A | The Use of Mathematics in Principles of Economics

(This appendix should be consulted after first reading Welcome to Economics!) Economics is not math. There is no important concept in this course that cannot be explained without mathematics. That said, math is a tool that can be used to illustrate economic concepts. Remember the saying a picture is worth a thousand words? Instead of a picture, think of a graph. It is the same thing. Economists use models as the primary tool to derive insights about economic issues and problems. Math is one way of working with (or manipulating) economic models.

There are other ways of representing models, such as text or narrative. But why would you use your fist to bang a nail, if you had a hammer? Math has certain advantages over text. It disciplines your thinking by making you specify exactly what you mean. You can get away with fuzzy thinking in your head, but you cannot when you reduce a model to algebraic equations. At the same time, math also has disadvantages. Mathematical models are necessarily based on simplifying assumptions, so they are not likely to be perfectly realistic. Mathematical models also lack the nuances which can be found in narrative models. The point is that math is one tool, but it is not the only tool or even always the best tool economists can use. So what math will you need for this book? The answer is: little more than high school algebra and graphs. You will need to know:

- What a function is
- How to interpret the equation of a line (i.e., slope and intercept)
- How to manipulate a line (i.e., changing the slope or the intercept)
- How to compute and interpret a growth rate (i.e., percentage change)
- How to read and manipulate a graph

In this text, we will use the easiest math possible, and we will introduce it in this appendix. So if you find some math in the book that you cannot follow, come back to this appendix to review. Like most things, math has diminishing returns. A little math ability goes a long way; the more advanced math you bring in, the less additional knowledge that will get you. That said, if you are going to major in economics, you should consider learning a little calculus. It will be worth your while in terms of helping you learn advanced economics more quickly.

Algebraic Models

Often economic models (or parts of models) are expressed in terms of mathematical functions. What is a function? A function describes a relationship. Sometimes the relationship is a definition. For example (using words), your professor is Adam Smith. This could be expressed as Professor = Adam Smith. Or Friends = Bob + Shawn + Margaret.

Often in economics, functions describe cause and effect. The variable on the left-hand side is what is being explained (“the effect”). On the right-hand side is what is doing the explaining (“the causes”). For example, suppose your GPA was determined as follows:

\[ \text{GPA} = 0.25 \times \text{combined\_SAT} + 0.25 \times \text{class\_attendance} + 0.50 \times \text{hours\_spent\_studying} \]

This equation states that your GPA depends on three things: your combined SAT score, your class attendance, and the number of hours you spend studying. It also says that study time is twice as important (0.50) as either combined SAT score (0.25) or class attendance (0.25). If this relationship is true, how could you raise your GPA? By not skipping class and studying more. Note that you cannot do anything about your SAT score, since if you are in college, you have (presumably) already taken the SATs.

Of course, economic models express relationships using economic variables, like Budget = money\_spent\_on\_econ\_books + money\_spent\_on\_music, assuming that the only things you buy are economics books and music.

Most of the relationships we use in this course are expressed as linear equations of the form:
Expressing Equations Graphically

Graphs are useful for two purposes. The first is to express equations visually, and the second is to display statistics or data. This section will discuss expressing equations visually.

To a mathematician or an economist, a variable is the name given to a quantity that may assume a range of values. In the equation of a line presented above, $x$ and $y$ are the variables, with $x$ on the horizontal axis and $y$ on the vertical axis, and $b$ and $m$ representing factors that determine the shape of the line. To see how this equation works, consider a numerical example:

$$y = 9 + 3x$$

In this equation for a specific line, the $b$ term has been set equal to 9 and the $m$ term has been set equal to 3. Table A1 shows the values of $x$ and $y$ for this given equation. Figure A1 shows this equation, and these values, in a graph. To construct the table, just plug in a series of different values for $x$, and then calculate what value of $y$ results. In the figure, these points are plotted and a line is drawn through them.

<table>
<thead>
<tr>
<th>$x$</th>
<th>$y$</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>9</td>
</tr>
<tr>
<td>1</td>
<td>12</td>
</tr>
<tr>
<td>2</td>
<td>15</td>
</tr>
<tr>
<td>3</td>
<td>18</td>
</tr>
<tr>
<td>4</td>
<td>21</td>
</tr>
<tr>
<td>5</td>
<td>24</td>
</tr>
<tr>
<td>6</td>
<td>27</td>
</tr>
</tbody>
</table>

Table A1 Values for the Slope Intercept Equation

![Figure A1 Slope and the Algebra of Straight Lines](http://cnx.org/content/col12190/1.4)

This line graph has $x$ on the horizontal axis and $y$ on the vertical axis. The $y$-intercept—that is, the point where the line intersects the $y$-axis—is 9. The slope of the line is 3; that is, there is a rise of 3 on the vertical axis for every increase of 1 on the horizontal axis. The slope is the same all along a straight line.

This example illustrates how the $b$ and $m$ terms in an equation for a straight line determine the shape of the line. The
b term is called the y-intercept. The reason for this name is that, if \( x = 0 \), then the b term will reveal where the line intercepts, or crosses, the y-axis. In this example, the line hits the vertical axis at 9. The m term in the equation for the line is the slope. Remember that slope is defined as rise over run; more specifically, the slope of a line from one point to another is the change in the vertical axis divided by the change in the horizontal axis. In this example, each time the x term increases by one (the run), the y term rises by three. Thus, the slope of this line is three. Specifying a y-intercept and a slope—that is, specifying b and m in the equation for a line—will identify a specific line. Although it is rare for real-world data points to arrange themselves as an exact straight line, it often turns out that a straight line can offer a reasonable approximation of actual data.

**Interpreting the Slope**

The concept of slope is very useful in economics, because it measures the relationship between two variables. A positive slope means that two variables are positively related; that is, when x increases, so does y, or when x decreases, y decreases also. Graphically, a positive slope means that as a line on the line graph moves from left to right, the line rises. The length-weight relationship, shown in Figure A3 later in this Appendix, has a positive slope. We will learn in other chapters that price and quantity supplied have a positive relationship; that is, firms will supply more when the price is higher.

A negative slope means that two variables are negatively related; that is, when x increases, y decreases, or when x decreases, y increases. Graphically, a negative slope means that, as the line on the line graph moves from left to right, the line falls. The altitude-air density relationship, shown in Figure A4 later in this appendix, has a negative slope. We will learn that price and quantity demanded have a negative relationship; that is, consumers will purchase less when the price is higher.

A slope of zero means that there is no relationship between x and y. Graphically, the line is flat; that is, zero rise over the run. Figure A5 of the unemployment rate, shown later in this appendix, illustrates a common pattern of many line graphs: some segments where the slope is positive, other segments where the slope is negative, and still other segments where the slope is close to zero.

The slope of a straight line between two points can be calculated in numerical terms. To calculate slope, begin by designating one point as the “starting point” and the other point as the “end point” and then calculating the rise over run between these two points. As an example, consider the slope of the air density graph between the points representing an altitude of 4,000 meters and an altitude of 6,000 meters:

\[
\begin{align*}
\text{Rise: Change in variable on vertical axis (end point minus original point)} \\
&= 0.100 - 0.307 \\
&= -0.207 \\
\text{Run: Change in variable on horizontal axis (end point minus original point)} \\
&= 6,000 - 4,000 \\
&= 2,000
\end{align*}
\]

Thus, the slope of a straight line between these two points would be that from the altitude of 4,000 meters up to 6,000 meters, the density of the air decreases by approximately 0.1 kilograms/cubic meter for each of the next 1,000 meters.

Suppose the slope of a line were to increase. Graphically, that means it would get steeper. Suppose the slope of a line were to decrease. Then it would get flatter. These conditions are true whether or not the slope was positive or negative to begin with. A higher positive slope means a steeper upward tilt to the line, while a smaller positive slope means a flatter upward tilt to the line. A negative slope that is larger in absolute value (that is, more negative) means a steeper downward tilt to the line. A slope of zero is a horizontal flat line. A vertical line has an infinite slope.

Suppose a line has a larger intercept. Graphically, that means it would shift out (or up) from the old origin, parallel to the old line. If a line has a smaller intercept, it would shift in (or down), parallel to the old line.

