CHAPTER 2 - INTRODUCTION TO CHOICE IN A WORLD OF SCARCITY

Learning Objectives

- How Individuals Make Choices Based on Their Budget Constraint
- The Production Possibilities Frontier and Social Choices
- Confronting Objections to the Economic Approach

Bring It Home

Choices … to What Degree?

In 2015, the median income for workers who hold master's degrees varies from males to females. The average of the two is $2,951 weekly. Multiply this average by 52 weeks, and you get an average salary of $153,452. Compare that to the median weekly earnings for a full-time worker over 25 with no higher than a bachelor's degree: $1,224 weekly and $63,648 a year. What about those with no higher than a high school diploma in 2015? They earn just $664 weekly and $34,528 over 12 months. In other words, says the Bureau of Labor Statistics (BLS), earning a bachelor's degree boosted salaries 54% over what you would have earned if you had stopped your education after high school. A master's degree yields a salary almost double that of a high school diploma.

Given these statistics, we might expect many people to choose to go to college and at least earn a bachelor's degree. Assuming that people want to improve their material well-being, it seems like they would make those choices that provide them with the greatest opportunity to consume goods and services. As it turns out, the analysis is not nearly as simple as this. In fact, in 2014, the BLS reported that while almost 88% of the population in the United States had a high school diploma, only 33.6%

of 25 to 65 year olds had bachelor's degrees, and only 7.4% of 25 to 65 year olds in 2014 had earned a master's.

This brings us to the subject of this chapter: why people make the choices they make and how economists explain those choices.

You will learn quickly when you examine the relationship between economics and scarcity that choices involve tradeoffs. Every choice has a cost.

In 1968, the Rolling Stones recorded "You Can't Always Get What You Want." Economists chuckled, because they had been singing a similar tune for decades. English economist Lionel Robbins (1898–1984), in his *Essay on the Nature and Significance of Economic Science* in 1932, described not always getting what you want in this way:

"The time at our disposal is limited. There are only twenty-four hours in the day. We have to choose between the different uses to which they may be put. ... Everywhere we turn, if we choose one thing we must relinquish others which, in different circumstances, we would wish not to have relinquished. Scarcity of means to satisfy given ends is an almost ubiquitous condition of human nature."

Because people live in a world of scarcity, they cannot have all the time, money, possessions, and experiences they wish. Neither can society.

This chapter will continue our discussion of scarcity and the economic way of thinking by first introducing three critical concepts: opportunity cost, marginal decision making, and diminishing returns. Later, it will consider whether the economic way of thinking accurately describes either how we *make* choices and how we *should* make them.

Attribution

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2.1 - HOW INDIVIDUALS MAKE CHOICES BASED ON THEIR BUDGET CONSTRAINT

Learning Objectives

- Calculate and graph budget constraints
- Explain opportunity sets and opportunity costs
- Evaluate the law of diminishing marginal utility
- Explain how marginal analysis and utility influence choices

Consider the typical consumer's budget problem. Consumers have a limited amount of income to spend on the things they need and want. Suppose Alphonso has $10 in spending money each week that he can allocate between bus tickets for getting to work and the burgers that he eats for lunch. Burgers cost $2 each, and bus tickets are 50 cents each. We can see Alphonso's budget problem in Figure 2.1a.

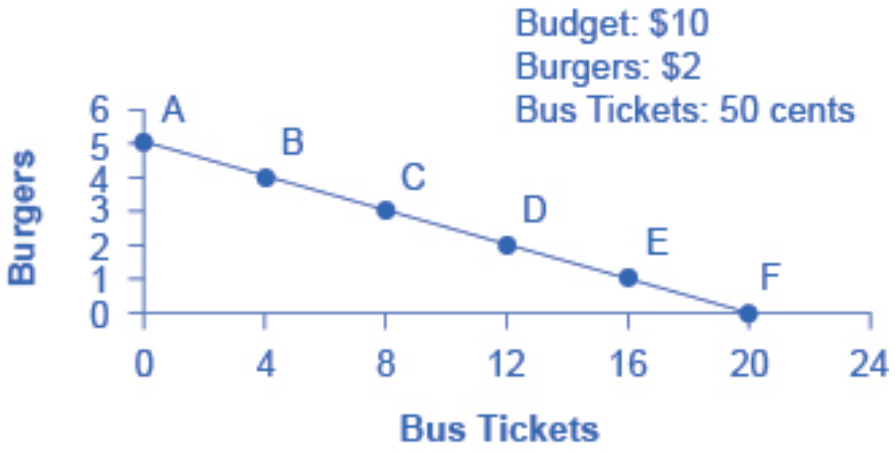

Figure 2.1a The Budget Constraint: Alphonso's Consumption Choice Opportunity Frontier. Each point on the budget constraint represents a combination of burgers and bus tickets whose total cost adds up to Alphonso's budget of $10. The relative price of burgers and bus tickets determines the slope of the budget constraint. All along the budget set, giving up one burger means gaining four bus tickets. The Budget Constraint: Alphonso's Consumption Choice Opportunity Frontier by Steven A. Greenlaw & David Shapiro (OpenStax), licensed under CC BY 4.0.

Figure 2.1a The Budget Constraint: Alphonso's Consumption Choice Opportunity Frontier (Text version)

Figure 2.1a The **Budget Constraint**: Alphonso's Consumption Choice Opportunity Frontier graph shows the budget line as a downward slope that connects all points)A-F) and represents the opportunity set of burgers and bus tickets. The vertical axis is burger purchases ranging from 0-6 and the horizontal axis is bus ticket purchase ranging from 0 to 24.

Description of Points in Figure 2.1a The Budget Constraint: Alphonso's Consumption Choice Opportunity Frontier graph

Points	Point location in the graph
A	5 burger purchases , 0 bus ticket purchases
B	4 burger purchases , 4 bus ticket purchases
C	8 burger purchases , 3 bus ticket purchases
D	2 burger purchases , 12 bus ticket purchases
E	1 burger purchases , 16 bus ticket purchases
F	0 burger purchases, 20 bus ticket purchases

If Alphonso spends all his money on burgers, he can afford five per week. ($10 per week \div $2 per burger = 5 burgers per week .) However, if he does this, he will not be able to afford any bus tickets. Point A in the figure shows the choice (zero bus tickets and five burgers). Alternatively, if Alphonso spends all his money on bus tickets, he can afford 20 per week. ($10 per week $0.50 per bus ticket = 20 bus tickets per week.) Then, however, he will not be able to afford any burgers. Point F shows this alternative choice (20 bus tickets and zero burgers).

If we connect all the points between A and F, we get Alphonso's **budget constraint**. This indicates all the combination of burgers and bus tickets Alphonso can afford, given the price of the two goods and his budget amount.

If Alphonso is like most people, he will choose some combination that includes both bus tickets and burgers. That is, he will choose some combination on the budget constraint that is between points A and F. Every point on (or inside) the constraint shows a combination of burgers and bus tickets that Alphonso can afford. Any point outside the constraint is not affordable, because it would cost more money than Alphonso has in his budget.

The budget constraint clearly shows the tradeoff Alphonso faces in choosing between burgers and bus tickets. Suppose he is currently at point D, where he can afford 12 bus tickets and two burgers. What would it cost Alphonso for one more burger? It would be natural to answer $2, but that's not the way economists think. Instead they ask, how many bus tickets would Alphonso have to give up to get one more burger, while staying within his budget? Since bus tickets cost 50 cents, Alphonso would have to give up four to afford one more burger. That is the true cost to Alphonso.

The Concept of Opportunity Cost

Economists use the term **opportunity cost** to indicate what one must give up to obtain what he or she desires. The idea behind opportunity cost is that the cost of one item is the lost opportunity to do or consume something else. In short, opportunity cost is the value of the next best alternative. For Alphonso, the opportunity cost of a burger is the four bus tickets he would have to give up. He would decide whether or not to choose the burger depending on whether the value of the burger exceeds the value of the forgone alternative—in this case, bus tickets. Since people must choose, they inevitably face tradeoffs in which they have to give up things they desire to obtain other things they desire more.

Link It Up

Linestanding.com [New Tab] (http://www.linestanding.com/) is an example of opportunity cost—paying someone else to wait in line for you.

A fundamental principle of economics is that every choice has an opportunity cost. If you sleep through your economics class, the opportunity cost is the learning you miss from not attending class. If you spend your income on video games, you cannot spend it on movies. If you choose to marry one person, you give up the opportunity to marry anyone else. In short, opportunity cost is all around us and part of human existence.

Identifying Opportunity Cost

In many cases, it is reasonable to refer to the opportunity cost as the price. If your cousin buys a new bicycle for $300, then $300 measures the amount of "other consumption" that he has forsaken. For practical purposes, there may be no special need to identify the specific alternative product or products that he could have bought with that $300, but sometimes the price as measured in dollars may not accurately capture the true opportunity cost. This problem can loom especially large when costs of time are involved.

For example, consider a boss who decides that all employees will attend a two-day retreat to "build team spirit." The out-of-pocket monetary cost of the event may involve hiring an outside consulting firm to run the retreat, as well as room and board for all participants. However, an opportunity cost exists as well: during the two days of the retreat, none of the employees are doing any other work.

Attending college is another case where the opportunity cost exceeds the monetary cost. The out-of-pocket costs of attending college include tuition, books, room and board, and other expenses. However, in addition, during the hours that you are attending class and studying, it is impossible to work at a paying job. Thus, college imposes both an out-of-pocket cost and an opportunity cost of lost earnings.

Work It Out

What is the opportunity cost associated with increased airport security measures?

After the terrorist plane hijackings on September 11, 2001, many steps were proposed to improve air travel safety. For example, the federal government could provide armed "sky marshals" who would

travel inconspicuously with the rest of the passengers. The cost of having a sky marshal on every flight would be roughly $3 billion per year. Retrofitting all U.S. planes with reinforced cockpit doors to make it harder for terrorists to take over the plane would have a price tag of $450 million. Buying more sophisticated security equipment for airports, like three-dimensional baggage scanners and cameras linked to face recognition software, could cost another $2 billion.

However, the single biggest cost of greater airline security does not involve spending money. It is the opportunity cost of additional waiting time at the airport. According to the United States Department of Transportation (DOT), there were 895.5 million systemwide (domestic and international) scheduled service passengers in 2015. Since the 9/11 hijackings, security screening has become more intensive, and consequently, the procedure takes longer than in the past. Say that, on average, each air passenger spends an extra 30 minutes in the airport per trip. Economists commonly place a value on time to convert an opportunity cost in time into a monetary figure. Because many air travelers are relatively high-paid business people, conservative estimates set the average price of time for air travelers at $20 per hour. By these back-of-the-envelope calculations, the opportunity cost of delays in airports could be as much as 800 million × 0.5 hours × $20/hour, or $8 billion per year. Clearly, the opportunity costs of waiting time can be just as important as costs that involve direct spending.

In some cases, realizing the opportunity cost can alter behavior. Imagine, for example, that you spend $8 on lunch every day at work. You may know perfectly well that bringing a lunch from home would cost only $3 a day, so the opportunity cost of buying lunch at the restaurant is $5 each day (that is, the $8 buying lunch costs minus the $3 your lunch from home would cost). Five dollars each day does not seem to be that much. However, if you project what that adds up to in a year—250 days a year × $5 per day equals $1,250, the cost, perhaps, of a decent vacation. If you describe the opportunity cost as "a nice vacation" instead of "$5 a day," you might make different choices.

Marginal Decision-Making and Diminishing Marginal Utility

The budget constraint framework helps to emphasize that most choices in the real world are not about getting all of one thing or all of another; that is, they are not about choosing either the point at one end of the budget constraint or else the point all the way at the other end. Instead, most choices involve **marginal analysis**, which means examining the benefits and costs of choosing a little more or a little less of a good. People naturally compare costs and benefits, but often we look at total costs and total benefits, when the optimal choice necessitates comparing how costs and benefits change from one option to another. You might think of marginal analysis as "change analysis." Marginal analysis is used throughout economics.

We now turn to the notion of **utility**. People desire goods and services for the satisfaction or utility those goods and services provide. Utility is subjective but that does not make it less real. Economists typically

assume that the more of some good one consumes (for example, slices of pizza), the more utility one obtains. At the same time, the utility a person receives from consuming the first unit of a good is typically more than the utility received from consuming the fifth or the tenth unit of that same good. When Alphonso chooses between burgers and bus tickets, for example, the first few bus rides that he chooses might provide him with a great deal of utility—perhaps they help him get to a job interview or a doctor's appointment. However, later bus rides might provide much less utility—they may only serve to kill time on a rainy day. Similarly, the first burger that Alphonso chooses to buy may be on a day when he missed breakfast and is ravenously hungry. However, if Alphonso has a burger every single day, the last few burgers may taste pretty boring. The general pattern that consumption of the first few units of any good tends to bring a higher level of utility to a person than consumption of later units is a common pattern. Economists refer to this pattern as the **law of diminishing marginal utility**, which means that as a person receives more of a good, the additional (or marginal) utility from each additional unit of the good declines. In other words, the first slice of pizza brings more satisfaction than the sixth.

The law of diminishing marginal utility explains why people and societies rarely make all-or-nothing choices. You would not say, "My favorite food is ice cream, so I will eat nothing but ice cream from now on." Instead, even if you get a very high level of utility from your favorite food, if you ate it exclusively, the additional or marginal utility from those last few servings would not be very high. Similarly, most workers do not say: "I enjoy leisure, so I'll never work." Instead, workers recognize that even though some leisure is very nice, a combination of all leisure and no income is not so attractive. The budget constraint framework suggests that when people make choices in a world of scarcity, they will use marginal analysis and think about whether they would prefer a little more or a little less.

A rational consumer would only purchase additional units of some product as long as the marginal utility exceeds the opportunity cost. Suppose Alphonso moves down his budget constraint from Point A to Point B to Point C and further. As he consumes more bus tickets, the marginal utility of bus tickets will diminish, while the opportunity cost, that is, the marginal utility of foregone burgers, will increase. Eventually, the opportunity cost will exceed the marginal utility of an additional bus ticket. If Alphonso is rational, he won't purchase more bus tickets once the marginal utility just equals the opportunity cost. While we can't (yet) say exactly how many bus tickets Alphonso will buy, that number is unlikely to be the most he can afford, 20.

Sunk Costs

In the budget constraint framework, all decisions involve what will happen next: that is, what quantities of goods will you consume, how many hours will you work, or how much will you save. These decisions do not look back to past choices. Thus, the budget constraint framework assumes that **sunk costs**, which are costs that were incurred in the past and cannot be recovered, should not affect the current decision.

Consider the case of Selena, who pays $8 to see a movie, but after watching the film for 30 minutes, she knows that it is truly terrible. Should she stay and watch the rest of the movie because she paid for the ticket, or should she leave? The money she spent is a sunk cost, and unless the theater manager is sympathetic, Selena will not get a refund. However, staying in the movie still means paying an opportunity cost in time. Her choice is whether to spend the next 90 minutes suffering through a cinematic disaster or to do something—anything—else. The lesson of sunk costs is to forget about the money and time that is irretrievably gone and instead to focus on the marginal costs and benefits of current and future options.

For people and firms alike, dealing with sunk costs can be frustrating. It often means admitting an earlier error in judgment. Many firms, for example, find it hard to give up on a new product that is doing poorly because they spent so much money in creating and launching the product. However, the lesson of sunk costs is to ignore them and make decisions based on what will happen in the future.

From a Model with Two Goods to One of Many Goods

The budget constraint diagram containing just two goods, like most models used in this book, is not realistic. After all, in a modern economy people choose from thousands of goods. However, thinking about a model with many goods is a straightforward extension of what we discussed here. Instead of drawing just one budget constraint, showing the tradeoff between two goods, you can draw multiple budget constraints, showing the possible tradeoffs between many different pairs of goods. In more advanced classes in economics, you would use mathematical equations that include many possible goods and services that can be purchased, together with their quantities and prices, and show how the total spending on all goods and services is limited to the overall budget available. The graph with two goods that we presented here clearly illustrates that every choice has an opportunity cost, which is the point that does carry over to the real world.

Key Concepts & Summary

Economists see the real world as one of scarcity: that is, a world in which people's desires exceed what is possible. As a result, economic behavior involves tradeoffs in which individuals, firms, and society must forgo something that they desire to obtain things that they desire more. Individuals face the tradeoff of what quantities of goods and services to consume. The budget constraint, which is the frontier of the opportunity set, illustrates the range of available choices. The relative

price of the choices determines the slope of the budget constraint. Choices beyond the budget constraint are not affordable.

Opportunity cost measures cost by what we forgo in exchange. Sometimes we can measure opportunity cost in money, but it is often useful to consider time as well, or to measure it in terms of the actual resources that we must forfeit.

Most economic decisions and tradeoffs are not all-or-nothing. Instead, they involve marginal analysis, which means they are about decisions on the margin, involving a little more or a little less. The law of diminishing marginal utility points out that as a person receives more of something—whether it is a specific good or another resource—the additional marginal gains tend to become smaller. Because sunk costs occurred in the past and cannot be recovered, they should be disregarded in making current decisions.

Attribution

Except where otherwise noted, this chapter is adapted from "How Individuals Make Choices Based on Their Budget Constraint (https://openstax.org/books/principles-microeconomics-2e/pages/2-1-how-individuals-make-choices-based-on-their-budget-constraint)" and "Key Concepts and Summary (https://openstax.org/books/principles-microeconomics-2e/pages/2-key-concepts-and-summary)" In *Principles of Microeconomics 2e* (https://openstax.org/books/principles-microeconomics-2e/pages/1-introduction) (OpenStax) by Steven A. Greenlaw & David Shapiro, licensed under CC BY 4.0./Adaptations include addition of key concepts and summary and the removal of Understanding Budget Constraints, and minor edits.

Access for free at https://openstax.org/books/principles-microeconomics-2e/pages/1-introduction

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2.2 - THE PRODUCTION POSSIBILITIES FRONTIER AND SOCIAL CHOICES

Learning Objectives

- Interpret production possibilities frontier graphs
- Contrast a budget constraint and a production possibilities frontier
- Explain the relationship between a production possibilities frontier and the law of diminishing returns
- Contrast productive efficiency and allocative efficiency
- Define comparative advantage

Just as individuals cannot have everything they want and must instead make choices, society as a whole cannot have everything it might want, either. This section of the chapter will explain the constraints society faces, using a model called the **production possibilities frontier (PPF)**. There are more similarities than differences between individual choice and social choice. As you read this section, focus on the similarities.

Because society has limited resources (e.g., labour, land, capital, raw materials) at any point in time, there is a limit to the quantities of goods and services it can produce. Suppose a society desires two products, healthcare and education. The production possibilities frontier in Figure 2.2a illustrates this situation.

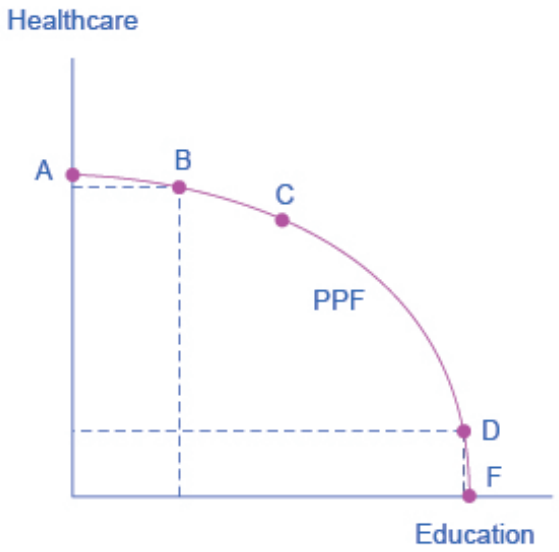

Figure 2.2a A Healthcare vs. Education Production Possibilities Frontier. This production possibilities frontier shows a tradeoff between devoting social resources to healthcare and devoting them to education. At A all resources go to healthcare and at B, most go to healthcare. At D most resources go to education, and at F, all go to education. A Healthcare vs. Education Production Possibilities Frontier by Steven A. Greenlaw & David Shapiro (OpenStax), licensed under CC BY 4.0.

Figure 2.2a shows healthcare on the vertical axis and education on the horizontal axis. If the society were to allocate all of its resources to healthcare, it could produce at point A which is located at the highest point on the healthcare axis and the lowest point (point 0) of education. However, it would not have any resources to produce education. If it were to allocate all of its resources to education, it could produce at point F which is located at the lowest point on the healthcare axis (point 0) and the highest point of education. Alternatively, the society could choose to produce any combination of healthcare and education on the production possibilities frontier. In effect, the production possibilities frontier plays the same role for society as the budget constraint plays for Alphonso. 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. PPF (production possibilities frontier) is depicted by a downward sloping arched curve connecting point A to point F with Point B, C and D occurring along this line to denote possible combinations that could occur along 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 is 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 healthcare. That is the tradeoff society faces. Suppose it considers moving from point B to point C. What would the opportunity cost be for the additional education? The opportunity cost would be

the healthcare society has to forgo. Just as with Alphonso's budget constraint, the slope of the production possibilities frontier shows the opportunity cost. By now you might be saying, "Hey, this PPF is sounding like the budget constraint." If so, read the following Clear It Up feature.

Clear It Up

What's the difference between a budget constraint and a PPF?

There are two major differences between a budget constraint and a production possibilities frontier. The first is the fact that the budget constraint is a straight line. This is because its slope is given by the relative prices of the two goods, which from the point of view of an individual consumer, are fixed, so the slope doesn't change. In contrast, the PPF has a curved shape because of the law of the diminishing returns. Thus, the slope is different at various points on the PPF. The second major difference is the absence of specific numbers on the axes of the PPF. There are no specific numbers because we do not know the exact amount of resources this imaginary economy has, nor do we know how many resources it takes to produce healthcare and how many resources it takes to produce education. If this were a real world example, that data would be available.

Whether or not we have specific numbers, conceptually we can measure the opportunity cost of additional education as society moves from point B to point C on the PPF. We measure the additional education by the horizontal distance between B and C. The foregone healthcare is given by the vertical distance between B and C. The slope of the PPF between B and C is (approximately) the vertical distance (the "rise") over the horizontal distance (the "run"). This is the opportunity cost of the additional education.

The PPF and the Law of Increasing Opportunity Cost

The budget constraints that we presented earlier in this chapter, showing individual choices about what quantities of goods to consume, were all straight lines. The reason for these straight lines was that the relative prices of the two goods in the consumption budget constraint determined the slope of the budget constraint. However, we drew the production possibilities frontier for healthcare and education as a curved line. Why does the PPF have a different shape?

To understand why the PPF is curved, start by considering point A at the top left-hand side of the PPF. At point A, all available resources are devoted to healthcare and none are left for education. This situation would be extreme and even ridiculous. For example, children are seeing a doctor every day, whether they are 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 healthcare to education, so that the economy is at point B instead of point A. Diverting some resources away from A to B causes relatively little reduction in health because the last few marginal dollars going into healthcare services are not producing much additional gain in health. However, putting those marginal dollars into education, which is completely without resources at point A, can produce relatively large gains. For this reason, the shape of the PPF from A to B is relatively flat, representing a relatively small drop-off in health and a relatively large gain in education.

Now consider the other end, at the lower right, of the production possibilities frontier. Imagine that society starts at choice D, which is devoting nearly all resources to education and very few to healthcare, and moves to point F, which is devoting *all* spending to education and none to healthcare. For the sake of concreteness, you can imagine that in the movement from D to F, the last few doctors must become high school science teachers, the last few nurses must become school librarians rather than dispensers of vaccinations, and the last few emergency rooms are turned into kindergartens. The gains to education from adding these last few resources to education are very small. However, the opportunity cost lost to health will be fairly large, and thus the slope of the PPF between D and F is steep, showing a large drop in health for only a small gain in education.

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 common enough that economists have given it a name: the law of increasing opportunity cost, which holds that as production of a good or service increases, the marginal opportunity cost of producing it increases as well. This happens because some resources are better suited for producing certain goods and services instead of others. When government spends a certain amount more on reducing crime, for example, the original increase in opportunity cost of reducing crime could be relatively small. However, additional increases typically cause relatively larger increases in the opportunity cost of reducing crime, and paying for enough police and security to reduce crime to nothing at all would be a tremendously high opportunity cost.

The curvature of the production possibilities frontier shows that as we add more resources to education, moving from left to right along the horizontal axis, the original increase in opportunity cost is fairly small, but gradually increases. Thus, the slope of the PPF is relatively flat near the vertical-axis intercept. Conversely, as we add more resources to healthcare, moving from bottom to top on the vertical axis, the original declines in opportunity cost are fairly large, but again gradually diminish. Thus, the slope of the PPF is relatively steep

near the horizontal-axis intercept. In this way, the law of increasing opportunity cost produces the outward-bending shape of the production possibilities frontier.

Productive Efficiency and Allocative Efficiency

The study of economics does not presume to tell a society what choice it should make along its production possibilities frontier. In a market-oriented economy with a democratic government, the choice will involve a mixture of decisions by individuals, firms, and government. However, economics can point out that some choices are unambiguously better than others. This observation is based on the concept of efficiency. In everyday usage, efficiency refers to lack of waste. An inefficient machine operates at high cost, while an efficient machine operates at lower cost, because it is not wasting energy or materials. An inefficient organization operates with long delays and high costs, while an efficient organization meets schedules, is focused, and performs within budget.

