The PPF and Gains from Trade - Examples

1 The PPF and Opportunity Costs

The production possibilities frontier (PPF for short) shows all the different possible attainable combinations of the production of two goods. Any point that is along the PPF is both efficient (uses our resources to the best of our ability) and feasible (can be reached given our current resources). The slope of the PPF at any given point is the opportunity cost of production. More specifically, it shows how much of one good we have to give up in exchange for one more unit of the other good.

Take, for example, the PPF in Figure 1. Here our economy is simplified to two goods — guns and butter. For further simplification, we’ll assume that the PPF is a straight line (we have a constant opportunity cost). If we dedicate all our time to making guns, we can produce 50 guns a day. This is illustrated by the intercept at 50 on the “guns” axis. On the other hand, if we dedicate all our time to making butter, we can produce 100 pounds of butter per day, illustrated by the intercept at 100 on the “butter” axis. To calculate the opportunity costs, we look at how much of each good we have to give up to make more of

\[\text{Figure 1: An example PPF using guns and butter.}\]

\[\text{Change in # of Guns Produced}\]
\[\text{Change in Lbs. of Butter Produced}\]

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1Disclaimer: This handout has not been reviewed by the professor. In the case of any discrepancy between this handout and lecture material, the lecture material should be considered the correct source. Despite all efforts, typos may find their way in - please read with a wary eye.
the other. Using the formula in the class notes:

\[
\text{Opportunity cost of producing guns} = \frac{\text{decrease in production of butter}}{\text{increase in production of guns}}
\]

\[
\text{Opportunity cost of producing butter} = \frac{\text{decrease in production of guns}}{\text{increase in production of butter}}
\]

1.1 Example: Calculating the opportunity costs of guns and butter

Let’s use the graph in Figure 1. What is the opportunity cost of producing one more gun?

\[
\text{Opportunity cost of producing guns} = \frac{2 \text{ lbs butter}}{1 \text{ gun}}
\]

That means that each gun we make “costs” two pounds of butter. If the PPF is a straight line, an easy way to calculate this is:

\[
\text{Opportunity cost of producing guns} = \frac{\text{lbs. of butter we can make if we make only butter}}{\# \text{ of guns we can make if we make only guns}} = \frac{100 \text{ lbs butter}}{50 \text{ guns}} = \frac{2 \text{ lbs butter}}{1 \text{ gun}}
\]

Similarly, we can find the opportunity cost of producing one more pound of butter:

\[
\text{Opportunity cost of producing butter} = \frac{\# \text{ of guns we can make if we make only guns}}{\text{lbs. of butter we can make if we make only butter}} = \frac{50 \text{ guns}}{100 \text{ lbs butter}} = \frac{1/2 \text{ guns}}{1 \text{ lb butter}}
\]

This tells us that each pound of butter “costs” a half of a gun. We could also compare two points on the PPF to get the same result. For example, what’s the opportunity cost of moving from producing 40 to 60 pounds of butter per day (i.e. increasing butter production
by 20 pounds)?

\[
\text{Opportunity cost} = \frac{(\# \text{ of guns made at 40 lbs of butter}) - (\# \text{ of guns made at 60 lbs of butter})}{20 \text{ lbs of butter}}
\]

\[
= \frac{30 \text{ guns} - 20 \text{ guns}}{20 \text{ lbs butter}}
\]

\[
= \frac{10 \text{ guns}}{20 \text{ lbs butter}}
\]

We have to give up 10 guns to make another 20 pounds of butter, which, after simplification, yields the same trade-off rate that we found before (1/2 gun for each pound of butter).

## 2 Finding Comparative Advantage

We say someone (or some country) has a **comparative advantage** in production when its *opportunity cost of producing a good is lower*. When comparative advantage exists (and it basically always does), the two parties can both potentially benefit from specialization and trade at an agreed upon rate of exchange (or “price”).

### 2.1 Example: PPFs, Opportunity Costs, and Gains from Trade for France and Sweden

We have two countries, France and Sweden, with the PPFs shown in Figure 2. Let’s look at the opportunity cost (OC) of guns in each country. To make things easier to understand, I’m going to simplify the fractions until everything is in terms of 1 more gun or 1 more pound of butter.

\[
\text{OC of guns in France} = \frac{2 \text{ lbs of butter}}{1 \text{ gun}}
\]

\[
\text{OC of guns in Sweden} = \frac{2 \text{ lbs of butter}}{5 \text{ guns}} \rightarrow \frac{2/5 \text{ lbs of butter}}{1 \text{ gun}}
\]