**Solving Models with Algebra**

Economists often use models to answer a specific question, like: What will the unemployment rate be if the economy grows at 3% per year? Answering specific questions requires solving the “system” of equations that represent the model.

Suppose the demand for personal pizzas is given by the following equation:
where \( Q_d \) is the amount of personal pizzas consumers want to buy (i.e., quantity demanded), and \( P \) is the price of pizzas. Suppose the supply of personal pizzas is:

\[
Q_s = 2 + 5P
\]

where \( Q_s \) is the amount of pizza producers will supply (i.e., quantity supplied).

Finally, suppose that the personal pizza market operates where supply equals demand, or

\[
Q_d = Q_s
\]

We now have a system of three equations and three unknowns (\( Q_d, Q_s, \) and \( P \)), which we can solve with algebra:

Since \( Q_d = Q_s \), we can set the demand and supply equation equal to each other:

\[
Q_d = Q_s
\]

\[
16 - 2P = 2 + 5P
\]

Subtracting 2 from both sides and adding 2P to both sides yields:

\[
16 - 2P - 2 = 2 + 5P - 2
\]

\[
14 - 2P = 5P
\]

\[
14 = 7P
\]

\[
2 = P
\]

In other words, the price of each personal pizza will be $2. How much will consumers buy?

Taking the price of $2, and plugging it into the demand equation, we get:

\[
Q_d = 16 - 2P
\]

\[
= 16 - 2(2)
\]

\[
= 16 - 4
\]

\[
= 12
\]

So if the price is $2 each, consumers will purchase 12. How much will producers supply? Taking the price of $2, and plugging it into the supply equation, we get:

\[
Q_s = 2 + 5P
\]

\[
= 2 + 5(2)
\]

\[
= 2 + 10
\]

\[
= 12
\]

So if the price is $2 each, producers will supply 12 personal pizzas. This means we did our math correctly, since \( Q_d = Q_s \).

Solving Models with Graphs

If algebra is not your forte, you can get the same answer by using graphs. Take the equations for \( Q_d \) and \( Q_s \) and graph them on the same set of axes as shown in Figure A2. Since \( P \) is on the vertical axis, it is easiest if you solve each equation for \( P \). The demand curve is then \( P = 8 - 0.5Q_d \) and the supply curve is \( P = -0.4 + 0.2Q_s \). Note that the vertical intercepts are 8 and -0.4, and the slopes are -0.5 for demand and 0.2 for supply. If you draw the graphs carefully, you will see that where they cross (\( Q_s = Q_d \)), the price is $2 and the quantity is 12, just like the algebra predicted.
Growth Rates

Growth rates are frequently encountered in real world economics. A growth rate is simply the percentage change in some quantity. It could be your income. It could be a business’s sales. It could be a nation’s GDP. The formula for computing a growth rate is straightforward:

\[
\text{Percentage change} = \frac{\text{Change in quantity}}{\text{Quantity}}
\]

Suppose your job pays $10 per hour. Your boss, however, is so impressed with your work that he gives you a $2 per hour raise. The percentage change (or growth rate) in your pay is $2/$10 = 0.20 or 20%.

To compute the growth rate for data over an extended period of time, for example, the average annual growth in GDP over a decade or more, the denominator is commonly defined a little differently. In the previous example, we defined the quantity as the initial quantity—or the quantity when we started. This is fine for a one-time calculation, but when we compute the growth over and over, it makes more sense to define the quantity as the average quantity over the period in question, which is defined as the quantity halfway between the initial quantity and the next quantity. This is harder to explain in words than to show with an example. Suppose a nation’s GDP was $1 trillion in 2005 and $1.03 trillion in 2006. The growth rate between 2005 and 2006 would be the change in GDP ($1.03 trillion – $1.00 trillion) divided by the average GDP between 2005 and 2006 ($1.03 trillion + $1.00 trillion)/2. In other words:

\[
= \frac{\$1.03 \text{ trillion} - \$1.00 \text{ trillion}}{\$1.03 \text{ trillion} + \$1.00 \text{ trillion}} / 2
= \frac{0.03}{1.015}
= 0.0296
= 2.96\% \text{ growth}
\]

Note that if we used the first method, the calculation would be ($1.03 trillion – $1.00 trillion) / $1.00 trillion = 3% growth, which is approximately the same as the second, more complicated method. If you need a rough approximation, use the first method. If you need accuracy, use the second method.

A few things to remember: A positive growth rate means the quantity is growing. A smaller growth rate means the quantity is growing more slowly. A larger growth rate means the quantity is growing more quickly. A negative growth rate means the quantity is decreasing.

The same change over times yields a smaller growth rate. If you got a $2 raise each year, in the first year the growth rate would be $2/$10 = 20%, as shown above. But in the second year, the growth rate would be $2/$12 = 0.167 or 16.7% growth. In the third year, the same $2 raise would correspond to a $2/$14 = 14.2%. The moral of the story is this: To keep the growth rate the same, the change must increase each period.

Displaying Data Graphically and Interpreting the Graph

Graphs are also used to display data or evidence. Graphs are a method of presenting numerical patterns. They
condense detailed numerical information into a visual form in which relationships and numerical patterns can be seen more easily. For example, which countries have larger or smaller populations? A careful reader could examine a long list of numbers representing the populations of many countries, but with over 200 nations in the world, searching through such a list would take concentration and time. Putting these same numbers on a graph can quickly reveal population patterns. Economists use graphs both for a compact and readable presentation of groups of numbers and for building an intuitive grasp of relationships and connections.

Three types of graphs are used in this book: line graphs, pie graphs, and bar graphs. Each is discussed below. We also provide warnings about how graphs can be manipulated to alter viewers’ perceptions of the relationships in the data.

**Line Graphs**

The graphs we have discussed so far are called line graphs, because they show a relationship between two variables: one measured on the horizontal axis and the other measured on the vertical axis.

Sometimes it is useful to show more than one set of data on the same axes. The data in Table A2 is displayed in Figure A3 which shows the relationship between two variables: length and median weight for American baby boys and girls during the first three years of life. (The median means that half of all babies weigh more than this and half weigh less.) The line graph measures length in inches on the horizontal axis and weight in pounds on the vertical axis. For example, point A on the figure shows that a boy who is 28 inches long will have a median weight of about 19 pounds. One line on the graph shows the length-weight relationship for boys and the other line shows the relationship for girls. This kind of graph is widely used by healthcare providers to check whether a child’s physical development is roughly on track.

![Figure A3 The Length-Weight Relationship for American Boys and Girls](image)

The line graph shows the relationship between height and weight for boys and girls from birth to 3 years. Point A, for example, shows that a boy who is 28 inches long will have a median weight of about 19 pounds. One line on the graph shows the length-weight relationship for boys and the other line shows the relationship for girls. These data apply only to children in the first three years of life.

<table>
<thead>
<tr>
<th>Boys from Birth to 36 Months</th>
<th>Girls from Birth to 36 Months</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Length (inches)</strong></td>
<td><strong>Weight (pounds)</strong></td>
</tr>
<tr>
<td>20.0</td>
<td>8.0</td>
</tr>
<tr>
<td>22.0</td>
<td>10.5</td>
</tr>
</tbody>
</table>

*Table A2 Length to Weight Relationship for American Boys and Girls*
Boys from Birth to 36 Months  |  Girls from Birth to 36 Months
---|---
24.0 | 24.0
13.5 | 13.2
26.0 | 26.0
16.4 | 16.0
28.0 | 28.0
19.0 | 18.8
30.0 | 30.0
21.8 | 21.2
32.0 | 32.0
24.3 | 24.0
34.0 | 34.0
27.0 | 26.2
36.0 | 36.0
29.3 | 28.9
38.0 | 38.0
32.0 | 31.3

**Table A2 Length to Weight Relationship for American Boys and Girls**

Not all relationships in economics are linear. Sometimes they are curves. **Figure A4** presents another example of a line graph, representing the data from **Table A3**. In this case, the line graph shows how thin the air becomes when you climb a mountain. The horizontal axis of the figure shows altitude, measured in meters above sea level. The vertical axis measures the density of the air at each altitude. Air density is measured by the weight of the air in a cubic meter of space (that is, a box measuring one meter in height, width, and depth). As the graph shows, air pressure is heaviest at ground level and becomes lighter as you climb. **Figure A4** shows that a cubic meter of air at an altitude of 500 meters weighs approximately one kilogram (about 2.2 pounds). However, as the altitude increases, air density decreases. A cubic meter of air at the top of Mount Everest, at about 8,828 meters, would weigh only 0.023 kilograms. The thin air at high altitudes explains why many mountain climbers need to use oxygen tanks as they reach the top of a mountain.

