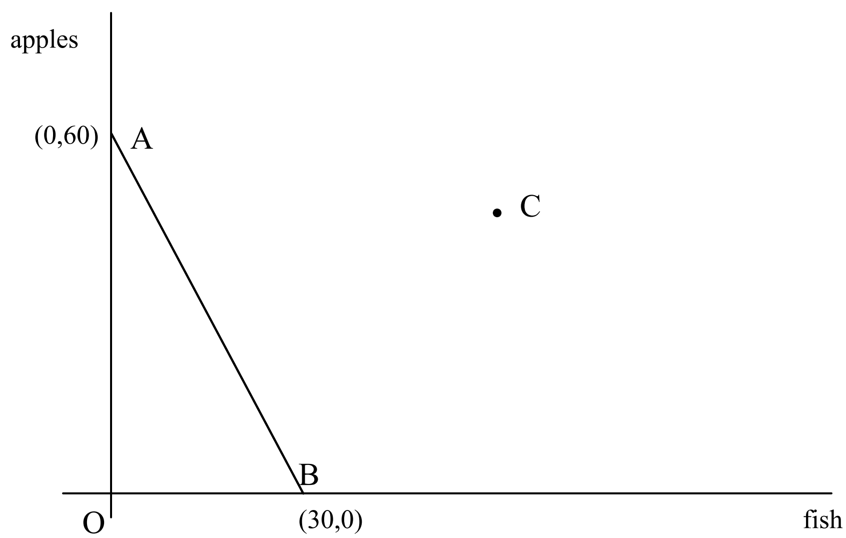
Figure 1 has a special name. It is the *production possibilities curve*, or PPC Formally, the production possibilities curve plots the combinations of goods—in this case, the combinations of fish and apples—that can be produced.

Feasibility and efficiency

There are two important characterizations that are associated with the production possibilities curve. For one thing, the production possibility curve divides the space of all combinations of fish and apples into feasible and unfeasible portions. Figure 2 illustrates this division. Note that I have labeled the origin of the graph, where the horizontal and vertical axis meet as “O”. In addition, the vertical intercept is labeled “A” and the horizontal intercept is labeled “B”. The triangle formed by points OAB is combination of all bundles and fish and apples that Robinson can produce in one day. We call these combinations elements of the feasible set. Any point outside the OAB triangle cannot be produced and is referred to unfeasible. For instance, Point C is combination of fish and apples that Robinson is incapable of producing in a day.

Figure 2

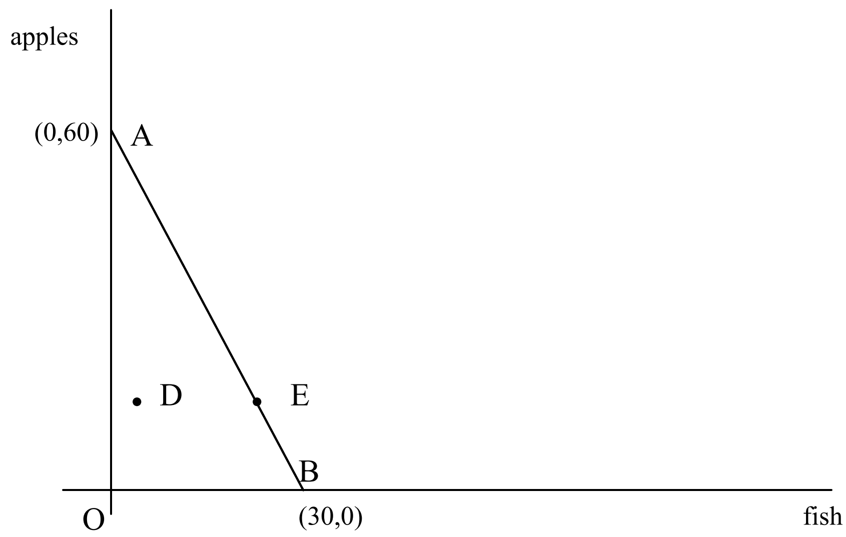
The Difference between Feasible and Unfeasible



Another distinction is efficiency. This divides the production possibility curve and all other feasible combinations into two groups. Efficient bundles are those that lie on the production possibility curve itself. Inefficient bundles are combinations of fish and apples that are feasible, but lie inside the triangle. Figure 3 illustrates the efficiency-inefficiency

Figure 3

The difference between efficient and inefficient



distinction. Point E is combination fish and applies that lies on the production possibilities curve whereas Point D represents a combination of fish and apples that Robinson could produce, but would waste opportunities of producing *more* fish and/or apples.