The production possibilities frontier can illustrate two kinds of efficiency: **productive efficiency** and **allocative efficiency**. Figure 2.2b illustrates these ideas using a production possibilities frontier between healthcare and education.

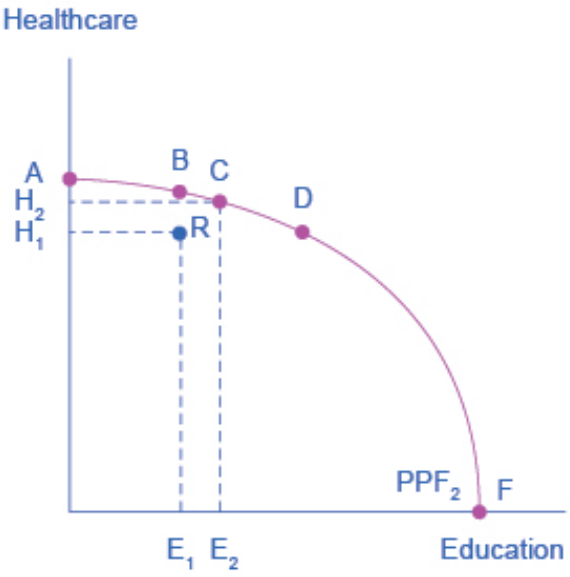

Figure 2.2b Productive and Allocative Efficiency. Productive and Allocative Efficiency by Steven A. Greenlaw & David Shapiro (OpenStax), licensed under CC BY 4.0.

Figure 2.2b Productive and Allocative Efficiency (Text version)

Figure 2.2b has the same base graph as Figure 2.3: healthcare is on the vertical axis and education on the horizontal axis. Point A is located at the lowest point (point 0) of education and the highest point on the healthcare axis. Point F is located at the highest point of education and the lowest point on the healthcare axis (point 0). The PPF (production possibilities frontier) is depicted by a downward sloping arched curve connecting point A to point F with Point B, C and D occurring along this line to denote possible combinations that could occur along the PPF. But it also denotes productive efficiency which is illustrated by Point R located below and to the left of the PPF line at (E_1, H_1) and Point C located at (E_2, H_2).

Productive efficiency means it is impossible to produce more of one good without decreasing the quantity that is produced of another good. Thus, all choices along a given PPF like B, C, and D display productive efficiency, but R does not. Allocative efficiency means that the particular mix of goods being produced—that is, the specific choice along the production possibilities frontier—represents the allocation that society most desires.

Productive efficiency means that, given the available inputs and technology, it is impossible to produce more of one good without decreasing the quantity that is produced of another good. All choices on the PPF in Figure 2.2b, including A, B, C, D, and F, display productive efficiency. As a firm moves from any one of these choices to any other, either healthcare increases and education decreases or vice versa. However, any choice inside the production possibilities frontier is productively inefficient and wasteful because it is possible to produce more of one good, the other good, or some combination of both goods.

For example, point R is productively inefficient because it is possible at choice C to have more of both goods: education on the horizontal axis is higher at point C than point R (E_2 is greater than E_1), and healthcare on the vertical axis is also higher at point C than point R (H_2 is great than H_1).

We can show the particular mix of goods and services produced—that is, the specific combination of selected healthcare and education along the production possibilities frontier—as a ray (line) from the origin to a specific point on the PPF. Output mixes that had more healthcare (and less education) would have a steeper ray, while those with more education (and less healthcare) would have a flatter ray.

Allocative efficiency means that the particular combination of goods and services on the production possibility curve that a society produces represents the combination that society most desires. How to determine what a society desires can be a controversial question, and is usually a discussion in political science, sociology, and philosophy classes as well as in economics. At its most basic, allocative efficiency means producers supply the quantity of each product that consumers demand. Only one of the productively efficient choices will be the allocatively efficient choice for society as a whole.

Why Society Must Choose

Every society faces the problem of scarcity, where limited resources conflict with unlimited needs and wants. The production possibilities curve illustrates the choices involved in this dilemma.

Every economy faces two situations in which it may be able to expand consumption of all goods. In the first case, a society may discover that it has been using its resources inefficiently, in which case by improving efficiency and producing on the production possibilities frontier, it can have more of all goods (or at least more of some and less of none). In the second case, as resources grow over a period of years (e.g., more labour and more capital), the economy grows. As it does, the production possibilities frontier for a society will tend to shift outward and society will be able to afford more of all goods.

However, improvements in productive efficiency take time to discover and implement, and economic growth happens only gradually. Thus, a society must choose between tradeoffs in the present. For government, this process often involves trying to identify where additional spending could do the most good and where reductions in spending would do the least harm. At the individual and firm level, the market economy coordinates a process in which firms seek to produce goods and services in the quantity, quality, and price that people want. However, for both the government and the market economy in the short term, increases in production of one good typically mean offsetting decreases somewhere else in the economy.

The PPF and Comparative Advantage

While every society must choose how much of each good or service it should produce, it does not need to produce every single good it consumes. Often how much of a good a country decides to produce depends on how expensive it is to produce it versus buying it from a different country. As we saw earlier, the curvature of a country's PPF gives us information about the tradeoff between devoting resources to producing one good versus another. In particular, its slope gives the opportunity cost of producing one more unit of the good in the x-axis in terms of the other good (in the y-axis). Countries tend to have different opportunity costs of producing a specific good, either because of different climates, geography, technology, or skills.

Suppose two countries, the US and Brazil, need to decide how much they will produce of two crops: sugar cane and wheat. Due to its climatic conditions, Brazil can produce quite a bit of sugar cane per acre but not much wheat. Conversely, the U.S. can produce large amounts of wheat per acre, but not much sugar cane. Clearly, Brazil has a lower opportunity cost of producing sugar cane (in terms of wheat) than the U.S. The reverse is also true: the U.S. has a lower opportunity cost of producing wheat than Brazil. We illustrate this by the PPFs of the two countries in Figure 2.2c.

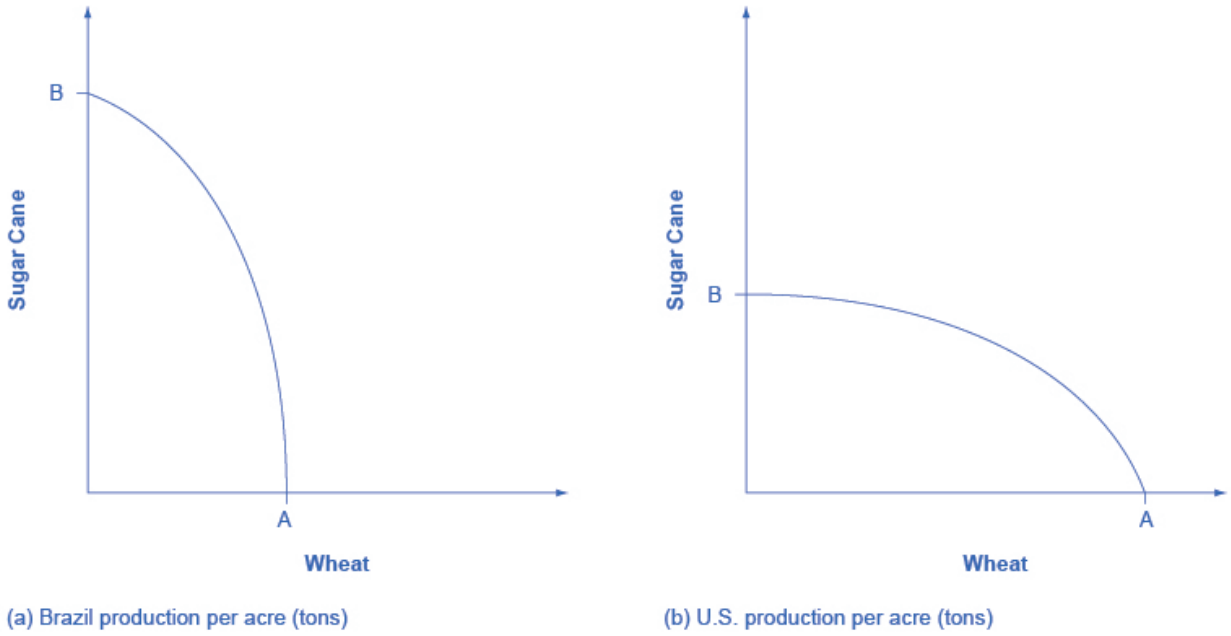

Figure 2.2c Production Possibility Frontier for the U.S. and Brazil. The U.S. PPF is flatter than the Brazil PPF implying that the opportunity cost of wheat in terms of sugar cane is lower in the U.S. than in Brazil. Conversely, the opportunity cost of sugar cane is lower in Brazil. The U.S. has comparative advantage in wheat and Brazil has comparative advantage in sugar cane. Production Possibility Frontier for the U.S. and Brazil by Steven A. Greenlaw & David Shapiro (OpenStax), licensed under CC BY 4.0.

Figure 2.2c Production Possibility Frontier for the U.S. and Brazil (Text version)

Figure 2.2c Production Possibility Frontier for the U.S. and Brazil graph shows two images. Both images have y-axes labeled "Sugar Cane" and x-axes labeled "Wheat." In image (a), Brazil's Sugar Cane production per acre (tons) is nearly double the production of its wheat. The line slopes steeply from high Sugar Cane levels at point B on the y-axis to mid x-axis Wheat levels at point A. In image. (b), the U.S.'s Sugar Cane production per acre (tons) is nearly half the production of its wheat. The line slope curves more gradually from the middle of y-axis Sugar Cane levels at point B to far right Point A (Wheat) on the x-axis. The U.S. PPF is flatter than the Brazil PPF implying that the opportunity cost of wheat in terms of sugar cane is lower in the U.S. than in Brazil. Conversely, the opportunity cost of sugar cane is lower in Brazil. The U.S. has comparative advantage in wheat and Brazil has comparative advantage in sugar cane.

When a country can produce a good at a lower opportunity cost than another country, we say that this country has a **comparative advantage** in that good. Comparative advantage is not the same as absolute advantage, which is when a country can produce more of a good. In our example, Brazil has an absolute advantage in sugar cane and the U.S. has an absolute advantage in wheat. One can easily see this with a simple observation of the extreme production points in the PPFs of the two countries. If Brazil devoted all of its

resources to producing wheat, it would be producing at point A. If however it had devoted all of its resources to producing sugar cane instead, it would be producing a much larger amount than the U.S., at point B.

The slope of the PPF gives the opportunity cost of producing an additional unit of wheat. While the slope is not constant throughout the PPFs, it is quite apparent that the PPF in Brazil is much steeper than in the U.S., and therefore the opportunity cost of wheat generally higher in Brazil. When countries engage in trade, they specialize in the production of the goods in which they have comparative advantage, and trade part of that production for goods in which they do not have comparative advantage. With trade, manufacturers produce goods where the opportunity cost is lowest, so total production increases, benefiting both trading parties.

Key Concepts & Summary

A production possibilities frontier defines the set of choices society faces for the combinations of goods and services it can produce given the resources available. The shape of the PPF is typically curved outward, rather than straight. Choices outside the PPF are unattainable and choices inside the PPF are wasteful. Over time, a growing economy will tend to shift the PPF outwards.

The law of diminishing returns holds that as increments of additional resources are devoted to producing something, the marginal increase in output will become increasingly smaller. All choices along a production possibilities frontier display productive efficiency; that is, it is impossible to use society's resources to produce more of one good without decreasing production of the other good. The specific choice along a production possibilities frontier that reflects the mix of goods society prefers is the choice with allocative efficiency. The curvature of the PPF is likely to differ by country, which results in different countries having comparative advantage in different goods. Total production can increase if countries specialize in the goods in which they have comparative advantage and trade some of their production for the remaining goods.

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2.3 - CONFRONTING OBJECTIONS TO THE ECONOMIC APPROACH

Learning Objectives

- Analyze arguments against economic approaches to decision-making
- Interpret a tradeoff diagram
- Contrast normative statements and positive statements

It is one thing to understand the economic approach to decision-making and another thing to feel comfortable applying it. The sources of discomfort typically fall into two categories: that people do not act in the way that fits the economic way of thinking, and that even if people did act that way, they should try not to. Let's consider these arguments in turn.

First Objection: People, Firms, and Society Do Not Act Like This

The economic approach to decision-making seems to require more information than most individuals possess and more careful decision-making than most individuals actually display. After all, do you or any of your friends draw a budget constraint and mutter to yourself about maximizing utility before you head to the shopping mall? Do members of the U.S. Congress contemplate production possibilities frontiers before they vote on the annual budget? The messy ways in which people and societies operate somehow doesn't look much like neat budget constraints or smoothly curving production possibilities frontiers.

However, the economics approach can be a useful way to analyze and understand the tradeoffs of economic decisions. To appreciate this point, imagine for a moment that you are playing basketball, dribbling to the right, and throwing a bounce-pass to the left to a teammate who is running toward the basket. A physicist or

engineer could work out the correct speed and trajectory for the pass, given the different movements involved and the weight and bounciness of the ball. However, when you are playing basketball, you do not perform any of these calculations. You just pass the ball, and if you are a good player, you will do so with high accuracy.

Someone might argue: "The scientist's formula of the bounce-pass requires a far greater knowledge of physics and far more specific information about speeds of movement and weights than the basketball player actually has, so it must be an unrealistic description of how basketball passes actually occur." This reaction would be wrongheaded. The fact that a good player can throw the ball accurately because of practice and skill, without making a physics calculation, does not mean that the physics calculation is wrong.

Similarly, from an economic point of view, someone who shops for groceries every week has a great deal of practice with how to purchase the combination of goods that will provide that person with utility, even if the shopper does not phrase decisions in terms of a budget constraint. Government institutions may work imperfectly and slowly, but in general, a democratic form of government feels pressure from voters and social institutions to make the choices that are most widely preferred by people in that society. Thus, when thinking about the economic actions of groups of people, firms, and society, it is reasonable, as a first approximation, to analyze them with the tools of economic analysis.

Second Objection: People, Firms, and Society Should Not Act This Way

The economics approach portrays people as self-interested. For some critics of this approach, even if self-interest is an accurate description of how people behave, these behaviors are not moral. Instead, the critics argue that people should be taught to care more deeply about others. Economists offer several answers to these concerns.

First, economics is not a form of moral instruction. Rather, it seeks to describe economic behavior as it actually exists. Philosophers draw a distinction between **positive statements**, which describe the world as it is, and **normative statements**, which describe how the world should be. Positive statements are factual. They may be true or false, but we can test them, at least in principle. Normative statements are subjective questions of opinion. We cannot test them since we cannot prove opinions to be true or false. They just are opinions based on one's values. For example, an economist could analyze a proposed subway system in a certain city. If the expected benefits exceed the costs, he concludes that the project is worthy—an example of positive analysis. Another economist argues for extended unemployment compensation during the Great Depression because a rich country like the United States should take care of its less fortunate citizens—an example of normative analysis.

Even if the line between positive and normative statements is not always crystal clear, economic analysis does

try to remain rooted in the study of the actual people who inhabit the actual economy. Fortunately however, the assumption that individuals are purely self-interested is a simplification about human nature. In fact, we need to look no further than to Adam Smith, the very father of modern economics to find evidence of this. The opening sentence of his book, *The Theory of Moral Sentiments*, puts it very clearly: "How selfish soever man may be supposed, there are evidently some principles in his nature, which interest him in the fortune of others, and render their happiness necessary to him, though he derives nothing from it except the pleasure of seeing it." Clearly, individuals are both self-interested and altruistic.

Second, we can label self-interested behavior and profit-seeking with other names, such as personal choice and freedom. The ability to make personal choices about buying, working, and saving is an important personal freedom. Some people may choose high-pressure, high-paying jobs so that they can earn and spend considerable amounts of money on themselves. Others may allocate large portions of their earnings to charity or spend it on their friends and family. Others may devote themselves to a career that can require much time, energy, and expertise but does not offer high financial rewards, like being an elementary school teacher or a social worker. Still others may choose a job that does consume much of their time or provide a high level of income, but still leaves time for family, friends, and contemplation. Some people may prefer to work for a large company; others might want to start their own business. People's freedom to make their own economic choices has a moral value worth respecting.

Clear It Up

Is a diagram by any other name the same?

When you study economics, you may feel buried under an avalanche of diagrams. Your goal should be to recognize the common underlying logic and pattern of the diagrams, not to memorize each one.

This chapter uses only one basic diagram, although we present it with different sets of labels. The consumption budget constraint and the production possibilities frontier for society, as a whole, are the same basic diagram. Figure 2.3a shows an individual budget constraint and a production possibilities frontier for two goods, Good 1 and Good 2. The tradeoff diagram always illustrates three basic themes: scarcity, tradeoffs, and economic efficiency.

The first theme is scarcity. It is not feasible to have unlimited amounts of both goods. Even if the budget constraint or a PPF shifts, scarcity remains—just at a different level. The second theme is tradeoffs. As depicted in the budget constraint or the production possibilities frontier, it is necessary to forgo some of one good to gain more of the other good. The details of this tradeoff vary. In a budget constraint we determine, the tradeoff is determined by the relative prices of the goods: that is, the relative price of two goods in the consumption choice budget constraint. These tradeoffs appear as a

straight line. However, a curved line represents the tradeoffs in many production possibilities frontiers because the **law of diminishing returns** holds that as we add resources to an area, the marginal gains tend to diminish. Regardless of the specific shape, tradeoffs remain.

The third theme is economic efficiency, or getting the most benefit from scarce resources. All choices on the production possibilities frontier show productive efficiency because in such cases, there is no way to increase the quantity of one good without decreasing the quantity of the other. Similarly, when an individual makes a choice along a budget constraint, there is no way to increase the quantity of one good without decreasing the quantity of the other. The choice on a production possibilities set that is socially preferred, or the choice on an individual's budget constraint that is personally preferred, will display allocative efficiency.

The basic budget constraint/production possibilities frontier diagram will recur throughout this book. Some examples include using these tradeoff diagrams to analyze trade, environmental protection and economic output, equality of incomes and economic output, and the macroeconomic tradeoff between consumption and investment. Do not allow the different labels to confuse you. The budget constraint/production possibilities frontier diagram is always just a tool for thinking carefully about scarcity, tradeoffs, and efficiency in a particular situation.

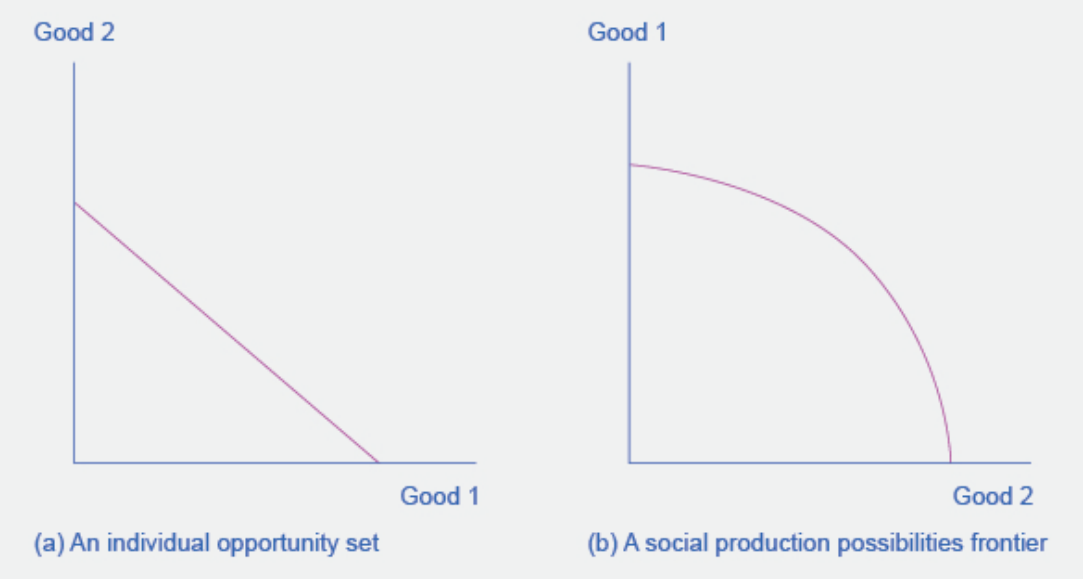

Figure 2.3a The Tradeoff Diagram. Both the individual opportunity set (or budget constraint) and the social production possibilities frontier show the constraints under which individual consumers and society as a whole operate. Both diagrams show the tradeoff in choosing more of one good at the cost of less of the other. The Tradeoff Diagram by Steven A. Greenlaw & David Shapiro (Openstax), licensed under CC BY 4.0

Figure 2.3a The Tradeoff Diagram (Text version)

Two graphs will occur frequently throughout the text. They represent the possible outcomes of

constraints/production of goods. The graph on the left has "Good 2" along the y-axis and "Good 1" along the x-axis and the line is trending straight down from left to right. The graph on the right has "Good 1" along the y-axis and "Good 2" along the x-axis and the line is curving downward left to right. Both the individual opportunity set (or budget constraint) and the social production possibilities frontier show the constraints under which individual consumers and society as a whole operate. Both diagrams show the tradeoff in choosing more of one good at the cost of less of the other.

Third, self-interested behavior can lead to positive social results. For example, when people work hard to make a living, they create economic output. Consumers who are looking for the best deals will encourage businesses to offer goods and services that meet their needs. Adam Smith, writing in *The Wealth of Nations*, named this property the **invisible hand**. In describing how consumers and producers interact in a market economy, Smith wrote:

"Every individual... generally, indeed, neither intends to promote the public interest, nor knows how much he is promoting it. By preferring the support of domestic to that of foreign industry, he intends only his own security; and by directing that industry in such a manner as its produce may be of the greatest value, he intends only his own gain. And he is in this, as in many other cases, led by an invisible hand to promote an end which was no part of his intention...By pursuing his own interest he frequently promotes that of the society more effectually than when he really intends to promote it."

The metaphor of the invisible hand suggests the remarkable possibility that broader social good can emerge from selfish individual actions.

Fourth, even people who focus on their own self-interest in the economic part of their life often set aside their own narrow self-interest in other parts of life. For example, you might focus on your own self-interest when asking your employer for a raise or negotiating to buy a car. Then you might turn around and focus on other people when you volunteer to read stories at the local library, help a friend move to a new apartment, or donate money to a charity. Self-interest is a reasonable starting point for analyzing many economic decisions, without needing to imply that people never do anything that is not in their own immediate self-interest.

Bring It Home

Choices ... to What Degree?

What have we learned? We know that scarcity impacts all the choices we make. An economist might argue that people do not obtain a bachelor's or master's degree because they do not have the

resources to make those choices or because their incomes are too low and/or the price of these degrees is too high. A bachelor's or a master's degree may not be available in their **opportunity set**.

The price of these degrees may be too high not only because the actual price, college tuition (and perhaps room and board), is too high. An economist might also say that for many people, the full opportunity cost of a bachelor's or a master's degree is too high. For these people, they are unwilling or unable to make the tradeoff of forfeiting years of working, and earning an income, to earn a degree.

Finally, the statistics we introduced at the start of the chapter reveal information about intertemporal choices. An economist might say that people choose not to obtain a college degree because they may have to borrow money to attend college, and the interest they have to pay on that loan in the future will affect their decisions today. Also, it could be that some people have a preference for current consumption over future consumption, so they choose to work now at a lower salary and consume now, rather than postponing that consumption until after they graduate college.

Key Concepts & Summary

The economic way of thinking provides a useful approach to understanding human behavior. Economists make the careful distinction between positive statements, which describe the world as it is, and normative statements, which describe how the world should be. Even when economics analyzes the gains and losses from various events or policies, and thus draws normative conclusions about how the world should be, the analysis of economics is rooted in a positive analysis of how people, firms, and governments actually behave, not how they should behave.

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2.4 - CONFRONTING SCARCITY: CHOICES IN PRODUCTION

Start Up: Tightening Security at the World's Airports

Do you want safer air travel or not? While that question is seldom asked so bluntly, any person who travels by air can tell you that our collective answer has been "yes," and it has been accompanied by increases in security and its associated costs at airports all over the world. Why? In short, "9/11." Terrorists hijacked four U.S. commercial airliners on September 11, 2001, and the tragic results that followed led to a sharp tightening in airport security.

In an effort to prevent similar disasters, airport security officials scrutinize luggage and passengers more carefully than ever before. In the months following 9/11, delays of as much as three hours were common as agents tried to assure that no weapons or bombs could be smuggled onto another plane.

"What to produce?" is a fundamental economic question. Every economy must answer this question. Should it produce more education, better health care, improved transportation, a cleaner environment? There are limits to what a nation can produce; deciding to produce more of one thing inevitably means producing less of something else. Individuals in much of the world, after the tragedy of 9/11, clearly were willing to give up time, and a fair amount of individual privacy, in an effort to obtain greater security. Nations and individual cities also devoted additional resources to police and other forms of protection in an effort to prevent tragedies such as 9/11. People all over the world chose to produce less of other goods in order to devote more resources to the production of greater security. And, as of early 2009, the choice to devote more resources to security had paid off; there had been no similar hijackings in the United States.

