I. Production Possibility Frontier (PPF)

A. The Production Possibility Frontier (PPF)

A recurring choice that appears in all economic systems is the choice between consumption today and consumption tomorrow.

When you put money in a savings account you are delaying consumption today. Presumably, you put the money in the bank to earn interest so you will have more money in the future. You are sacrificing consumption today so you can consume more in the future.

Nations make similar decisions as individuals deciding whether or not to sacrifice consumption today so they can consume more in the future.   An economy has a choice on how it can spend its income. They could use their income to produce consumer goods (consumption today) or they could use that income to produce capital goods, goods which are used to produce other goods and services. Using income to produce capital goods is a process called **investment.** It takes time for capital to produce goods and services, so by investing, an economy is willing to sacrifice consumption today for consumption in the future.

 We can best illustrate this tradeoff between capital and consumption goods by using a **production possibility frontier curve (PPF).** The production possibility frontier shows all the combinations of two goods that can be produced if all of society's resources are used efficiently.

In our graph, we will put capital goods on the Y-axis and consumption goods on the X-axis. Figure 1 shows the production possibility frontier for consumption and capital goods.

Point A represents a point where all the resources in the economy are being used to produce capital goods. In this case only capital goods are produced and no consumption goods are produced.

Point B represents the opposite case where all the resources in the economy are being used to produced consumption goods. In this case only consumption goods are being produced and no capital goods are produced.

There are any number of combinations in between these two extremes, and any point on the curve in Figure 2 are possible production points for the economy. Points E and F are points along the PPF, which means that an economy utilizing all its resources efficiently can produce at those points.

Point C is another point that is obtainable in this economy. In fact any point inside the production possibility frontier is obtainable. However, Point C is not desirable since it implies

that the economy is not using its resources efficiently. We can see that, because the economy can go to another point which would be able to produce more capital goods **and** more consumption good. Thus the economy doesn't want to remain at a point inside its PPF. How does an economy get to be at a point inside its PPF? There are two possibilities:

(1) Resources such as labor are not being fully utilized. If there is unemployment, then the economy is not producing at its full potential. As workers get hired, the economy will be able to produce more.

(2) Resources are wasted or mismanaged. Even if workers and capital are fully employed, there can be ways in which the economy produces below full potential. Suppose a new law was put into effect saying that all college educated individuals could only work as janitors, while those only with a high school education would be allowed to run corporations and factories. Although labor might be fully utilized, it is clear that it is being mismanaged as jobs are not matched with the skill sets. As a result production will be less.

Point D represents a point that is unattainable. Given the level of technology in the economy, there is no method which will allow the economy to reach that level of consumption and capital goods.

Figure 1
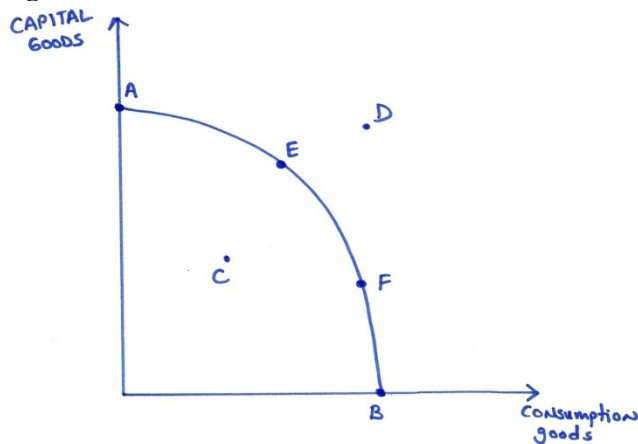
C. Properties of the Production Possibility Frontier

PPFs are not just useful in examining the tradeoffs between consumption and capital goods, they can be used to examine the tradeoffs between any two goods. For example the table below shows an economy with fixed resources is able to produce the following combinations of grapes and apples.

POINT	GRAPES	APPLES
A	75	0
B	60	12
C	45	22
D	30	30
E	15	36
F	0	40

Figure 2 uses the data in the table to graph the PPF between apples and grapes.