![Altitude-Air Density Relationship](image)

**Figure A4 Altitude-Air Density Relationship** This line graph shows the relationship between altitude, measured in meters above sea level, and air density, measured in kilograms of air per cubic meter. As altitude rises, air density declines. The point at the top of Mount Everest has an altitude of approximately 8,828 meters above sea level (the horizontal axis) and air density of 0.023 kilograms per cubic meter (the vertical axis).
<table>
<thead>
<tr>
<th>Altitude (meters)</th>
<th>Air Density (kg/cubic meters)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1.200</td>
</tr>
<tr>
<td>500</td>
<td>1.093</td>
</tr>
<tr>
<td>1,000</td>
<td>0.831</td>
</tr>
<tr>
<td>1,500</td>
<td>0.678</td>
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<tr>
<td>2,000</td>
<td>0.569</td>
</tr>
<tr>
<td>2,500</td>
<td>0.484</td>
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<tr>
<td>3,000</td>
<td>0.415</td>
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<tr>
<td>3,500</td>
<td>0.357</td>
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<td>4,000</td>
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<td>5,000</td>
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<td>0.022</td>
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<td>9,500</td>
<td>0.019</td>
</tr>
<tr>
<td>10,000</td>
<td>0.014</td>
</tr>
</tbody>
</table>

Table A3 Altitude to Air Density Relationship

The length-weight relationship and the altitude-air density relationships in these two figures represent averages. If you were to collect actual data on air pressure at different altitudes, the same altitude in different geographic locations will have slightly different air density, depending on factors like how far you are from the equator, local weather conditions, and the humidity in the air. Similarly, in measuring the height and weight of children for the previous line graph, children of a particular height would have a range of different weights, some above average and some below. In the real world, this sort of variation in data is common. The task of a researcher is to organize that data in a way that helps to understand typical patterns. The study of statistics, especially when combined with computer statistics and spreadsheet programs, is a great help in organizing this kind of data, plotting line graphs, and looking for typical underlying relationships. For most economics and social science majors, a statistics course will be required at some point.

One common line graph is called a time series, in which the horizontal axis shows time and the vertical axis displays another variable. Thus, a time series graph shows how a variable changes over time. Figure A5 shows the unemployment rate in the United States since 1975, where unemployment is defined as the percentage of adults who want jobs and are looking for a job, but cannot find one. The points for the unemployment rate in each year are plotted...
on the graph, and a line then connects the points, showing how the unemployment rate has moved up and down since 1975. The line graph makes it easy to see, for example, that the highest unemployment rate during this time period was slightly less than 10% in the early 1980s and 2010, while the unemployment rate declined from the early 1990s to the end of the 1990s, before rising and then falling back in the early 2000s, and then rising sharply during the recession from 2008–2009.

**Figure A5 U.S. Unemployment Rate, 1975–2014** This graph provides a quick visual summary of unemployment data. With a graph like this, it is easy to spot the times of high unemployment and of low unemployment.

**Pie Graphs**

A pie graph (sometimes called a pie chart) is used to show how an overall total is divided into parts. A circle represents a group as a whole. The slices of this circular “pie” show the relative sizes of subgroups.

**Figure A6** shows how the U.S. population was divided among children, working age adults, and the elderly in 1970, 2000, and what is projected for 2030. The information is first conveyed with numbers in **Table A4**, and then in three pie charts. The first column of **Table A4** shows the total U.S. population for each of the three years. Columns 2–4 categorize the total in terms of age groups—from birth to 18 years, from 19 to 64 years, and 65 years and above. In columns 2–4, the first number shows the actual number of people in each age category, while the number in parentheses shows the percentage of the total population comprised by that age group.

<table>
<thead>
<tr>
<th>Year</th>
<th>Total Population</th>
<th>19 and Under</th>
<th>20–64 years</th>
<th>Over 65</th>
</tr>
</thead>
<tbody>
<tr>
<td>1970</td>
<td>205.0 million</td>
<td>77.2 (37.6%)</td>
<td>107.7 (52.5%)</td>
<td>20.1 (9.8%)</td>
</tr>
<tr>
<td>2000</td>
<td>275.4 million</td>
<td>78.4 (28.5%)</td>
<td>162.2 (58.9%)</td>
<td>34.8 (12.6%)</td>
</tr>
<tr>
<td>2030</td>
<td>351.1 million</td>
<td>92.6 (26.4%)</td>
<td>188.2 (53.6%)</td>
<td>70.3 (20.0%)</td>
</tr>
</tbody>
</table>

**Table A4 U.S. Age Distribution, 1970, 2000, and 2030 (projected)**
The three pie graphs illustrate the division of total population into three age groups for the three different years.

In a pie graph, each slice of the pie represents a share of the total, or a percentage. For example, 50% would be half of the pie and 20% would be one-fifth of the pie. The three pie graphs in Figure A6 show that the share of the U.S. population 65 and over is growing. The pie graphs allow you to get a feel for the relative size of the different age groups from 1970 to 2000 to 2030, without requiring you to slog through the specific numbers and percentages in the table. Some common examples of how pie graphs are used include dividing the population into groups by age, income level, ethnicity, religion, occupation; dividing different firms into categories by size, industry, number of employees; and dividing up government spending or taxes into its main categories.

**Bar Graphs**

A bar graph uses the height of different bars to compare quantities. Table A5 lists the 12 most populous countries in the world. Figure A7 provides this same data in a bar graph. The height of the bars corresponds to the population of each country. Although you may know that China and India are the most populous countries in the world, seeing how the bars on the graph tower over the other countries helps illustrate the magnitude of the difference between the sizes of national populations.
The graph shows the 12 countries of the world with the largest populations. The height of the bars in the bar graph shows the size of the population for each country.

<table>
<thead>
<tr>
<th>Country</th>
<th>Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>China</td>
<td>1,369</td>
</tr>
<tr>
<td>India</td>
<td>1,270</td>
</tr>
<tr>
<td>United States</td>
<td>321</td>
</tr>
<tr>
<td>Indonesia</td>
<td>255</td>
</tr>
<tr>
<td>Brazil</td>
<td>204</td>
</tr>
<tr>
<td>Pakistan</td>
<td>190</td>
</tr>
<tr>
<td>Nigeria</td>
<td>184</td>
</tr>
<tr>
<td>Bangladesh</td>
<td>158</td>
</tr>
<tr>
<td>Russia</td>
<td>146</td>
</tr>
<tr>
<td>Japan</td>
<td>127</td>
</tr>
<tr>
<td>Mexico</td>
<td>121</td>
</tr>
<tr>
<td>Philippines</td>
<td>101</td>
</tr>
</tbody>
</table>

Table A5 Leading 12 Countries of the World by Population

Bar graphs can be subdivided in a way that reveals information similar to that we can get from pie charts. Figure A8 offers three bar graphs based on the information from Figure A6 about the U.S. age distribution in 1970, 2000, and 2030. Figure A8 (a) shows three bars for each year, representing the total number of persons in each age bracket for each year. Figure A8 (b) shows just one bar for each year, but the different age groups are now shaded inside the bar. In Figure A8 (c), still based on the same data, the vertical axis measures percentages rather than the number of persons. In this case, all three bar graphs are the same height, representing 100% of the population, with each bar divided according to the percentage of population in each age group. It is sometimes easier for a reader to run his or her eyes across several bar graphs, comparing the shaded areas, rather than trying to compare several pie graphs.
Figure A8 U.S. Population with Bar Graphs

Population data can be represented in different ways. (a) Shows three bars for each year, representing the total number of persons in each age bracket for each year. (b) Shows just one bar for each year, but the different age groups are now shaded inside the bar. (c) Sets the vertical axis as a measure of percentages rather than the number of persons. All three bar graphs are the same height and each bar is divided according to the percentage of population in each age group.