In this chapter we use our first model, the production possibilities model, to examine the nature of choices to produce more of some goods and less of others. As its name suggests, the production possibilities model shows the goods and services that an economy is capable of producing—its possibilities—given the factors of production and the technology it has available. The model specifies what it means to use resources fully and efficiently and suggests some important implications for international trade. We can also use the model to illustrate economic growth, a process that expands the set of production possibilities available to an economy.

We then turn to an examination of the type of economic system in which choices are made. An economic system is the set of rules that define how an economy's resources are to be owned and how decisions about their use are to be made. We will see that economic systems differ in terms of how they answer the

fundamental economic questions. Many of the world's economic systems, including the systems that prevail in North America, Europe, and much of Asia and Central and South America, rely on individuals operating in a market economy to make those choices. Other economic systems, including those of Cuba and North Korea today and historically those of the former Soviet Union, Soviet bloc countries, and China, rely—or relied—on government to make these choices. Different economic systems result in different sets of choices and thus different outcomes; the fact that market economies generally outperform the others when it comes to providing more of the things that people want helps to explain the dramatic shift from government-dominated toward market-dominated economic systems that has occurred throughout the world in the past 25 years. The chapter concludes with an examination of the role of government in an economy that relies chiefly on markets to allocate goods and services.

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2.5 - FACTORS OF PRODUCTION

Learning Objectives

- Define the three factors of production—labour, capital, and natural resources.
- Explain the role of technology and entrepreneurs in the utilization of the economy's factors of production.

Choices concerning what goods and services to produce are choices about an economy's use of its factors of production, the resources available to it for the production of goods and services. The value, or satisfaction, that people derive from the goods and services they consume and the activities they pursue is called utility. Ultimately, then, an economy's factors of production create utility; they serve the interests of people.

The factors of production in an economy are its labour, capital, and natural resources. Labour is the human effort that can be applied to the production of goods and services. People who are employed or would like to be are considered part of the labour available to the economy. Capital is a factor of production that has been produced for use in the production of other goods and services. Office buildings, machinery, and tools are examples of capital. Natural resources are the resources of nature that can be used for the production of goods and services.

In the next three sections, we will take a closer look at the factors of production we use to produce the goods and services we consume. The three basic building blocks of labour, capital, and natural resources may be used in different ways to produce different goods and services, but they still lie at the core of production. We will then look at the roles played by technology and entrepreneurs in putting these factors of production to work. As economists began to grapple with the problems of scarcity, choice, and opportunity cost two centuries ago, they focused on these concepts, just as they are likely to do two centuries hence.

Labour

Labour is human effort that can be applied to production. People who work to repair tires, pilot airplanes, teach children, or enforce laws are all part of the economy's labour. People who would like to work but have not found employment—who are unemployed—are also considered part of the labour available to the economy.

In some contexts, it is useful to distinguish two forms of labour. The first is the human equivalent of a natural resource. It is the natural ability an untrained, uneducated person brings to a particular production process. But most workers bring far more. The skills a worker has as a result of education, training, or experience that can be used in production are called human capital. Students who are attending a college or university are acquiring human capital. Workers who are gaining skills through experience or through training are acquiring human capital. Children who are learning to read are acquiring human capital.

The amount of labour available to an economy can be increased in two ways. One is to increase the total quantity of labour, either by increasing the number of people available to work or by increasing the average number of hours of work per week. The other is to increase the amount of human capital possessed by workers.

Capital

Long ago, when the first human beings walked the earth, they produced food by picking leaves or fruit off a plant or by catching an animal and eating it. We know that very early on, however, they began shaping stones into tools, apparently for use in butchering animals. Those tools were the first capital because they were produced for use in producing other goods—food and clothing.

Modern versions of the first stone tools include saws, meat cleavers, hooks, and grinders; all are used in butchering animals. Tools such as hammers, screwdrivers, and wrenches are also capital. Transportation equipment, such as cars and trucks, is capital. Facilities such as roads, bridges, ports, and airports are capital. Buildings, too, are capital; they help us to produce goods and services.

Capital does not consist solely of physical objects. The score for a new symphony is capital because it will be used to produce concerts. Computer software used by business firms or government agencies to produce goods and services is capital. Capital may thus include physical goods and intellectual discoveries. Any resource is capital if it satisfies two criteria:

1. The resource must have been produced.
2. The resource can be used to produce other goods and services.

One thing that is not considered capital is money. A firm cannot use money directly to produce other goods, so money does not satisfy the second criterion for capital. Firms can, however, use money to acquire capital. Money is a form of financial capital. Financial capital includes money and other "paper" assets (such as stocks and bonds) that represent claims on future payments. These financial assets are not capital, but they can be used directly or indirectly to purchase factors of production or goods and services.

Natural Resources

There are two essential characteristics of natural resources. The first is that they are found in nature—that no human effort has been used to make or alter them. The second is that they can be used for the production of goods and services. That requires knowledge; we must know how to use the things we find in nature before they become resources.

Consider oil. Oil in the ground is a natural resource because it is found (not manufactured) and can be used to produce goods and services. However, 250 years ago oil was a nuisance, not a natural resource. Pennsylvania farmers in the eighteenth century who found oil oozing up through their soil were dismayed, not delighted. No one knew what could be done with the oil. It was not until the mid-nineteenth century that a method was found for refining oil into kerosene that could be used to generate energy, transforming oil into a natural resource. Oil is now used to make all sorts of things, including clothing, drugs, gasoline, and plastic. It became a natural resource because people discovered and implemented a way to use it.

Defining something as a natural resource only if it can be used to produce goods and services does not mean that a tree has value only for its wood or that a mountain has value only for its minerals. If people gain utility from the existence of a beautiful wilderness area, then that wilderness provides a service. The wilderness is thus a natural resource.

The natural resources available to us can be expanded in three ways. One is the discovery of new natural resources, such as the discovery of a deposit of ore containing titanium. The second is the discovery of new uses for resources, as happened when new techniques allowed oil to be put to productive use or sand to be used in manufacturing computer chips. The third is the discovery of new ways to extract natural resources in order to use them. New methods of discovering and mapping oil deposits have increased the world's supply of this important natural resource.

Technology and the Entrepreneur

Goods and services are produced using the factors of production available to the economy. Two things play a crucial role in putting these factors of production to work. The first is technology, the knowledge that can be

applied to the production of goods and services. The second is an individual who plays a key role in a market economy: the entrepreneur. An entrepreneur is a person who, operating within the context of a market economy, seeks to earn profits by finding new ways to organize factors of production. In non-market economies the role of the entrepreneur is played by bureaucrats and other decision makers who respond to incentives other than profit to guide their choices about resource allocation decisions.

The interplay of entrepreneurs and technology affects all our lives. Entrepreneurs put new technologies to work every day, changing the way factors of production are used. Farmers and factory workers, engineers and electricians, technicians and teachers all work differently than they did just a few years ago, using new technologies introduced by entrepreneurs. The music you enjoy, the books you read, the athletic equipment with which you play are produced differently than they were five years ago. The book you are reading was written and manufactured using technologies that did not exist ten years ago. We can dispute whether all the changes have made our lives better. What we cannot dispute is that they have made our lives different.

Key Takeaways

- Factors of production are the resources the economy has available to produce goods and services.
- Labour is the human effort that can be applied to the production of goods and services. Labour's contribution to an economy's output of goods and services can be increased either by increasing the quantity of labour or by increasing human capital.
- Capital is a factor of production that has been produced for use in the production of other goods and services.
- Natural resources are those things found in nature that can be used for the production of goods and services.
- Two keys to the utilization of an economy's factors of production are technology and, in the case of a market economic system, the efforts of entrepreneurs.

Try It!

Explain whether each of the following is labour, capital, or a natural resource.

1. An unemployed factory worker
2. A college professor
3. The library building on your campus
4. Yellowstone National Park
5. An untapped deposit of natural gas
6. The White House
7. The local power plant

Check your Answers[1]

1. **Question 1)** An unemployed factory worker could be put to work; he or she counts as labour. **Question 2)** A college professor is labour. **Question 3)** The library building on your campus is part of capital. **Question 4)** Yellowstone National Park. Those areas of the park left in their natural state are a natural resource. Facilities such as visitors' centers, roads, and campgrounds are capital. **Question 5)** An untapped deposit of natural gas is a natural resource. Once extracted and put in a storage tank, natural gas is capital. **Question 6)** The White House is capital. **Question 7)** The local power plant is capital.

Case in Point: Technology Cuts Costs, Boosts Productivity and Profits

Figure 2.5a. Oil Platform (https://www.flickr.com/photos/jstephenconn/7933885172/in/photolist-d66eDE-4wFxFo-5s7UQ9-bPhyuc-NuDD8R-6uvxKL-bnEtbo-9XVyze-5umBk9-3QoQ5-52RVds-9XVyzc-VvmG8i-4txRE-2k3AFBT-29nyRh1-mpGc9v-2kzAjbp-6NLjbs-hKGB2G-hKFwH4-hKG2Ht-2kT8LCk-2n7HsKv-2jd57T4-7GtThU-2ncgsTL-2eFXLTX-4svmTi-8ntGRC-8K3mnH-ewZKWQ-xzPGM-xzPFo-4RvJjD-2n7FdY4-2eBnBvG-2jmtRqE-2huKv2K-2guzjN4-SzRvrC-3dfdEB-69vEai-ccWzWG-2kT9z3Z-2mjYnqT-2i4K6EB-2hBksnf-2hLfSNc-2j83zMd) by J. Stephen Conn, licensed under CC BY-NC 2.0.

Technology can seem an abstract force in the economy—important, but invisible.

It is not invisible to the 130 people who work on a Shell Oil Company oil rig called Mars, located in the deep waters of the Gulf of Mexico, about 160 miles southwest of Pensacola, Florida. The name Mars reflects its otherworld appearance—it extends 300 feet above the water's surface and has steel tendons that reach 3,000 feet to the floor of the gulf. This facility would not exist if it were not for the development of better oil discovery methods that include three-dimensional seismic mapping techniques, satellites that locate oil from space, and drills that can make turns as drilling

foremen steer them by monitoring them on computer screens from the comfort of Mars. "We don't hit as many dry holes," commented Shell manager Miles Barrett. As a result of these new technologies, over the past two decades, the cost of discovering a barrel of oil dropped from $20 to under $5. And the technologies continue to improve. Three-dimensional surveys are being replaced with four-dimensional ones that allow geologists to see how the oil fields change over time.

The Mars project was destroyed by Hurricane Katrina in 2005. Royal Dutch Shell completed repairs in 2006—at a cost of $200 million. But, the facility is again pumping 130,000 barrels of oil per day and 150 million cubic feet of natural gas—the energy equivalent of an additional 26,000 barrels of oil.

Technology is doing more than helping energy companies track oil deposits. It is changing the way soft drinks and other grocery items are delivered to retail stores. For example, when a PepsiCo delivery driver arrives at a 7-Eleven, the driver keys into a handheld computer the inventory of soft drinks, chips, and other PepsiCo products. The information is transmitted to a main computer at the warehouse that begins processing the next order for that store. The result is that the driver can visit more stores in a day and PepsiCo can cover a given territory with fewer drivers and trucks.

New technology is even helping to produce more milk from cows. Ed Larsen, who owns a 1,200-cow dairy farm in Wisconsin, never gets up before dawn to milk the cows, the way he did as a boy. Rather, the cows are hooked up to electronic milkers. Computers measure each cow's output, and cows producing little milk are sent to a "hospital wing" for treatment. With the help of such technology, as well as better feed, today's dairy cows produce 50% more milk than did cows 20 years ago. Even though the number of dairy cows in the United States in the last 20 years has fallen 17%, milk output has increased 25%.

Who benefits from technological progress? Consumers gain from lower prices and better service. Workers gain: Their greater ability to produce goods and services translates into higher wages. And firms gain: Lower production costs mean higher profits. Of course, some people lose as technology advances. Some jobs are eliminated, and some firms find their services are no longer needed. One can argue about whether particular technological changes have improved our lives, but they have clearly made—and will continue to make—them far different.

Sources: David Ballingrud, "Drilling in the Gulf: Life on Mars," *St. Petersburg Times* (Florida), August 5, 2001, p. 1A; Barbara Hagenbaugh, "Dairy Farms Evolve to Survive," *USA Today*, August 7, 2003, p. 1B; Del Jones and Barbara Hansen, "Special Report: A Who's Who of Productivity," *USA Today*, August 30, 2001, p. 1B; and Christopher Helman, Shell Shocked, *Forbes Online*, July 27, 2006.

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2.6 - THE PRODUCTION POSSIBILITIES CURVE

Learning Objectives

- Explain the concept of the production possibilities curve and understand the implications of its downward slope and bowed-out shape.
- Use the production possibilities model to distinguish between full employment and situations of idle factors of production and between efficient and inefficient production.
- Understand specialization and its relationship to the production possibilities model and comparative advantage.

An economy's factors of production are scarce; they cannot produce an unlimited quantity of goods and services. A production possibilities curve is a graphical representation of the alternative combinations of goods and services an economy can produce. It illustrates the production possibilities model. In drawing the production possibilities curve, we shall assume that the economy can produce only two goods and that the quantities of factors of production and the technology available to the economy are fixed.

Watch It!

Watch the video Production Possibilities Curve Review (https://www.youtube.com/watch?v=O6XL__2CDPU) (6 mins)

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://ecampusontario.pressbooks.pub/laboureconomics/?p=831#oembed-1

Video Source: Jacob Clifford. (2014, August 14). *Production possibilities curve review* [Video] YouTube. https://www.youtube.com/watch?v=O6XL__2CDPU

Constructing a Production Possibilities Curve

To construct a production possibilities curve, we will begin with the case of a hypothetical firm, Alpine Sports, Inc., a specialized sports equipment manufacturer. Christie Ryder began the business 15 years ago with a single ski production facility near Killington ski resort in central Vermont. Ski sales grew, and she also saw demand for snowboards rising—particularly after snowboard competition events were included in the 2002 Winter Olympics in Salt Lake City. She added a second plant in a nearby town. The second plant, while smaller than the first, was designed to produce snowboards as well as skis. She also modified the first plant so that it could produce both snowboards and skis. Two years later she added a third plant in another town. While even smaller than the second plant, the third was primarily designed for snowboard production but could also produce skis.

We can think of each of Ms. Ryder's three plants as a miniature economy and analyze them using the production possibilities model. We assume that the factors of production and technology available to each of the plants operated by Alpine Sports are unchanged.

Suppose the first plant, Plant 1, can produce 200 pairs of skis per month when it produces only skis. When devoted solely to snowboards, it produces 100 snowboards per month. It can produce skis and snowboards simultaneously as well.

The table in Figure 2.6a A Production Possibilities Curve gives three combinations of skis and snowboards that Plant 1 can produce each month. Combination A involves devoting the plant entirely to ski production; combination C means shifting all of the plant's resources to snowboard production; combination B involves the production of both goods. These values are plotted in a production possibilities curve for Plant 1. The curve is a downward-sloping straight line, indicating that there is a linear, negative relationship between the production of the two goods.

Neither skis nor snowboards is an independent or a dependent variable in the production possibilities model; we can assign either one to the vertical or to the horizontal axis. Here, we have placed the number of pairs of

skis produced per month on the vertical axis and the number of snowboards produced per month on the horizontal axis.

The negative slope of the production possibilities curve reflects the scarcity of the plant's capital and labor. Producing more snowboards requires shifting resources out of ski production and thus producing fewer skis. Producing more skis requires shifting resources out of snowboard production and thus producing fewer snowboards.

The slope of Plant 1's production possibilities curve measures the rate at which Alpine Sports must give up ski production to produce additional snowboards. Because the production possibilities curve for Plant 1 is linear, we can compute the slope between any two points on the curve and get the same result. Between points A and B, for example, the slope equals −2 pairs of skis/snowboard (equals −100 pairs of skis/50 snowboards). (Many students are helped when told to read this result as "−2 pairs of skis *per* snowboard.") We get the same value between points B and C, and between points A and C.

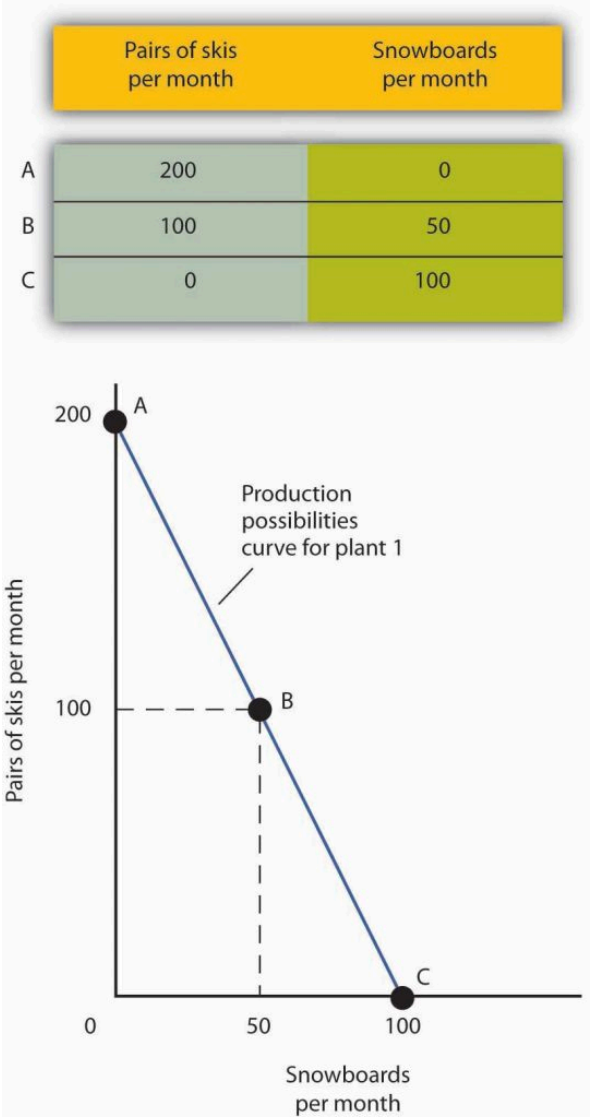


Figure 2.6a. A Production Possibilities Curve. A Production Possibilities Curve by University of Minnesota, licensed under CC BY-NC-SA 4.0.

Figure 2.6a. A Production Possibilities Curve (Text version)

The table shows the combinations of pairs of skis and snowboards that Plant 1 is capable of producing each month. These are also illustrated with a production possibilities curve. Notice that this curve is linear, sloping downward left to right.

Table 2.6a A Production Possibilities Curve

Points	Pairs of skis per month	Snowboards per month
A	200	0
B	100	50
C	0	100

To see this relationship more clearly, examine Figure 2.6b The Slope of a Production Possibilities Curve. Suppose Plant 1 is producing 100 pairs of skis and 50 snowboards per month at point B. Now consider what would happen if Ms. Ryder decided to produce 1 more snowboard per month. The segment of the curve around point B is magnified in Figure 2.6b The Slope of a Production Possibilities Curve. The slope between points B and B′ is −2 pairs of skis/snowboard. Producing 1 additional snowboard at point B′ requires giving up 2 pairs of skis. We can think of this as the opportunity cost of producing an additional snowboard at Plant 1. This opportunity cost equals the absolute value of the slope of the production possibilities curve.

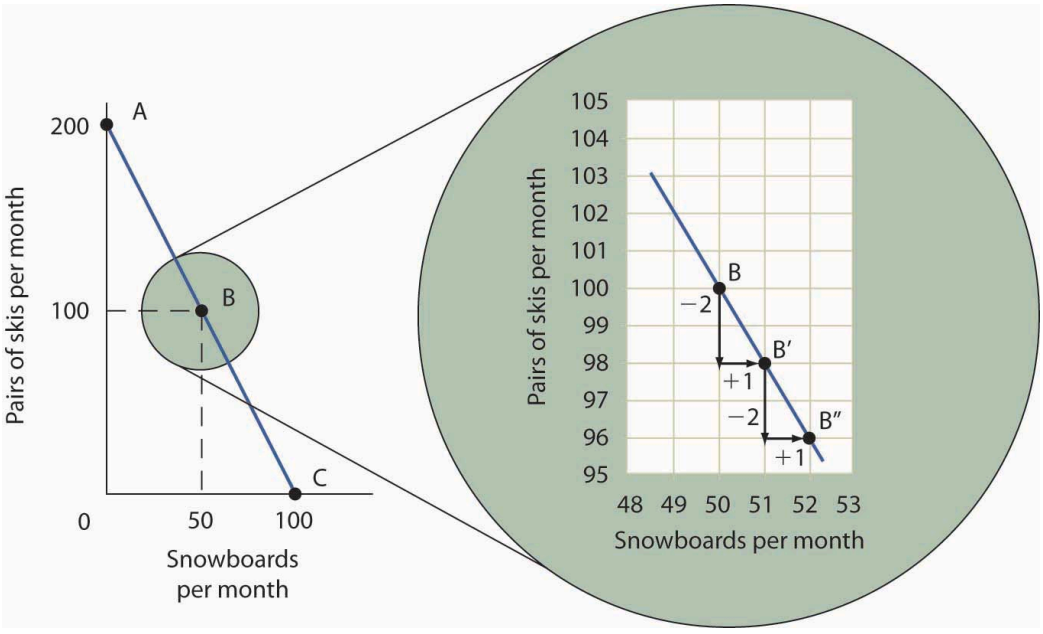


Figure 2.6b. The Slope of a Production Possibilities Curve. The Slope of a Production Possibilities Curve by University of Minnesota, licensed under CC BY-NC-SA 4.0.

Figure 2.6b. The Slope of a Production Possibilities Curve (Text version)

The table shows the data for Figure 2.6b. The vertical axis is pairs of skis per month and the horizontal axis is snowboards per month. The slope is linear, trending downwards left to right.

Table 2.6b. The Slope of a Production Possibilities Curve

Points	Pair of skis per month	Snowboards per month
B	100	50
B’	98	51
B”	96	52

The slope of the linear production possibilities curve in Figure 2.6a “A Production Possibilities Curve” is constant; it is −2 pairs of skis/snowboard. In the section of the curve shown here, the slope can be calculated between points B and B′. Expanding snowboard production to 51 snowboards per month from 50 snowboards per month requires a reduction in ski production to 98 pairs of skis per month from 100 pairs. The slope equals −2 pairs of skis/snowboard (that is, it must give up two pairs of skis to free up the resources necessary to produce one additional snowboard). To shift from B′ to B″, Alpine Sports must give up two more pairs of skis per snowboard. The absolute value of the slope of a production possibilities curve measures the opportunity cost of an additional unit of the good on the horizontal axis measured in terms of the quantity of the good on the vertical axis that must be forgone.

The absolute value of the slope of any production possibilities curve equals the opportunity cost of an additional unit of the good on the horizontal axis. It is the amount of the good on the vertical axis that must be given up in order to free up the resources required to produce one more unit of the good on the horizontal axis. We will make use of this important fact as we continue our investigation of the production possibilities curve.

Figure 2.6c Production Possibilities at Three Plants production possibilities curves for each of the firm’s three plants. Each of the plants, if devoted entirely to snowboards, could produce 100 snowboards. Plants 2 and 3, if devoted exclusively to ski production, can produce 100 and 50 pairs of skis per month, respectively. The exhibit gives the slopes of the production possibilities curves for each plant. The opportunity cost of an additional snowboard at each plant equals the absolute values of these slopes (that is, the number of pairs of skis that must be given up per snowboard).

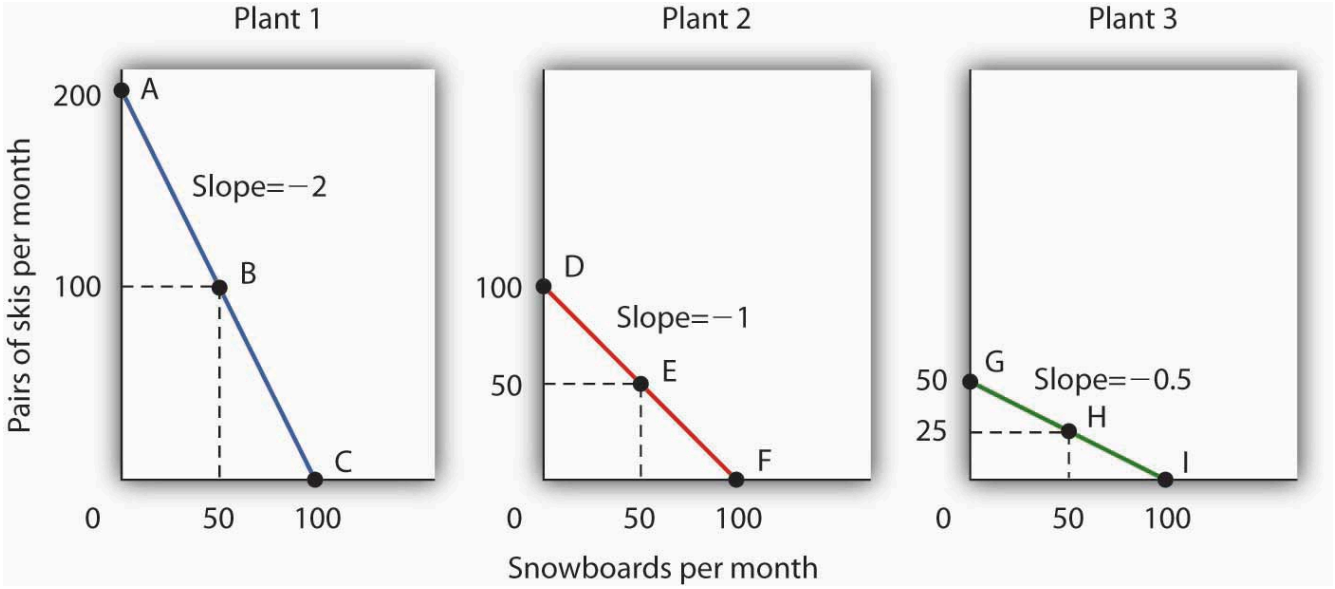


Figure 2.6c Production Possibilities at Three Plants. Production Possibilities at Three Plants by University of Minnesota, licensed under CC BY-NC-SA 4.0.