Think of efficiency in this way. Robinson harvests apples and catches fish represented by Point D. Suppose that Point E is a bundle that has the same number of apples as Point D, but clearly has more fish. It would be inefficient for Robinson to produce the combination represented by Point D because Robinson prefers more fish to less. The time wasted not catching the additional fish is not valued by Robinson, so the efficient outcome is go out to the ocean and spend the time catching more fish.

Opportunity cost

There is one more important concept that can be derived from the production possibility curve. The *opportunity cost* is the next best alternative for a person when deciding what to do. In the case of Robinson, the opportunity cost is what else he could be doing with his time. To put this concept into practice, think of what it would cost Robinson if he gave up one fish. The cost of one fish is captured by the slope of the production possibility curve. To compute the slope of this straight line, we have information on two points. Let $apple_1 = 60$, $fish_1 = 0$ correspond to the bundle at the vertical axis and $apple_2 = 0$, $fish_2 = 30$ correspond to the bundle at the horizontal axis.Recall the formula from high school algebra:

$$\frac{rise}{run} = \frac{apple_1 - apple_2}{fish_1 - fish_2} = \frac{\Delta apple}{\Delta fish} = \frac{60-0}{0-30} = -2$$

In this equation, the change in the item on the y-axis is put in the numerator and the change in the item on the x-axis is put in the denominator. One point is the vertical intercept and the other point is the horizontal axis. (The symbol Δ stands for "change in".) The result of the calculation is that Robinson would obtain 2 apples for every one fish that he gives up. Thus, the opportunity cost is 2 apples for every fish for Robinson.[2]

There is a tradeoff embodied in the slope of the production possibilities curve. That tradeoff is the opportunity cost. The slope is negative, which can be interpreted as what the person has to give up of one item in order to obtain more of another item. Indeed, economics exists to study environments in which scarcity requires that people recognize these tradeoffs. It would not be very interesting to study a world in there is an infinite quantity of goods available. Our next step is to see how trade can improve things when people have different opportunity costs.

Robinson's PPC is a line plotting combinations of apples and fish that he could produce in a given day. It is also possible to represent this as an equation. In this case, we know the vertical intercept and we know that there is a given amount of apples lost when producing one more fish. Because the amount of apples not produced to produce one more fish is constant, the equation is a linear equation. In other words, we can apply the slope-intercept formula to represent the PPC in equation form. To illustrate this, we know that if Robinson produces no fish, he will produce 60 apples. We have already computed the slope, or opportunity cost for Robinson. Thus, we apply the slope-intercept approach, obtaining $a = 60 - 3 \times f$, where a stands for the number of apples and f stands for the number of fish.

When opportunity costs differ

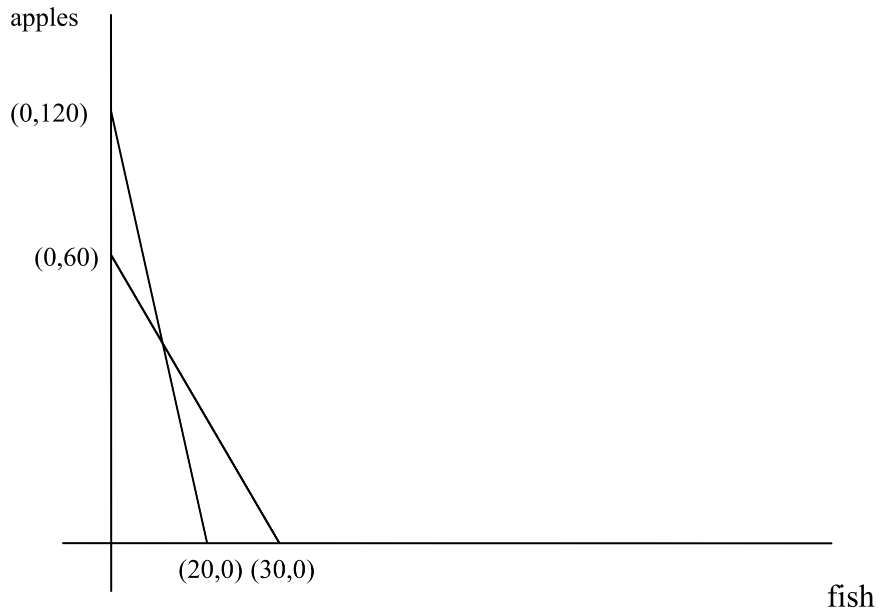
Thus far, the illustrations have concentrated on Robinson's production possibility curve. It is time to bring Robinson and Friday together. Figure 4 plots the combinations of fish and apples that each person can produce. We begin by calculating the opportunity cost for Friday. Let $apple_1 = 120$, $fish_1 = 0$ correspond to the bundle at the vertical axis and $apple_2 = 0$, $fish_2 = 20$ correspond to the bundle at the horizontal axis. With Friday's production possibility curve, we get $\frac{apple_1 - apple_2}{fish_1 - fish_2} = \frac{\Delta apple}{\Delta fish} = \frac{120-0}{0-20} = -6$. In other words, Friday will get 6 apples for every fish he gives up.