Using Figure 2 we can illustrate several properties of PPF.
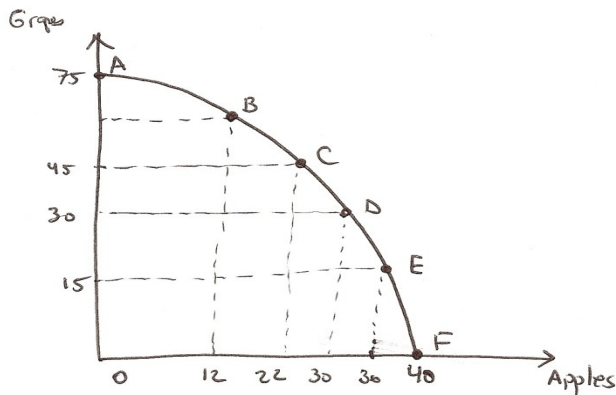
Property #1: PPF have negative slope. Note that throughout the curve, the slope is negative. For example as we move from Point C to Point D, the number of grapes decreases by 15 while the number of apples increases by 8. The slope from C to D is -15/8.   The reason for the negative slope is quite straightforward. Because resources are limited, in order to produce more apples, the other product (grapes) must be sacrificed. Thus between C and D, in order to produce 8 more apples, the economy has to sacrifice 15 grapes.

Property #2: The Law of Increasing Opportunity Costs implies that PPF is bowed. Notice in Figure 2 that opportunity cost is increasing as we shift production from grapes to apples. For example, as we move from A to B, in order to get 12 apples we have to sacrifice 15 bushels of grapes. The opportunity cost per apple is 15/12 = 1.25 grapes. Now as we move from E to F, if we sacrifice 15 bushels of grapes we only get 4 more apples. The opportunity cost per apple is 15/4 = 3.75 grapes. Why does the opportunity cost increase? It's reasonable to assume that apples and grapes require different land to grow best. As we shift production more and more away from grapes, we are increasingly taking away land that is best suited towards grape production and shifting it to apple production. As a result we are sacrificing more grapes to get less apples. This idea of increasing opportunity cost explains why the PPF curve is bowed. If the opportunity cost was constant then the PPF would simply be a straight line.

Property #3: Economic growth is characterized by the PPF shifting outwards to the right.

Economic growth can occur if:
   (1) There are more resources such as more labor or more capital or
   (2) There is new technology that allows producers to produce more output with the same level of inputs.

Figure 3 shows how economic growth can be represented by our PPF. Suppose that the economy was fully utilizing its resources at Point D. With new technology, with the same amount of capital and labor it can produce both more apples and more grapes and will move to a higher point such as Point G. This will be true at every other old combination and thus the curve will shift to the right.

Figure 3: Economic Growth
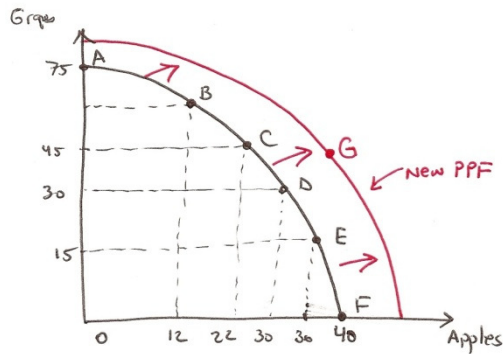
D. Economic Growth and Dilemma for Poor Countries

As we mentioned, the sources of economic growth are either an increase in capital or an increase in technology or a combination of both. Economies can reach higher levels of capital or technology by increasing the amount of capital goods. In other words, countries that sacrifice consumption today will experience faster economic growth and will have more consumption in the future. For many developing countries, this choice is a very hard one to make. Poor countries find themselves having to use most of its resources just to provide very basic consumption goods such as food and clothing, leaving very little for capital goods. As a result, they will experience little, if any economic growth. On the other hand, rich countries such as the United States can afford to sacrifice some current consumption and invest in capital goods and thus will experience faster economic growth. The end result is a widening of the gap between poor countries and rich countries over time.

Figure 4 shows the PPF for a typical poor country and a typical rich country. A typical poor country such as Mali will choose a combination that produces mostly consumption goods and very little capital goods. Whereas a rich country like Singapore will choose a point that has a higher level of capital goods relative to consumption goods. The result is faster economic growth for Singapore, and slow economic growth for Mali.