Figure 2.6c Production Possibilities at Three Plants Text Version

The slopes of the production possibilities curves for each plant differ. The steeper the curve, the greater the opportunity cost of an additional snowboard. Here, the opportunity cost is lowest at Plant 3 and greatest at Plant 1.

The three tables below outline data for the graphs above. The vertical axis is pairs of skis per month and the horizontal axis is snowboards per month. Plant 1 has a slope of negative 2, Plant 2 has a slope of negative 1,

Table 2.6c Production Possibilities Plant 1

Points	Pairs of skis per month	Snowboards per month
A	200	0
B	100	50
C	0	100

Table 2.6d Production Possibilities Plant 2

Points	Pairs of skis per month	Snowboards per month
D	100	0
E	50	50
F	0	100

Table 2.6e Production Possibilities Plant 3

Points	Pairs of skis per month	Snowboards per month
G	50	0
H	25	50
I	0	100

The exhibit gives the slopes of the production possibilities curves for each of the firm's three plants. The opportunity cost of an additional snowboard at each plant equals the absolute values of these slopes. More generally, the absolute value of the slope of any production possibilities curve at any point gives the opportunity cost of an additional unit of the good on the horizontal axis, measured in terms of the number of units of the good on the vertical axis that must be forgone.

The greater the absolute value of the slope of the production possibilities curve, the greater the opportunity cost will be. The plant for which the opportunity cost of an additional snowboard is greatest is the plant with the steepest production possibilities curve; the plant for which the opportunity cost is lowest is the plant with the flattest production possibilities curve. The plant with the lowest opportunity cost of producing snowboards is Plant 3; its slope of −0.5 means that Ms. Ryder must give up half a pair of skis in that plant to produce an additional snowboard. In Plant 2, she must give up one pair of skis to gain one more snowboard. We have already seen that an additional snowboard requires giving up two pairs of skis in Plant 1.

Watch It!

Watch the video (Production Possibility Frontier/Curve, PPF, PPC) Why can't things be free? (https://www.youtube.com/watch?v=PGaDeJ-oKzQ) (4 mins)

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://ecampusontario.pressbooks.pub/laboureconomics/?p=831#oembed-2

Video Source: Economics Mafia. (2014, June 29). *(Production possibility frontier/curve, PPF, PPC) Why can't things be free?* [Video]. YouTube. https://www.youtube.com/watch?v=PGaDeJ-oKzQ

Comparative Advantage and the Production Possibilities

Curve

To construct a combined production possibilities curve for all three plants, we can begin by asking how many pairs of skis Alpine Sports could produce if it were producing only skis. To find this quantity, we add up the values at the vertical intercepts of each of the production possibilities curves in Figure 2.6c Production Possibilities at Three Plants. These intercepts tell us the maximum number of pairs of skis each plant can produce. Plant 1 can produce 200 pairs of skis per month, Plant 2 can produce 100 pairs of skis at per month, and Plant 3 can produce 50 pairs. Alpine Sports can thus produce 350 pairs of skis per month if it devotes its resources exclusively to ski production. In that case, it produces no snowboards.

Now suppose the firm decides to produce 100 snowboards. That will require shifting one of its plants out of ski production. Which one will it choose to shift? The sensible thing for it to do is to choose the plant in which snowboards have the lowest opportunity cost—Plant 3. It has an advantage not because it can produce more snowboards than the other plants (all the plants in this example are capable of producing up to 100 snowboards per month) but because it is the least productive plant for making skis. Producing a snowboard in Plant 3 requires giving up just half a pair of skis.

Economists say that an economy has a comparative advantage in producing a good or service if the opportunity cost of producing that good or service is lower for that economy than for any other. Plant 3 has a comparative advantage in snowboard production because it is the plant for which the opportunity cost of additional snowboards is lowest. To put this in terms of the production possibilities curve, Plant 3 has a comparative advantage in snowboard production (the good on the horizontal axis) because its production possibilities curve is the flattest of the three curves.

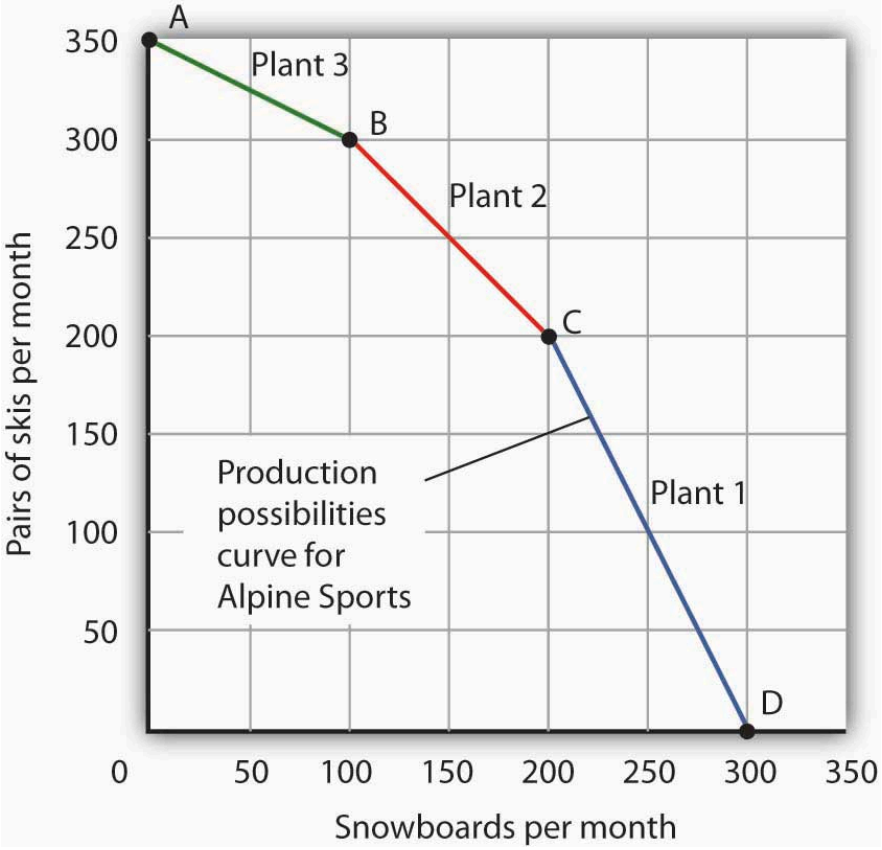


Figure 2.6d. The Combined Production Possibilities Curve for Alpine Sports. The Combined Production Possibilities Curve for Alpine Sports by University of Minnesota, licensed under CC BY-N-SA 4.0.

The curve shown combines the production possibilities curves for each plant. At point A, Alpine Sports produces 350 pairs of skis per month and no snowboards. If the firm wishes to increase snowboard production, it will first use Plant 3, which has a comparative advantage in snowboards.

Plant 3's comparative advantage in snowboard production makes a crucial point about the nature of comparative advantage. It need not imply that a particular plant is especially good at an activity. In our example, all three plants are equally good at snowboard production. Plant 3, though, is the least efficient of the three in ski production. Alpine thus gives up fewer skis when it produces snowboards in Plant 3. Comparative advantage thus can stem from a lack of efficiency in the production of an alternative good rather than a special proficiency in the production of the first good.

The combined production possibilities curve for the firm's three plants is shown in a class="xref" href="#fig2_5">Figure 2.6d The Combined Production Possibilities Curve for Alpine Sports. We begin at point A, with all three plants producing only skis. Production totals 350 pairs of skis per month and zero snowboards. If the firm were to produce 100 snowboards at Plant 3, ski production would fall by 50 pairs per month (recall that the opportunity cost per snowboard at Plant 3 is half a pair of skis). That would bring ski

production to 300 pairs, at point B. If Alpine Sports were to produce still more snowboards in a single month, it would shift production to Plant 2, the facility with the next-lowest opportunity cost. Producing 100 snowboards at Plant 2 would leave Alpine Sports producing 200 snowboards and 200 pairs of skis per month, at point C. If the firm were to switch entirely to snowboard production, Plant 1 would be the last to switch because the cost of each snowboard there is 2 pairs of skis. With all three plants producing only snowboards, the firm is at point D on the combined production possibilities curve, producing 300 snowboards per month and no skis.

Notice that this production possibilities curve, which is made up of linear segments from each assembly plant, has a bowed-out shape; the absolute value of its slope increases as Alpine Sports produces more and more snowboards. This is a result of transferring resources from the production of one good to another according to comparative advantage. We shall examine the significance of the bowed-out shape of the curve in the next section.

The Law of Increasing Opportunity Cost

We see in Figure 2.6d The Combined Production Possibilities Curve for Alpine Sports that, beginning at point A and producing only skis, Alpine Sports experiences higher and higher opportunity costs as it produces more snowboards. The fact that the opportunity cost of additional snowboards increases as the firm produces more of them is a reflection of an important economic law. The law of increasing opportunity cost holds that as an economy moves along its production possibilities curve in the direction of producing more of a particular good, the opportunity cost of additional units of that good will increase.

We have seen the law of increasing opportunity cost at work traveling from point A toward point D on the production possibilities curve in Figure 2.6d The Combined Production Possibilities Curve for Alpine Sports. The opportunity cost of each of the first 100 snowboards equals half a pair of skis; each of the next 100 snowboards has an opportunity cost of 1 pair of skis, and each of the last 100 snowboards has an opportunity cost of 2 pairs of skis. The law also applies as the firm shifts from snowboards to skis. Suppose it begins at point D, producing 300 snowboards per month and no skis. It can shift to ski production at a relatively low cost at first. The opportunity cost of the first 200 pairs of skis is just 100 snowboards at Plant 1, a movement from point D to point C, or 0.5 snowboards per pair of skis. We would say that Plant 1 has a comparative advantage in ski production. The next 100 pairs of skis would be produced at Plant 2, where snowboard production would fall by 100 snowboards per month. The opportunity cost of skis at Plant 2 is 1 snowboard per pair of skis. Plant 3 would be the last plant converted to ski production. There, 50 pairs of skis could be produced per month at a cost of 100 snowboards, or an opportunity cost of 2 snowboards per pair of skis.

The bowed-out production possibilities curve for Alpine Sports illustrates the law of increasing opportunity

cost. Scarcity implies that a production possibilities curve is downward sloping; the law of increasing opportunity cost implies that it will be bowed out, or concave, in shape.

The bowed-out curve of Figure 2.6d The Combined Production Possibilities Curve for Alpine Sports becomes smoother as we include more production facilities. Suppose Alpine Sports expands to 10 plants, each with a linear production possibilities curve. Panel (a) of Figure 2.6e Production Possibilities for the Economy shows the combined curve for the expanded firm, constructed as we did in Figure 2.6d The Combined Production Possibilities Curve for Alpine Sports. This production possibilities curve includes 10 linear segments and is almost a smooth curve. As we include more and more production units, the curve will become smoother and smoother. In an actual economy, with a tremendous number of firms and workers, it is easy to see that the production possibilities curve will be smooth. We will generally draw production possibilities curves for the economy as smooth, bowed-out curves, like the one in Panel (b). This production possibilities curve shows an economy that produces only skis and snowboards. Notice the curve still has a bowed-out shape; it still has a negative slope. Notice also that this curve has no numbers. Economists often use models such as the production possibilities model with graphs that show the general shapes of curves but that do not include specific numbers.

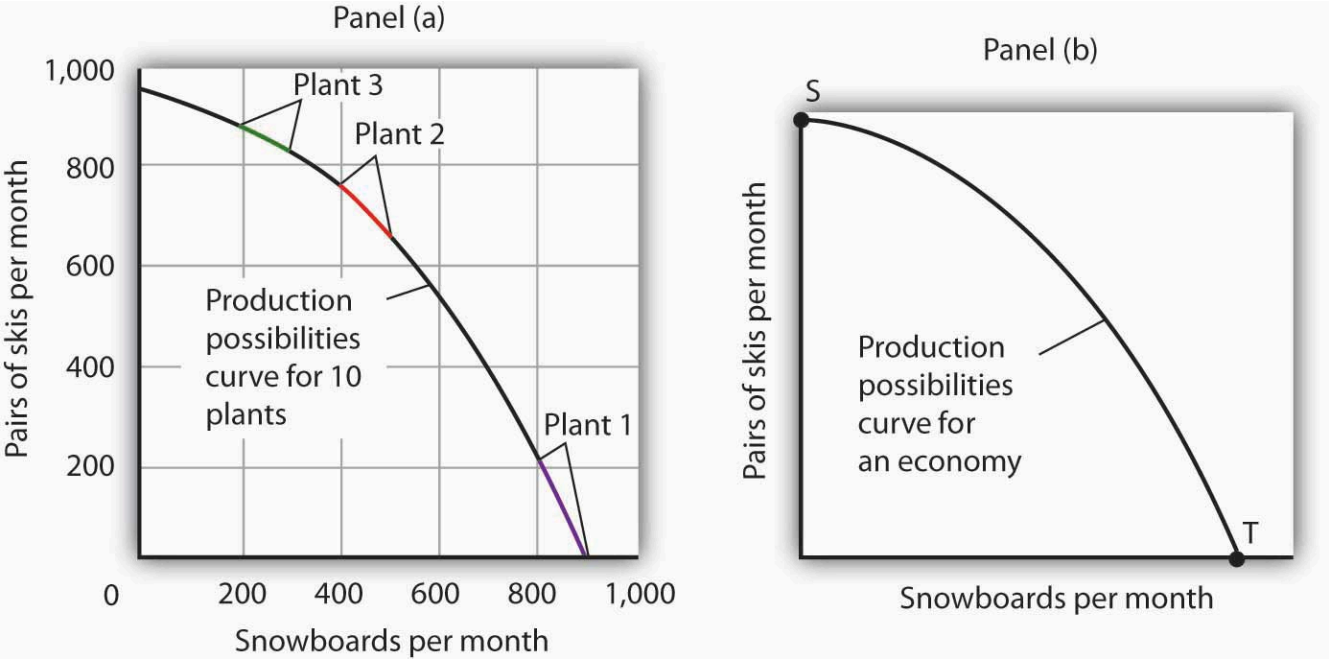


Figure 2.6e. Production Possibilities for the Economy. Production Possibilities for the Economy by University of Minnesota, licensed under CC BY- NC-SA 4.0.

As we combine the production possibilities curves for more and more units, the curve becomes smoother. It retains its negative slope and bowed-out shape. In Panel (a) we have a combined production possibilities curve for Alpine Sports, assuming that it now has 10 plants producing skis and snowboards. Even though each of the plants has a linear curve, combining them according to comparative advantage, as we did with 3 plants in

Figure 2.6d The Combined Production Possibilities Curve for Alpine Sports, produces what appears to be a smooth, nonlinear curve, even though it is made up of linear segments. In drawing production possibilities curves for the economy, we shall generally assume they are smooth and "bowed out," as in Panel (b). This curve depicts an entire economy that produces only skis and snowboards.

Movements Along the Production Possibilities Curve

We can use the production possibilities model to examine choices in the production of goods and services. In applying the model, we assume that the economy can produce two goods, and we assume that technology and the factors of production available to the economy remain unchanged. In this section, we shall assume that the economy operates on its production possibilities curve so that an increase in the production of one good in the model implies a reduction in the production of the other.

We shall consider two goods and services: national security and a category we shall call "all other goods and services." This second category includes the entire range of goods and services the economy can produce, aside from national defense and security. Clearly, the transfer of resources to the effort to enhance national security reduces the quantity of other goods and services that can be produced. In the wake of the 9/11 attacks in 2001, nations throughout the world increased their spending for national security. This spending took a variety of forms. One, of course, was increased defense spending. Local and state governments also increased spending in an effort to prevent terrorist attacks. Airports around the world hired additional agents to inspect luggage and passengers.

The increase in resources devoted to security meant fewer "other goods and services" could be produced. In terms of the production possibilities curve in Figure 2.6f Spending More for Security, the choice to produce more security and less of other goods and services means a movement from A to B. Of course, an economy cannot really *produce* security; it can only attempt to provide it. The attempt to provide it requires resources; it is in that sense that we shall speak of the economy as "producing" security.

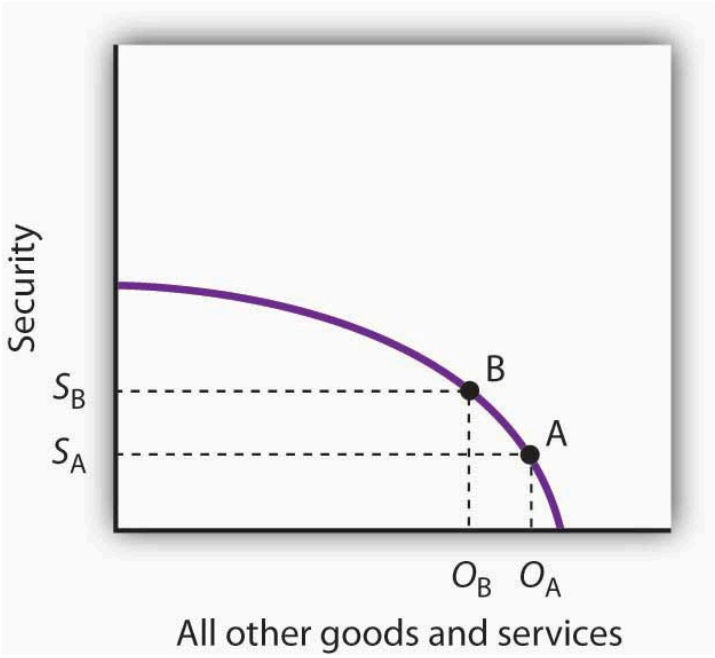


Figure 2.6f Spending More for Security. Spending More for Security by University of Minnesota, licensed under CC BY-NC-SA 4.0.

Here, an economy that can produce two categories of goods, security and "all other goods and services," begins at point A on its production possibilities curve. The economy produces S_A units of security and O_A units of all other goods and services per period. A movement from A to B requires shifting resources out of the production of all other goods and services and into spending on security. The increase in spending on security, to S_A units of security per period, has an opportunity cost of reduced production of all other goods and services. Production of all other goods and services falls by $O_A - O_B$ units per period.

At point A, the economy was producing S_A units of security on the vertical axis—defense services and various forms of police protection—and O_A units of other goods and services on the horizontal axis. The decision to devote more resources to security and less to other goods and services represents the choice we discussed in the chapter introduction. In this case we have categories of goods rather than specific goods. Thus, the economy chose to increase spending on security in the effort to defeat terrorism. Since we have assumed that the economy has a fixed quantity of available resources, the increased use of resources for security and national defense necessarily reduces the number of resources available for the production of other goods and services.

The law of increasing opportunity cost tells us that, as the economy moves along the production possibilities curve in the direction of more of one good, its opportunity cost will increase. We may conclude that, as the economy moved along this curve in the direction of greater production of security, the opportunity cost of the additional security began to increase. That is because the resources transferred from the production of

other goods and services to the production of security had a greater and greater comparative advantage in producing things other than security.

The production possibilities model does not tell us where on the curve a particular economy will operate. Instead, it lays out the possibilities facing the economy. Many countries, for example, chose to move along their respective production possibilities curves to produce more security and national defense and less of all other goods in the wake of 9/11. We will see in the chapter on demand and supply how choices about what to produce are made in the marketplace.

Producing on Versus Producing Inside the Production Possibilities Curve

An economy that is operating inside its production possibilities curve could, by moving onto it, produce more of all the goods and services that people value, such as food, housing, education, medical care, and music. Increasing the availability of these goods would improve the standard of living. Economists conclude that it is better to be on the production possibilities curve than inside it.

Two things could leave an economy operating at a point inside its production possibilities curve. First, the economy might fail to use fully the resources available to it. Second, it might not allocate resources on the basis of comparative advantage. In either case, production within the production possibilities curve implies the economy could improve its performance.

Idle Factors of Production

Suppose an economy fails to put all its factors of production to work. Some workers are without jobs, some buildings are without occupants, some fields are without crops. Because an economy's production possibilities curve assumes the full use of the factors of production available to it, the failure to use some factors results in a level of production that lies inside the production possibilities curve.

If all the factors of production that are available for use under current market conditions are being utilized, the economy has achieved full employment. An economy cannot operate on its production possibilities curve unless it has full employment.

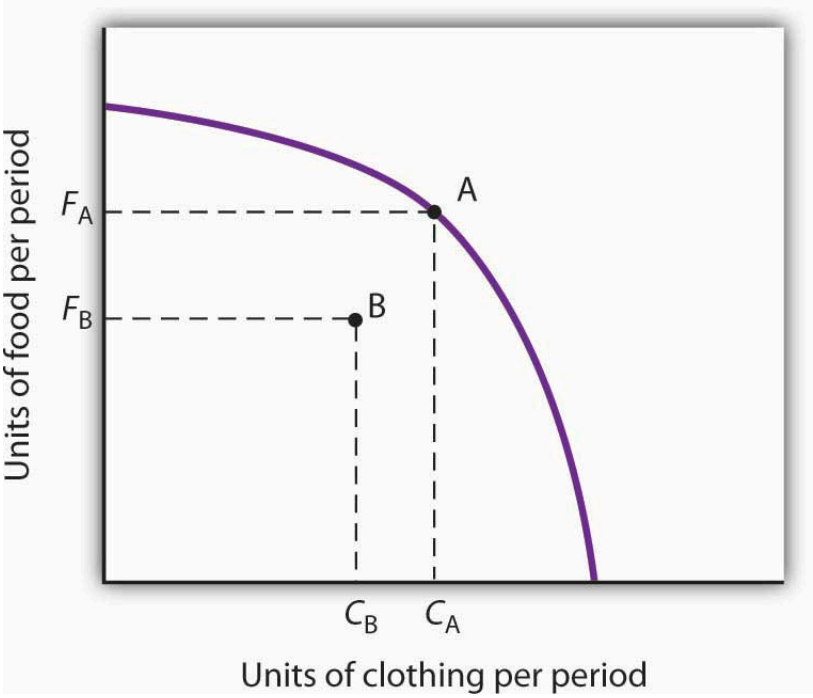


Figure 2.6g Idle Factors and Production. Idle Factors and Production by University of Minnesota, licensed under CC BY-NC-SA 4.0.

Figure 2.6g Idle Factors and Production Text Version

The vertical axis is units of food per period and the horizontal axis is units of clothing per period. There is a downward arched curve from left to right. Point A occurs along the production possibilities curve. Point B occurs shift to the left and downward and does not occur on the production possibilities curve. The production possibilities curve shown suggests an economy that can produce two goods, food and clothing. As a result of a failure to achieve full employment, the economy operates at a point such as B, producing F_B units of food and C_B units of clothing per period. Putting its factors of production to work allows a move to the production possibilities curve, to a point such as A. The production of both goods rises.

Figure 2.6g "Idle Factors and Production" shows an economy that can produce food and clothing. If it chooses to produce at point A, for example, it can produce F_A units of food and C_A units of clothing. Now suppose that a large fraction of the economy's workers lose their jobs, so the economy no longer makes full use of one factor of production: labor. In this example, production moves to point B, where the economy produces less food (F_B) and less clothing (C_B) than at point A. We often think of the loss of jobs in terms of the workers; they have lost a chance to work and to earn income. But the production possibilities model points to another loss: goods and services the economy could have produced that are not being produced.

Inefficient Production

Now suppose Alpine Sports is fully employing its factors of production. Could it still operate inside its production possibilities curve? Could an economy that is using all its factors of production still produce less than it could? The answer is "Yes," and the key lies in comparative advantage. An economy achieves a point on its production possibilities curve only if it allocates its factors of production on the basis of comparative advantage. If it fails to do that, it will operate inside the curve.

Suppose that, as before, Alpine Sports has been producing only skis. With all three of its plants producing skis, it can produce 350 pairs of skis per month (and no snowboards). The firm then starts producing snowboards. This time, however, imagine that Alpine Sports switches plants from skis to snowboards in numerical order: Plant 1 first, Plant 2 second, and then Plant 3. Figure 2.6h "Efficient Versus Inefficient Production" illustrates the result. Instead of the bowed-out production possibilities curve ABCD, we get a bowed-in curve, AB′C′D. Suppose that Alpine Sports is producing 100 snowboards and 150 pairs of skis at point B′. Had the firm based its production choices on comparative advantage, it would have switched Plant 3 to snowboards and then Plant 2, so it could have operated at a point such as C. It would be producing more snowboards and more pairs of skis—and using the same quantities of factors of production it was using at B′. Had the firm based its production choices on comparative advantage, it would have switched Plant 3 to snowboards and then Plant 2, so it would have operated at point C. It would be producing more snowboards and more pairs of skis—and using the same quantities of factors of production it was using at B′. When an economy is operating on its production possibilities curve, we say that it is engaging in efficient production. If it is using the same quantities of factors of production but is operating inside its production possibilities curve, it is engaging in inefficient production. Inefficient production implies that the economy could be producing more goods without using any additional labor, capital, or natural resources.