Figure A7 and Figure A8 show how the bars can represent countries or years, and how the vertical axis can represent a numerical or a percentage value. Bar graphs can also compare size, quantity, rates, distances, and other quantitative categories.

Comparing Line Graphs with Pie Charts and Bar Graphs

Now that you are familiar with pie graphs, bar graphs, and line graphs, how do you know which graph to use for your data? Pie graphs are often better than line graphs at showing how an overall group is divided. However, if a pie graph has too many slices, it can become difficult to interpret.

Bar graphs are especially useful when comparing quantities. For example, if you are studying the populations of different countries, as in Figure A7, bar graphs can show the relationships between the population sizes of multiple countries. Not only can it show these relationships, but it can also show breakdowns of different groups within the population.

A line graph is often the most effective format for illustrating a relationship between two variables that are both changing. For example, time series graphs can show patterns as time changes, like the unemployment rate over time.
Line graphs are widely used in economics to present continuous data about prices, wages, quantities bought and sold, the size of the economy.

**How Graphs Can Be Misleading**

Graphs not only reveal patterns; they can also alter how patterns are perceived. To see some of the ways this can be done, consider the line graphs of Figure A9, Figure A10, and Figure A11. These graphs all illustrate the unemployment rate—but from different perspectives.
Figure A10 Presenting Unemployment Rates in Different Ways, All of Them Accurate

Simply changing the width and height of the area in which data is displayed can alter the perception of the data.
Suppose you wanted a graph which gives the impression that the rise in unemployment in 2009 was not all that large, or all that extraordinary by historical standards. You might choose to present your data as in Figure A9 (a). Figure A9 (a) includes much of the same data presented earlier in Figure A5, but stretches the horizontal axis out longer relative to the vertical axis. By spreading the graph wide and flat, the visual appearance is that the rise in unemployment is not so large, and is similar to some past rises in unemployment. Now imagine you wanted to emphasize how unemployment spiked substantially higher in 2009. In this case, using the same data, you can stretch the vertical axis out relative to the horizontal axis, as in Figure A9 (b), which makes all rises and falls in unemployment appear larger.

A similar effect can be accomplished without changing the length of the axes, but by changing the scale on the vertical axis. In Figure A10 (c), the scale on the vertical axis runs from 0% to 30%, while in Figure A10 (d), the vertical axis runs from 3% to 10%. Compared to Figure A5, where the vertical scale runs from 0% to 12%, Figure A10 (c) makes the fluctuation in unemployment look smaller, while Figure A10 (d) makes it look larger.

Another way to alter the perception of the graph is to reduce the amount of variation by changing the number of points plotted on the graph. Figure A10 (e) shows the unemployment rate according to five-year averages. By averaging out some of the year-to-year changes, the line appears smoother and with fewer highs and lows. In reality, the unemployment rate is reported monthly, and Figure A11 (f) shows the monthly figures since 1960, which fluctuate more than the five-year average. Figure A11 (f) is also a vivid illustration of how graphs can compress lots of data. The graph includes monthly data since 1960, which over almost 50 years, works out to nearly 600 data points.
Reading that list of 600 data points in numerical form would be hypnotic. You can, however, get a good intuitive sense of these 600 data points very quickly from the graph.

A final trick in manipulating the perception of graphical information is that, by choosing the starting and ending points carefully, you can influence the perception of whether the variable is rising or falling. The original data show a general pattern with unemployment low in the 1960s, but spiking up in the mid-1970s, early 1980s, early 1990s, early 2000s, and late 2000s. Figure A11 (g), however, shows a graph that goes back only to 1975, which gives an impression that unemployment was more-or-less gradually falling over time until the 2009 recession pushed it back up to its “original” level—which is a plausible interpretation if one starts at the high point around 1975.

These kinds of tricks—or shall we just call them “presentation choices”—are not limited to line graphs. In a pie chart with many small slices and one large slice, someone must decided what categories should be used to produce these slices in the first place, thus making some slices appear bigger than others. If you are making a bar graph, you can make the vertical axis either taller or shorter, which will tend to make variations in the height of the bars appear more or less.

Being able to read graphs is an essential skill, both in economics and in life. A graph is just one perspective or point of view, shaped by choices such as those discussed in this section. Do not always believe the first quick impression from a graph. View with caution.

Key Concepts and Summary

Math is a tool for understanding economics and economic relationships can be expressed mathematically using algebra or graphs. The algebraic equation for a line is \( y = b + mx \), where \( x \) is the variable on the horizontal axis and \( y \) is the variable on the vertical axis, the \( b \) term is the \( y \)-intercept and the \( m \) term is the slope. The slope of a line is the same at any point on the line and it indicates the relationship (positive, negative, or zero) between two economic variables.

Economic models can be solved algebraically or graphically. Graphs allow you to illustrate data visually. They can illustrate patterns, comparisons, trends, and apportionment by condensing the numerical data and providing an intuitive sense of relationships in the data. A line graph shows the relationship between two variables: one is shown on the horizontal axis and one on the vertical axis. A pie graph shows how something is allotted, such as a sum of money or a group of people. The size of each slice of the pie is drawn to represent the corresponding percentage of the whole. A bar graph uses the height of bars to show a relationship, where each bar represents a certain entity, like a country or a group of people. The bars on a bar graph can also be divided into segments to show subgroups.

Any graph is a single visual perspective on a subject. The impression it leaves will be based on many choices, such as what data or time frame is included, how data or groups are divided up, the relative size of vertical and horizontal axes, whether the scale used on a vertical starts at zero. Thus, any graph should be regarded somewhat skeptically, remembering that the underlying relationship can be open to different interpretations.

Review Questions

Exercise A1
Name three kinds of graphs and briefly state when is most appropriate to use each type of graph.

Exercise A2
What is slope on a line graph?

Exercise A3
What do the slices of a pie chart represent?

Exercise A4
Why is a bar chart the best way to illustrate comparisons?

Exercise A5
How does the appearance of positive slope differ from negative slope and from zero slope?
B | The Expenditure-Output Model

(This appendix should be consulted after first reading The Aggregate Demand/Aggregate Supply Model and The Keynesian Perspective.) The fundamental ideas of Keynesian economics were developed before the AD/AS model was popularized. From the 1930s until the 1970s, Keynesian economics was usually explained with a different model, known as the expenditure-output approach. This approach is strongly rooted in the fundamental assumptions of Keynesian economics: it focuses on the total amount of spending in the economy, with no explicit mention of aggregate supply or of the price level (although as you will see, it is possible to draw some inferences about aggregate supply and price levels based on the diagram).

The Axes of the Expenditure-Output Diagram

The expenditure-output model, sometimes also called the Keynesian cross diagram, determines the equilibrium level of real GDP by the point where the total or aggregate expenditures in the economy are equal to the amount of output produced. The axes of the Keynesian cross diagram presented in Figure B1 show real GDP on the horizontal axis as a measure of output and aggregate expenditures on the vertical axis as a measure of spending.

Figure B1 The Expenditure-Output Diagram

The aggregate expenditure-output model shows aggregate expenditures on the vertical axis and real GDP on the horizontal axis. A vertical line shows potential GDP where full employment occurs. The 45-degree line shows all points where aggregate expenditures and output are equal. The aggregate expenditure schedule shows how total spending or aggregate expenditure increases as output or real GDP rises. The intersection of the aggregate expenditure schedule and the 45-degree line will be the equilibrium. Equilibrium occurs at \( E_0 \), where aggregate expenditure \( AE_0 \) is equal to the output level \( Y_0 \).

Remember that GDP can be thought of in several equivalent ways: it measures both the value of spending on final goods and also the value of the production of final goods. All sales of the final goods and services that make up GDP will eventually end up as income for workers, for managers, and for investors and owners of firms. The sum of all the income received for contributing resources to GDP is called national income (\( Y \)). At some points in the discussion that follows, it will be useful to refer to real GDP as “national income.” Both axes are measured in real (inflation-adjusted) terms.

The Potential GDP Line and the 45-degree Line
The Keynesian cross diagram contains two lines that serve as conceptual guideposts to orient the discussion. The first is a vertical line showing the level of potential GDP. Potential GDP means the same thing here that it means in the AD/AS diagrams: it refers to the quantity of output that the economy can produce with full employment of its labor and physical capital.

