

Production Possibilities Curve (a.k.a. Production Possibilities Frontier)

Let's use the **Production Possibilities Curve (PPC)** to examine opportunity cost.

PPC - shows the maximum amount of goods and services that can be produced, **for a given level of technology and resources**.

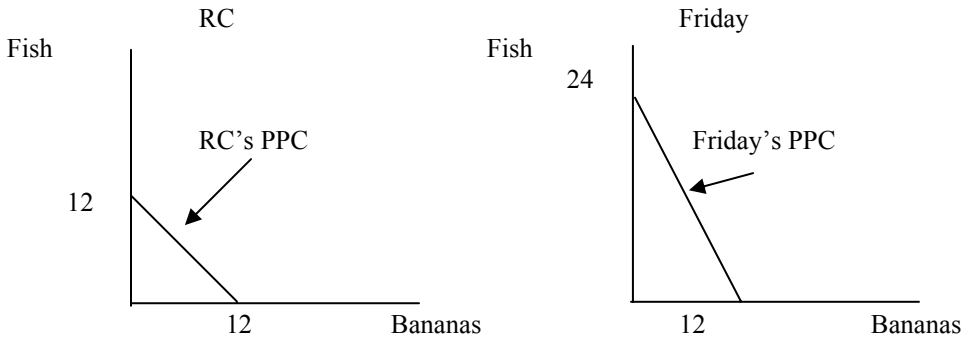
Suppose we are on a deserted tropical island, with Robinson Crusoe (RC) and Friday. There are only two activities to spend time on, banana gathering and fishing. Each person has specific productive abilities.

PPC can be represented numerically and graphically (and algebraically if you want). We'll suppose the following figures represent the possible production, say from a day's work, that RC and Friday can achieve. Ignore the arrows for a bit.

<u>RC</u>			<u>Friday</u>		
	Fish	Bananas		Fish	Bananas
	12	0		24	0
or	11	1	or	22	1
or	10	2	or	20	2
	.	.		.	.
or	1	11	or	2	11
or	0.5	11.5	or	1	11.5
or	0	12	or	0	12

We will assume that all other linear combinations of production can occur. That is, we will connect the dots. Thus, we are assuming that half or even a 10<sup>th</sup> of a banana can be produced. Don't worry about this.

See below for the graphical representation.



Those points on or inside the PPC are feasible (possible). Points outside the PPC are unattainable (not possible). Points inside the PPC are inefficient, as society is not producing as much output as is possible with the given resources and technology. We could do better. Points actually on the PPC are efficient (society can do not better with the resources and technology). For an example of inefficient use of resources, consider Mark McGwire cooking meals for people, and Julia Child hitting clean up for the Cardinals. Do you think we could arrange resources differently and get more recipes and homeruns? See also the example about meals and pianos later in these notes for a numerical example.

Notice how scarcity is depicted. If RC wants more fish, he must produce fewer bananas. If he wants additional bananas, he must give up fish. (The PPC slopes downward)

Also, we have drawn a linear PPC. That is, the opportunity cost of producing a banana remains constant as we produce more and more bananas. This keeps the math simple, and we'll do this unless mentioned otherwise (I'll be sure to tell you).

### Absolute Advantage

People often get **absolute advantage** confused with **comparative advantage**. To determine who has the **absolute advantage** in an activity, we have both people completely specialize in that activity. Whoever is capable of producing the most of the good has the absolute advantage.

**Specialization** – producing a bundle different than the bundle you consume

**Complete specialization** – spending all time producing only one good

Note: we will not see complete specialization in consumption. This would require someone to consume only one good. This is very unlikely to occur, as we all consume a multitude of goods (clothes, ice cream, chick peas, liver). Imagine eating only SPAM, or wearing only wool clothing.

Thus, Friday has the absolute advantage in fish production, as when he completely specializes in fish production (produces only fish), he produces 24 F, whereas if RC completely specializes in fish production, he is only able to produce 12 F.

Neither has an absolute advantage in banana production, as they both produce 12 bananas if completely specializing in banana production.

That being said about absolute advantage, it will be the comparative advantage that determines who produces what, as we shall see later. It seems like absolute advantage is the way to go, but it isn't always the case at all. Read on...

### Opportunity Costs / Comparative Advantage

Recall that opportunity cost is the highest valued foregone alternative. In this example, deciding what is the highest foregone alternative is easy, as there are only two activities, fishing and banana gathering. If you produce more bananas, you are producing fewer fish.