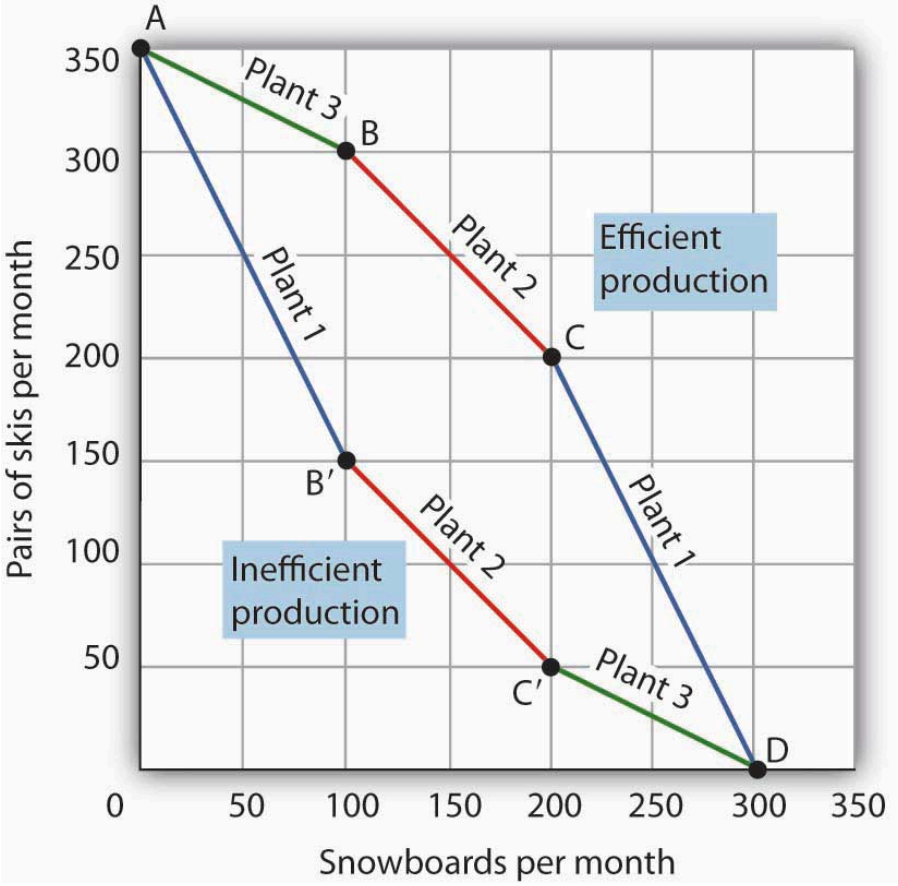


Figure 2.6h Efficient Versus Inefficient Production. Efficient Versus Inefficient Production by University of Minnesota, licensed under CC BY-NC-SA 4.0.

Figure 2.6h Efficient Versus Inefficient Production Text Version

The graph has a vertical axis pairs of skis per month and horizontal axis snowboards per month and depicts 2 lines: the efficient production and inefficient production.

Now suppose that, to increase snowboard production, it transfers plants in numerical order: Plant 1 first, then Plant 2, and finally Plant 3. The inefficient production starts with Plant 1 at Point A (350 pairs of skis, 0 snowboards), then Plant 2 at Point B' (150 pairs of skis, 100 snowboards) then Plant 3 at Point C' (50 pairs of skis, 200 snowboards) ending at Point D (0 pairs of skis, 300 snowboards). The result is the bowed-in curve AB′C′D.

The efficient production is an arching curve that slopes downward left to right. It connects Plant 3 from point A (350 pairs of skis, 0 snowboards) to Plant 2 at Point B (300 pairs of skis, 100 snowboards) and connects with Plant 1 at Point C (200 pairs of skis, 200 snowboards) and ends at Point D (0 pairs of skis, 300 snowboards). Production on the production possibilities curve ABCD requires that factors of production be transferred according to comparative advantage.

When factors of production are allocated on a basis other than comparative advantage, the result is inefficient production. Suppose Alpine Sports operates the three plants we examined in Figure 2.6c "Production Possibilities at Three Plants". Suppose further that all three plants are devoted exclusively to ski production; the firm operates at A. Now suppose that, to increase snowboard production, it transfers plants in numerical order: Plant 1 first, then Plant 2, and finally Plant 3. The result is the bowed-in curve AB′C′D. Production on the production possibilities curve ABCD requires that factors of production be transferred according to comparative advantage.

Points on the production possibilities curve thus satisfy two conditions: the economy is making full use of its factors of production, and it is making efficient use of its factors of production. If there are idle or inefficiently allocated factors of production, the economy will operate inside the production possibilities curve. Thus, the production possibilities curve not only shows what can be produced; it provides insight into how goods and services should be produced. It suggests that to obtain efficiency in production, factors of production should be allocated on the basis of comparative advantage. Further, the economy must make full use of its factors of production if it is to produce the goods and services it is capable of producing.

Specialization

The production possibilities model suggests that specialization will occur. Specialization implies that an economy is producing the goods and services in which it has a comparative advantage. If Alpine Sports selects point C in Figure 2.6h Efficient Versus Inefficient Production, for example, it will assign Plant 1 exclusively to ski production and Plants 2 and 3 exclusively to snowboard production.

Such specialization is typical in an economic system. Workers, for example, specialize in particular fields in which they have a comparative advantage. People work and use the income they earn to buy—perhaps import—goods and services from people who have a comparative advantage in doing other things. The result is a far greater quantity of goods and services than would be available without this specialization.

Think about what life would be like without specialization. Imagine that you are suddenly completely cut off from the rest of the economy. You must produce everything you consume; you obtain nothing from anyone else. Would you be able to consume what you consume now? Clearly not. It is hard to imagine that most of us could even survive in such a setting. The gains we achieve through specialization are enormous.

Nations specialize as well. Much of the land in the United States has a comparative advantage in agricultural production and is devoted to that activity. Hong Kong, with its huge population and tiny endowment of land, allocates virtually none of its land to agricultural use; that option would be too costly. Its land is devoted largely to nonagricultural use.

Watch it!

Watch the video Specialization and Trade: Crash Course Economics #2 (https://www.youtube.com/watch?v=NI9TLDIPVcs) (9 mins)

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://ecampusontario.pressbooks.pub/laboureconomics/?p=831#oembed-3

Video Source: CrashCourse. (2015, July 15).*Specialization and Trade: Crash Course Economics #2* [Video]. YouTube. https://www.youtube.com/watch?v=NI9TLDIPVcs

Key Takeaways

- A production possibilities curve shows the combinations of two goods an economy is capable of producing.
- The downward slope of the production possibilities curve is an implication of scarcity.
- The bowed-out shape of the production possibilities curve results from allocating resources based on comparative advantage. Such an allocation implies that the law of increasing opportunity cost will hold.
- An economy that fails to make full and efficient use of its factors of production will operate inside its production possibilities curve.
- Specialization means that an economy is producing the goods and services in which it has a comparative advantage.

Try It!

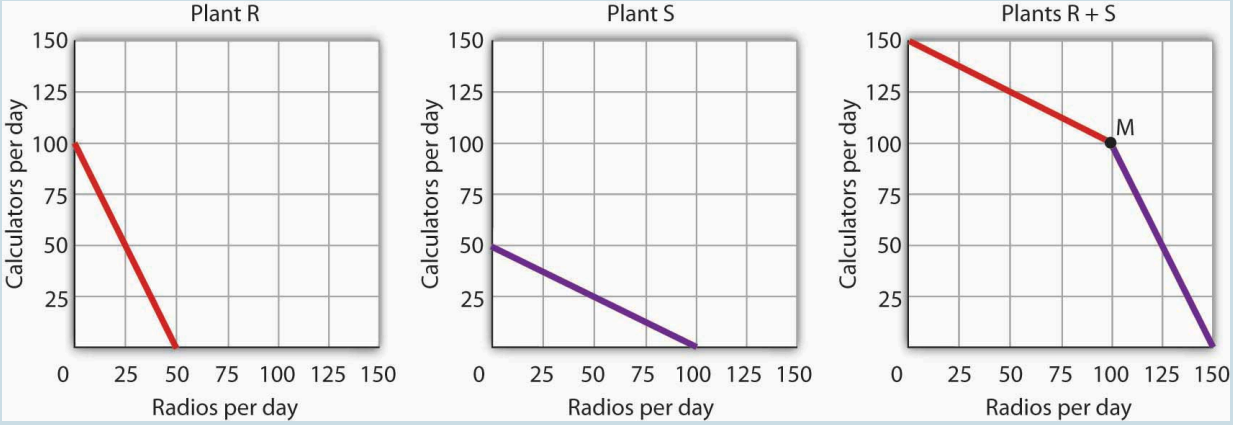
Suppose a manufacturing firm is equipped to produce radios or calculators. It has two plants, Plant R and Plant S, at which it can produce these goods. Given the labor and the capital available at both plants, it can produce the combinations of the two goods at the two plants shown.

Output per day, Plant S

Combination	Calculators	Radios
D	50	0
E	25	50
F	0	100

Put calculators on the vertical axis and radios on the horizontal axis. Draw the production possibilities curve for Plant R. On a separate graph, draw the production possibilities curve for Plant S. Which plant has a comparative advantage in calculators? In radios? Now draw the combined curves for the two plants. Suppose the firm decides to produce 100 radios. Where will it produce them? How many calculators will it be able to produce? Where will it produce the calculators?

Check your Answer



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Answer to Try It! Problem Figure 2.11 Text Version

Figure depicts three separate graphs: the production possibilities curves for Plant R and Plant S, along with the combined curve for both plants (Plant R+S). All three graphs have the vertical axis calculators per day and the horizontal axis radios per day.

Plant R has a comparative advantage in producing calculators. It has a straight steep downward sloping curve left to right starting from Point R1 (100 calculators, 0 radios) going through Point R2 (50 calculators, 25 radios) and ending at Point R3 (0 calculators, 50 radios).

Plant S has a comparative advantage in producing radios, so if the firm goes from producing 150 calculators and no radios to producing 100 radios it will produce them at Plant S. It has a straight gradual downward sloping curve left to right starting from Point S1 (50 calculators, 0 radios) going through Point S2 (25 calculators, 50 radios) and ending at Point S3 (0 calculators, 100 radios).

In the production possibilities curve for both plants, the firm would be at M, producing 100 calculators at Plant R. Plant R is the first part and then Plant S is the second part. Plant R occurs first in the first part of the production possibilities curve gradually sloping straight from Point RS1 (150 calculators, 0 radios) going through Point RS2 (125 calculators, 50 radios) and ending at Point M (100 calculators, 100 radios). Plant S occurs next continuing from Point M (100 calculators, 100 radios) going through Point RS3 (50 calculators, 125 radios) and ending at Point RS4 (0 calculators, 150 radios). This part of the curve has a steeper straight downward sloping curve.

Figure 2.11 (seen above) depicts the production possibilities curves for the two plants are shown, along with the combined curve for both plants. Plant R has a comparative advantage in producing calculators. Plant S has a comparative advantage in producing radios, so if the firm goes from producing 150 calculators and no radios to producing 100 radios it will produce them at Plant S. In the production possibilities curve for both plants, the firm would be at M, producing 100 calculators at Plant R.

Case in Point: The Cost of the Great Depression

Figure 2.6i. Crowd at New York's American Union Bank during a bank run early in the Great Depression. The Bank opened in 1917 and went out of business on June 30, 1931. Crowd at New York's American Union Bank during a bank run early in the Great Depression [National Archives Photo, NLR-PHOCO-A-7420(1007)] archived by National Archives, licensed under Public Domain.

The U.S. economy looked very healthy in the beginning of 1929. It had enjoyed seven years of dramatic growth and unprecedented prosperity. Its resources were fully employed; it was operating quite close to its production possibilities curve. In the summer of 1929, however, things started going wrong. Production and employment fell. They continued to fall for several years. By 1933, more than 25% of the nation's workers had lost their jobs. Production had plummeted by almost 30%. The economy had moved well within its production possibilities curve.Output began to grow after 1933, but the economy continued to have vast numbers of idle workers, idle factories, and idle farms. These resources were not put back to work fully until 1942, after the U.S. entry into World War II demanded mobilization of the economy's factors of production. Between 1929 and 1942, the

economy produced 25% fewer goods and services than it would have if its resources had been fully employed. That was a loss, measured in today's dollars, of well over $3 trillion. In material terms, the forgone output represented a greater cost than the United States would ultimately spend in World War II. The Great Depression was a costly experience indeed.

Key Concepts & Summary

A production possibilities curve shows the combinations of two goods an economy is capable of producing. The downward slope of the production possibilities curve is an implication of scarcity. The bowed-out shape of the production possibilities curve results from allocating resources based on comparative advantage. Such an allocation implies that the law of increasing opportunity cost will hold. An economy that fails to make full and efficient use of its factors of production will operate inside its production possibilities curve. Specialization means that an economy is producing the goods and services in which it has a comparative advantage.

Attribution

Video References

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- Crowd at New York's American Union Bank during a bank run early in the Great Depression. © National Archives is licensed under a Public Domain license

2.7 - APPLICATIONS OF THE PRODUCTION POSSIBILITIES MODEL

Learning Objectives

- Define economic growth in terms of the production possibilities model and discuss factors that make such growth possible.
- Explain the classification of economic systems, the role of government in different economic systems, and the strengths and weaknesses of different systems.

The production possibilities curve gives us a model of an economy. The model provides powerful insights about the real world, insights that help us to answer some important questions: What determines the rate at which production will increase over time? What is the role of economic freedom in the economy? In this section we explore applications of the model to questions of economic growth and the choice of an economic system.

Economic Growth

An increase in the physical quantity or in the quality of factors of production available to an economy or a technological gain will allow the economy to produce more goods and services; it will shift the economy's production possibilities curve outward. The process through which an economy achieves an outward shift in its production possibilities curve is called economic growth. An outward shift in a production possibilities curve is illustrated in Figure 2.7a "Economic Growth and the Production Possibilities Curve". In Panel (a), a point such as N is not attainable; it lies outside the production possibilities curve. Growth shifts the curve outward, as in Panel (b), making previously unattainable levels of production possible.

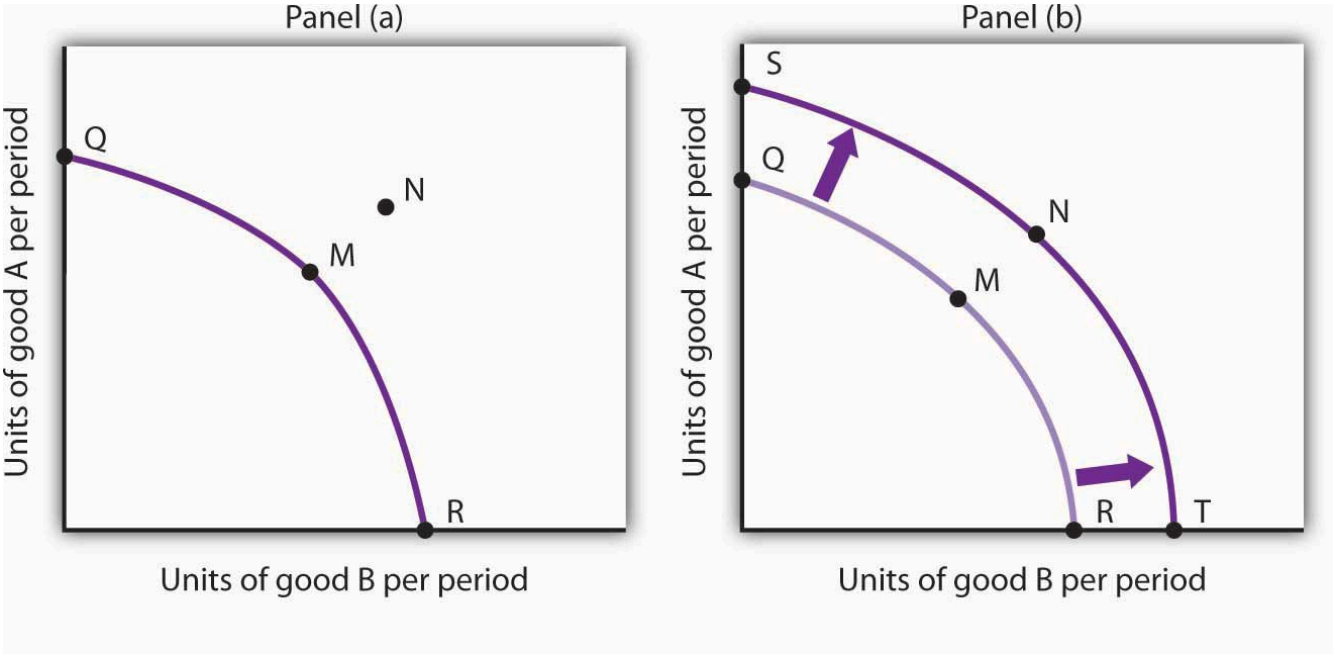

Figure 2.7a Economic Growth and the Production Possibilities Curve. In the first graph, Panel (a), a point such as N is not attainable; it lies outside the production possibilities curve. The second graph shows growth that shifts the curve outward, as in Panel (b), making previously unattainable levels of production possible. Economic Growth and the Production Possibilities Curve by University of Minnesota, licensed under CC BY-NC-SA 4.0.

Figure 2.7a Economic Growth and the Production Possibilities Curve (Text version)

Figure 2.7a depits two graphs, both have a vertical axis of Units of goods A per period and a horizontal axis Units of good B per period.

Panel A, has a downward sloping convex curve which slopes from left to right starting midway up the vertical axis at Point Q goes through Point M and ending at R on the horizontal axis. Point N lays outside and above the curve; therefore, a point such as N is not attainable as it lies outside the production possibilities curve.

Panel B shows growth that shifts the curve outward, making previously unattainable levels of production possible. Panel B is the same graph as Panel A but depicts the curve shifting outwards to obtain Point N. The curve shifts outward: Point Q shifts upwards to Point S, Point M shift to Point N and Point R shift to the left to Point T.

An economy capable of producing two goods, A and B, is initially operating at point M on production possibilities curve OMR in Panel (a). Given this production possibilities curve, the economy could not produce a combination such as shown by point N, which lies outside the curve. An increase in the factors of production available to the economy would shift the curve outward to SNT, allowing the choice of a point such as N, at which more of both goods will be produced.

The Sources of Economic Growth

Economic growth implies an outward shift in an economy's production possibilities curve. Recall that when we draw such a curve, we assume that the quantity and quality of the economy's factors of production and its technology are unchanged. Changing these will shift the curve. Anything that increases the quantity or quality of the factors of production available to the economy or that improves the technology available to the economy contributes to economic growth.

Consider, for example, the dramatic gains in human capital that have occurred in the United States since the beginning of the past century. In 1900, about 3.5% of U.S. workers had completed a high school education. By 2006, that percentage rose almost to 92. Fewer than 1% of the workers in 1900 had graduated from college; as late as 1940 only 3.5% had graduated from college. By 2006, nearly 32% had graduated from college. In addition to being better educated, today's workers have received more and better training on the job. They bring far more economically useful knowledge and skills to their work than did workers a century ago.

Moreover, the technological changes that have occurred within the past 100 years have greatly reduced the time and effort required to produce most goods and services. Automated production has become commonplace. Innovations in transportation (automobiles, trucks, and airplanes) have made the movement of goods and people cheaper and faster. A dizzying array of new materials is available for manufacturing. And the development of modern information technology—including computers, software, and communications equipment—that seemed to proceed at breathtaking pace especially during the final years of the last century and continuing to the present has transformed the way we live and work.

Look again at the technological changes of the last few years described in the Case in Point on advances in technology. Those examples of technological progress through applications of computer technology—from new ways of mapping oil deposits to new methods of milking cows—helped propel the United States and other economies to dramatic gains in the ability to produce goods and services. They have helped shift the countries' production possibilities curve outward. They have helped fuel economic growth.

Waiting for Growth

One key to growth is, in effect, the willingness to wait, to postpone current consumption in order to enhance future productive capability. When Stone Age people fashioned the first tools, they were spending time building capital rather than engaging in consumption. They delayed current consumption to enhance their future consumption; the tools they made would make them more productive in the future.

Resources society could have used to produce consumer goods are being used to produce new capital goods and new knowledge for production instead—all to enhance future production. An even more important

source of growth in many nations has been increased human capital. Increases in human capital often require the postponement of consumption. If you are a college student, you are engaged in precisely this effort. You are devoting time to study that could have been spent working, earning income, and thus engaging in a higher level of consumption. If you are like most students, you are making this choice to postpone consumption because you expect it will allow you to earn more income, and thus enjoy greater consumption, in the future.

Think of an economy as being able to produce two goods, capital and consumer goods (those destined for immediate use by consumers). By focusing on the production of consumer goods, the people in the economy will be able to enjoy a higher standard of living today. If they reduce their consumption—and their standard of living—today to enhance their ability to produce goods and services in the future, they will be able to shift their production possibilities curve outward. That may allow them to produce even more consumer goods. A decision for greater growth typically involves the sacrifice of present consumption.

Arenas for Choice: A Comparison of Economic Systems

Under what circumstances will a nation achieve efficiency in the use of its factors of production? The discussion above suggested that Christie Ryder would have an incentive to allocate her plants efficiently because by doing so she could achieve greater output of skis and snowboards than would be possible from inefficient production. But why would she want to produce more of these two goods—or of any goods? Why would decision makers throughout the economy want to achieve such efficiency?

Economists assume that privately owned firms seek to maximize their profits. The drive to maximize profits will lead firms such as Alpine Sports to allocate resources efficiently to gain as much production as possible from their factors of production. But whether firms will seek to maximize profits depends on the nature of the economic system within which they operate.

Classifying Economic Systems

Each of the world's economies can be viewed as operating somewhere on a spectrum between market capitalism and command socialism. In a market capitalist economy, resources are generally owned by private individuals who have the power to make decisions about their use. A market capitalist system is often referred to as a free enterprise economic system. In a command socialist economy, the government is the primary owner of capital and natural resources and has broad power to allocate the use of factors of production. Between these two categories lie mixed economies that combine elements of market capitalist and of command socialist economic systems.

No economy represents a pure case of either market capitalism or command socialism. To determine where

an economy lies between these two types of systems, we evaluate the extent of government ownership of capital and natural resources and the degree to which government is involved in decisions about the use of factors of production.

Figure 2.7b "Economic Systems" suggests the spectrum of economic systems. Market capitalist economies lie toward the left end of this spectrum; command socialist economies appear toward the right. Mixed economies lie in between. The market capitalist end of the spectrum includes countries such as the United States, the United Kingdom, and Canada. Hong Kong, though now part of China, has a long history as a market capitalist economy and is generally regarded as operating at the market capitalist end of the spectrum. Countries at the command socialist end of the spectrum include North Korea and Cuba.

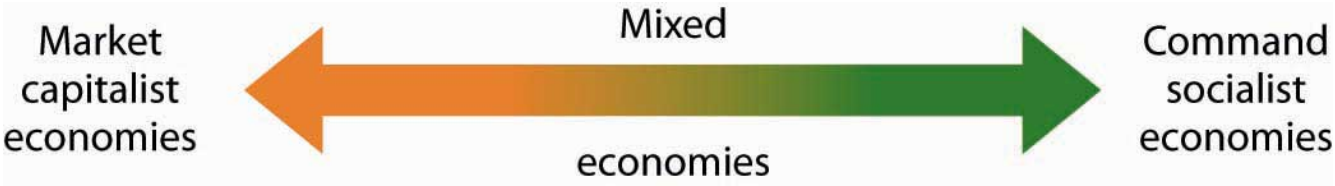

Figure 2.7b Economic Systems. Economic Systems by University of Minnesota, licensed under CC BY-NC-SA 4.0.

Some European economies, such as France, Germany, and Sweden, have a sufficiently high degree of regulation that we consider them as operating more toward the center of the spectrum. Russia and China, which long operated at the command socialist end of the spectrum, can now be considered mixed economies. Most economies in Latin America once operated toward the right end of the spectrum. While their governments did not exercise the extensive ownership of capital and natural resources that are one characteristic of command socialist systems, their governments did impose extensive regulations. Many of these nations are in the process of carrying out economic reforms that will move them further in the direction of market capitalism.

The global shift toward market capitalist economic systems that occurred in the 1980s and 1990s was in large part the result of three important features of such economies. First, the emphasis on individual ownership and decision-making power has generally yielded greater individual freedom than has been available under command socialist or some more heavily regulated mixed economic systems that lie toward the command socialist end of the spectrum. People seeking political, religious, and economic freedom have thus gravitated toward market capitalism. Second, market economies are more likely than other systems to allocate resources on the basis of comparative advantage. They thus tend to generate higher levels of production and income than do other economic systems. Third, market capitalist-type systems appear to be the most conducive to entrepreneurial activity.