Figure 4: Economic Growth and Dilemma for Poor Countries
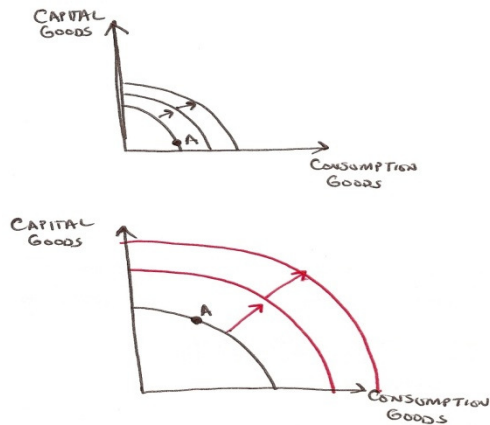
II. Interdependence and Gains from Trade
A. Specialization: Comparative and Absolute Advantage

An early economist, named David Ricardo came up with a theory called the **Theory of Comparative Advantage** which stated that individuals should specialize in what they do "best" in. But how do we determine who is "best" in a given task?

Let us introduce two terms that will help answer this question:
  (1) **Absolute Advantage:** A person (or nation) is said to have an absolute advantage of another if they can produce more of a good with the same amount of resources
  (2) **Comparative Advantage:** A person (or nation) is said to have a comparative advantage if they can produce a good at a lower *opportunity cost.*
It is easiest to see the distinction between these two terms by example.

Example 1

Suppose that Greg and Marsha are the only individuals that live in an island economy. These two individuals produce only 2 items economy: baskets of fruit and timber from cut trees. The following table summarizes the production on the island on a given day:

Table 1

	Baskets of Fruit	Number of Trees Cut
Greg	10	5
Marsha	30	10

The table says that if Greg spent the entire day gathering fruit he could gather 10 baskets, while if he spent the day cutting trees he could have cut 5 trees. Similarly, Marsha can gather 30 baskets of fruit on a given day, or she can cut 10 trees.

1. **Who has an absolute advantage of cutting trees?** Given the same resource (in this case 1 day) who can produce more trees? The answer is clearly Marsha. She can cut 10 trees in 1 day, while Greg can only cut 5 trees.
2. **Who has an absolute advantage of gathering fruit?** Again given the constraint of 1 day, Marsha can gather more fruit (30 baskets) than Greg (10 baskets).

In this island economy, **Marsha has an absolute advantage in gathering fruits AND in cutting trees.** Marsha can produce more of both goods in a given day, but does that mean she should produce both? Before we can answer that we have to see who has a comparative advantage in the two goods.

3. **Who has a comparative advantage of cutting trees?** Recall that by definition that a person has a comparative advantage if they can produce a good at a lower opportunity cost. We need to figure out what the opportunity cost is of cutting one tree is for both Greg and Marsha.

  • Opportunity Cost of Cutting Trees for Greg: If Greg spent the entire day cutting down trees, he is sacrificing 10 baskets of fruits that he could have been gathering. Thus the

opportunity cost of spending the day cutting down 5 trees is 10 baskets of fruit. We can write the opportunity cost as the following ratio:

10 baskets of fruits:5 cut trees

To figure out the opportunity cost of cutting 1 tree we can simply divide both sides by 5.

2 baskets of fruit:1cut tree

The opportunity cost for Greg of cutting 1 tree is 2 baskets of fruit.

- Opportunity Cost of Cutting Trees for Marsha: If Marsha spends the day cutting down trees, she is sacrificing 30 baskets of fruits that she could have been gathering. Thus the opportunity cost of spending the day cutting down 10 trees is 30 baskets of fruit. We can write the opportunity cost as follows.

30 baskets of fruits:10 cut trees

To figure out the opportunity cost of cutting 1 tree we can simply divide both sides by 10.

3 baskets of fruit:1cut tree

The opportunity cost for Marsha of cutting 1 tree is 3 baskets of fruit

Since the opportunity cost of cutting 1 tree is lower for Greg (2 baskets of fruit) than for Marsha (3 baskets of fruit) we say that **Greg has the comparative advantage in cutting down trees.**

4. **Who has a comparative advantage in gathering fruit?** We can do the exact same analysis for fruit as we did for trees. We need to calculate how many cut trees are sacrificed by gathering 1 basket of fruit.

- Opportunity Cost of gathering fruit for Greg: If Greg spent the day gathering fruit, he would sacrifice the 5 trees he could have cut.

5 trees:10 baskets of fruit or
½ tree: 1 basket of fruit

The opportunity cost for Greg of gathering 1 basket of fruit is ½ tree.

- Opportunity Cost of gathering fruit for Marsha: If Marsha spent the day gathering fruit, she would sacrifice the 10 trees she could have cut down.