#### Bananas

What does RC give up when he desires to produce one additional banana? One fish. RC's opportunity cost of producing a banana is 1 fish. See RC's PPC – notice the arrow from (12 F, 0 B) to (11F, 1B).

What must Friday give up if he produces an additional banana? 2 fish. Friday's opportunity cost of producing a banana is 2 fish. See Friday's PPC – notice the arrow from (24F, 0B) to (22F, 1B).

#### Fish

What is RC's opportunity cost of producing a fish? 1 banana.

What is Friday's opportunity cost of producing a fish?  $\frac{1}{2}$  banana.

Back to bananas. Consider who we should have producing bananas. If RC produces a banana, he must give up 1 fish. However if Friday produces a banana, he must give up 2 fish. RC is a relatively better banana gatherer, as he must give up only 1 fish to produce a banana, while it costs Friday 2 fish to produce a banana. We say RC is the low cost producer of bananas, as he has the lowest opportunity cost of producing bananas. It is smart, then, to have RC gather bananas.

We say that RC has a **comparative advantage** in production of bananas, because he is the low (opportunity) cost producer of bananas.

People (or nations) should **specialize in production of the good in which they have a comparative advantage**. As we shall see below in the example, if people or nations specialize in production of the good in which they have a comparative advantage in, and then trade, society as a whole will be made better off. There will be extra output that is created from rearranging production from the low-cost producer to the high-cost producer. We call this extra output the **gains from trade**. More on this later...

Now the fish. Friday has a lower opportunity cost of producing a fish than RC does (1/2 B vs. 1 B). We thus say that Friday is the low cost producer of fish. Thus, Friday has a comparative advantage in fish production. To produce an additional fish, he must give up only 1/2 B while RC must give up 1 B to produce an additional fish.

Note: it will always be the case that if person A has the comparative advantage in one good, person B has the comparative advantage in the other good. (In the unlikely case where both have the same opportunity costs, neither will have a comparative advantage in either activity. Each is equally good).

Even in the case where person A has an absolute advantage in both goods (person A is absolutely better at producing both goods), person B will still have a comparative advantage in one of the goods, and thus A and B will benefit from trading. Or in other words, just because the US may be able to produce beer and marijuana absolutely better than Mexico, that does not mean we should isolate ourselves from trading with Mexico. In fact, Mexico likely has a comparative advantage in marijuana, and hence we should trade for Mexican marijuana. Mexico is bad in both activities, but they will specialize in the activity in which they are relatively less bad. Both the US and Mexico will be better off from this trade.

Specialization and Exchange in Action – this should convince you that comp. advantage isn't silly

**Autarky**

**Autarky** is just another term for self-sufficiency. Here RC and Friday consume (eat) the same bundle of goods that they produce (gather and catch). That is, no specialization, no exchange.

For a starting point (although arbitrary) we will begin with each person spending half of his time on each activity. We will compare this outcome to the specialization and exchange outcome.

	Production = Consumption	
	Fish	Bananas
Friday	12	6
Crusoe	<u>6</u>	<u>6</u>
Total	18	12

**Specialization and Exchange**

Friday, having taken Econ 211 and having learned about comparative advantage, has an idea. He realizes that Friday has the comparative advantage in fishing (is a relatively better fisherman than Crusoe), and realizes that Crusoe is the relatively better banana producer. Friday says to Crusoe, "I am a good fisherman, and you're a good banana gatherer. Why don't you stop fishing, and spend all your time gathering bananas. I spend lots of time fishing, and then I'll trade you fish for bananas."

	Production		Exchange		Consumption	
	Fish	Bananas	Fish	Bananas	Fish	Bananas
Friday	20	2	-7	+5	13	7
Crusoe	<u>0</u>	<u>12</u>	+7	-5	<u>7</u>	<u>7</u>
Total	20	14	0	0	20	14