Suppose Christie Ryder had the same three plants we considered earlier in this chapter but was operating in a

mixed economic system with extensive government regulation. In such a system, she might be prohibited from transferring resources from one use to another to achieve the gains possible from comparative advantage. If she were operating under a command socialist system, she would not be the owner of the plants and thus would be unlikely to profit from their efficient use. If that were the case, there is no reason to believe she would make any effort to assure the efficient use of the three plants. Generally speaking, it is economies toward the market capitalist end of the spectrum that offer the greatest inducement to allocate resources on the basis of comparative advantage. They tend to be more productive and to deliver higher material standards of living than do economies that operate at or near the command socialist end of the spectrum.

Government in a Market Economy

The production possibilities model provides a menu of choices among alternative combinations of goods and services. Given those choices, which combinations will be produced?

In a market economy, this question is answered in large part through the interaction of individual buyers and sellers. As we have already seen, government plays a role as well. It may seek to encourage greater consumption of some goods and discourage consumption of others. In the United States, for example, taxes imposed on cigarettes discourage smoking, while special treatment of property taxes and mortgage interest in the federal income tax encourages home ownership. Government may try to stop the production and consumption of some goods altogether, as many governments do with drugs such as heroin and cocaine. Government may supplement the private consumption of some goods by producing more of them itself, as many U.S. cities do with golf courses and tennis courts. In other cases, there may be no private market for a good or service at all. In the choice between security and defense versus all other goods and services outlined at the beginning of this chapter, government agencies are virtually the sole providers of security and national defense.

All nations also rely on government to provide defense, enforce laws, and redistribute income. Even market economies rely on government to regulate the activities of private firms, to protect the environment, to provide education, and to produce a wide range of other goods and services. Government's role may be limited in a market economy, but it remains fundamentally important.

Key Takeaways

- The ideas of comparative advantage and specialization suggest that restrictions on international trade are likely to reduce production of goods and services.
- Economic growth is the result of increasing the quantity or quality of an economy's factors of production and of advances in technology.
- Policies to encourage growth generally involve postponing consumption to increase capital and human capital.
- Market capitalist economies have generally proved more productive than mixed or command socialist economies.
- Government plays a crucial role in any market economy.

Try It!

Draw a production possibilities curve for an economy that can produce two goods, CD players and jackets. You do not have numbers for this one—just draw a curve with the usual bowed-out shape. Put the quantity of CD players per period on the vertical axis and the quantity of jackets per period on the horizontal axis. Now mark a point A on the curve you have drawn; extend dotted lines from this point to the horizontal and vertical axes. Mark the initial quantities of the two goods as CDA and JA, respectively. Explain why, in the absence of economic growth, an increase in jacket production requires a reduction in the production of CD players. Now show how economic growth could lead to an increase in the production of both goods.

Check your Answers

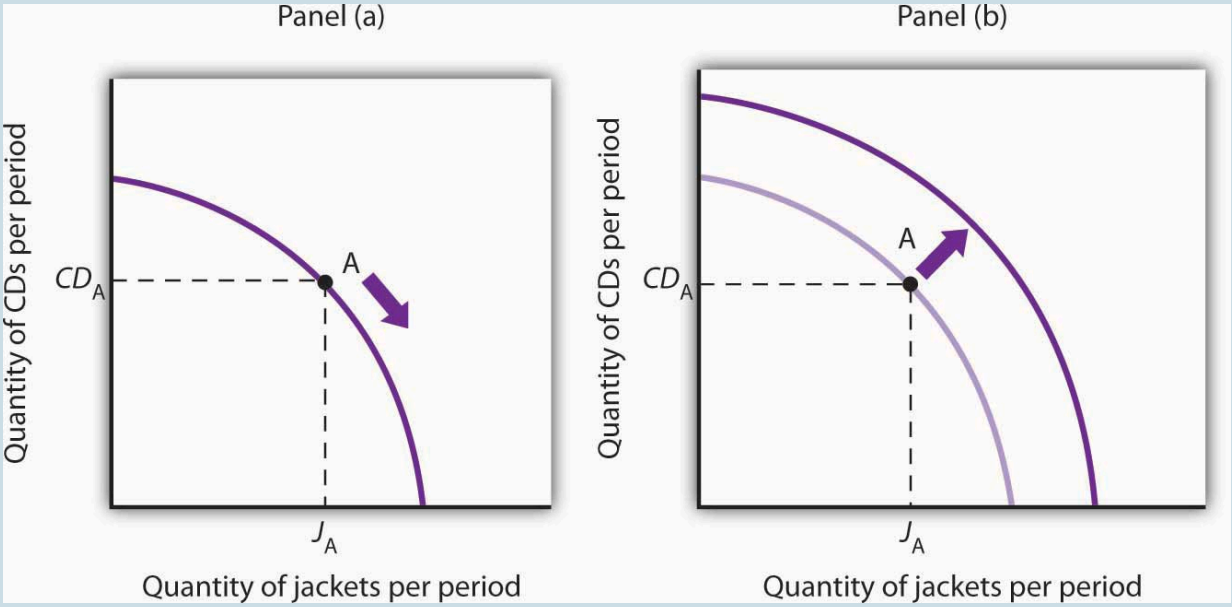

Figure 2.7c. Figure by University of Minnesota, licensed under CC BY-NC-SA 4.0.

Your first production possibilities curve should resemble the one in Panel (a). Starting at point A, an increase in jacket production requires a move down and to the right along the curve, as shown by the arrow, and thus a reduction in the production of CD players. Alternatively, if there is economic growth, it shifts the production possibilities curve outward, as in Panel (b). This shift allows an increase in production of both goods, as suggested by the arrow.

Figure 2.7c Answer to Try it! Problem Text Version

Figure 2.7c depicts two graphs that have the horizontal axis Quantity of CDs per period and a vertical axis Quantity of jackets per period.

Panel A depicts a downward sloping convex curve which slopes from left to right, intersecting Point A is located at (JA, CDA). Starting at point A, an increase in jacket production requires a move down and to the right along the curve (shown downward arrow) and thus a reduction in the production of CD players.

Panel B depicts the same base figure as Panel A, a downward sloping convex curve which slopes from left to right, intersecting Point A is located at (JA, CDA). The curve shifts outward from Point A, shifting from left to right (shown by arrow pointing left to right).

Case in Point: The European Union and the Production Possibilities Curve

Figure 2.7d. Found euros by Dana McMahan, licensed under CC BY-NC 2.0.

Formed by the Maastricht Treaty of 1993, The European Union represents one of the boldest efforts of our time to exploit the theory of comparative advantage. The Treaty sought to eliminate all trade barriers between the European Union's members. It established a European Parliament and a European Central Bank. The Bank introduced the euro in 1999, a currency that replaced national currencies such as the German deutsche mark and the French franc. At first, the euro was used only for transactions between banks. 320 million people in 15 EU nations (Austria, Belgium, Cyprus, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Malta, the Netherlands, Portugal, Slovenia, and Spain) used the euro by 2008. While the dollar continues to be more widely used, the total value of euros in circulation exceeds that of dollars.

The movement toward European integration can be dated back more than half a century. In 1950, just five years after a war that had devastated much of the world, Robert Schuman, the French Minister of Foreign Affairs, proposed a union between France and Germany to cooperate in the production of iron and steel. In the context of the time, Schuman's proposal was a radical one. World War II had begun with Germany's attempt to seize control of Europe—and ultimately the world. Japan and Italy joined Germany in this effort. Germany had captured France; France had been liberated in 1944 by the Allied invasion in Normandy. The proposal for cooperation between

two countries that had been the most bitter of enemies was a revolutionary one. Schuman's speech, delivered on May 9, 1950, is celebrated throughout Europe as "Europe Day."

In effect, the European Union has created an entity very much like the United States. Countries within the European Union retain their own languages and cultural differences, but they have ceded a remarkable degree of sovereignty to the Union. Members of the European Union can trade as freely with each other as can states within the United States. Just as the U.S. Constitution prohibits states from restricting trade with other states, the European Union has dismantled all forms of restrictions that countries within the Union used to impose on one another. Just as restrictions on specialization among Ms. Ryder's plants in Alpine Sports would have forced it to operate inside its production possibilities curve, restrictions that had existed among members of the European Union once put the members of the Union inside their collective production possibilities curve.

The experiment appears to have been a success. Trade among member nations has expanded sharply. A study by Carmen Diaz Mora, an economist at the University of Castilla-La Mancha in Spain, found that the bulk of the expanded trade within the Union was trade within industries and that it was driven by comparative advantage. In particular, she found that countries in the northern part of the Union, such as France and Germany, tended to specialize in relatively high-valued goods—office equipment and electrical goods—while countries in the southern part of the Union specialized in relatively low-valued goods such as food and textile products. In trade within the clothing industry, countries such as Italy tend to specialize in the production of higher-valued clothing, while lower-income countries such as Portugal specialize in the production of cheaper clothing. In sparkling wines, France specializes in the higher-quality end of the spectrum, while Spain specializes in the low-quality end. Similarly, Germany specializes in the production of higher-quality cars while Spain specializes in lower-quality vehicles. Similar exchanges occur across a wide range of goods and services.

Diaz Mora found that comparative advantage tended to correspond to income levels. Countries in the northern part of the European Union tend to have high per capita incomes and high levels of human capital and technology—these countries gained by specializing in the production of high-valued goods. Countries in the southern part of the Union also gained by specialization—in the production of low-valued goods. This specialization has increased the welfare of people throughout the Union.

Sources: Carmen Diaz Mora, "The Role of Comparative Advantage in Trade Within Industries: A Panel Data Approach for the European Union," Weltwirtschaftliches Archiv 138:2 (2002), 291–316.

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2.8 - OPPORTUNITY COSTS & SUNK COSTS

Learning Objectives

- Understand the three step process for making binary decisions
- Calculate the opportunity cost of an action
- Understand how sunk costs influence our decision making

Economics looks at how rational individuals make decisions. An important part of being a rational decision maker is considering **opportunity costs**. In our introductory section we identified the concept of scarcity. Normally we are quite good at considering scarcity when it comes to resources and money. What we are less good at considering is scarcity of time.

Consider the following image that shows the number of weeks an average human lives. Sometimes it kind of feels like our lives are made up of a countless number of weeks. But there they are—fully countable—staring you in the face. This isn't meant to scare you, but rather to emphasize that a rational consumer doesn't ignore time, but incorporates it into the analysis of any decision they make.

So how do you 'spend' your time? In economics, we want to place a value on each different opportunity we have so we can compare them.

What if your friends were to ask you if you want to go out to the club? How much do you value it? As economists, we want to measure the happiness you will get from this experience by finding your maximum **willingness to pay.** Let's say that for a 5 hour night at the club, the MOST you are willing to pay is $100. Seem high? If you have gone clubbing, this is likely close to what you paid for it.

Suppose the costs of going clubbing are $50 ($15 cover, $20 for drinks and $15 for a ride home). With that analysis it seems like you should go, but so far we have only considered the **explicit costs** of the experience.

An explicit cost represents a clear direct payment of cash (whether actual cash or from debit, credit, etc). But what about our time? We must consider time as another cost of the action.

How do we measure time? Simple – what else could we be doing with that time? Assume you also work as a server at the campus pub, where you get paid $15 an hour (including tips). This makes it easy to put a dollar amount on your time. For 5 hours of clubbing, you are forgoing the opportunity to earn $\$75 (\$15 \times 5)$. This is your **implicit cost** for clubbing, or the cost that has been incurred but does not result in a direct payment.

It is important to note that the implicit costs are the benefit of the next best option. There are an infinite number of things we could be doing with our time, from watching a movie to studying economics, but for implicit costs we only consider the next best. If we took them all into account our costs would be infinite.

Consider the two options side by side as shown in Table 2.8a.

	Clubbing	Working
Willingness to Pay/Total Benefit	$100	$75
Explicit Costs	$50	$0
Total 'Happiness'	$50	$75

Table 2.8a. Comparison between clubbing and working. Image by Dr. Emma Hutchinson, University of Victoria, licensed under CC BY 4.0.

Table 2.8a Comparison between clubbing and working Text Version

Table 2.8a depicts the side by side comparison between clubbing and working to illustrate explicit costs. The equation is the Willingness to Pay/Total Benefit + Explicit Costs = Total 'Happiness' where clubbing is $\$100 - \$50 = \$50$and working is $\$75 - \$0 = \$75$.

Table 2.8a. Comparison between clubbing and working

	Clubbing	**Working**
Willingness to Pay/Total Benefit	$100	$75
Explicit Costs	$50	$0
Total 'Happiness'	$50	$75

Table 2.8aThis shows us something interesting. Even though we are willing to pay $100 to go out clubbing, our 'happiness' from working is greater. A rational consumer would chose to work. The $75 we could be

earning from working is equal to our implicit costs of going out since, rather than going clubbing, we could be making money for the 5 hours. To truly consider costs we must always consider our **opportunity costs** which include the implicit and explicit costs of an action.

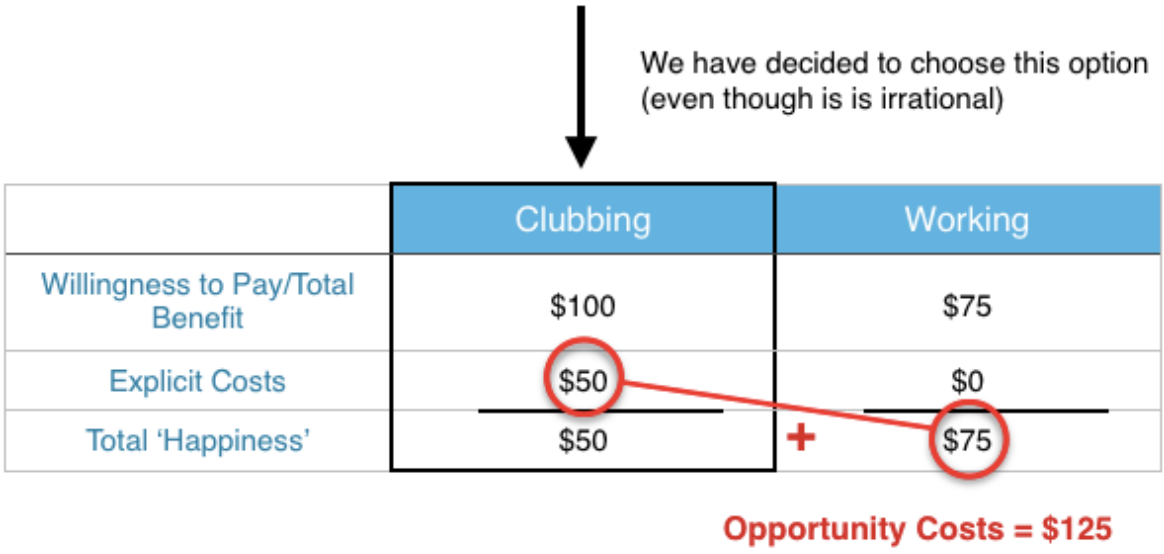


Table 2.8b Opportunity cost with clubbing and working. Image by Dr. Emma Hutchinson, University of Victoria, licensed under CC BY 4.0.

Table 2.8b Opportunity cost with clubbing and working Text Version

Table 2.8 b considers the opportunity cost with clubbing and working. We have decided to choose the clubbing option (even though it is irrational). Using the same data as Table 2.8a add the Explicit Costs from the Clubbing column and the Total 'Happiness' from the Working column to obtain the Opportunity Costs. In other words Explicit Costs (cover, drinks and ride home) + Implicit Costs (forgone income from 5 hours) = Opportunity Costs. $\$50 + \$75 = \$125$.

Table 2.8b Data for the comparison between clubbing and working Tables 1.2a & 1.2b

	Clubbing ($)	**Working ($)**
Willingness to Pay/Total Benefit	$100	$75
Explicit Costs	$50	$0
Total 'Happiness'	$50	$75

In this example if you were to go clubbing opportunity costs are: Explicit Costs (cover, drinks and ride home) $50 Implicit Costs (forgone income from 5 hours) : $75 Opportunity Costs : $125 Should you go clubbing?

You are only willing to pay $100, and your opportunity costs are $125 so no! Does this mean you should never go out? Not at all. You just may be surprised that your willingness to pay may be well over $100.

How to measure 'Happiness'

In our previous analysis we refer to the concept of "Total Happiness." The problem is, happiness is not an easy value to measure. Daniel Bernoulli, an economist, first introduced the concept of **utility** as a means of measuring happiness. Classical economists will often assume that utilities can be measured as a hard number. In reality, it is must harder to measure the happiness a consumer receives from a good. Often, we will use the measurement of how much a consumer is *willing to pay,* but even this information can be difficult to assess. For the remainder of Topic 1, we will refer to happiness as something that can be measured, recognizing that this is rarely as easy as it will appear here.

Scarcity

This consideration of opportunity cost is rooted in an understanding that all resources are scarce. The first image paints a compelling picture of the scarcity of time, and our financial resources are also scarce. Being a rational decision maker means considering the scarcity of all resources associated with an action. As decision makers, we have to make **trade-offs** on what we do with finite resources.

This leads us to a fairly simple conclusion. We should do something if the benefits outweigh the costs. The key insight is that the *costs* we are referring to are *opportunity costs,* which consider the next best alternative use of our resources.

Making Decisions

We have now looked at how to analyze two options, but how do we make the decision? We can lay the process out in three steps:

1. Find your **willingness to pay** (or wage you would earn) from the option you are considering and the next best alternative
2. Subtract the explicit costs from each option to find your happiness
3. Choose the option with that makes you happier

If we want to change this into the process for a binary decision (yes or no):

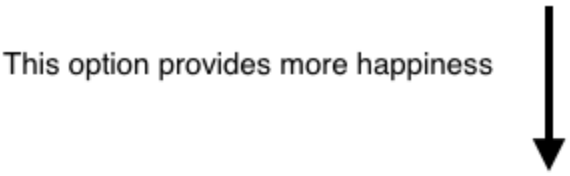
1. Add up all the benefits of an action
2. Subtract all costs explicit and implicit
3. If benefits > costs, this is the right choice

It is important to note that not all decisions are binary.

Sunk Costs

Just as it is important to understand the costs that should be considered in decision making, it is important to understand what costs should not. Consider the two options you may have when you wake up – do you work out or sleep in? Have you ever convinced yourself to get out of bed by reminding yourself that you paid $60 for your monthly gym membership? Well, you fell victim to a common logical fallacy.

A **sunk cost** is a cost that no matter what is unrecoverable. As such it should have no impact on future decision making. This may sound strange, but consider the your two options using the analysis learned above for making decisions.



	Work-out	Sleep-In
Willingness to Pay/Total Benefit	$20	$30
Explicit Costs	$0	$0
Total 'Happiness'	$20	$30

Table 2.8c. Sunk Costs Work-Out vs. Sleep-In. Image by Dr. Emma Hutchinson, University of Victoria, licensed under CC BY 4.0.

The Table2.8c above, Sunk Costs Work-Out vs. Sleep-In, depicts the side by side comparison between working out and sleeping in to illustrate sunk costs. Following our steps we find the maximum willingness to pay for each option, subtract the explicit costs, and compare the happiness from each. Working-out would be $\$20 - \$0 = \$20$ and Sleeping-in would be $\$30 - \$0 = \$30$; therefore, Sleeping-in would provide more happiness. It does not matter that we spend $60 on a gym membership because no matter what we do we

can't get that money back. With this willingness to pay reflected in the table, the better option is to Sleep-In, with an opportunity cost of $20.

Notice that the $60 is not included as an explicit costs because it is not an additional cost we have to incur as a result of working out. Since we have already paid the $60, it is no longer something we consider.

Why Buy a Gym Membership?

Figure 2.8a Image (https://unsplash.com/photos/JNPvv1u8yRg) by Scott Webb, licensed under Unsplash License.

Why would one ever buy a gym membership? Well in this case, it might be a bad idea. The 'willingness to pay' represents how badly someone might want to go to the gym. If you knew that every morning you would wake up and value sleeping more than working out, then a gym pass might not be for you.

If that was the case you would need to find a way to increase your willingness to go to the gym, for example, if you committed to a work out plan with a friend, the social cost of sleeping in may be high, incentivizing you to get out of bed.

The important lesson here is to be mindful of your future motivation when you are incurring a sunk cost.

Sunk Costs & Business

Sunk costs aren't exclusive to gym memberships, in fact, the sunk cost fallacy is common in big business and government. Ever heard the expression "we've invested too much in this project to back out now?" Even if you have not, it sounds fairly logical – unfortunately it is not.

Consider a mining company that has invested $5 million in the infrastructure of a mine. After new information, they learn of another, richer mine site that they can mine for $4million, with projected revenues of $8 million. The current mine site will cost $1 million to extract the remaining resources ($4 million projected revenue). What should the company do?

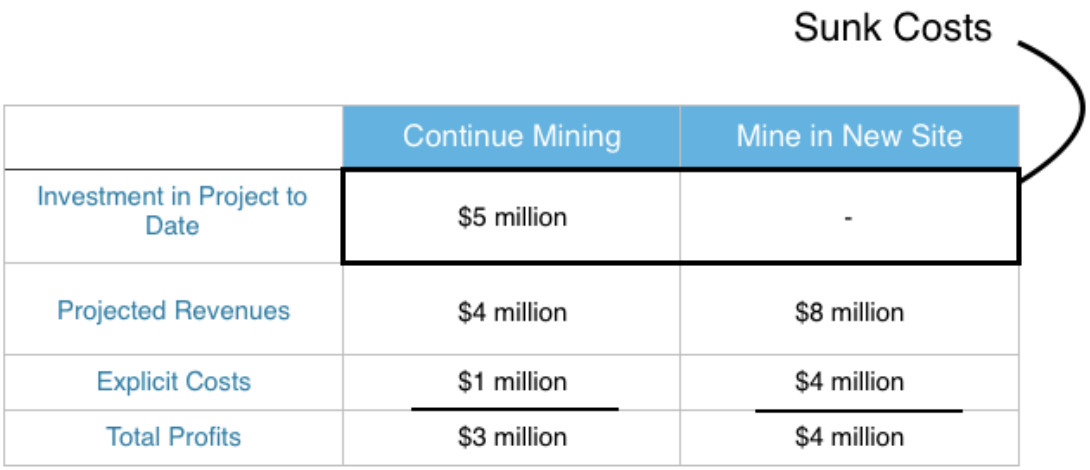


Table 2.8d .Table of sunk costs and business comparing continuing to mine and mining in a new site. Image by Dr. Emma Hutchinson, University of Victoria, licensed under CC BY 4.0.

Table 2.8d. Table of sunk costs and business comparing continuing to mine and mining in a new site Text version

Table 2.8d. Table of sunk costs and business comparing continuing to mine and mining in a new site

	Continue Mining	**Mine in a New Site**
Investment in Project to Date	$5 million	No figure available
Project Revenues	$4 million	$8 million
Explicit Costs	$1 million	$4 million
Total Profits	$3 million	$4 million

Investment in Project to Date is reflective of sunk costs: $5 million to continue mining and an unknown figure to mine in a new site.

Project revenues subtract explicit costs equal the total profits for the project. As shown the total profits from

the new site are higher, so despite the fact they have invested $5 million in the old site, they should abandon it and mine the new. The conclusion: sunk costs are irrelevant for decision making.

Want to know how you can avoid the sunk cost fallacy in your decision making? Take a look at Sunk Cost Bias: How It Hinders Your Life and 4 Ways to Overcome It [New Tab] (https://litemind.com/sunk-cost-bias/).

Exercises 1.2

1. Which of the following statements about opportunity cost is TRUE?

   I. Opportunity cost is equal to implicit costs plus explicit costs.
   II. Opportunity cost only measures direct monetary costs.
   III. Opportunity cost accounts for alternative uses of resources such as time and money.

   a. I, II and III.
   b. I
   c. III only.
   d. I and III only.

2. Which of the following statements about opportunity costs is TRUE?

   I. I. The opportunity cost of a given action is equal to the value foregone of all feasible alternative actions.
   II. II. Opportunity costs only measure direct out of pocket expenditures.
   III. III. To calculate accurately the opportunity cost of an action we need to first identify the next best alternative to that action.

   a. III only.
   b. I and III only.
   c. II only.
   d. None of the statements is true.

3. Suppose that you deciding between seeing a move and going to a concert on a particular

Saturday evening. You are willing to pay $20 to see the movie and the movie ticket costs $5. You are willing to pay $80 for the concert and the concert ticket costs $50. The opportunity cost of going to the movie is:

a. $5
b. $30
c. $35
d. $65

4. Suppose that you are willing to pay $20 to see a movie on Saturday night. A ticket costs $10, and the next-best alternative use of your time would be to go to dinner with a friend. The cost of the dinner is $20 and you value the experience of having dinner with your friend at $60. The opportunity cost of seeing the movie is equal to:

a. $50
b. $30
c. $20
d. $10

5. Suppose that you are willing to pay $50 to see a movie on Saturday night. A ticket costs $15 , and the next-best alternative use of your time would be to go to a concert which costs $80 and you value at $100. The opportunity cost of seeing the movie is equal to:

a. $15
b. $20
c. $35
d. $70

6. Suppose you play a round of golf costing $75. The golf takes four hours to play. If you were not playing golf you could be working and earning $40 per hour. The opportunity cost of your golf game is:

a. $75.
b. $235.
c. $155.
d. $160.

