

Production Possibilities

A **production possibilities frontier** shows the tradeoffs in the production of goods. To understand this concept, assume that there are two goods x and y , that resources are fully employed and common to both goods, and that technology is fixed. To produce more y , resources (e.g. labor and capital) must therefore be moved from x to y . This means that the production of more y causes less x to be produced.

Gains in the output of y from moving a unit of input (e.g. labor) from x to y decrease as more y and less x are produced. For example, the first unit of labor (e.g. 1 person) moved from x to y may give 10 additional units of y , while the second unit of labor (e.g. 2nd person) moved from x to y may give only 8 additional units of y .

To understand why subsequent units of input moved from x to y yield less gains in the output of y , consider moving labor from the production of corn to the production of night stands. The first person moved from the production of corn to the production of night stands may increase the output of night stands by 3 units because this gives more people to assemble the night stands. As additional labor is moved from corn production, there are more people to assemble night stands yet there is a limit on the quantity of lumber that can be cut with the saws used in the production of night stands. When a 3rd person is moved from the production of corn to the production of night stands, the saws may already be in use constantly so that it is not possible to cut additional lumber for the third person to assemble. Although the first person moved from the production of corn to the production of night stands yielded 3 additional night stands, the 3rd person moved does not yield any additional units of night stands.

As subsequent units of input are moved from x to y , there is a greater decrease in the output of x . For example, the first unit of input moved from x to y may cause the production of x to drop by 1 unit, while the second unit of input moved from x to y may cause the production of x to drop by 2 units.

To understand why subsequent units of input moved from x to y cause a greater decrease in the output of x , consider the tradeoff between the production of corn and the production of night stands. The first person moved from the production of corn to the production of night stands may decrease corn production by 300 bushels since fewer acres of corn can be tended. When the 3rd person is moved from the production of corn to the production of night stands, corn production may fall from 600 bushels to zero bushels because there may not be anyone left on the farm. Although the first person moved from the production of corn to the production of night stands reduced corn output by 300 bushels, the 3rd person moved reduced corn production by 600 bushels.

The **law of increasing cost** summarizes this discussion: To increase the production of one good, a greater amount of another good must be sacrificed. In other words, the opportunity cost of producing y in terms of x increases as more of y is produced and less of x is produced. The reason for the law of increasing cost is that resources are not equally efficient in all uses (e.g. Labor used in corn production is not as efficient at producing night stands as it is at producing corn).

It is possible to calculate the opportunity cost of increasing the production of night stands. Assume that the table below presents the tradeoffs between the production of corn and the production of night stands:

		<u>Quantity</u>		
Corn	1,500	1,200	800	600
Night Stands	25	28	29	29

What is the opportunity cost of increasing the production of night stands from 25 to 28 units? In moving the production of night stands from 25 to 28 units, 3 night stands are gained at the expense of 300 bushels of corn. Thus, the opportunity cost of 3 more night stands is 300 bushels of corn.

What is the unit cost of a night stand when the production of night stands increases from 25 to 28 units?

$$\begin{aligned} 3 \text{ night stands} &= 300 \text{ bushels of corn} && \Rightarrow \\ 1 \text{ night stand} &= 100 \text{ bushels of corn} \end{aligned}$$

Thus, the opportunity cost of 1 night stand is 100 bushels of corn.

What is the opportunity cost of increasing the production of night stands from 28 to 29 units? In moving the production of night stands from 28 to 29 units, 1 night stand is gained at the expense of 400 bushels of corn. Thus, the opportunity cost of 1 more night stand is 400 bushels of corn.

This example shows that as inputs are moved from the production of corn to the production of night stands that the opportunity cost of a night stand increases, in accordance with the law of increasing cost.