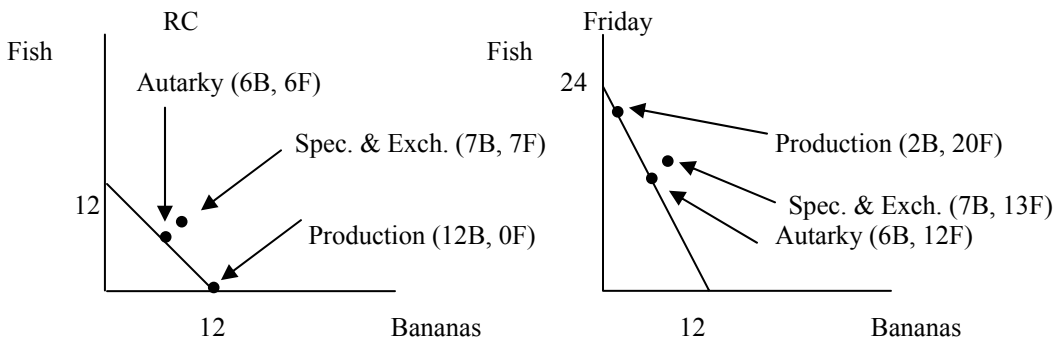
They agree to produce the above combinations, which of course are points on their individual PPCs (I am not cheating), and then agree to trade, as outlined above.

Compare to autarky. There is an extra 2F and 2B produced. Each of RC and Friday gets to consume an extra banana and an extra fish. Neither is working any more or working any harder. No new resources have been discovered. Is it that trade that is productive? Yep. We call the extra stuff produced the “**gains from trade**”. The gains from trade are literally the extra two bananas and fish produced (and consumed).

Where do the extras come from? Why do we say trade is productive?

Specialization enables Crusoe to cut back on his high cost activity (fishing) and expand time spent on his low cost activity (banana gathering.) Likewise, specialization allows Friday to spend extra time on his low cost activity (fishing) and cut back on his high cost activity (gathering bananas). Each spends more time on the activity that they are “relatively good” at. By specializing, and producing the good in which they have a comparative advantage, each gains. **However, it is trade that allows them to specialize. You can’t have specialization without exchange.** RC will never agree to spend all his time producing bananas unless he can trade with Friday (he doesn’t want to eat all bananas). It is the act of exchange (trade) that allows the specialization to occur, which allows the extra output to be produced. We say **trade is productive**.

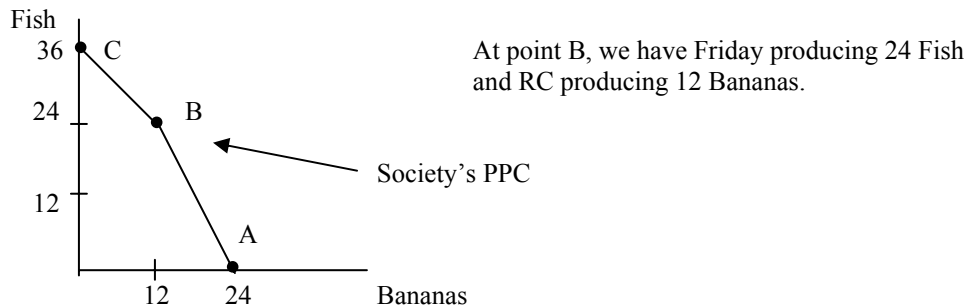
Another look at the PPC



Trade allows both people to consume at a point that was outside their PPC; that is, they get to consume at a point that was previously unattainable (opportunities have been expanded). Neato! Trade is good!

Society’s PPC – how do we combine individuals’ PPCs to get the economy as a whole?

There are three important points on society’s PPC. First, have both people completely specialize in banana production (A). Then, both people completely specialize in fish production (C). Finally, have each person completely specialize in the activity in which they have the comparative advantage (B). Connect the dots, but notice there is a kink at point B. Your curve should bow outwards.



Why? Suppose that society decides that it wants 30 fish and as many bananas as possible. How should it arrange production? First, it makes sense to have Friday produce as many fish as possible, as he is the low-cost producer of fish. He will spend all of his time producing fish, and then, since society wants even more fish (Friday can only produce 24), only then will RC begin to produce fish (he is the high-cost producer of fish). Thus, we want to exhaust the production of the low-cost producer before we have the high cost

producer (there kink is where the low cost producer is exhausted). Thus, for points on the upper section of the PPC (if society wants lots of fish), Friday will always be producing 24 fish. Any number of fish beyond 24 would come from RC.

If society wanted lots of bananas, the logic is just the same. First, exhaust the low-cost producer, then bring in the high-cost producer. If society wanted 18 bananas and as many fish as possible, first have RC (low-cost) produce as many as he can, then have Friday (high-cost) begin producing bananas. Thus, on the lower section of the PPC, RC is always producing 12 bananas. See below for more details.

What if we want 12 fish and as many bananas as possible?

What if we want 8 bananas and as many fish as possible?

If you have each person specialize in the wrong activity, you will get a kink, but this will make your PPC bowed inward. You will end up at an inefficient point. Don't do this, it is the commie bastard point.