As we did for Robinson, we can represent Friday's PPC in equation form. Here, the vertical intercept is 120 and the slope is -6. Thus, $a = 120 - 6 \times f$ is the equation that solves for the number of apples that Friday will produce, given that he has produced a particular number of fish.

The essential result is that the opportunity cost for Friday is different than it is for Robinson. The concept of comparative advantage is associated with the result that there are different opportunity costs. To illustrate the concept of comparative advantage, we begin by identifying who is the low-cost producer of apples. After doing the calculations, we know that Robinson produces 2 apples for every fish he gives up while Friday produces six apples for every fish he gives up. In this case, we have made fish our numeraire; in other words, we are specifying the opportunity cost of apples in terms of fish. Based on our calculations, Friday is the low-cost producer of apples. To get six apples, he only has to give up one fish. In contrast, Robinson would have to give up three fish to get six apples. Friday has to forego fewer fish to get a fixed number of apples *relative* to Robinson. Consequently, we refer to Friday has having lower opportunity for producing apples; or, alternatively, Friday has a comparative advantage in producing apples.

Figure 4

Illustrating different opportunity costs



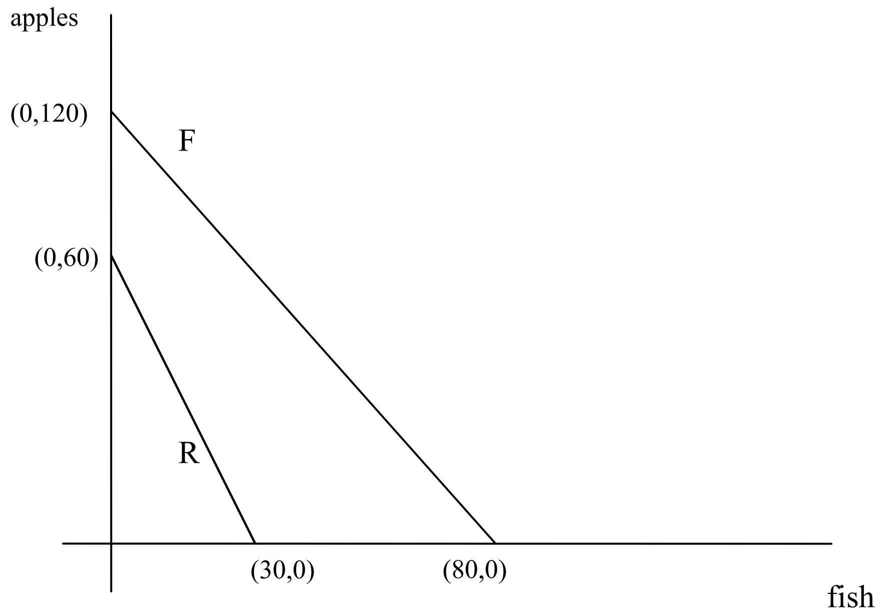
News is not all bad for Robinson. Note that Robinson only has to give three apples to obtain one fish while Friday has to give up six apples to obtain one fish. It follows that Robinson is the low-cost producer of fish; or, Robinson has a comparative advantage in producing fish.

It is worthwhile to point out that no person can have a comparative advantage in producing every good. The concept of comparative advantage is a relative concept and requires comparing relative opportunity costs. In a case in which one person has a lower opportunity cost in producing one good, the other person must have the lower opportunity cost in producing the other item. It is a tautology.