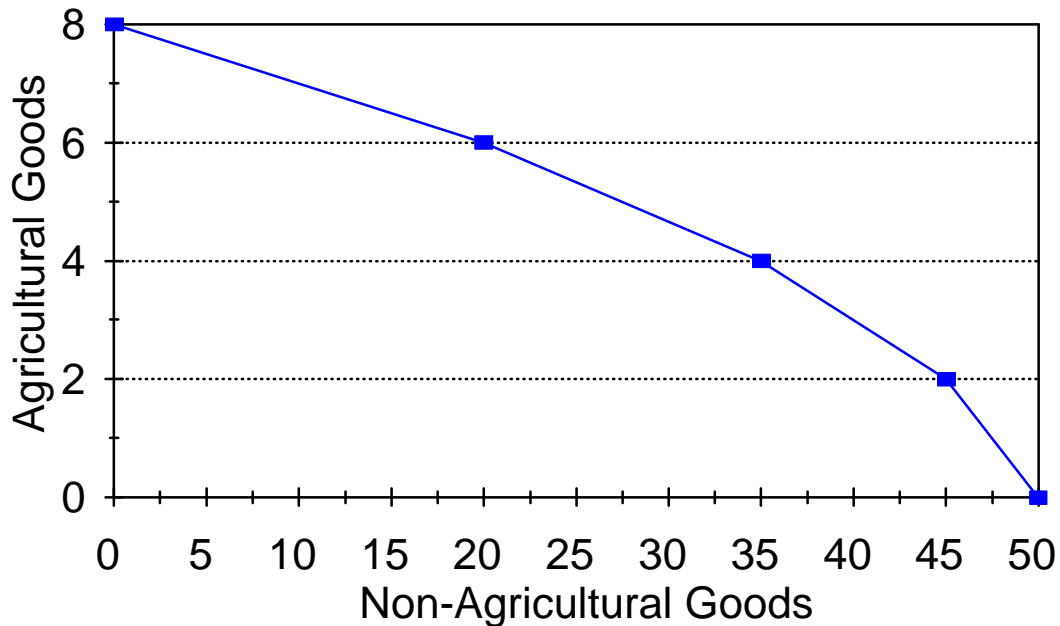
Agricultural goods versus non-agricultural goods tradeoff:

Consider the tradeoff between agricultural goods and non-agricultural goods:

Agricultural Goods	0	2	4	6	8	<i>in units</i>
Non-Agricultural Goods	50	45	35	20	0	

Graph the production possibilities frontier for the above table. Place agricultural goods on the y-axis and non-agricultural goods on the x-axis. Plot the points (non-agricultural goods, agricultural goods) and connect the points with lines. For instance, plot the points (50,0) and (0,8).

Production Possibilities Frontier



Notice that the law of increasing cost holds:

To obtain 2 additional units of agricultural goods when there are 50 units of non-agricultural goods, it cost $50 - 45 = 5$ units of non-agricultural goods.

To obtain 2 additional units of agricultural goods when there are 45 units of non-agricultural goods, it cost $45 - 35 = 10$ units of non-agricultural goods.

To obtain 2 additional units of agricultural goods when there are 20 units of non-agricultural goods, it cost $20 - 0 = 20$ units of non-agricultural goods.

What is the opportunity cost of one additional unit of agricultural goods when there are 50 units of non-agricultural goods?

2 units of agricultural goods = 5 units of non-agricultural goods

1 unit of agricultural goods = 2.5 units of non-agricultural goods

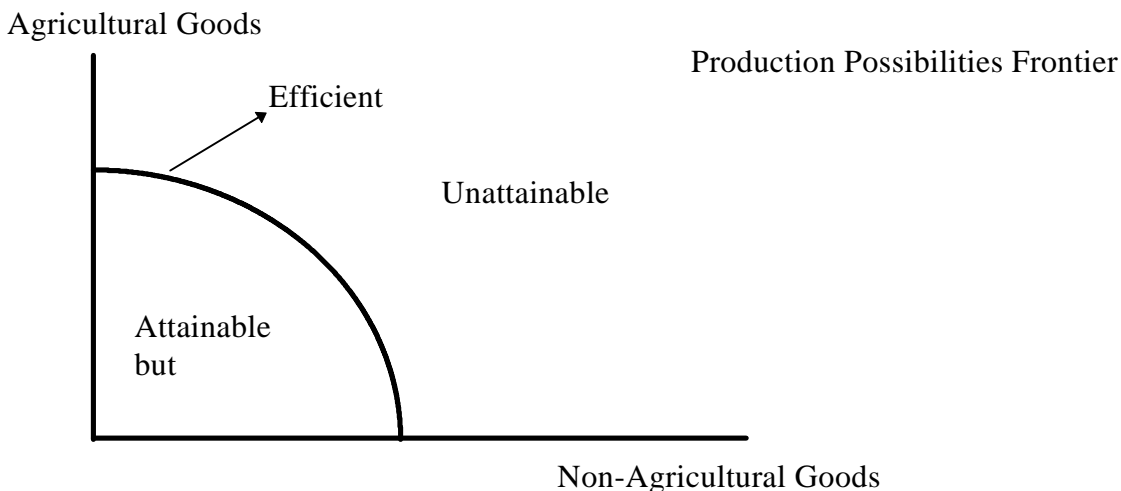
Assumptions used in Constructing a Production Possibilities Frontier:

1. *Two Goods*. For instance, assume that there are only agricultural goods and non-agricultural goods in the economy. This assumption allows us to use graphs to analyze the tradeoffs between goods.
2. *Common Resources*. This assumption is that the same resources can be used to produce either of the two goods.
3. *Fixed Technology*. Given full employment, this assumption is to preclude the possibility of increasing the output of one good without decreasing the output of another good, which is usually the case in the short run. In other words, it is not possible to get more of one good without giving up some of another good.
4. *Full Employment*. Given fixed technology, this assumption is to preclude the possibility of increasing the output of one good without decreasing the output of another good, which is usually the case in the short run. In other words, it is not possible to get more of one good without giving up some of another good.
5. *Fixed Resources*. This assumption precludes an increase in output from the discovery of additional resources.

Note: These assumptions are realistic for the short run but not for the long run.

Efficient Production:

Given the assumptions above, it is possible to determine the efficient points of production, the inefficient points, the attainable points, and the unattainable points of production:



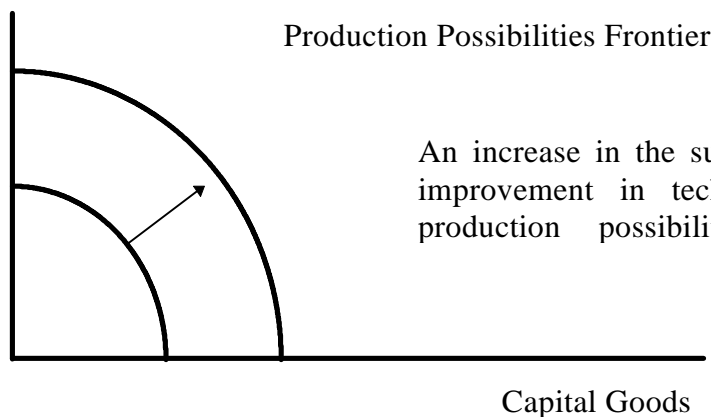
Movement of the Production Possibilities Frontier:

There are four ways to shift the production possibilities frontier outward, which is referred to as economic growth:

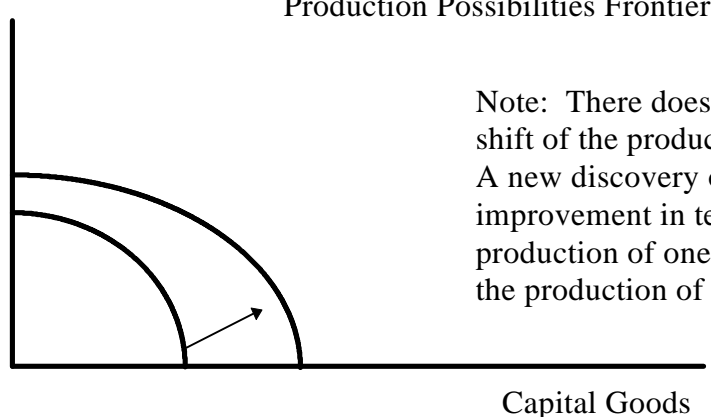
1. *Increase the supply of resources.* For example, migration increases the labor supply and the discovery of new oil reserves increases the supply of natural resources.
2. *Improve the technology.* In other words, the discovery of more efficient means of production will shift the production possibilities frontier outward.
3. *Select an allocation of goods that has capital accumulation.* This means that some consumption must be given up today so that more capital goods can be produced.