The second conceptual line on the Keynesian cross diagram is the 45-degree line, which starts at the origin and reaches up and to the right. A line that stretches up at a 45-degree angle represents the set of points (1, 1), (2, 2), (3, 3) and so on, where the measurement on the vertical axis is equal to the measurement on the horizontal axis. In this diagram, the 45-degree line shows the set of points where the level of aggregate expenditure in the economy, measured on the vertical axis, is equal to the level of output or national income in the economy, measured by GDP on the horizontal axis.

When the macroeconomy is in equilibrium, it must be true that the aggregate expenditures in the economy are equal to the real GDP—because by definition, GDP is the measure of what is spent on final sales of goods and services in the economy. Thus, the equilibrium calculated with a Keynesian cross diagram will always end up where aggregate expenditure and output are equal—which will only occur along the 45-degree line.

The Aggregate Expenditure Schedule

The final ingredient of the Keynesian cross or expenditure-output diagram is the aggregate expenditure schedule, which will show the total expenditures in the economy for each level of real GDP. The intersection of the aggregate expenditure line with the 45-degree line—at point E₀ in Figure B1—will show the equilibrium for the economy, because it is the point where aggregate expenditure is equal to output or real GDP. After developing an understanding of what the aggregate expenditures schedule means, we will return to this equilibrium and how to interpret it.

Building the Aggregate Expenditure Schedule

Aggregate expenditure is the key to the expenditure-income model. The aggregate expenditure schedule shows, either in the form of a table or a graph, how aggregate expenditures in the economy rise as real GDP or national income rises. Thus, in thinking about the components of the aggregate expenditure line—consumption, investment, government spending, exports and imports—the key question is how expenditures in each category will adjust as national income rises.

Consumption as a Function of National Income

How do consumption expenditures increase as national income rises? People can do two things with their income: consume it or save it (for the moment, let’s ignore the need to pay taxes with some of it). Each person who receives an additional dollar faces this choice. The marginal propensity to consume (MPC), is the share of the additional dollar of income a person decides to devote to consumption expenditures. The marginal propensity to save (MPS) is the share of the additional dollar a person decides to save. It must always hold true that:

\[ \text{MPC} + \text{MPS} = 1 \]

For example, if the marginal propensity to consume out of the marginal amount of income earned is 0.9, then the marginal propensity to save is 0.1.

With this relationship in mind, consider the relationship among income, consumption, and savings shown in Figure B2. (Note that we use “Aggregate Expenditure” on the vertical axis in this and the following figures, because all consumption expenditures are parts of aggregate expenditures.)

An assumption commonly made in this model is that even if income were zero, people would have to consume something. In this example, consumption would be $600 even if income were zero. Then, the MPC is 0.8 and the MPS is 0.2. Thus, when income increases by $1,000, consumption rises by $800 and savings rises by $200. At an income of $4,000, total consumption will be the $600 that would be consumed even without any income, plus $4,000 multiplied by the marginal propensity to consume of 0.8, or $ 3,200, for a total of $ 3,800. The total amount of consumption and saving must always add up to the total amount of income. (Exactly how a situation of zero income and negative savings would work in practice is not important, because even low-income societies are not literally at zero income, so the point is hypothetical.) This relationship between income and consumption, illustrated in Figure B2 and Table B1, is called the consumption function.
In the expenditure-output model, how does consumption increase with the level of national income? Output on the horizontal axis is conceptually the same as national income, since the value of all final output that is produced and sold must be income to someone, somewhere in the economy. At a national income level of zero, $600 is consumed. Then, each time income rises by $1,000, consumption rises by $800, because in this example, the marginal propensity to consume is 0.8.

The pattern of consumption shown in Table B1 is plotted in Figure B2. To calculate consumption, multiply the income level by 0.8, for the marginal propensity to consume, and add $600, for the amount that would be consumed even if income was zero. Consumption plus savings must be equal to income.

<table>
<thead>
<tr>
<th>Income</th>
<th>Consumption</th>
<th>Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>$0</td>
<td>$600</td>
<td>−$600</td>
</tr>
<tr>
<td>$1,000</td>
<td>$1,400</td>
<td>−$400</td>
</tr>
<tr>
<td>$2,000</td>
<td>$2,200</td>
<td>−$200</td>
</tr>
<tr>
<td>$3,000</td>
<td>$3,000</td>
<td>$0</td>
</tr>
<tr>
<td>$4,000</td>
<td>$3,800</td>
<td>$200</td>
</tr>
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<td>$5,000</td>
<td>$4,600</td>
<td>$400</td>
</tr>
<tr>
<td>$6,000</td>
<td>$5,400</td>
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</tr>
<tr>
<td>$7,000</td>
<td>$6,200</td>
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</tr>
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<td>$7,000</td>
<td>$1,000</td>
</tr>
<tr>
<td>$9,000</td>
<td>$7,800</td>
<td>$1,200</td>
</tr>
</tbody>
</table>

Table B1 The Consumption Function

However, a number of factors other than income can also cause the entire consumption function to shift. These factors were summarized in the earlier discussion of consumption, and listed in Table B1. When the consumption function moves, it can shift in two ways: either the entire consumption function can move up or down in a parallel manner, or the slope of the consumption function can shift so that it becomes steeper or flatter. For example, if a tax cut leads consumers to spend more, but does not affect their marginal propensity to consume, it would cause an upward shift to a new consumption function that is parallel to the original one. However, a change in household preferences for saving that reduced the marginal propensity to save would cause the slope of the consumption function to become steeper: that is, if the savings rate is lower, then every increase in income leads to a larger rise in consumption.
Investment as a Function of National Income

Investment decisions are forward-looking, based on expected rates of return. Precisely because investment decisions depend primarily on perceptions about future economic conditions, they do not depend primarily on the level of GDP in the current year. Thus, on a Keynesian cross diagram, the investment function can be drawn as a horizontal line, at a fixed level of expenditure. Figure B3 shows an investment function where the level of investment is, for the sake of concreteness, set at the specific level of 500. Just as a consumption function shows the relationship between consumption levels and real GDP (or national income), the investment function shows the relationship between investment levels and real GDP.

![Figure B3 The Investment Function](image)

The investment function is drawn as a flat line because investment is based on interest rates and expectations about the future, and so it does not change with the level of current national income. In this example, investment expenditures are at a level of 500. However, changes in factors like technological opportunities, expectations about near-term economic growth, and interest rates would all cause the investment function to shift up or down.

The appearance of the investment function as a horizontal line does not mean that the level of investment never moves. It means only that in the context of this two-dimensional diagram, the level of investment on the vertical aggregate expenditure axis does not vary according to the current level of real GDP on the horizontal axis. However, all the other factors that vary investment—new technological opportunities, expectations about near-term economic growth, interest rates, the price of key inputs, and tax incentives for investment—can cause the horizontal investment function to shift up or down.

Government Spending and Taxes as a Function of National Income

In the Keynesian cross diagram, government spending appears as a horizontal line, as in Figure B4, where government spending is set at a level of 1,300. As in the case of investment spending, this horizontal line does not mean that government spending is unchanging. It means only that government spending changes when Congress decides on a change in the budget, rather than shifting in a predictable way with the current size of the real GDP shown on the horizontal axis.
Figure B4 The Government Spending Function  The level of government spending is determined by political factors, not by the level of real GDP in a given year. Thus, government spending is drawn as a horizontal line. In this example, government spending is at a level of 1,300. Congressional decisions to increase government spending will cause this horizontal line to shift up, while decisions to reduce spending would cause it to shift down.

The situation of taxes is different because taxes often rise or fall with the volume of economic activity. For example, income taxes are based on the level of income earned and sales taxes are based on the amount of sales made, and both income and sales tend to be higher when the economy is growing and lower when the economy is in a recession. For the purposes of constructing the basic Keynesian cross diagram, it is helpful to view taxes as a proportionate share of GDP. In the United States, for example, taking federal, state, and local taxes together, government typically collects about 30–35% of income as taxes.

