2.7: The Production Possibilities Frontier

Learning Objectives

- Explain the production possibilities frontier

Just as individuals cannot have everything they want and must instead make choices, society as a whole cannot have everything it might want, either. Economists use a model called the production possibilities frontier (PPF) to explain the constraints society faces in deciding what to produce.

As you read this section, you will see parallels between individual choice and societal choice. There are more similarities than differences, so for now focus on the similarities.

While individuals face budget and time constraints, societies face the constraint of limited resources (e.g. labor, land, capital, raw materials, etc.). Because at any given moment, society has limited resources, it follows that there's a limit to the quantities of goods and services it can produce. In other words, the products are limited because the resources are limited.

Suppose a society desires two products: health care and education. This situation is illustrated by the production possibilities frontier in Figure 1.

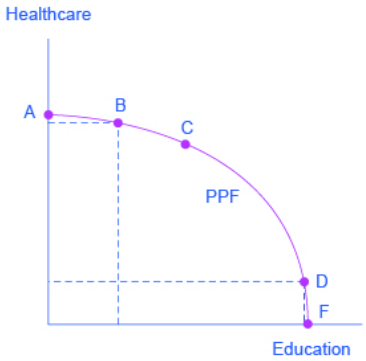

Figure 1. A production possibilities frontier showing health care and education.

Health care is shown on the vertical (or y) axis, and education is shown on the horizontal (or x) axis. Where does the PPF come from? It comes from the production processes for producing the two goods, and the limited amounts of resources available to use for that purpose. For example, suppose one teacher can teach 25 students in school. If society has a total of 10 teachers, education can be provided to a maximum of 250 students. We would say one teacher could "produce" 25 students worth of education using the education processes available.

Suppose a society allocated all of its resources to producing health care. That is certainly one possible way of allocating a society's resources, but it would mean there would be no resources left for education. This choice is shown in Figure 1 at point A. Similarly, the society could allocate all of its resources to producing education, and none to producing healthcare, as shown at point F. Alternatively, the society could choose to produce any combination of health care and education shown on the production possibilities frontier. In effect, the production possibilities frontier plays the same role for society as the budget constraint plays for an individual consumer. Society can choose any combination of the two goods on or inside the PPF. However, it does not have enough resources to produce outside the PPF.

Most importantly, the production possibilities frontier clearly shows the tradeoff between healthcare and education. Suppose society has chosen to operate at point B, and it's considering producing more education. Because the PPF is downward sloping from left to right, the only way society can obtain more education is by giving up some health care. That's the trade-off this society faces. Suppose it considers moving from point B to point C. What would be the opportunity cost for the additional education? The opportunity cost would be the health care that society has to give up.

Do you remember Charlie choosing combinations of burgers and bus tickets within his budget constraint? In effect, the production possibilities frontier plays the same role for society as the budget constraint plays for Charlie. Society can choose any combination of the two goods on or inside the PPF, but it doesn't have enough resources to produce outside the PPF. Just as with Charlie's budget constraint, the opportunity cost is shown by the *slope* of the production possibilities frontier.

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Watch It

Take another look at the production possibilities frontier in this video about the imaginary “Econ Isle.”

A link to an interactive elements can be found at the bottom of this page.

Differences between a Budget Constraint and a PPF

We’re now ready to address the differences between society’s PPF and an individual’s budget constraint.

A budget constraint shows the different combinations of goods and services a consumer can purchase with their fixed budget. A production possibilities frontier shows the possible combinations of goods and services that a society can produce with its limited resources. The first difference between a budget constraint and a production possibilities frontier is that the PPF, because it’s looking at societal choice, is going to have much larger numbers on the axes than those on an individual’s budget constraint.

The most important difference between the two graphs, though, is that *a budget constraint is a straight line, while a production possibilities curve is typically bowed outwards*, i.e. concave towards the origin. The reason for this difference is pretty simple: the slope of a budget line is defined as the ratio of the prices of the two goods or services. No matter how many of each good or service a consumer buys, the prices stay the same. By contrast, the slope of a PPF is the cost to society of producing one good or service relative to the other good or service. When society reallocates resources from one product to another, the relative costs change, which means the slope of the PPF does also. Let’s dig into this.

To understand why the PPF is curved, start by considering point A at the top left-hand side of the PPF. Considering the situation in Figure 1 (shown again below), suppose we have only two types of resources: doctors and teachers. At point A, all available resources (i.e. all the doctors and all the teachers) are devoted to providing health care and none is left for education. Say the doctors are practicing medicine and the teachers are helping out as best they can. This situation would be extreme and even ridiculous. For example, children are seeing a doctor every day, whether they’re sick or not, but not attending school. People are having cosmetic surgery on every part of their bodies, but no high school or college education exists!