At this point of the analysis, assume that the allocation of goods has zero capital accumulation (i.e. hold all other variables constant). Consider a production possibilities frontier that shows the tradeoffs between consumer and capital goods:

Consumer Goods

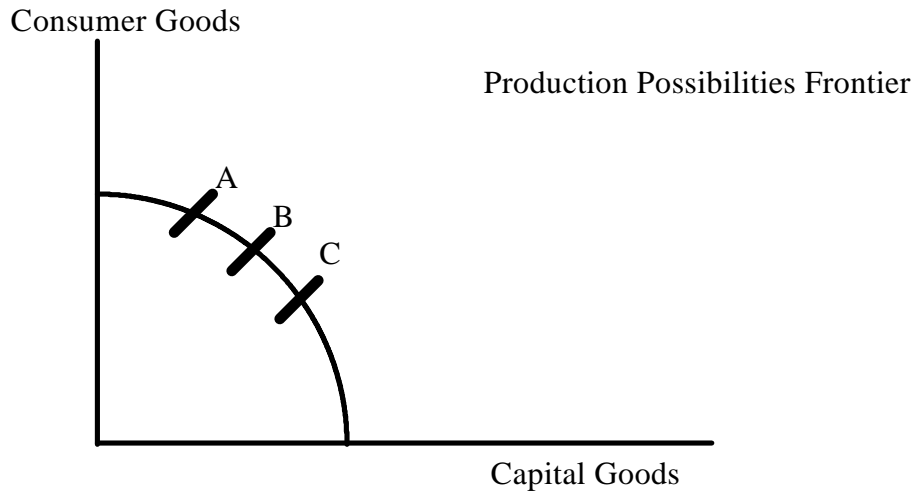


Consumer Goods

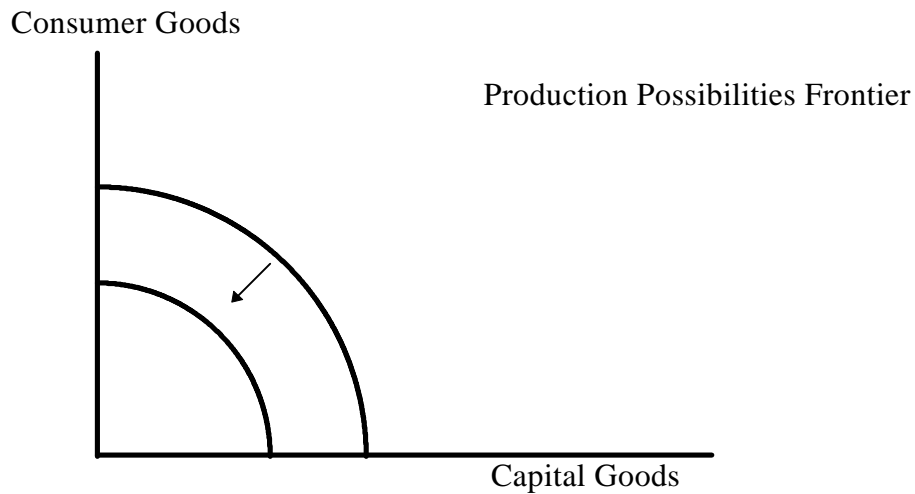


How the Allocation of Goods Affects the Movement of the Production Possibilities Frontier:

Hold all other variables constant (e.g. technology and the supply of resources).