7. Suppose you have bought and paid for a ticket to see Lady Gaga in concert. You were willing to pay up to $200 for this ticket, but it only cost you $110. On the day of the concert, a friend

offers you a free ticket to the opera instead. Assuming that it is impossible to resell the Lady Gaga ticket, what is the minimum value you would have to place on a night at the opera, in order for you to choose the opera over Lady Gaga?

a. $200.
b. $110.
c. $90.
d. $0.

8. Suppose that you are willing to pay $350 to see Leonard Cohen play at the Save-On-Foods Arena. Tickets cost $100, and the next-best alternative use of your time would be to work in paid employment earning $50 over the evening. The opportunity cost of seeing Leonard Cohen is equal to:

a. $50.
b. $100.
c. $150.
d. $200.

9. I am considering loaning my brother $10,000 for one year. He has agreed to pay 10% interest on the loan. If I don't loan my brother the $10,000, it will stay in my bank account for the year, where it will earn 2% interest. What is the opportunity cost to me of the loan to my brother?

a. $200.
b. $800.
c. $1,000.
d. $1,200.

10. In January, in an attempt to commit to getting fit, I signed a year-long, binding contract at a local gym, agreeing to pay $40 per month in membership fees. I also spent $300 on extremely stylish gym clothes. This morning, I was trying to decide whether or not to actually go to the gym. Which of the following was relevant to this decision?

a. The $40 that I paid the gym this month.
b. The $300 I spent on gym clothes.
c. The fact that I also had to write a 103 midterm exam today.
d. All of the above were relevant.

11. Suppose you have bought and paid for a ticket to see Kanye in concert. You were willing to pay up to $350 for this ticket, but it only cost you $100. On the day of the concert, a friend offers you a free ticket to Lady Gaga instead. You can resell your Kanye ticket for $80. What do your sunk costs equal?

    a. $0.
    b. $20.
    c. $80.
    d. $100.

12. As a member of UVic's University Club, I pay $30 per month in membership fees. In a typical month I spend about $50 on beer at the Club. Every month I also have the option of attending a meeting of the whiskey club (open only to Club members), at a cost per meeting of $15, payable at the beginning of each meeting. Given this, what do my monthly SUNK COSTS equal?

    a. $15.
    b. $30.
    c. $45.
    d. $95.

Check your answer[1]

Attribution

Except where otherwise noted, this chapter is adapted from "Opportunity Costs & Sunk Costs (https://pressbooks.bccampus.ca/uvicecon103/chapter/1-2-opportunity-costs-sunk-costs/)" and "Topic 1 Solutions (https://pressbooks.bccampus.ca/uvicecon103/chapter/topic-1-solutions/)" In *Principles of Microeconomics* (https://pressbooks.bccampus.ca/uvicecon103/) by Dr. Emma Hutchinson, University of Victoria licesnsed under CC BY 4.0. / A derivative of *Principles of Economics (https://openstax.org/books/principles-economics/pages/1-introduction)* (OpenStax) by Steven A. Greenlaw, Timothy Taylor, licesensed under CC BY 2.0. Access for free at https://openstax.org/books/principles-economics/pages/1-introduction/ Adaptations include removal of:

1. **Question 1)** D , **Question 2)** A , **Question 3)** C , **Question 4)** A , **Question 5)** C , **Question 6)** B , **Question 7)** A , **Question 8)** C , **Question 9)**A , **Question 10)** C , **Question 11)** B , **Question 12)** B

- image describing spending/ scheduling time throughout your life
- removal of question 12 from Exercises 1.2.

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2.9 - ECONOMIC MODELS

Learning Objectives

- Review basic algebra and calculus' concepts relevant in introductory economics
- Assess the benefits and drawbacks of using simplifying assumptions in economics
- Apply the steps of the scientific method to economic questions
- Recognize the uses and limitations of economic models
- Contrast normative and positive statements about economic policy

Math Review

Mathematical economics uses mathematical methods, such as algebra and calculus, to represent theories and analyze problems in economics.

As a social science, economics analyzes the production, distribution, and consumption of goods and services. The study of economics requires the use of mathematics in order to analyze and synthesize complex information.

Mathematical Economics

Mathematical economics is the application of mathematical methods to represent theories and analyze problems in economics. Using mathematics allows economists to form meaningful, testable propositions about complex subjects that would be hard to express informally. Math enables economists to make specific and positive claims that are supported through formulas, models, and graphs. Mathematical disciplines, such as algebra and calculus, allow economists to study complex information and clarify assumptions.

Algebra

Algebra is the study of operations and their application to solving equations. It provides structure and a definite direction for economists when they are analyzing complex data. Math deals with specified numbers, while algebra introduces quantities without fixed numbers (known as **variables**). Using variables to denote quantities allows general relationships between quantities to be expressed concisely. **Quantitative** results in science, economics included, are expressed using algebraic equations.

Concepts in algebra that are used in economics include variables and algebraic expressions. Variables are letters that represent general, non-specified numbers. Variables are useful because they can represent numbers whose values are not yet known, they allow for the description of general problems without giving quantities, they allow for the description of relationships between quantities that may vary, and they allow for the description of mathematical properties. Algebraic expressions can be simplified using basic math operations including addition, subtraction, multiplication, division, and exponentiation.

In economics, theories need the flexibility to formulate and use general structures. By using algebra, economists are able to develop theories and structures that can be used with different scenarios regardless of specific quantities.

Calculus

Calculus is the mathematical study of change. Economists use calculus in order to study economic change whether it involves the world or human behavior.

Calculus has two main branches:

- Differential calculus is the study of the definition, properties, and applications of the derivative of a function (rates of change and slopes of curves). By finding the derivative of a function, you can find the rate of change of the original function.
- Integral calculus is the study of the definitions, properties, and applications of two related concepts, the indefinite and definite integral (accumulation of quantities and the areas under curves).

Calculus is widely used in economics and has the ability to solve many problems that algebra cannot. In economics, calculus is used to study and record complex information – commonly on graphs and curves. Calculus allows for the determination of a maximal profit by providing an easy way to calculate marginal cost and marginal revenue. It can also be used to study supply and demand curves.

Common Mathematical Terms

Economics utilizes a number of mathematical concepts on a regular basis such as:

- **Dependent Variable:** The output or the effect variable. Typically represented as yy, the dependent variable is graphed on the yy-axis. It is the variable whose change you are interested in seeing when you change other variables.
- **Independent or Explanatory Variable:** The inputs or causes. Typically represented as x1x1, x2x2, x3x3, etc., the independent variables are graphed on the xx-axis. These are the variables that are changed in order to see how they affect the dependent variable.
- **Slope:** The direction and steepness of the line on a graph. It is calculated by dividing the amount the line increases on the yy-axis (vertically) by the amount it changes on the xx-axis (horizontally). A positive slope means the line is going up toward the right on a graph, and a negative slope means the line is going down toward the right. A horizontal line has a slope of zero, while a vertical line has an undefined slope. The slope is important because it represents a rate of change.
- **Tangent:** The single point at which two curves touch. The derivative of a curve, for example, gives the equation of a line tangent to the curve at a given point.

Assumptions

Economists use **assumptions** in order to **simplify** economics processes so that they are easier to understand.

As a field, economics deals with complex processes and studies substantial amounts of information. Economists use assumptions in order to simplify economic processes so that it is easier to understand. Simplifying assumptions are used to gain a better understanding about economic issues with regards to the world and human behavior.

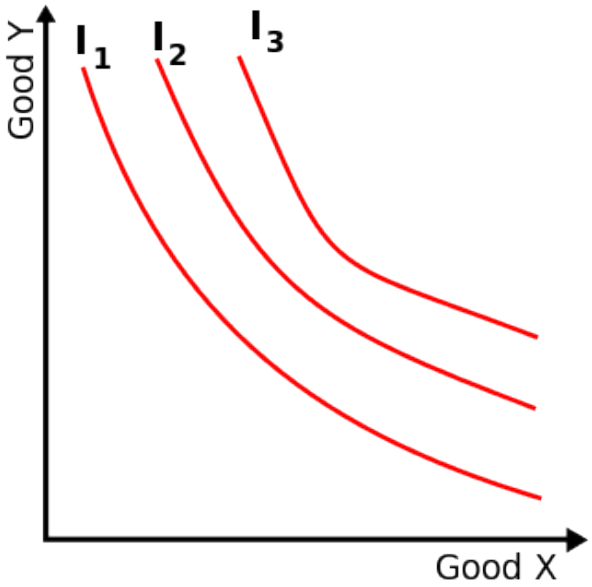

Figure 2.9a Simple indifference curve. Simple indifference curve (https://commons.wikimedia.org/wiki/File:Simple-indifference-curves.svg#/media/File:Simple-indifference-curves.svg) by SilverStar, licensed under CC BY 2.5.

Illustrates three indifference curves, with I3 having highest utility, and I1 lowest.

Simple indifference curve: An indifference curve is used to show potential demand patterns. It is an example of a graph that works with simplifying assumptions to gain a better understanding of the world and human behavior in relation to economics.

Economic Assumptions

Neo-classical economics works with three basic assumptions:

1. People have rational preferences among outcomes that can be identified and associated with a value.
2. Individuals maximize utility (as consumers) and firms maximize profit (as producers).
3. People act independently on the basis of full and relevant information.

Benefits of Economic Assumptions

Assumptions provide a way for economists to simplify economic processes and make them easier to study and understand. An assumption allows an economist to break down a complex process in order to develop a

theory and realm of understanding. Good simplification will allow the economists to focus only on the most relevant variables. Later, the theory can be applied to more complex scenarios for additional study.

For example, economists assume that individuals are rational and maximize their utilities. This simplifying assumption allows economists to build a structure to understand how people make choices and use resources. In reality, all people act differently. However, using the assumption that all people are rational enables economists study how people make choices.

Criticisms of Economic Assumptions

Although, simplifying assumptions help economists study complex scenarios and events, there are criticisms to using them. Critics have stated that assumptions cause economists to rely on unrealistic, unverifiable, and highly simplified information that in some cases simplifies the proofs of desired conclusions. Examples of such assumptions include perfect information, profit maximization, and rational choices. Economists use the simplified assumptions to understand complex events, but criticism increases when they base theories off the assumptions because assumptions do not always hold true. Although simplifying can lead to a better understanding of complex phenomena, critics explain that the simplified, unrealistic assumptions cannot be applied to complex, real world situations.

Hypotheses and Tests

Economics, as a science, follows the scientific method in order to study data, observe patterns, and predict results of stimuli. There are specific steps that must be followed when using the scientific method. Economics follows these steps in order to study data and build principles:

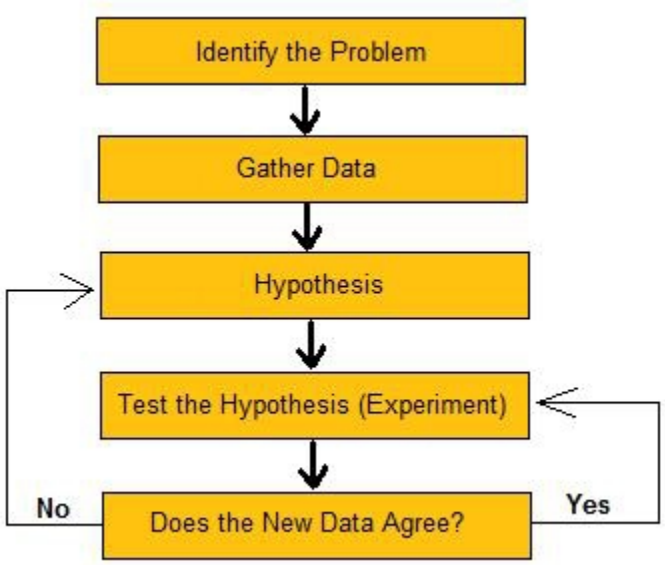

Figure 2.9b. Flowchart of the steps in the Scientific Method. Flowchart of the steps in the Scientific Method (https://commons.wikimedia.org/wiki/File:The_Scientific_Method.jpg) by CK-12 Foundation, licensed under CC BY-SA 3.0.

Scientific Method: The scientific method is used in economics to study data, observe patterns, and predict results.

1. **Identify the problem** – in the case of economics, this first step of the scientific method involves determining the focus or intent of the work. What is the economist studying? What is he trying to prove or show through his work?
2. **Gather data** – economics involves extensive amounts of data. For this reason, it is important that economists can break down and study complex information. The second step of the scientific method involves selecting the data that will be used in the study.
3. **Hypothesis** – the third step of the scientific method involves creating a model that will be used to make sense of all of the data. A **hypothesis** is simply a prediction. What does the economist think the overall outcome of the study will be?
4. **Test hypothesis** – the fourth step of the scientific method involves testing the hypothesis to determine if it is true. This is a critical stage within the scientific method. The observations must be tested to make sure they are unbiased and reproducible. In economics, extensive testing and observation is required because the outcome must be obtained more than once in order for it to be valid. It is not unusual for testing to take some time and for economists to make adjustments throughout the testing process.
5. **Analyze the results** – the final step of the scientific method is to analyze the results. First, an economist will ask himself if the data agrees with the hypothesis. If the answer is "yes," then the hypothesis was

accurate. If the answer is "no," then the economist must go back to the original hypothesis and adjust the study accordingly. A negative result does not mean that the study is over. It simply means that more work and analysis is required.

Observation of data is critical for economists because they take the results and interpret them in a meaningful way. Cause and effect relationships are used to establish economic theories and principles. Over time, if a theory or principle becomes accepted as universally true, it becomes a law. In general, a law is always considered to be true. The scientific method provides the framework necessary for the progression of economic study. All economic theories, principles, and laws are generalizations or abstractions. Through the use of the scientific method, economists are able to break down complex economic scenarios in order to gain a deeper understanding of critical data.

Economic Models

A model is simply a framework that is designed to show complex economic processes.

Economic Models

In economics, a model is defined as a theoretical construct that represents economic processes through a set of variables and a set of logical or quantitative relationships between the two. A model is simply a framework that is designed to show complex economic processes. Most models use mathematical techniques in order to investigate, theorize, and fit theories into economic situations.

Uses of an Economic Model

Economists use models in order to study and portray situations. The focus of a model is to gain a better understanding of how things work, to observe patterns, and to predict the results of stimuli. Models are based on theory and follow the rules of **deductive** logic.

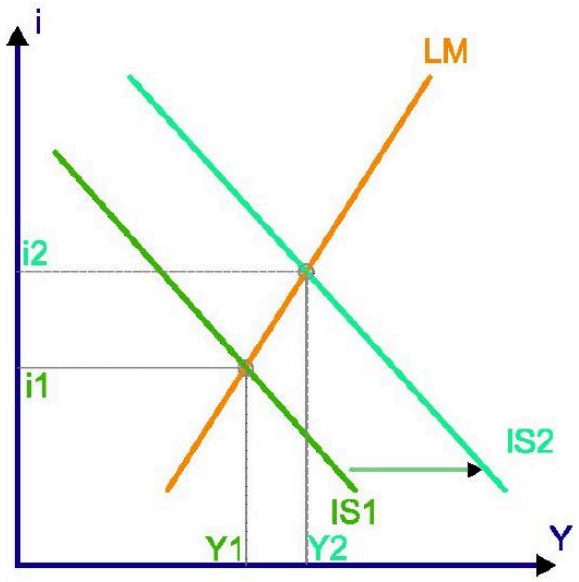

Figure 2.9c. Economic model diagram. Islm (https://commons.wikimedia.org/wiki/File:Islm.svg) by [[:en:User: {{{1}}}|{{{1}}}]], licensed under CC BY-SA 3.0. A derivative Thomas Steiner's Islm.

In economics, economic model diagrams are used in order to study and portray situations and gain a better understand of how things work. Economic models have two functions:

1. to simplify and abstract from observed data,
2. to serve as a means of selection of data based on a paradigm of econometric study.

Economic processes are known to be enormously complex, so simplification to gain a clearer understanding is critical. Selecting the correct data is also very important because the nature of the model will determine what economic facts are studied and how they will be compiled. Examples of the uses of economic models include: professional academic interest, forecasting economic activity, proposing economic policy, presenting reasoned arguments to politically justify economic policy, as well as economic planning and allocation.

Constructing a Model

The construction and use of a model will vary according to the specific situation. However, creating a model does have two basic steps: 1) generate the model, and 2) checking the model for accuracy – also known as

diagnostics. The diagnostic step is important because a model is only useful if the data and analysis is accurate.

Limitations of a Model

Due to the complexity of economic models, there are obviously limitations that come into account. First, all of the data provided must be complete and accurate in order for the analysis to be successful. Also, once the data is entered, it must be analyzed correctly. In most cases, economic models use mathematical or quantitative analysis. Within this realm of observation, accuracy is very important. During the construction of a model, the information will be checked and updated as needed to ensure accuracy. Some economic models also use **qualitative** analysis. However, this kind of analysis is known for lacking precision. Furthermore, models are fundamentally only as good as their founding assumptions.

The use of economic models is important in order to further study and understand economic processes. Steps must be taken throughout the construction of the model to ensure that the data provided and analyzed is correct.

Normative and Positive Economics

Positive economics is defined as the "what is" of economics, while **normative economics** focuses on the "what ought to be".

Positive and normative economic thought are two specific branches of economic reasoning. Although they are associated with one another, positive and normative economic thought have different focuses when analyzing economic scenarios.

Positive Economics

Positive economics is a branch of economics that focuses on the description and explanation of phenomena, as well as their casual relationships. It focuses primarily on facts and cause-and-effect behavioral relationships, including developing and testing economic theories. As a science, positive economics focuses on analyzing economic behavior. It avoids economic value judgments. For example, positive economic theory would describe how money supply growth impacts inflation, but it does not provide any guidance on what policy should be followed. "The unemployment rate in France is higher than that in the United States" is a positive economic statement. It gives an overview of an economic situation without providing any guidance for necessary actions to address the issue.

Normative Economics

Normative economics is a branch of economics that expresses value or normative judgments about economic fairness. It focuses on what the outcome of the economy or goals of public policy *should* be. Many normative judgments are conditional. They are given up if facts or knowledge of facts change. In this instance, a change in values is seen as being purely scientific. Welfare economist Amartya Sen explained that basic (normative) judgments rely on knowledge of facts.

An example of a normative economic statement is "The price of milk should be $6 a gallon to give dairy farmers a higher living standard and to save the family farm. " It is a normative statement because it reflects value judgments. It states facts, but also explains what should be done. Normative economics has subfields that provide further scientific study including social choice theory, cooperative game theory, and mechanism design.

Relationship Between Positive and Normative Economics

Positive economics does impact normative economics because it ranks economic policies or outcomes based on acceptability (normative economics). Positive economics is defined as the "what is" of economics, while normative economics focuses on the "what ought to be. " Positive economics is utilized as a practical tool for achieving normative objectives. In other words, positive economics clearly states an economic issue and normative economics provides the value-based solution for the issue.

Key Takeaways

- Using mathematics allows economists to form meaningful, testable propositions about complex subjects that would be hard to express informally.
- Algebra is the study of operations and their application to solving equations. It provides structure and a definite direction for economists when they are analyzing complex data.
- Concepts in algebra that are used in economics include variables and algebraic expressions.
- Calculus is the mathematical study of change. Economists use calculus in order to study economic change whether it involves the world or human behavior.
- In economics, calculus is used to study and record complex information – commonly on

graphs and curves.

- Neo-classical economics employs three basic assumptions: people have rational preferences among outcomes that can be identified and associated with a value, individuals maximize utility and firms maximize profit, and people act independently on the basis of full and relevant information.
- An assumption allows an economist to break down a complex process in order to develop a theory and realm of understanding. Later, the theory can be applied to more complex scenarios for additional study.
- Critics have stated that assumptions cause economists to rely on unrealistic, unverifiable, and highly simplified information that in some cases simplifies the proofs of desired conclusions.
- Although simplifying can lead to a better understanding of complex phenomena, critics explain that the simplified, unrealistic assumptions cannot be applied to complex, real world situations.
- The scientific method involves identifying a problem, gathering data, forming a hypothesis, testing the hypothesis, and analyzing the results.
- A hypothesis is simply a prediction.
- In economics, extensive testing and observation is required because the outcome must be obtained more than once in order to be valid.
- Cause and effect relationships are used to establish economic theories and principles. Over time, if a theory or principle becomes accepted as universally true, it becomes a law. In general, a law is always considered to be true.
- The scientific method provides the framework necessary for the progression of economic study.
- Many models use mathematical techniques in order to investigate, theorize, and fit theories into economic situations.
- Economic models have two functions: 1) to simplify and abstract from observed data, and 2) to serve as a means of selection of data based on a paradigm of econometric study.
- Creating a model has two basic steps: 1) generate the model, and 2) checking the model for accuracy – also known as diagnostics.
- Examples of the uses of economic models include: professional academic interest, forecasting economic activity, proposing economic policy, presenting reasoned arguments to politically justify economic policy, as well as economic planning and allocation.
- Positive economics is a branch of economics that focuses on the description and explanation of phenomena, as well as their casual relationships.
- Positive economics clearly states an economic issue and normative economics provides the

value-based solution for the issue.

- Normative economics is a branch of economics that expresses value or normative judgments about economic fairness. It focuses on what the outcome of the economy or goals of public policy should be.
- Positive economics does impact normative economics because it ranks economic polices or outcomes based on acceptability (normative economics).

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2.10 - WHY IT MATTERS: LABOUR MARKETS

Why understand labour markets?

Figure 2.10a. What determines incomes? In the U.S., income is based on one's value to an employer, which depends in part on education. Image by Steven A. Greenlaw & David Shapiro (OpenStax), licesned under CC BY 4.0. Modification of work by AFL-CIO America's Unions/Flickr Creative Commons and COD Newsroom/Flickr Creative Commons.

Working your way through college used to be fairly common in the United States. According to a 2015 study by the Georgetown Center on Education and the Workforce, 40% of college students work 30 hours or more per week.

At the same time, the cost of college seems to rise every year. The data show that the cost of tuition, fees, room and board has more than doubled since 1984. Thus, even full time employment may not be enough to cover college expenses anymore. Working full time at minimum wage–40 hours per week, 52 weeks per year—earns $15,080 before taxes, which is less than the $19,548 the College Board estimates it cost in 2016 for a year of college at a public university. The result of these costs is that student loan debt topped $1.3 trillion this year.

Despite these disheartening figures, the value of a bachelor's degree has never been higher. How do we explain this? This module will tell us. We will learn about:

- The theory of labour markets
- How wages are determined in an imperfectly competitive labour market
- How unions affect wages and employment
- How labour market outcomes are determined under bilateral monopoly
- Theories of employment discrimination
- How Immigration affects labour market outcomes

In a market economy like the United States, income comes from ownership of the means of production: resources or assets. More precisely, one's income is a function of two things: the quantity of each resource one owns, and the value society places on those resources.

Recall from the module on production and costs that each factor of production has an associated factor payment. For the majority of us, the most important resource we own is our labour. Thus, most of our income is wages, salaries, commissions, tips and other types of labour income. Your labour income depends on how many hours you have to work and the wage rate an employer will pay you for those hours. At the same time, some people own real estate, which they can either use themselves or rent out to other users. Some people have financial assets like bank accounts, stocks and bonds, for which they earn interest, dividends or some other form of income. Each of these factor payments, like wages for labour and interest for financial capital, is determined in their respective factor markets.

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2.11 - SELF-CHECK, CRITICAL THINKING & REVIEW QUESTIONS

Self-Check Questions

1. Suppose Alphonso's town raised the price of bus tickets to $1 per trip (while the price of burgers stayed at $2 and his budget remained $10 per week.) Draw Alphonso's new budget constraint. What happens to the opportunity cost of bus tickets?
2. Return to the example in Figure 2.2b[New Tab]. Suppose there is an improvement in medical technology that enables more healthcare with the same amount of resources. How would this affect the production possibilities curve and, in particular, how would it affect the opportunity cost of education?
3. Could a nation be producing in a way that is allocatively efficient, but productively inefficient?
4. What are the similarities between a consumer's budget constraint and society's production possibilities frontier, not just graphically but analytically?
5. Individuals may not act in the rational, calculating way described by the economic model of decision making, measuring utility and costs at the margin, but can you make a case that they behave approximately that way?
6. Would an op-ed piece in a newspaper urging the adoption of a particular economic policy be a positive or normative statement?
7. Would a research study on the effects of soft drink consumption on children's cognitive development be a positive or normative statement?