This does not mean that people cannot be absolutely better at producing both items. The concept of absolute advantage captures this comparison. To illustrate, consider a case in which two peoples production possibility curves are represented in Figure 5. We continue to represent Robinson's production possibility curve as the one with the vertical

Figure 5

Absolute Advantage



intercept at (0F, 60A) and the horizontal intercept at (30F, 0A). Now, let Friday's production possibility curve be captured by the one with the vertical intercept at (0F, 120A) and the horizontal intercept at (80F, 0A). Figure 5 depicts a case in which Friday has an absolute advantage in the production of both fish and apples. For a given amount of time, Friday is capable of producing more apples than Robinson and also capable of producing more fish than Robinson.

For reference, note that in Figure 4, Friday has an absolute advantage in producing apples, but Robinson has an absolute advantage in producing fish. To be more concrete, if both Friday and Robinson spent all their time harvesting apples, Friday would produce more apples than Robinson. This is what it means for Friday to have an absolute advantage in producing apples over Robinson. In contrast, if both spent all of their time catching fish, Robinson would catch more fish than Friday; hence, Robinson has an absolute advantage in catching fish over Friday.

The difference between absolute advantage and comparative advantage can be summarized easily. Absolute advantage is based on comparing two people's productivity. Comparative advantage is based on comparing two people's opportunity cost. Productivity is an absolute comparison over one good. If a person's productivity is measured in terms of the time it takes to produce one good. Comparative advantage is based on the production of one good relative to another; that is, in terms of foregone production of the "other" good. When we compare relative production, we are talking about comparative advantage. When we compare production of one good, we are talking about absolute advantage.

As we see in the next section, comparative advantage can be exploited to benefit individual traders.

Comparative advantage and benefits from trade

Let's revisit the case depicted in Figure 4 in which Robinson has a comparative advantage in producing fish and Friday has the comparative advantage in producing apples. The question is, Can we exploit the comparative advantages present in this island economy?

The answer is yes. Moreover, the mechanism involves trade and specialization. We start by organizing Robinson and Friday's production. Both are smart. They realize that comparative advantage is present. One night, they propose specializing their production. Robinson knows that he has the comparative advantage in producing fish and proposes that he spend all his time producing fish. Friday recognizes his comparative advantage in producing apples and specializes in producing apples. Friday wants fish and Robinson wants apples, so they agree to trade four apples for every fish.

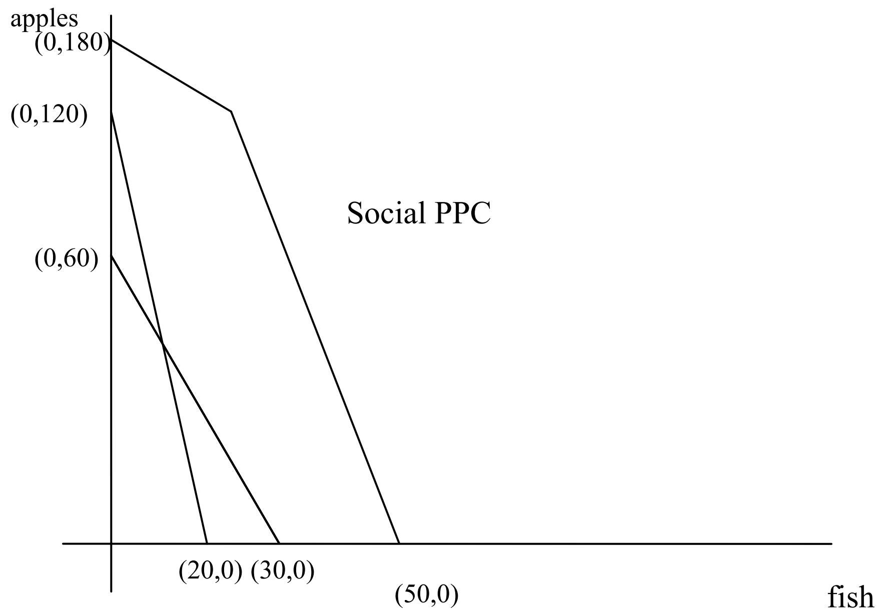
First, let's determine if this is a good deal for both parties. From Robinson's perspective, the price is lower than his opportunity cost. Remember, left alone, Robinson would only obtain two apples for each fish he produced. Since four is greater than two, Robinson likes the terms. From Friday's perspective, he would be giving up six apples for every fish he produced. Since, four is less than six, Friday also likes the terms of trade proposed.