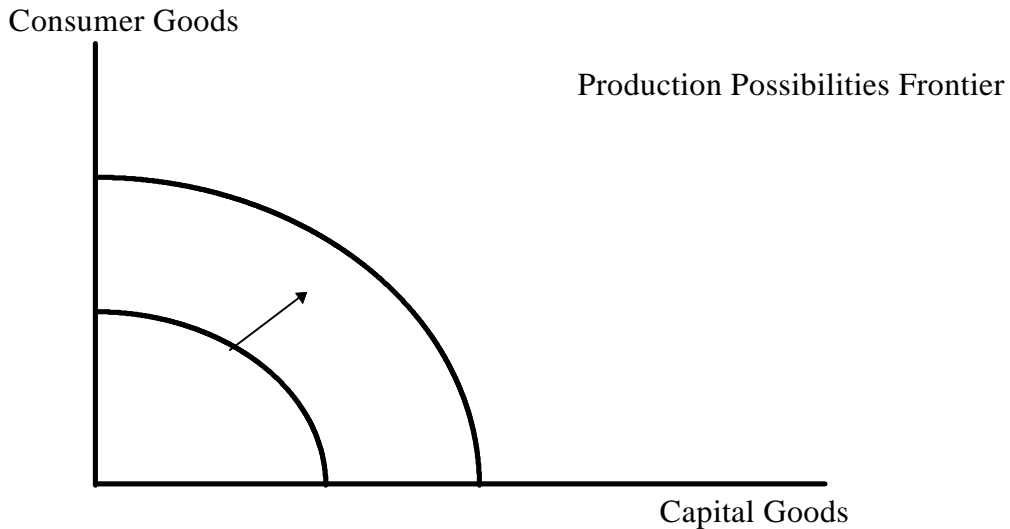


Point A: The production of capital goods is not sufficient to cover the depreciation of capital goods. This means that the production possibilities frontier will shift inward (i.e. There will be fewer machines for production in the future):



Point B: The production of capital goods equals the depreciation of capital goods so the production possibilities frontier will not shift.

Point C: The production of capital goods is greater than the depreciation of capital goods. This means that the production possibilities frontier will shift outward (i.e. There will be more machines for production in the future).



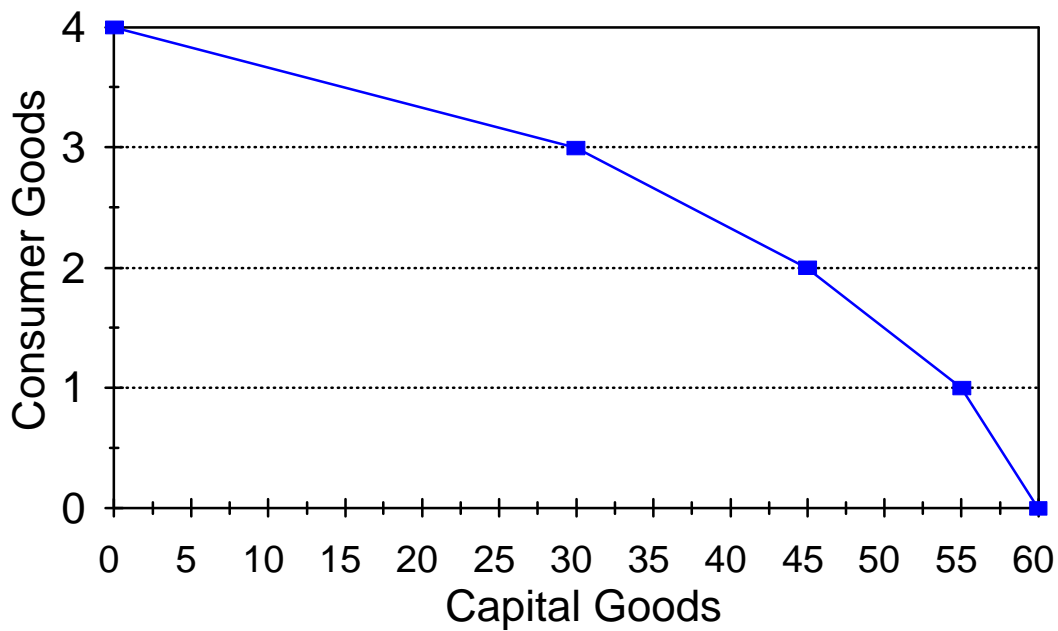
Does the analysis above mean that society should decrease the consumption of consumer goods and increase the production of capital goods so that there will be more of both goods in the future? The answer to this question is ambiguous at this stage of our analysis. The problem with answering this question is that you do not yet have a way to compare the benefits (i.e. more future consumption) of having more capital goods with the losses (i.e. less consumption now) of having more capital goods. That is, increasing the level of capital goods means that there will be more consumption goods in the future but less consumption goods now.