10 trees:30 baskets of fruit or
1/3 tree: 1 basket of fruit

The opportunity cost for Marsha of gathering 1 basket of fruit is 1/3 tree

Since the opportunity cost of gathering a basket of fruit is lower for Marsha (1/3 tree) than for Greg (1/2 tree) we say that **Marsha has a comparative advantage in gathering baskets of fruit.**

Note that it is impossible for someone to have a comparative advantage in both goods. If an individual has a comparative advantage in one good, it **always** implies that the other individual will have the comparative advantage of the other good.

Now that we have a better understanding of what absolute and comparative advantage are, we can restate the theory of comparative advantage.

Key Point: Producers should specialize in the production of goods in which they have a comparative advantage. By specializing and trading society will be better off.

In our example, Greg should focus on cutting down trees while Marsha should specialize in gathering fruit. This will occur even though Marsha has an absolute advantage in the production of both products. In our next step we will see how specialization and trade can make an economy better off.

B. Gains From Trade

Example 2
We can illustrate graphically how specialization and trade can lead to both parties being better off.

Suppose that we have two cities, Boston and Chicago. Both cities produce two goods (red socks and white socks).

Table 2

	Quantity pairs of Red Socks produced in 1 day	Quantity pairs of White Socks produced in 1 day
Boston	3	3
Chicago	2	1

We see from Table 2 that Boston has an absolute advantage in produce both red socks and white socks.
Which city has the comparative advantage in producing a pair of red socks?
Calculate the opportunity cost of producing a pair of red socks.
Boston in 1 day could either produce 3 pairs of white socks or 3 pairs of red socks
3 pairs of white socks: 3 pairs of red socks
1 pair of white socks: 1pair of red socks
The opportunity cost to Boston of producing a pair of red socks is 1 pair of white socks.

Chicago in 1 day could either produce a pair of white socks of 2 pairs of red socks.

1 pair of white socks:2 pairs of red socks
½ pair of white socks: 1 pair of red socks
The opportunity cost to Chicago of producing a pair of red socks is ½ pair of white socks.

Thus Chicago has a comparative advantage in producing pairs of red socks and should specialize in its production.

Since Chicago has a comparative advantage in producing red socks, it must be true that Boston has a comparative advantage in producing white socks. We can quickly check this.

Boston in 1 day could either produce 3 pairs of white socks or 3 pairs of red socks
3 pairs of white socks: 3 pairs of red socks
1 pair of white socks: 1pair of red socks
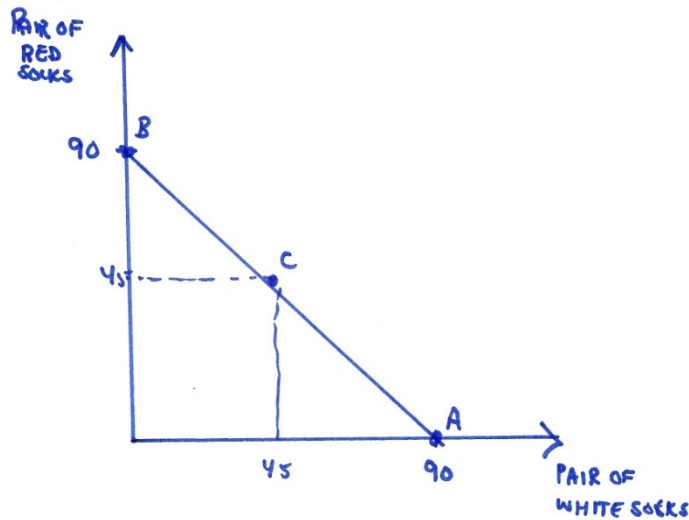The opportunity cost to Boston of producing a pair of white socks is 1 pair of red socks.

Chicago in 1 day could produce 2 pairs of red socks or 1 pair of white socks
The opportunity cost to Chicago of producing a pair of white socks is 2 pairs of red socks.

Boston has the lower opportunity cost to produce white socks and should specialize in white socks.

To start our gains from trade analysis, let's see what Boston and Chicago could produce in a given month (30 days) using our data from Table 2. Figure 1 illustrates Boston's production possibilities in a month. To graph we must first start at the end points. We need to figure out how much Boston would have produced if they spent the entire time producing only 1 good. For example, if Boston had spent every day gathering producing pairs of red socks, they would have produced 90 pairs of red socks (3 pairs x 30 days). This production possibility is marked as Point B in Figure 1. Conversely, if Boston had spent every day producing white socks, they would have produced 90 pairs of white socks trees (3 pairs x 30 days). This production possibility is marked as Point A. Thus we have our end points. Suppose that the city of Boston actually chooses to spend half its days producing red socks and the other half producing white socks. In other words, they'll spend 15 days producing red socks (45 pairs of red socks will be produced) and they'll spend 15 days producing white socks (45 pairs of white socks will be produced). We can show that production possibility as Point C in Figure 1. We can draw a line through all the production possibilities. Each point along the curve is a production option for Boston.