Table B2 revises the earlier table on the consumption function so that it takes taxes into account. The first column shows national income. The second column calculates taxes, which in this example are set at a rate of 30%, or 0.3. The third column shows after-tax income; that is, total income minus taxes. The fourth column then calculates consumption in the same manner as before: multiply after-tax income by 0.8, representing the marginal propensity to consume, and then add $600, for the amount that would be consumed even if income was zero. When taxes are included, the marginal propensity to consume is reduced by the amount of the tax rate, so each additional dollar of income results in a smaller increase in consumption than before taxes. For this reason, the consumption function, with taxes included, is flatter than the consumption function without taxes, as Figure B5 shows.

Figure B5 The Consumption Function Before and After Taxes  The upper line repeats the consumption function from Figure B2. The lower line shows the consumption function if taxes must first be paid on income, and then consumption is based on after-tax income.
<table>
<thead>
<tr>
<th>Income</th>
<th>Taxes</th>
<th>After-Tax Income</th>
<th>Consumption</th>
<th>Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>$0</td>
<td>$0</td>
<td>$0</td>
<td>$600</td>
<td>−$600</td>
</tr>
<tr>
<td>$1,000</td>
<td>$300</td>
<td>$700</td>
<td>$1,160</td>
<td>−$460</td>
</tr>
<tr>
<td>$2,000</td>
<td>$600</td>
<td>$1,400</td>
<td>$1,720</td>
<td>−$320</td>
</tr>
<tr>
<td>$3,000</td>
<td>$900</td>
<td>$2,100</td>
<td>$2,280</td>
<td>−$180</td>
</tr>
<tr>
<td>$4,000</td>
<td>$1,200</td>
<td>$2,800</td>
<td>$2,840</td>
<td>−$40</td>
</tr>
<tr>
<td>$5,000</td>
<td>$1,500</td>
<td>$3,500</td>
<td>$3,400</td>
<td>$100</td>
</tr>
<tr>
<td>$6,000</td>
<td>$1,800</td>
<td>$4,200</td>
<td>$3,960</td>
<td>$240</td>
</tr>
<tr>
<td>$7,000</td>
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<tr>
<td>$8,000</td>
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<td>$5,600</td>
<td>$5,080</td>
<td>$520</td>
</tr>
<tr>
<td>$9,000</td>
<td>$2,700</td>
<td>$6,300</td>
<td>$5,640</td>
<td>$660</td>
</tr>
</tbody>
</table>

Table B2 The Consumption Function Before and After Taxes

Exports and Imports as a Function of National Income

The export function, which shows how exports change with the level of a country’s own real GDP, is drawn as a horizontal line, as in the example in Figure B6 (a) where exports are drawn at a level of $840. Again, as in the case of investment spending and government spending, drawing the export function as horizontal does not imply that exports never change. It just means that they do not change because of what is on the horizontal axis—that is, a country’s own level of domestic production—and instead are shaped by the level of aggregate demand in other countries. More demand for exports from other countries would cause the export function to shift up; less demand for exports from other countries would cause it to shift down.

![Figure B6 The Export and Import Functions](image)

(a) The export function

(b) The import function

Imports are drawn in the Keynesian cross diagram as a downward-sloping line, with the downward slope determined...
by the marginal propensity to import (MPI), out of national income. In Figure B6 (b), the marginal propensity to import is 0.1. Thus, if real GDP is $5,000, imports are $500; if national income is $6,000, imports are $600, and so on. The import function is drawn as downward sloping and negative, because it represents a subtraction from the aggregate expenditures in the domestic economy. A change in the marginal propensity to import, perhaps as a result of changes in preferences, would alter the slope of the import function.

**Work It Out**

### Using an Algebraic Approach to the Expenditure-Output Model

In the expenditure-output or Keynesian cross model, the equilibrium occurs where the aggregate expenditure line (AE line) crosses the 45-degree line. Given algebraic equations for two lines, the point where they cross can be readily calculated. Imagine an economy with the following characteristics.

- **Y** = Real GDP or national income
- **T** = Taxes = 0.3Y
- **C** = Consumption = 140 + 0.9(Y – T)
- **I** = Investment = 400
- **G** = Government spending = 800
- **X** = Exports = 600
- **M** = Imports = 0.15Y

#### Step 1. Determine the aggregate expenditure function. In this case, it is:

\[
AE = C + I + G + X - M
\]

\[
AE = 140 + 0.9(Y - T) + 400 + 800 + 600 - 0.15Y
\]

#### Step 2. The equation for the 45-degree line is the set of points where GDP or national income on the horizontal axis is equal to aggregate expenditure on the vertical axis. Thus, the equation for the 45-degree line is: \( AE = Y \).

#### Step 3. The next step is to solve these two equations for Y (or AE, since they will be equal to each other). Substitute Y for AE:

\[
Y = 140 + 0.9(Y - 0.3Y) + 400 + 800 + 600 - 0.15Y
\]

#### Step 4. Insert the term 0.3Y for the tax rate T. This produces an equation with only one variable, Y.

#### Step 5. Work through the algebra and solve for Y.

\[
Y = 140 + 0.9(Y - 0.3Y) + 400 + 800 + 600 - 0.15Y
\]

\[
Y = 140 + 0.9Y - 0.27Y + 1800 - 0.15Y
\]

\[
Y = 1940 + 0.48Y
\]

\[
Y - 0.48Y = 1940
\]

\[
0.52Y = 1940
\]

\[
0.52 = 3730
\]

This algebraic framework is flexible and useful in predicting how economic events and policy actions will affect real GDP.

#### Step 6. Say, for example, that because of changes in the relative prices of domestic and foreign goods, the marginal propensity to import falls to 0.1. Calculate the equilibrium output when the marginal propensity to import is changed to 0.1.
\[ Y = 140 + 0.9(Y - 0.3Y) + 400 + 800 + 600 - 0.1Y \]
\[ Y = 1940 - 0.53Y \]
\[ 0.47Y = 1940 \]
\[ Y = 4127 \]

Step 7. Because of a surge of business confidence, investment rises to 500. Calculate the equilibrium output.

\[ Y = 140 + 0.9(Y - 0.3Y) + 500 + 800 + 600 - 0.15Y \]
\[ Y = 2040 + 0.48Y \]
\[ Y - 0.48Y = 2040 \]
\[ 0.52Y = 2040 \]
\[ Y = 3923 \]

For issues of policy, the key questions would be how to adjust government spending levels or tax rates so that the equilibrium level of output is the full employment level. In this case, let the economic parameters be:

- \( Y = \text{National income} \)
- \( T = \text{Taxes} = 0.3Y \)
- \( C = \text{Consumption} = 200 + 0.9(Y - T) \)
- \( I = \text{Investment} = 600 \)
- \( G = \text{Government spending} = 1,000 \)
- \( X = \text{Exports} = 600 \)
- \( Y = \text{Imports} = 0.1(Y - T) \)

Step 8. Calculate the equilibrium for this economy (remember \( Y = AE \)).

\[ Y = 200 + 0.9(Y - 0.3Y) + 600 + 1000 + 600 - 0.1(Y - 0.3Y) \]
\[ Y - 0.63Y + 0.07Y = 2400 \]
\[ 0.44Y = 2400 \]
\[ Y = 5454 \]

Step 9. Assume that the full employment level of output is 6,000. What level of government spending would be necessary to reach that level? To answer this question, plug in 6,000 as equal to \( Y \), but leave \( G \) as a variable, and solve for \( G \). Thus:

\[ 6000 = 200 + 0.9(6000 - 0.3(6000)) + 600 + G + 600 - 0.1(6000 - 0.3(6000)) \]

Step 10. Solve this problem arithmetically. The answer is: \( G = 1,240 \). In other words, increasing government spending by 240, from its original level of 1,000, to 1,240, would raise output to the full employment level of GDP.

Indeed, the question of how much to increase government spending so that equilibrium output will rise from 5,454 to 6,000 can be answered without working through the algebra, just by using the multiplier formula. The multiplier equation in this case is:

\[ \frac{1}{1 - 0.56} = 2.27 \]

Thus, to raise output by 546 would require an increase in government spending of 546/2.27=240, which is the same as the answer derived from the algebraic calculation.