Applications:

1. Graph the production possibilities frontier for the data below:

	Output				
Consumer Goods	0	1	2	3	4
Capital Goods	60	55	45	30	0

Production Possibilities Frontier



Note that the law of increasing cost holds:

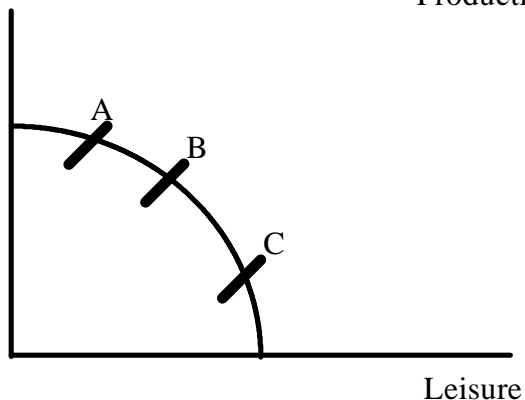
To obtain 1 additional unit of consumer goods when there are 60 units of capital goods, it cost $60 - 55 = 5$ units of capital goods.

To obtain 1 additional unit of consumer goods when there are 55 units of capital goods, it cost $55 - 45 = 10$ units of capital goods.

2. Show how your position on the production possibilities frontier for academics and leisure affects where you will be in the long run:

Academics

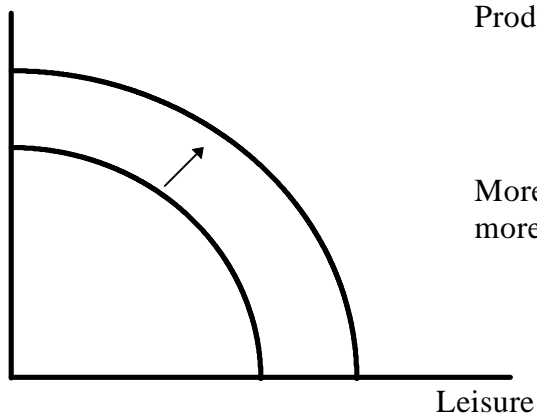
Production Possibilities Frontier



Point A: At this point there is a large investment in human capital. This will shift the production possibilities frontier outward:

Academics

Production Possibilities Frontier

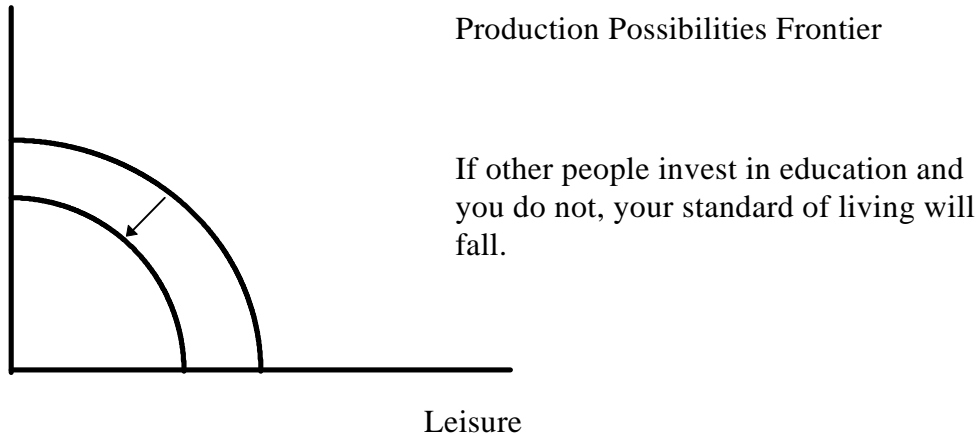


More education now will give you more consumption in the future.

Point B: At this point the investment in academics equals the economy's average investment in academics so the production possibilities frontier will not shift. In other words, everyone else is investing in academics so you must also invest to keep your production possibilities frontier from shifting inward.

Point C: At this point the investment in academics is less than the economy's average investment in academics so the production possibilities frontier will shift inward. In other words, other people are investing in academics while you are not so your standard of living will fall.

Academics



You should know the following:

1. Definition of a production possibilities frontier.
2. Law of increasing cost and why it exists.
3. How to demonstrate with data that the law of increasing opportunity cost exists.
4. How to graph a production possibilities frontier.
5. How to calculate the opportunity cost of changing production.
6. The location of the efficient points of production, the inefficient points, the attainable points, and the unattainable points of production.
7. Assumptions used in constructing a production possibilities frontier.
8. The factors that shift the position of the production possibilities frontier.
9. How the present position on the production possibilities frontier affects the long run position.