How do I know what point along the PPC that society will choose?

Answer: Beats me, take Econ 314. It depends on how society puts relative values on fish and bananas. If they like fish a great deal compared to bananas, we'd expect something on the upper half, and vice-versa.

Draw your self the following PPC. Put tanks (GI Joe type tanks) on the vertical axis, and cars on the horizontal axis. Now choose a point that society might choose for the year 1939. Any old point will do.

Do you think that US society would choose a different point in 1944 than they did in 1939? Does this have something to do with a different relative value of tanks versus cars in 1939 versus 1944? Why might the relative value have changed? Hint: Pearl Harbor.

Other tips / reminders

- The opportunity cost of one activity is always measured in terms of the other good. That is, if you want to know the opportunity cost of producing a banana, it is always measured in terms of fish.
- If one person has a comparative advantage in one activity, the other person must have the comparative advantage in the other activity. (Even if one person has an absolute advantage in both goods).
- If you calculate a person's opportunity cost of one activity, that person's opportunity cost of the other activity is the reciprocal of the first. For example,

Friday's opportunity cost of producing a B = 2F

Friday's opportunity cost of producing a F =  $\frac{1}{2}$  B

- There is a short cut method to determine the opportunity cost of each activity without writing out the whole production possibilities chart. So long as we have linear PPCs (and we will for these types of questions), use the endpoints to determine the opportunity costs.

For Friday, the endpoints are (0B, 24 F), and (12B, 0F). Suppose initially, Friday is producing 0 fish and 12 bananas. Now, he decides to produce 24 fish. What must he give up in order to produce the 24 fish? All 12 bananas.

Thus, Friday's opportunity cost of producing 24 F must be 12 B. Divide each by 24. Thus, his opportunity cost of producing 1 F =  $12 B / 24 = \frac{1}{2} B$ .

Likewise, the opportunity cost of 12 B is 24 F. Divide by 12. Thus, the opportunity cost of 1B =  $24 F / 12 = 2 F$ .

(The mathematically inclined will realize that I am looking at the absolute value of the slope of the PPC. The rest of you needn't worry.)

### Society's PPC – is there more to learn?

Recollect some stuff we talked about already. The low cost producer of bananas is RC (1 fish vs. 2 fish). Likewise, the low cost producer of fish is Friday (1/2 banana vs. 1 banana). Thus we concluded that **Friday has the comparative advantage in fish production**, and **RC has the comparative advantage in banana production**. That is, Friday is relatively better at fish production and RC is relatively better at banana production.

Flip to the next page and take a look at society's PPC, which is drawn. Let's think about how it is drawn. Suppose we decide that society, for argument's sake, starts out with a desire to eat only bananas. Thus, society will have both RC and Friday produce bananas, resulting in 24 bananas total (the bottom of society's PPC).

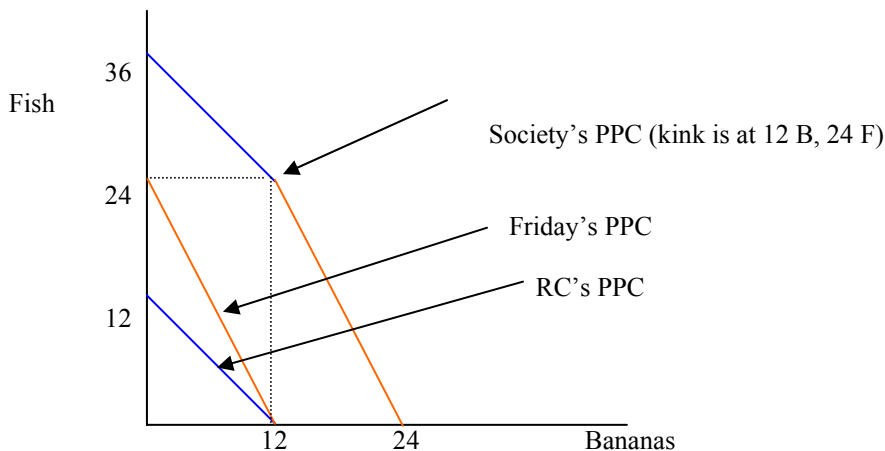
Now, suppose society decides to eat one fish. In this case, the question becomes – who should switch over to fish production? The answer is - the person who has the comparative advantage in fish production, Friday. (Why? Friday must only give up 1/2 banana to produce the fish where as RC would have to give up 1 banana to produce the fish). Friday produces 1 fish and 11.5 bananas, while RC continues to produce only 12 bananas.