Now imagine that some of these resources are diverted from health care to education, so that the economy is at point B instead of point A. What type of resources are going to move to producing education? The doctors are good at medicine, but they’re not particularly good at teaching, so it doesn’t make sense for them to switch. The teachers, though, are good at education, and not very good at healthcare. After all, that’s not what they were trained for. So it makes sense for teachers to be reallocated from healthcare to education. And when they move, the society doesn’t lose much healthcare, because the teachers weren’t very good at that. But the amount of education gained is great, because that’s what teachers are trained for. What this means is that from point A to B, the decrease in healthcare is small, while the gain in education is large. Graphically, the rise is small and the run is large so the slope (which is the ratio of rise over run) is flat. In other words, the opportunity cost of education in terms of healthcare is low.

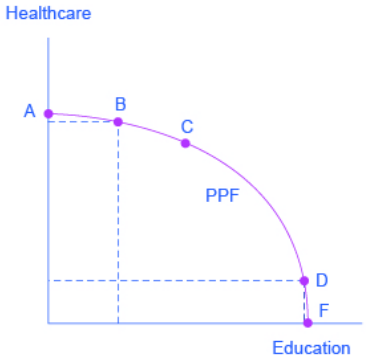

Figure 1 (shown again). A production possibilities frontier showing health care and education.

If we started at the other end of the PPF at point F and moved to point D, we would be moving doctors from teaching to healthcare with the result that the gain in healthcare would be large while the loss in education would be small (the same logic we used above). In short, the slope of the PPF from point F to D would be steep, and the opportunity cost of education in terms of healthcare would be high.

More generally, as society produces more and more of some good or service, the cost of production grows larger and larger relative to the cost of producing other goods or services. Thus, the slope of a PPF starts flat and becomes increasingly steeper. In the real world, of course, we have more than two goods and services, and we have more resources than just labor, but the general rule still holds.

There's another way to think about this. For consumers, there is only one scarce resource: budget dollars. As we choose more of one good and less of another, we are simply spending dollars on different items, but every dollar is worth the same in purchasing any item. For society, there are many scarce resources. In our simple example above, there were two different resources: doctors and teachers, and each resource is better at one job than at the other. In other words, each resource is not worth the same at producing different products. The general rule is when one is allocating only a single scarce resource, the trade-off (e.g. budget line) will be constant, but when there is more than one scarce resources, the trade-off will be increasingly costly (e.g. the PPF).

Watch It

Watch this video to see another explanation as to why the PPF is curved.

A link to an interactive elements can be found at the bottom of this page.

The Law of Diminishing Returns and the Curved Shape of the PPF

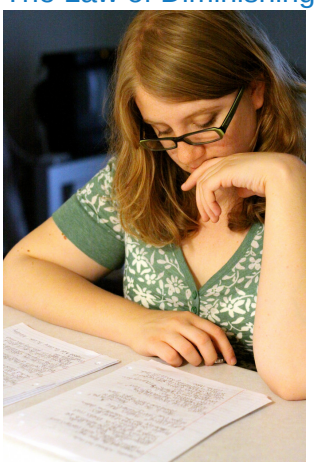

Figure 2. If you've ever pulled an all-nighter, you're probably familiar with the law of diminishing returns: as the night wears on and you get tired, every additional hour you study is a little less productive than the one before.

The lesson is not that society is likely to make an extreme choice like devoting no resources to education at point A or no resources to health at point F. Instead, the lesson is that the gains from committing additional marginal resources to education depend on how much is already being spent. If, on the one hand, very few resources are currently committed to education, then an increase in resources used can bring relatively large gains. On the other hand, if a large number of resources are already committed to education, then committing additional resources will bring relatively smaller gains.

This pattern is so common that it has been given a name: the **law of diminishing returns.** This law asserts that as additional increments of resources are devoted to a certain purpose, the marginal benefit from those additional increments will decline. For example, after not spending much at all on crime reduction, when a government spends a certain amount more, the gains in crime reduction could be relatively large. But additional increases after that typically cause relatively smaller reductions in crime, and paying for enough police and security to reduce crime to zero would be tremendously expensive.

The curve of the production possibilities frontier shows that as additional resources are added to education, moving from left to right along the horizontal axis, the initial gains are fairly large, but those gains gradually diminish. Similarly, as additional

resources are added to health care, moving from bottom to top on the vertical axis, the initial gains are fairly large but again gradually diminish. In this way, the law of diminishing returns produces the outward-bending shape of the production possibilities frontier.

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Learning Objectives

[glossary-page][glossary-term]law of diminishing returns: [/glossary-term]
[glossary-definition]as additional increments of resources are devoted to a certain purpose, the marginal benefit from those additional increments will decline[/glossary-definition][glossary-term]production possibilities frontier (or curve): [/glossary-term][glossary-definition]a diagram that shows the productively efficient combinations of two products that an economy can produce given the resources it has available[/glossary-definition][/glossary-page]

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