This algebraic framework is highly flexible. For example, taxes can be treated as a total set by political considerations (like government spending) and not dependent on national income. Imports might be based on before-tax income, not after-tax income. For certain purposes, it may be helpful to analyze the economy without exports and imports. A more complicated approach could divide up consumption, investment, government, exports and imports into smaller categories, or to build in some variability in the rates of taxes, savings, and imports. A wise economist will shape the model
Building the Combined Aggregate Expenditure Function

All the components of aggregate demand—consumption, investment, government spending, and the trade balance—are now in place to build the Keynesian cross diagram. Figure B7 builds up an aggregate expenditure function, based on the numerical illustrations of C, I, G, X, and M that have been used throughout this text. The first three columns in Table B3 are lifted from the earlier Table B2, which showed how to bring taxes into the consumption function. The first column is real GDP or national income, which is what appears on the horizontal axis of the income-expenditure diagram. The second column calculates after-tax income, based on the assumption, in this case, that 30% of real GDP is collected in taxes. The third column is based on an MPC of 0.8, so that as after-tax income rises by $700 from one row to the next, consumption rises by $560 (700 × 0.8) from one row to the next. Investment, government spending, and exports do not change with the level of current national income. In the previous discussion, investment was $500, government spending was $1,300, and exports were $840, for a total of $2,640. This total is shown in the fourth column. Imports are 0.1 of real GDP in this example, and the level of imports is calculated in the fifth column. The final column, aggregate expenditures, sums up C + I + G + X – M. This aggregate expenditure line is illustrated in Figure B7.

![Figure B7 A Keynesian Cross Diagram](image)

Each combination of national income and aggregate expenditure (after-tax consumption, government spending, investment, exports, and imports) is graphed. The equilibrium occurs where aggregate expenditure is equal to national income; this occurs where the aggregate expenditure schedule crosses the 45-degree line, at a real GDP of $6,000. Potential GDP in this example is $7,000, so the equilibrium is occurring at a level of output or real GDP below the potential GDP level.

<table>
<thead>
<tr>
<th>National Income</th>
<th>After-Tax Income</th>
<th>Consumption</th>
<th>Government Spending + Investment + Exports</th>
<th>Imports</th>
<th>Aggregate Expenditure</th>
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<tr>
<td>$3,000</td>
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<td>$2,280</td>
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<td>$6,000</td>
<td>$4,200</td>
<td>$3,960</td>
<td>$2,640</td>
<td>$600</td>
<td>$6,000</td>
</tr>
</tbody>
</table>

Table B3 National Income-Aggregate Expenditure Equilibrium
The aggregate expenditure function is formed by stacking on top of each other the consumption function (after taxes), the investment function, the government spending function, the export function, and the import function. The point at which the aggregate expenditure function intersects the vertical axis will be determined by the levels of investment, government, and export expenditures—which do not vary with national income. The upward slope of the aggregate expenditure function will be determined by the marginal propensity to save, the tax rate, and the marginal propensity to import. A higher marginal propensity to save, a higher tax rate, and a higher marginal propensity to import will all make the slope of the aggregate expenditure function flatter—because out of any extra income, more is going to savings or taxes or imports and less to spending on domestic goods and services.

The equilibrium occurs where national income is equal to aggregate expenditure, which is shown on the graph as the point where the aggregate expenditure schedule crosses the 45-degree line. In this example, the equilibrium occurs at 6,000. This equilibrium can also be read off the table under the figure; it is the level of national income where aggregate expenditure is equal to national income.

Equilibrium in the Keynesian Cross Model

With the aggregate expenditure line in place, the next step is to relate it to the two other elements of the Keynesian cross diagram. Thus, the first subsection interprets the intersection of the aggregate expenditure function and the 45-degree line, while the next subsection relates this point of intersection to the potential GDP line.

Where Equilibrium Occurs

The point where the aggregate expenditure line that is constructed from \(C + I + G + X - M\) crosses the 45-degree line will be the equilibrium for the economy. It is the only point on the aggregate expenditure line where the total amount being spent on aggregate demand equals the total level of production. In Figure B7, this point of equilibrium (\(E_0\)) happens at 6,000, which can also be read off Table B3.

The meaning of “equilibrium” remains the same; that is, equilibrium is a point of balance where no incentive exists to shift away from that outcome. To understand why the point of intersection between the aggregate expenditure function and the 45-degree line is a macroeconomic equilibrium, consider what would happen if an economy found itself to the right of the equilibrium point \(E\), say point H in Figure B8, where output is higher than the equilibrium. At point H, the level of aggregate expenditure is below the 45-degree line, so that the level of aggregate expenditure in the economy is less than the level of output. As a result, at point H, output is piling up unsold—not a sustainable state of affairs.
Figure B8 Equilibrium in the Keynesian Cross Diagram  If output was above the equilibrium level, at H, then the real output is greater than the aggregate expenditure in the economy. This pattern cannot hold, because it would mean that goods are produced but piling up unsold. If output was below the equilibrium level at L, then aggregate expenditure would be greater than output. This pattern cannot hold either, because it would mean that spending exceeds the number of goods being produced. Only point E can be at equilibrium, where output, or national income and aggregate expenditure, are equal. The equilibrium (E) must lie on the 45-degree line, which is the set of points where national income and aggregate expenditure are equal.

Conversely, consider the situation where the level of output is at point L—where real output is lower than the equilibrium. In that case, the level of aggregate demand in the economy is above the 45-degree line, indicating that the level of aggregate expenditure in the economy is greater than the level of output. When the level of aggregate demand has emptied the store shelves, it cannot be sustained, either. Firms will respond by increasing their level of production. Thus, the equilibrium must be the point where the amount produced and the amount spent are in balance, at the intersection of the aggregate expenditure function and the 45-degree line.
Finding Equilibrium

Table B4 gives some information on an economy. The Keynesian model assumes that there is some level of consumption even without income. That amount is $236 – $216 = $20. $20 will be consumed when national income equals zero. Assume that taxes are 0.2 of real GDP. Let the marginal propensity to save of after-tax income be 0.1. The level of investment is $70, the level of government spending is $80, and the level of exports is $50. Imports are 0.2 of after-tax income. Given these values, you need to complete Table B4 and then answer these questions:

- What is the consumption function?
- What is the equilibrium?
- Why is a national income of $300 not at equilibrium?
- How do expenditures and output compare at this point?

<table>
<thead>
<tr>
<th>National Income</th>
<th>Taxes</th>
<th>After-tax income</th>
<th>Consumption</th>
<th>I + G + X</th>
<th>Imports</th>
<th>Aggregate Expenditures</th>
</tr>
</thead>
<tbody>
<tr>
<td>$300</td>
<td></td>
<td>$236</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$400</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$500</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$600</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$700</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table B4

Step 1. Calculate the amount of taxes for each level of national income (reminder: GDP = national income) for each level of national income using the following as an example:

\[
\begin{align*}
\text{National Income (Y)} & = 300 \\
\text{Taxes} & = 0.2 \text{ or 20\%} \\
\text{Tax amount (T)} & = 0.2 \\
\end{align*}
\]

Step 2. Calculate after-tax income by subtracting the tax amount from national income for each level of national income using the following as an example:

\[
\begin{align*}
\text{National income minus taxes} & = 300 \\
\text{–$60} & = 240 \\
\text{After-tax income} & = 240 \\
\end{align*}
\]

Step 3. Calculate consumption. The marginal propensity to save is given as 0.1. This means that the marginal propensity to consume is 0.9, since \( \text{MPS} + \text{MPC} = 1 \). Therefore, multiply 0.9 by the after-tax income amount using the following as an example:

\[
\begin{align*}
\text{After-tax Income} & = 240 \\
\text{MPC} & = 0.9 \\
\text{Consumption} & = 216 \\
\end{align*}
\]

Step 4. Consider why the table shows consumption of $236 in the first row. As mentioned earlier, the Keynesian model assumes that there is some level of consumption even without income. That amount is $236 – $216 = $20.
Step 5. There is now enough information to write the consumption function. The consumption function is found by figuring out the level of consumption that will happen when income is zero. Remember that:

\[ C = \text{Consumption when national income is zero} + \text{MPC (after-tax income)} \]

Let C represent the consumption function, Y represent national income, and T represent taxes.\[ C = $20 + 0.9(Y - T) \]
\[ = $20 + 0.9($300 - $60) \]
\[ = $236 \]

Step 6. Use the consumption function to find consumption at each level of national income.