Now, with terms of trade in place, we can construct the social production possibilities curve. The objective is to demonstrate that by specializing, society can increase the total quantity of goods produced. In terms of the graphs, each person's production possibility curve will lie inside the social production possibility curve. In demonstrating that the social pie is bigger than any one person's feasible set of options, the only thing left is to trade in order to get the right consumption bundle.

With Robinson producing only fish, the maximum quantity of fish available in the economy will be 30 fish. With Friday specializing in apple harvesting, the island society will have 120 apples. So the combination, (30F, 120A) is one point on the social production possibilities curve. As Robinson spends a little less time catching fish, the

Figure 6

Constructing the Social PPC



bundle will change. For instance, if both Robinson and Friday produce only fish, society will produce the bundle (50F, 0A). Conversely, if both only produce apples, the social production will be (0F, 180A). Figure 6 represents the social production possibilities curve. Clearly, any bundle produced without the possibility of trade will be an inefficient point from society's perspective.

To illustrate how trade improves things. Suppose that Robinson completely specializes in fish production and Friday only produces apples. With (30F, 120A) and with terms of trade set at 4 apples per fish, one possible outcome is that Robinson trades 10 fish. At four apples per fish, Robinson consumes $4 \times 10 = 40$ apples. If no trade exists, Robinson would give up 10 fish, producing 20 fish and 20 apples. With trade, Robinson can consume 20 fish and 40 apples. To get 10 fish by himself, Friday would only get to consume 60 apples. With trade, Friday gets to consume 10 fish and 80 apples. Because both prefer more to less, both are happier. So, specialization and trade are means to achieve greater consumption. Once you know what you have a comparative advantage in producing, you specialize in that production activity.

Summary

The objective of this section is twofold. First, the observation is that people trade with one another. Countries trade with one another. Trade is a basic fact that permeates society. Second, How can economics account for this observation?

We present a model of a two-person economy. The key feature is that these two people have different opportunity costs. All we know about these two people's preferences is that they like more of each good. Using their different opportunity costs, we derive the social production possibility curve. With the social PPC acting a constraint on the total quantity of goods available, we propose a trading mechanism with a specific price such that each person in this economy will realize a bundle to consume that they could not have attained without trade. This result is quite powerful insofar as it can explain why self-interested parties will trade with another.

In addition, there is an important corollary to this main result that accounts for why people are not self-sufficient. In describing the benefits of trade, we recognize that low-cost producers are really just an example of people specializing in an activity in which they are most productive. Thus, the incentive to specialize accounts for the observation is that people typically focus on one main job. Accountants may grow some of their own food, but mostly they specialize on performing accounting services. We do not need to be totally self-sufficient when we realize that if we specialize in the activity in which we have a comparative advantage, others will likewise specialize. Through specialization, society increases the amount of goods and services produced and we all get to consume more stuff. Not a bad outcome.

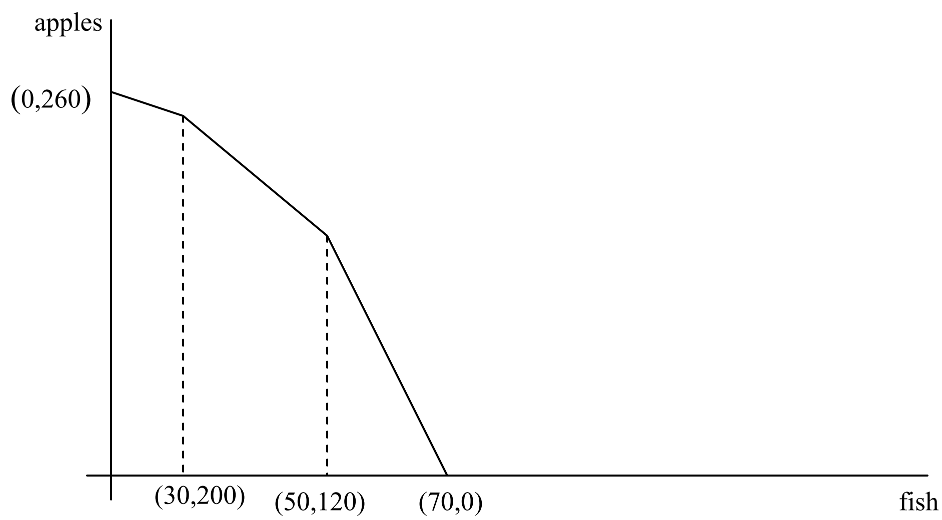
Production possibilities with lots of people

If we consider an economy populated by more than two people, the shape of the social production possibilities curve will change even further. In Figure 6, one begins to see that the social PPC bows out from the origin. The kink reflects the differences in the productivity of the two people on the island. So what happens if we keep adding people?