Figure 1: Boston's Production Possibilities (for 1 Month)

Note: The tradeoff between red socks and white socks is constant. That is if Boston spends the day producing red socks the will always have to sacrifice 3 pairs of white socks regadless. Since the opportunity cost is constant, the PPF for Boston is a straight line.

Figure 2: Chicago's Production Possibilities (for 1 Month)
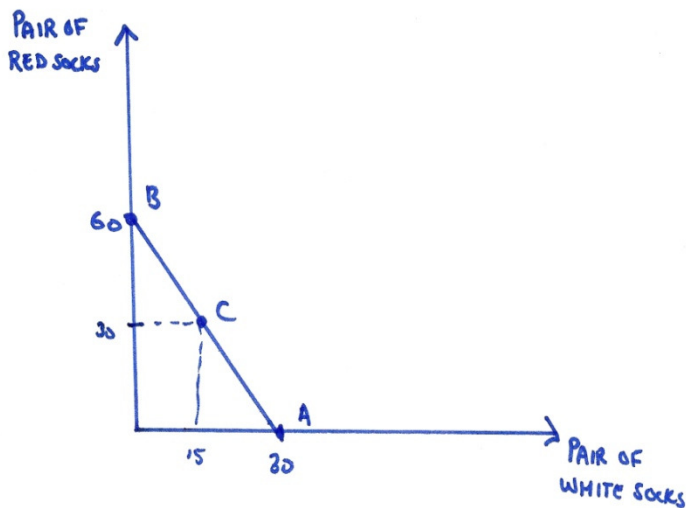
Consider if Chicago spent all 30 days producing pairs of red socks then they would have produced 60 pairs over the course of the month (Point B). If the city had spent the entire month producing pairs of white socks then they would have produced a total of 30 pairs of white socks in a month (Point A). Suppose that in actuality, Chicago decides to divide its time equally between red socks and white socks. If that were true then Chicago would produce 30 pairs of red socks and 15 pairs of white socks (Point C in Figure 2).

If we assume that both Boston and Chicago divided their time equally between the two tasks then the total amount produced in the economy will be 75 pairs of red socks (45 produced by Boston and 30 produced by Chicago) and 60 pairs of white socks will be produced (45 produced by Boston and 15 by Chicago).

Now we can illustrate how the theory of comparative advantage can lead to gains. Recall that we saw earlier that Boston should specialize in producing pairs of white socks, and that Chicago should specialize in producing pairs of red socks. Suppose that Boston spends the majority of its time producing pairs of white socks. Suppose it devotes 7 days producing red socks (total of 21 red socks produced) and 23 days producing white socks (total of 69 pairs produced). Meanwhile, Chicago will spend its entire time producing red socks, so that 60 pairs of red socks are produced.

The cities of Boston and Chicago will now come together and negotiate a trade agreement.

Suppose that the cities agree to exchange 18 pairs of white socks for 27 pairs of red socks.

After the trade agreement, Boston will send 18 pairs of white socks to Chicago and get 27 pairs of red socks in return.

Chicago will now have 18 pairs of white socks (received from Boston) and 33 pairs of red socks (after they have given the 27 pairs to Boston). Note that Chicago is able to consume more of both red socks and white socks than when they were self-sufficient. This is shown as Point D on Figure 3. Notice that Point D lies outside the PPF we had drawn earlier. Chicago is now able to consume a point outside its PPF. Chicago is clearly better off from the trade.

Boston, after the trade, will have (69 white socks – 18 white socks = 51 white socks), while it will have (21 red socks + 27 red socks = 48 red socks). Boston will also be better off, they can consume the same amount of white socks but more red socks compared to if they were self-sufficient. Again, the consumption point for Boston lies outside the PPF (Point D).

Figure 3: Gains from Trade for Boston

Figure 4: Gains from Trade for Chicago

PAIR OF
RED SOCKS

B

60

33 ---------- D

30 - - - - C

A

'5 '3   30   PAIR OF
WHITE SOCKS