Suppose we want a second fish? It still makes sense to have Friday produce it. Friday produces 2 fish (and 11 bananas), while RC still produces 12 bananas. Hmmmn... it's like we're sliding Friday along his PPC, while RC is always producing 12 bananas.

Say we want 24 fish? Still have Friday produce all 24 fish (while RC produces 12 bananas).

Suppose society wants 25 fish? We can't continue to slide Friday along his PPC, as he's hit the end. Here, finally, we have exhausted the low-cost producer of fish (Friday). He can only produce 24 fish in a day. If we want a 25<sup>th</sup> fish, we must have RC switch some of his time from banana production to fish production. But wait – RC does not have a comparative advantage in fish production – why would we have him produce fish? It is only after we exhaust the low cost producer (Friday), do we allow the high cost producer to produce fish. We slide along **RC's** PPC by one fish now.

If we want a 26<sup>th</sup> fish, again, we slide along RC's PPC.



### What's the point?

Along different portions of society's PPC, we are moving along one individual's PPC. On the top of the two person's PPC, we are moving along RC's. Along the bottom, we are moving along Friday's. Look at the picture again. Look at the colors.

### What then happens as we add a third person? How would we construct a 3-person PPC?

Here, there will be 4 relevant points. 2 endpoints, and 2 kinks. Suppose we start with everyone producing bananas. Now, society decides we'd like some fish. Who should we switch to fish first? The lowest-cost producer of fish. What if society wants more fish than the low cost producer can produce? Have the 2<sup>nd</sup> lowest cost producer of fish switch over to fish production. Even more? Finally, switch the third person over (which will get you the other endpoint).

As we add in thousands of people of different abilities, there will be thousands of kinks, and thousands of different opportunity costs along the PPC. Yet, at every point on the PPC we'd be moving along someone's PPC. With all these people, at least approximately, it will look like a smooth curve.

### What's the big picture? Why is the PPC curved?

As we want to produce more and more of one good, we're going to have to use of resources (factors or production) that are less and less well suited to production of the good. When we wanted fish, first we used Friday, who was well suited for fish production, then RC, who was not as well suited for fish production.

Suppose we are starting WWII. We decide we need to produce some tanks. At first, it is easy to find civilian factories to convert to tank factories. First, we switch over car factories. Then, if we need still more tanks, we switch over tractor factories, etc. However, if we still need more, now we need to switch over toy factories, then mattress factories, then pizza stores, which are not well suited to produce tanks. Then daycare centers. Then art schools.

**As we produce more and more of a good, the resources that are being used to produce it will be less suited to its production, and thus the opportunity cost of producing it will increase.**

For another example, as we need more home runs, first we switch Mark McGwire, then Sammy Sosa, then Michael Jordan, then Dan Dierdorf, then Brian Boitano, then Mini-me, then the guy in a coma at the hospital?

Or stated another way, some factors of production are better suited to produce one good, rather than another.

Consider various methods to produce a pizza. We could use a nice brick pizza oven. Say we run out of brick ovens and need more pizzas. We could switch over conventional ovens. Out of these? How about the hood of my overheating car? Then a bunch of hairdryers? A bunch of magnifying glasses on a sunny day? How about a blast furnace? Each is less suited for pizza production.

If you want to see more about this (did the horse stop breathing 3 pages ago?), check out the textbook on p. 4 again. Here is a curved PPC with some nice numbers. This is the example about factory goods and farm goods.

### One last bit about PPCs

Notice that that the PPC holds technology and the amount of productive resources constant. If we add resources (factors of production) or improve technology, this will shift the whole PPC outward (away from the origin). This is economic growth. If a horrific plague kills half of the labor force, the PPC will shift inward. This is economic contraction. One of the more important topics we'll worry about is exactly what causes the PPC to shift out. That is, what causes **economic growth**?

Start with a nice curved PPC and sketch what happens if each of the following happens.

What if we add resources (labor or capital)?

What if we improve technology?

What if we improve banana producing technology, but this change doesn't affect fish production?

What if we improve fish producing technology, but this change doesn't affect banana production?

What if workers are identical (in their productive abilities)?

If you have trouble here, assume both Friday and RC can produce 24 F or 12 B in a day. Draw society's PPC now. Does anyone have a comparative advantage?

**What should I read?**

Chapter 2. It's OK. Steer clear of the discussion of economic growth for now. We'll come back to this when we discuss some Macroeconomic topics later in the semester.