To illustrate, consider a third person on the island that we shall call Eve. For the sake of this illustration, Eve's PPC is given by $a = 80 - 4 \times f$. Note the Eve's opportunity cost is between Robinson's and Friday's. Recall that Robinson would have to produce three less fish to get six apples and Friday would have to produce one less fish to get six apples. Eve would have to produce 1.5 fewer fish to get six apples. If Eve, Friday, and Robinson produced only fish, the horizontal intercept, as depicted in Figure 7, would be (70F, 0A). Thus, this is one point on the social PPC. The first person to

Figure 7

Social PPC with three producers



Society would first turn to Friday to produce apples because he has the comparative advantage over Eve and Robinson. For each fish society does not produce, it will gain six apples. If Friday specialized only apples while Eve and Robinson produced fish, society would produce the combination (50F, 120A). The line connecting the horizontal axis to the point (50F, 120A) is one part of the social PPC, capturing the bundles that could be produced as Friday reduced his fish catching effort. As we move along this segment, Friday is moving from specializing in fish catching to specializing in apple harvesting.

To produce more apples, Eve would be the next most productive person. If Eve were to specialize in producing only apples, society would have the 30 fish produced by Robinson and would have 200 apples produced by Eve and Friday. The segment joining the points (50F, 120A) and (30F, 200A) in Figure 7 represents all the combinations that society could produce if Robinson specialized in fish, Friday specialized in apples, and Eve varied her production.

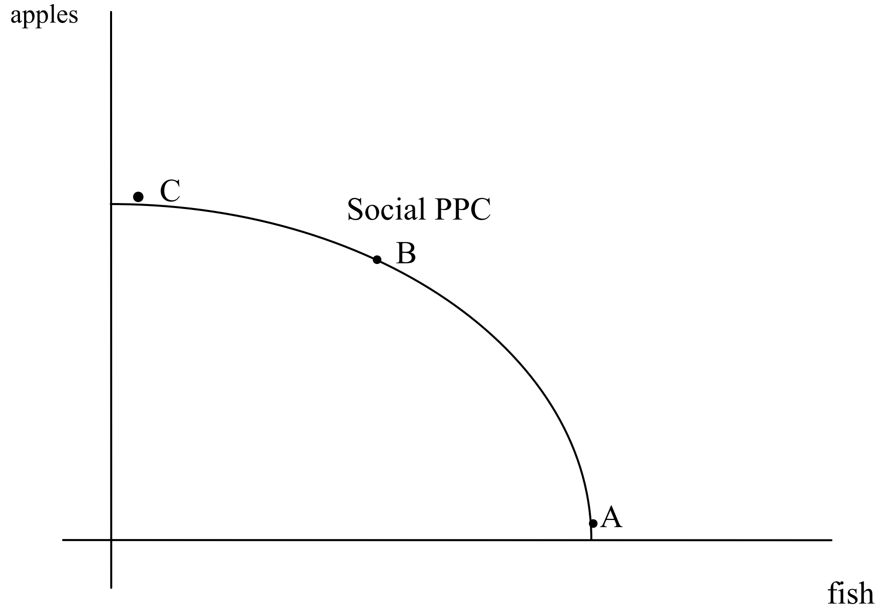
Lastly, consider the case in which Friday and Eve specialized in apples while Robinson varied his production. If Robinson produced only apples, society would produce zero fish and 260 apples. In Figure 7, the segment between the points (0F, 260A) and (30F, 200A) represents all the combinations that could be produced if Eve and Friday specialized in apple harvesting and Robinson varies his production activity.

The message is that the number of kinks in the social PPC is always one less than the number of people on the island. In order to get an additional apple, society uses the most productive apple harverster. So, if we kept adding more and more people, the kinks would eventually smooth out the social PPC. Each person would small relative to total, social production. The line segment associated with each person's varying production combinations would also shrink. The upshot is that the kink disappears. When all the production is considered for this economy with lots of people, we have the social PPC with many people is represented as in Figure 8.