It costs France 2 pounds of butter to make one gun (or put another way, France gets 2 additional pounds of butter for each gun it gives up), and it costs Sweden \(\frac{2}{5}\) pounds of butter
to make one gun. Now let’s look at the OC of butter.

\[
\begin{align*}
\text{OC of butter in France} &= \frac{1 \text{ gun}}{2 \text{ lbs butter}} \rightarrow \frac{1}{2} \text{ guns} \\
\text{OC of butter in Sweden} &= \frac{5 \text{ guns}}{2 \text{ lbs butter}} \rightarrow \frac{5}{2} \text{ guns}
\end{align*}
\]

It costs France \( \frac{1}{2} \) of a gun to make one more pound of butter, while it costs Sweden \( \frac{5}{2} \) of a gun to do so.

France has a comparative advantage in butter, since the opportunity cost of producing one more pound of butter is lower (in terms of guns) that Sweden’s \( \left( \frac{1}{2} \text{guns} < \frac{5}{2} \text{guns} \right) \), while Sweden has a comparative advantage in guns. In other words, to make one more pound of butter, France has to give up fewer guns than Sweden, and to make one more gun, Sweden has to give up less butter than France. The two countries can “gain from trade” if each specializes and produces only the good in which they have a comparative advantage and then trades with the other. So France should make only butter (thus making a total of 16 lbs of butter) and Sweden should make only guns (thus making a total of 10 guns). Then the two countries can trade with each other so they each get some of both goods.
2.2 Example: A Dinner Trade Between Roomates

Mike and Steve live together. Their PPFs are shown in Figure 3, which illustrates their trade-offs for making either hotdogs or cupcakes for dinner. Mike’s opportunity costs are pretty easy to calculate — there’s a direct 1 to 1 trade between producing hotdogs and cupcakes. Let’s look at Steve’s.

\[
\text{OC of cupcakes for Steve} = \frac{8 \text{ hotdogs}}{10 \text{ cupcakes}} = \frac{4 \text{ hotdogs}}{5 \text{ cupcakes}} \rightarrow \frac{4/5 \text{ hotdogs}}{1 \text{ cupcake}}
\]

Each cupcake Steve produces means he has to give up 4/5 hotdogs. His OC of hotdogs is

\[
\text{OC of hotdogs for Steve} = \frac{5/4 \text{ cupcakes}}{1 \text{ hotdog}}
\]

Steve has to give up 5/4 cupcakes for each additional hotdog he wants to produce.

Who has comparative advantage in what? Mike has a lower opportunity cost of making hotdogs than Steve does \((1\text{ cupcake for Mike} < \frac{5}{4} \text{ cupcakes for Steve})\), so he has a compar-
ative advantage in hotdogs. Conversely, Steve has a comparative advantage in cupcakes \((1 \text{hotdog for Mike} > \frac{4}{5} \text{ hotdogs for Steve})\). So Mike should make only hotdogs, Steve should make only cupcakes, and they can trade to get a bit of each.

### 2.2.1 Showing Trade Can Make People Better Off

Before Steve moved in, Mike lived by himself, and every meal he made himself his favorite feasible and efficient combination of hotdogs and cupcakes — 5 cupcakes and 5 hotdogs \((5,5)\). When Steve lived alone, he would make himself his own favorite feasible and efficient combination — 5 cupcakes and 4 hotdogs \((5,4)\). After they moved in together, Steve, being an economist, suggested they each specialize and then trade. At the end of an hour, Mike had 10 hotdogs and Steve had 10 cupcakes. How do we know that they can trade and make someone better off than they were before?

Say they agree to trade at a rate of 1 cupcake per hotdog. Mike would be okay with that, because it costs him just as much to trade them as it would to make them himself, and Steve is okay with it too, since he’s getting hotdogs for lower than his own opportunity cost. After all, he’s trading 1 cupcake for 1 hotdog vs. giving up 5/4 cupcakes for 1 hotdog if he produced it himself. After trading away 5 hotdogs, Mike is back to his original \((5,5)\); he’s at least as well off as he was before. Steve is BETTER off, since after trading away 5 of his 10 cupcakes, he now has \((5,5)\), which is more hotdogs than he had before . . . without losing any cupcakes!

You might wonder if this is fair to Mike. After all, Steve seems to have gotten all the benefit. But there are ways to make them both better off. We could change the prices a bit, or we could say Mike and Steve split that extra hotdog rather than giving the whole thing to Steve. But no matter what, if there is comparative advantage, we can use trade to make at least one person better off without making the other worse off.