Check your answers

1. The opportunity cost of bus tickets is the number of burgers that must be given up to obtain one more bus ticket. Originally, when the price of bus tickets was 50 cents per trip, this opportunity cost was $0.50 \div 2 = 0.25$ burgers. The reason for this is that at the original prices,

one burger ($2) costs the same as four bus tickets ($0.50), so the opportunity cost of a burger is four bus tickets, and the opportunity cost of a bus ticket is 0.25 (the inverse of the opportunity cost of a burger). With the new, higher price of bus tickets, the opportunity cost rises to {\scriptsize \$1 \div \$2 \scriptsize} or 0.50. You can see this graphically since the slope of the new budget constraint is steeper than the original one. If Alphonso spends all of his budget on burgers, the higher price of bus tickets has no impact so the vertical intercept of the budget constraint is the same. If he spends his entire budget on bus tickets, he can now afford only half as many, so the horizontal intercept is half as much. In short, the budget constraint rotates clockwise around the vertical intercept, steepening as it goes and the opportunity cost of bus tickets increases.

Figure 2.11a Question 1 Graph: Alphonso's New Budget Constraint Figure by Steven A. Greenlaw & David Shapiro (OpenStax), licensed under CC BY 4.0.

Figure 2.11a. Question 1 Graph: Alphonso's New Budget Constraint Text Version
The x-axis is number of burgers and the y-axis is number of bus tickets ($). The first line charts original number of bus tickets ($0.50) and number of burgers, a gradual curve downward from left to right. The second line charts the new cost of bus tickets ($1) and number of burgers, a sharper curve downward from left to right.

Question 1 Table 2.11a: Alphonso's New Budget Constraints

Points	Number of Burgers	Original Number of Bus Tickets	Number of Bus Tickets Increased Cost
1	5	0	0
2	4	4	2
3	3	8	4
4	2	12	6
5	1	16	8
6	0	20	10

2. Because of the improvement in technology, the vertical intercept of the PPF would be at a higher level of healthcare. In other words, the PPF would rotate clockwise around the horizontal intercept. This would make the PPF steeper, corresponding to an increase in the opportunity cost of education, since resources devoted to education would now mean forgoing a greater quantity of healthcare.
3. No. Allocative efficiency requires productive efficiency, because it pertains to choices along the production possibilities frontier.
4. Both the budget constraint and the PPF show the constraint that each operates under. Both show a tradeoff between having more of one good but less of the other. Both show the opportunity cost graphically as the slope of the constraint (budget or PPF).
5. When individuals compare cost per unit in the grocery store, or characteristics of one product versus another, they are behaving approximately like the model describes.
6. Since an op-ed makes a case for what should be, it is considered normative.
7. Assuming that the study is not taking an explicit position about whether soft drink consumption is good or bad, but just reporting the science, it would be considered positive.

Critical Thinking Questions

1. Suppose Alphonso's town raises the price of bus tickets from $0.50 to $1 and the price of burgers rises from $2 to $4. Why is the opportunity cost of bus tickets unchanged? Suppose Alphonso's weekly spending money increases from $10 to $20. How is his budget constraint affected from all three changes? Explain.
2. During the Second World War, Germany's factories were decimated. It also suffered many human casualties, both soldiers and civilians. How did the war affect Germany's production possibilities curve?
3. It is clear that productive inefficiency is a waste since resources are used in a way that produces less goods and services than a nation is capable of. Why is allocative inefficiency also wasteful?
4. What assumptions about the economy must be true for the invisible hand to work? To what extent are those assumptions valid in the real world?
5. Do economists have any particular expertise at making normative arguments? In other words, they have expertise at making positive statements (i.e., what *will* happen) about some economic policy, for example, but do they have special expertise to judge whether or not the policy *should* be undertaken?

Review Questions

1. Explain why scarcity leads to tradeoffs.
2. Explain why individuals make choices that are directly on the budget constraint, rather than inside the budget constraint or outside it.
3. What is comparative advantage?

4. What does a production possibilities frontier illustrate?
5. Why is a production possibilities frontier typically drawn as a curve, rather than a straight line?
6. Explain why societies cannot make a choice above their production possibilities frontier and should not make a choice below it.
7. What are diminishing marginal returns?
8. What is productive efficiency? Allocative efficiency?
9. What is the difference between a positive and a normative statement?
10. Is the economic model of decision-making intended as a literal description of how individuals, firms, and the governments actually make decisions?
11. What are four responses to the claim that people should not behave in the way described in this chapter?

Problems

Use this information to answer the following 4 questions: Marie has a weekly budget of $24, which she likes to spend on magazines and pies.

1. If the price of a magazine is $4 each, what is the maximum number of magazines she could buy in a week?
2. If the price of a pie is $12, what is the maximum number of pies she could buy in a week?
3. Draw Marie's budget constraint with pies on the horizontal axis and magazines on the vertical axis. What is the slope of the budget constraint?
4. What is Marie's opportunity cost of purchasing a pie?

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2.12 - REVIEW AND PRACTICE

Summary

Economics deals with choices. In this chapter we have examined more carefully the range of choices in production that must be made in any economy. In particular, we looked at choices involving the allocation of an economy's factors of production: labour, capital, and natural resources.

In addition, in any economy, the level of technology plays a key role in determining how productive the factors of production will be. In a market economy, entrepreneurs organize factors of production and act to introduce technological change.

The production possibilities model is a device that assists us in thinking about many of the choices about resource allocation in an economy. The model assumes that the economy has factors of production that are fixed in both quantity and quality. When illustrated graphically, the production possibilities model typically limits our analysis to two goods. Given the economy's factors of production and technology, the economy can produce various combinations of the two goods. If it uses its factors of production efficiently and has full employment, it will be operating on the production possibilities curve.

Two characteristics of the production possibilities curve are particularly important. First, it is downward sloping. This reflects the scarcity of the factors of production available to the economy; producing more of one good requires giving up some of the other. Second, the curve is bowed out. Another way of saying this is to say that the curve gets steeper as we move from left to right; the absolute value of its slope is increasing. Producing each additional unit of the good on the horizontal axis requires a greater sacrifice of the good on the vertical axis than did the previous units produced. This fact, called the law of increasing opportunity cost, is the inevitable result of efficient choices in production—choices based on comparative advantage.

The production possibilities model has important implications for international trade. It suggests that free trade will allow countries to specialize in the production of goods and services in which

they have a comparative advantage. This specialization increases the production of all goods and services.

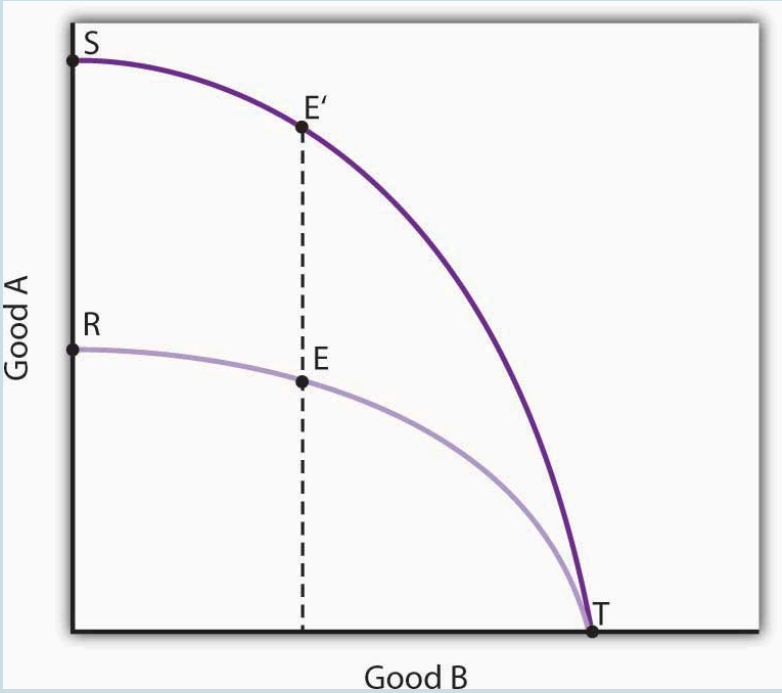
Increasing the quantity or quality of factors of production and/or improving technology will shift the production possibilities curve outward. This process is called economic growth. In the last 50 years, economic growth in the United States has resulted chiefly from increases in human capital and from technological advance.

Choices concerning the use of scarce resources take place within the context of a set of institutional arrangements that define an economic system. The principal distinctions between systems lie in the degree to which ownership of capital and natural resources and decision making authority over scarce resources are held by government or by private individuals. Economic systems include market capitalist, mixed, and command socialist economies. An increasing body of evidence suggests that market capitalist economies tend to be most productive; many command socialist and mixed economies are moving in the direction of market capitalist systems.

The presumption in favour of market-based systems does not preclude a role for government. Government is necessary to provide the system of laws on which market systems are founded. It may also be used to provide certain goods and services, to help individuals in need, and to regulate the actions of individuals and firms.

Concept Problems

1. How does a college education increase one's human capital?
2. Why does the downward-sloping production possibilities curve imply that factors of production are scarce?
3. In what ways are the bowed-out shape of the production possibilities curve and the law of increasing opportunity cost related?
4. Suppose an economy can produce two goods, A and B. It is now operating at point E on production possibilities curve RT. An improvement in the technology available to produce good A shifts the curve to ST, and the economy selects point E'. How does this change affect the opportunity cost of producing an additional unit of good B?



Question 4 Figure 2.12a. Figure by University of Minnesota, licensed under CC BY-NC-SA 4.0.

Question 4 Figure 2.12a (Text version)

Graph depicts two Goods, Good A is on the vertical axis and Good B is on the horizontal axis. Line 1 connects Points R and T. Point E in the middle of the trending slope between Good A and B.

Line 1: Point R is located at 0 B Goods and half way up the vertical axis and is a curved slope trending downwards toward Point T, which is located at 0 A Goods and the top end of B Goods scale.

Line 2: Depicts a steeper downward curve. Good A has now doubled and represented by Point S, which is located at 0 B Goods and the top of the vertical axis. Point T remains the same – located at 0 A Goods and the top end of B Goods scale. Point E remains in the middle of the trending slope between Good A and B, but has increased.

5. Could a nation's production possibilities curve ever shift inward? Explain what such a shift would mean, and discuss events that might cause such a shift to occur.
6. Suppose blue-eyed people were banned from working. How would this affect a nation's production possibilities curve?
7. Evaluate this statement: "The Canadian economy could achieve greater growth by devoting fewer resources to consumption and more to investment; it follows that such a shift would

be desirable."

8. Two countries, Sportsland and Foodland, have similar total quantities of labour, capital, and natural resources. Both can produce two goods, figs and footballs. Sportsland's resources are particularly well suited to the production of footballs but are not very productive in producing figs. Foodland's resources are very productive when used for figs but are not capable of producing many footballs. In which country is the cost of additional footballs generally greater? Explain.
9. Suppose a country is committed to using its resources based on the reverse of comparative advantage doctrine: it first transfers those resources for which the cost is greatest, not lowest. Describe this country's production possibilities curve.
10. The U.S. Constitution bans states from restricting imports of goods and services from other states. Suppose this restriction did not exist and that states were allowed to limit imports of goods and services produced in other states. How do you think this would affect U.S. output? Explain.
11. By 1993, nations in the European Union (EU) had eliminated all barriers to the flow of goods, services, labour, and capital across their borders. Even such things as consumer protection laws and the types of plugs required to plug in appliances have been standardized to ensure that there will be no barriers to trade. How do you think this elimination of trade barriers affected EU output?
12. How did the technological changes described in the Case in Point "Technology Cuts Costs, Boosts Productivity and Profits" affect the production possibilities curve for the United States?

Numerical Problems

1. Nathan can mow four lawns in a day or plant 20 trees in a day.

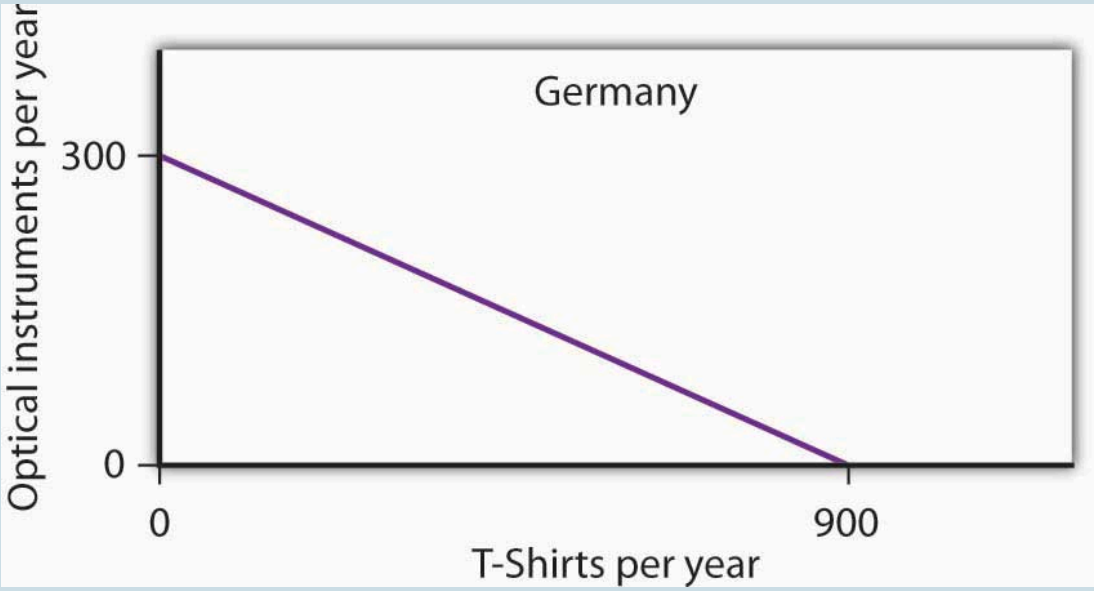
    1. Draw Nathan's production possibilities curve for mowing lawns and planting trees. Assume the production possibilities curve is linear and put the quantity of lawns

mowed per day on the horizontal axis and the quantity of trees planted per day on the vertical axis.
2. What is Nathan's opportunity cost of planting trees?
3. What is Nathan's opportunity cost of mowing lawns?

2. David can mow four lawns in a day or plant four trees in a day.

    1. Draw David's production possibilities curve for mowing lawns and planting trees. Again, assume a linear production possibilities curve and put the quantity of lawns mowed per day on the horizontal axis.
    2. What is David's opportunity cost of planting trees?
    3. What is David's opportunity cost of mowing lawns?

3. Given the production information in problems 1 and 2 above, who has the comparative advantage in planting trees? Mowing lawns?
4. The following graphs describe the production possibilities for Germany and Turkey. Use these graphs to answer the questions listed below:



Question 4 Figure 2.12b. The production possibilities for Germany. Figure by University of Minnesota, licensed under CC BY-NC-SA 4.0.

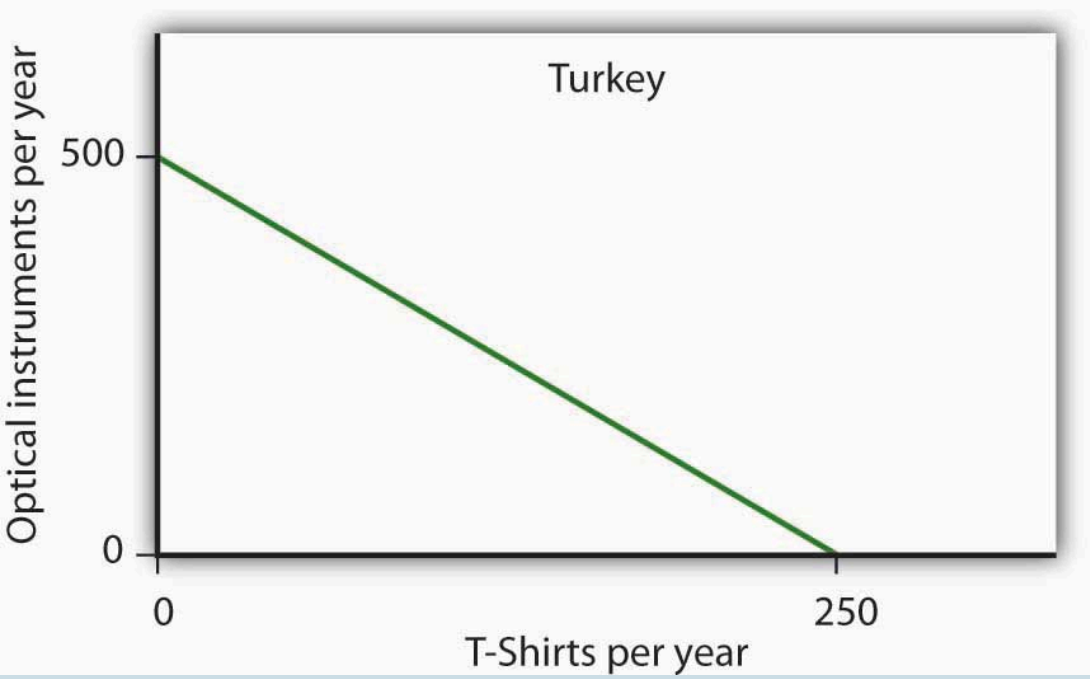


Figure 2.12c. The production possibilities for Turkey. Figure by University of Minnesota, licensed under CC BY-NC-SA 4.0.

1. What is the slope of Germany's production possibilities curve?
2. What is the slope of Turkey's production possibilities curve?
3. What is the opportunity cost of producing T-shirts in Germany?
4. What is the opportunity cost of producing T-shirts in Turkey?
5. What is the opportunity cost of producing optical instruments in Germany?
6. What is the opportunity cost of producing optical instruments in Turkey?
7. In which good does Germany have a comparative advantage?
8. In which good does Turkey have a comparative advantage?

5. The nation of Leisureland can produce two goods, bicycles and bowling balls. The western region of Leisureland can, if it devotes all its resources to bicycle production, produce 100 bicycles per month. Alternatively, it could devote all its resources to bowling balls and produce 400 per month—or it could produce any combination of bicycles and bowling balls lying on a straight line between these two extremes.

    1. Draw a production possibilities curve for western Leisureland (with bicycles on the vertical axis).

2. What it is the opportunity cost of producing an additional bowling ball measured in terms of forgone bicycles in western Leisureland?
3. Suppose that eastern Leisureland can, if it devotes all its resources to the production of bicycles, produce 400. If it devotes all its resources to bowling ball production, though, it can produce only 100. Draw the production possibilities curve for eastern Leisureland (again, assume it is linear and put bicycles on the vertical axis).
4. What is the opportunity cost of producing an additional bowling ball measured in terms of forgone bicycles in eastern Leisureland?
5. Explain the difference in opportunity cost between western and eastern Leisureland. Which region has a comparative advantage in producing bowling balls? Bicycles?
6. Draw the production possibilities curve for Leisureland, one that combines the curves for western and eastern Leisureland.
7. Suppose it is determined that 400 bicycles must be produced. How many bowling balls can be produced?
8. Where will these goods be produced?

6. The table below shows the production possibilities schedule for an economy.

Table 2.12a: Production possibilities schedule for an economy

Production Alternatives	Capital goods per period	Consumer goods per period
A	0	40
B	1	36
C	2	28
D	3	16
E	4	0

1. Putting capital goods per period on the horizontal axis and consumer goods per period on the vertical axis, graph the production possibilities curve for the economy.
2. If the economy is producing at alternative B, what is the opportunity cost to it of producing at alternative C instead?
3. If the economy is producing at alternative C, what is the opportunity cost to it of producing at alternative D instead?
4. Is it possible for this economy to produce 30 units of consumer goods per period while producing 1 unit of capital goods? Would this combination of goods represent efficient or inefficient production? Explain.
5. Which point, B or C, would lead to higher economic growth? Explain your answer.

Figure 2.12d shows the sources of growth in the United States between 1909 and 1929 and between 1950 and 1979, according to a study by Edward Denison (Denison, 1962). (Note: The sources of economic growth are cumulative and, taken collectively, explain 100% of total growth over the period.) Figure 2.12d data was extrapolated into two tables: Table 1 contains data for 1909 and 1929 and Table 2 contains data for 1909 and 1929.

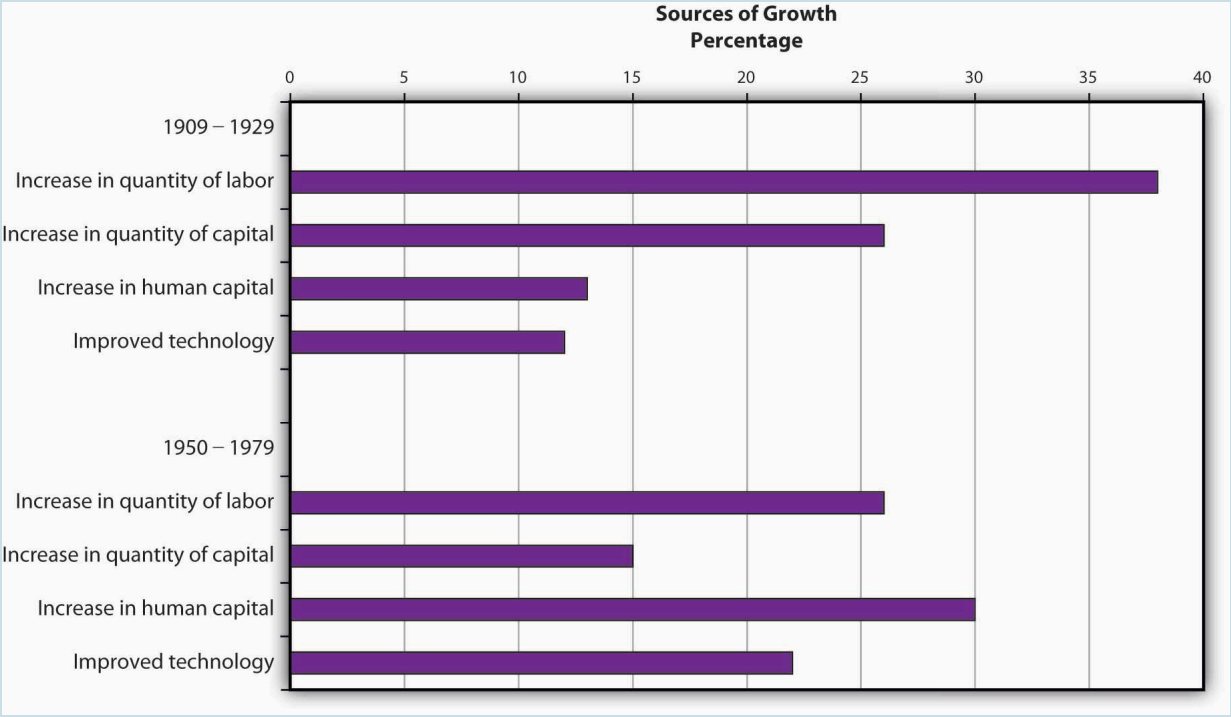


Figure 2.12d. Sources of growth in the United States between 1909 and 1929 and between 1950 and 1979. Figure by University of Minnesota, licensed under CC BY-NC-SA 4.0. Data obtained from study by Edward Denison (Denison, 1962).

Figure 2.12d. Sources of growth in the United States between 1909 and 1929 and between 1950 and 1979 (Text Version)

The tables below are an approximation of data reflected in Figure 2.12d. Sources of growth in the United States between 1909 and 1929 and between 1950 and 1979

Table 2.12b: Sources of growth in the United States between 1909 and 1929. Data obtained from study by Edward Denison (Denison, 1962).

Source of Economic Growth	Source of Growth Percentage
Increase in quantity of labour	38
Increase in quantity of capital	26
Increase in human capital	13
Improved technology	12

Table 2.12c: Sources of growth in the United States between between 1950 and 1979. Data obtained from study by Edward Denison (Denison, 1962).

Source of Economic Growth	Source of Growth Percentage
Increase in quantity of labour	26
Increase in quantity of capital	15
Increase in human capital	30
Improved technology	23

1. Approximately what percentage of U.S. growth between 1909 and 1929 was due to increases in quantities of factors of production?
2. Approximately what percentage of U.S. growth between 1909 and 1929 was due to increases in quality of factors of production and technological improvement?
3. Approximately what percentage of U.S. growth between 1950 and 1979 was due to increases in quantities of factors of production?
4. Approximately what percentage of U.S. growth between 1950 and 1979 was due to increases in quality of factors of production and technological improvement?

Watch It!

Watch the video Production Possibility Opportunity Cost Examples (https://www.youtube.com/watch?v=CKDtHPR5zd0)(9 mins)

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://ecampusontario.pressbooks.pub/laboureconomics/?p=844#oembed-1

Video Source: Economics tutoring ASU department of economics. (2016, January 24). P*roduction possibility opportunity cost examples* [Video]. YouTube. https://www.youtube.com/watch?v=CKDtHPR5zd0

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Original Source References

Denison, E., *The Sources of Economic Growth in the United States* (New York: Committee for Economic Development, 1962) and Edward Denison, *Trends in American Growth 1929–1982* (Washington, D.C.: Brookings Institutions, 1985).

Economics Tutoring ASU Department of Economics. (2016, January 24). Production Possibility Opportunity Cost Examples [Video]. YouTube. https://www.youtube.com/watch?v=CKDtHPR5zd0 . Licensed under YouTube license.

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2.13 - READING LIST

1. Current Population Survey (Household Survey) FRED [New Tab] (https://fred.stlouisfed.org/categories/12)
2. Statistics Canada [New Tab] (https://www.statcan.gc.ca/en/start)

Reading List compiled by Norm Smith.