There is an important concept that is present in Figure 8. Unlike the PPC for each person, the opportunity cost, or slope of the social PPC, changes at every point. Again, we use fish as the numeraire. Consider a case close to the horizontal axis, like Point A. If we give a just a little bit of fish, we get a lot of apples. The opportunity cost is a big (negative) number in this case. Next, consider an intermediate number of fish, such as Point B. Here, giving up a small quantity of fish will result in some gain of apples, but far fewer than at Point A. Finally, consider a point close to the vertical axis, like Point C. Here, if society gives up just a small quantity of fish, the gain in apples is almost zero.

Figure 8

Social PPC with many producers



The point is straightforward. The opportunity cost is diminishing as you move along the social production possibilities curve. This bowed-out, or concave, shape embodies one economics' important assumptions: increasing opportunity costs. Sometimes, this assumption is also called the principle of low-hanging fruit. The intuition is quite appealing. With lots of people involved, it is cheap to produce the first few items. However, the easy pickings eventually disappear and it becomes more and more difficult—read costly—to obtain each additional bit of the good.

This is what is happening to apples in Figure 8. When we have lots of fish and no apples, the first few apples are on low-hanging branches and easy to harvest. Once the easy pickings are gone, more effort is required to harvest the next apples, meaning that more fish will have to be given up. Eventually, the apples are so difficult to harvest that one must forego lots and lots of fish to get the last few apples.

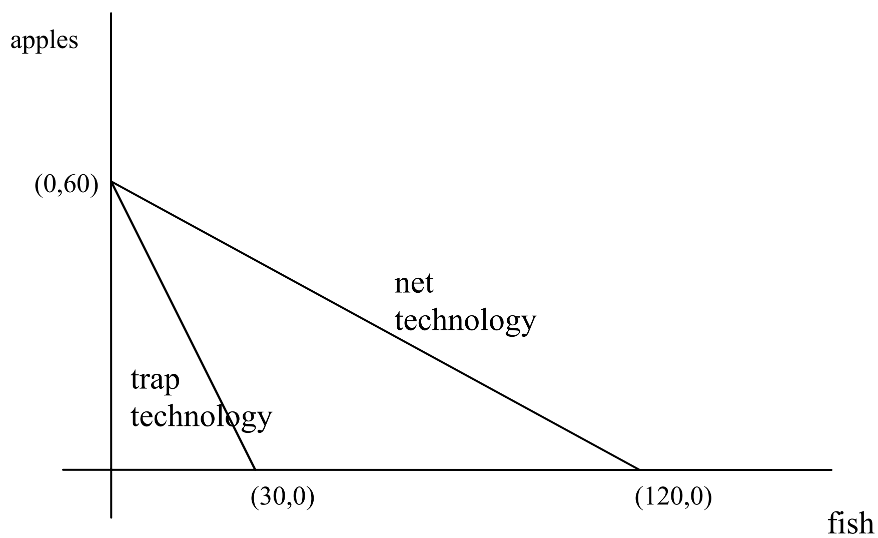
Technological Advancements

The social PPC is constructed at a point in time. So, it takes the level of technology available combined with the skills of the workers and all of the features that permit people to trade with one another. So, technological advancements, learning, and barriers to trade can all affect the social PPC. In this section, we will examine the effect that each of these factors will have on the production possibilities curve.

Consider first a case in which a new technology is introduced. To make this even more concrete, let us return to our case in which we specify the PPC for Robinson. Suppose Robinson develops a net, permitting to catch more fish. Instead of catching one fish every twenty minutes, the net permits Robinson to catch one fish every five minutes. The effect of this technological advance is to rotate his PPC as depicted in Figure 9.

Figure 9

Illustrating how a new fish trap affects Robinson's PPC

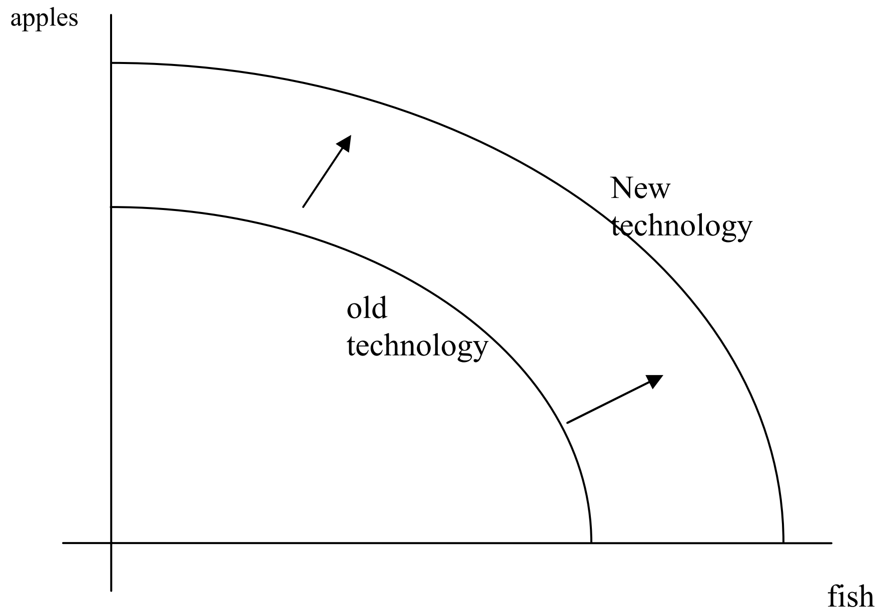


With the net, the maximum number of fish that Robinson can catch is 12 fish per hour times ten hours = 120 fish. From Figure 8, we see that the technological advancement causes Robinson's PPC to shift. In this case, the set of efficient combinations of fish and apples that Robinson can produce is greater than it was when he had his original fish trap.

In the case of a social PPC, technological advancement can be considered to make workers more productive across all goods. In this case, the entire social PPC shifts

Figure 10

Illustrating broad-based technological progress



outward. In other words, some technological advances make workers more productive with respect to producing each good. So, rather than just rotating from a fixed point on the vertical axis, as happened with Robinson's new fish net, society is more productive with respect to all goods produced. Figure 10 depicts a type of broad-based technological advance.

Figure 10 is also useful for depicting a case in which workers are more productive. For example, learning on the job is a general characteristic. If each of the workers specializing in one job learns over time, they will become more productive and thus, produce more of each type of good.

In constructing the social PPC from Robinson's and Friday's individual PPCs, no account was taken for resources that are used up in order to conduct trade. For example, maybe Robinson and Friday need to travel to conduct the exchange. Along the way some apples and fish are lost do to droppage or the like. Droppage would be an example of a transaction cost—that is, a quantity of the resource is used up while trading with another.

In addition to transaction costs, interference by government in the form of trading restrictions or taxes might also use up some of the resources. Any frictions that arise in the process of trading will affect the location of the social PPC. Indeed, if the frictions decrease over time, as trade barriers are lifted, the social PPC will shift outward as depicted in Figure 10.

When specialization backfires

The wrong message can be taken from this chapter when specialization is taken too far. In an industrialized society, one can imagine that tasks are divided. When repetitive tasks are under one person's purview, the attention can easily wane, resulting in less productive workers engaged in the specialized activity. In this case, too much specialization can be detrimental to the social production of goods and services.

Prices are an open question

While this chapter provides an explanation for why people specialize and trade with one another, it leaves open a big question. In order to get Robinson and Friday to trade with each, I specified a price that was agreeable to both. This is not the only price that induces them to trade. Therein lies the open the question, Where did the price come from?

With only two parties, the price would presumably come from some bargaining process. Bargaining processes involved threats and other factors that are outside the scope of a principles text. In the next chapters, we will begin to build up the market process in which the price is determined in order to clear the market. There are so many buyers and sellers that each one takes the price as given to them. They then decide how much to sell and how much to buy. The market process, captured by an amazing auctioneer, finds the price so that the total amount supplied by producers is exactly equal to the total amount purchased by consumers.

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[1] In the social sciences, an empirical regularity is an action that is observable and measurable.

[2] It is perfectly legitimate to specify the opportunity cost in terms of fish per apple. In Robinson's case, his opportunity cost is ½ fish for every apple. Typically, I will adopt the convention of choosing the opportunity cost in terms of the good on the x-axis. In other words, how many items of the good on the y-axis will the person get for giving up one unit of the good on the x-axis. In this way, the item on the x-axis is deemed the numeraire when specifying relative prices.