Step 7. Add investment (I), government spending (G), and exports (X). Remember that these do not change as national income changes:

Step 8. Find imports, which are 0.2 of after-tax income at each level of national income. For example:

<table>
<thead>
<tr>
<th>After-tax income</th>
<th>$240</th>
</tr>
</thead>
<tbody>
<tr>
<td>Imports of 0.2 or 20% of Y – T</td>
<td>$48</td>
</tr>
</tbody>
</table>

Step 9. Find aggregate expenditure by adding C + I + G + X – I for each level of national income. Your completed table should look like Table B5.

<table>
<thead>
<tr>
<th>National Income (Y)</th>
<th>Tax = 0.2 × Y (T)</th>
<th>After-tax income (Y – T)</th>
<th>Consumption C = $20 + 0.9(Y – T)</th>
<th>I + G + X</th>
<th>Minus Imports (M)</th>
<th>Aggregate Expenditures AE = C + I + G + X – M</th>
</tr>
</thead>
<tbody>
<tr>
<td>$300</td>
<td>$60</td>
<td>$240</td>
<td>$236</td>
<td>$200</td>
<td>$48</td>
<td>$388</td>
</tr>
<tr>
<td>$400</td>
<td>$80</td>
<td>$320</td>
<td>$308</td>
<td>$200</td>
<td>$64</td>
<td>$444</td>
</tr>
<tr>
<td>$500</td>
<td>$100</td>
<td>$400</td>
<td>$380</td>
<td>$200</td>
<td>$80</td>
<td>$500</td>
</tr>
<tr>
<td>$600</td>
<td>$120</td>
<td>$480</td>
<td>$452</td>
<td>$200</td>
<td>$96</td>
<td>$556</td>
</tr>
<tr>
<td>$700</td>
<td>$140</td>
<td>$560</td>
<td>$524</td>
<td>$200</td>
<td>$112</td>
<td>$612</td>
</tr>
</tbody>
</table>

**Table B5**

Step 10. Answer the question: What is equilibrium? Equilibrium occurs where AE = Y. Table B5 shows that equilibrium occurs where national income equals aggregate expenditure at $500.

Step 11. Find equilibrium mathematically, knowing that national income is equal to aggregate expenditure.

\[ Y = \frac{AE}{C + I + G + X} \]
\[ = \frac{C + I + G + X}{C + I + G + X - M} \]
\[ = \frac{$20 + 0.9(Y - T) + $70 + $80 + $50 - 0.2(Y - T)}{C + I + G + X - M} \]
\[ = \frac{$220 + 0.9(Y - T) - 0.2(Y - T)}{C + I + G + X - M} \]

Since T is 0.2 of national income, substitute T with 0.2 Y so that:

\[ Y = $220 + 0.9(Y - 0.2Y) - 0.2(Y - 0.2Y) \]
\[ = $220 + 0.9Y - 0.18Y - 0.2Y + 0.04Y \]
\[ = $220 + 0.56Y \]
Solve for Y.

\[ Y = 220 + 0.56Y \]
\[ Y - 0.56Y = 220 \]
\[ 0.44Y = 220 \]
\[ Y = \frac{220}{0.44} \]
\[ Y = 500 \]

Step 12. Answer this question: Why is a national income of $300 not an equilibrium? At national income of $300, aggregate expenditures are $388.

Step 13. Answer this question: How do expenditures and output compare at this point? Aggregate expenditures cannot exceed output (GDP) in the long run, since there would not be enough goods to be bought.

Recessionary and Inflationary Gaps

In the Keynesian cross diagram, if the aggregate expenditure line intersects the 45-degree line at the level of potential GDP, then the economy is in sound shape. There is no recession, and unemployment is low. But there is no guarantee that the equilibrium will occur at the potential GDP level of output. The equilibrium might be higher or lower.

For example, Figure B9 (a) illustrates a situation where the aggregate expenditure line intersects the 45-degree line at point \( E_0 \), which is a real GDP of $6,000, and which is below the potential GDP of $7,000. In this situation, the level of aggregate expenditure is too low for GDP to reach its full employment level, and unemployment will occur. The distance between an output level like \( E_0 \) that is below potential GDP and the level of potential GDP is called a recessionary gap. Because the equilibrium level of real GDP is so low, firms will not wish to hire the full employment number of workers, and unemployment will be high.

![Figure B9 Addressing Recessionary and Inflationary Gaps](http://cnx.org/content/col12190/1.4)

(a) If the equilibrium occurs at an output below potential GDP, then a recessionary gap exists. The policy solution to a recessionary gap is to shift the aggregate expenditure schedule up from \( AE_0 \) to \( AE_1 \), using policies like tax cuts or government spending increases. Then the new equilibrium \( E_1 \) occurs at potential GDP. (b) If the equilibrium occurs at an output above potential GDP, then an inflationary gap exists. The policy solution to an inflationary gap is to shift the aggregate expenditure schedule down from \( AE_0 \) to \( AE_1 \), using policies like tax increases or spending cuts. Then, the new equilibrium \( E_1 \) occurs at potential GDP.

What might cause a recessionary gap? Anything that shifts the aggregate expenditure line down is a potential cause of recession, including a decline in consumption, a rise in savings, a fall in investment, a drop in government spending or a rise in taxes, or a fall in exports or a rise in imports. Moreover, an economy that is at equilibrium with a recessionary
gap may just stay there and suffer high unemployment for a long time; remember, the meaning of equilibrium is that there is no particular adjustment of prices or quantities in the economy to chase the recession away.

The appropriate response to a recessionary gap is for the government to reduce taxes or increase spending so that the aggregate expenditure function shifts up from $AE_0$ to $AE_1$. When this shift occurs, the new equilibrium $E_1$ now occurs at potential GDP as shown in Figure B9 (a).

Conversely, Figure B9 (b) shows a situation where the aggregate expenditure schedule ($AE_0$) intersects the 45-degree line above potential GDP. The gap between the level of real GDP at the equilibrium $E_0$ and potential GDP is called an inflationary gap. The inflationary gap also requires a bit of interpreting. After all, a naive reading of the Keynesian cross diagram might suggest that if the aggregate expenditure function is just pushed up high enough, real GDP can be as large as desired—even doubling or tripling the potential GDP level of the economy. This implication is clearly wrong. An economy faces some supply-side limits on how much it can produce at a given time with its existing quantities of workers, physical and human capital, technology, and market institutions.

The inflationary gap should be interpreted, not as a literal prediction of how large real GDP will be, but as a statement of how much extra aggregate expenditure is in the economy beyond what is needed to reach potential GDP. An inflationary gap suggests that because the economy cannot produce enough goods and services to absorb this level of aggregate expenditures, the spending will instead cause an inflationary increase in the price level. In this way, even though changes in the price level do not appear explicitly in the Keynesian cross equation, the notion of inflation is implicit in the concept of the inflationary gap.

The appropriate Keynesian response to an inflationary gap is shown in Figure B9 (b). The original intersection of aggregate expenditure line $AE_0$ and the 45-degree line occurs at $8,000, which is above the level of potential GDP at $7,000. If $AE_0$ shifts down to $AE_1$, so that the new equilibrium is at $E_1$, then the economy will be at potential GDP without pressures for inflationary price increases. The government can achieve a downward shift in aggregate expenditure by increasing taxes on consumers or firms, or by reducing government expenditures.

### The Multiplier Effect

The Keynesian policy prescription has one final twist. Assume that for a certain economy, the intersection of the aggregate expenditure function and the 45-degree line is at a GDP of $700, while the level of potential GDP for this economy is $800. By how much does government spending need to be increased so that the economy reaches the full employment GDP? The obvious answer might seem to be $800 – $700 = $100; so raise government spending by $100. But that answer is incorrect. A change of, for example, $100 in government expenditures will have an effect of more than $100 on the equilibrium level of real GDP. The reason is that a change in aggregate expenditures circles through the economy: households buy from firms, firms pay workers and suppliers, workers and suppliers buy goods from other firms, those firms pay their workers and suppliers, and so on. In this way, the original change in aggregate expenditures is actually spent more than once. This is called the multiplier effect: An initial increase in spending, cycles repeatedly through the economy and has a larger impact than the initial dollar amount spent.

### How Does the Multiplier Work?

To understand how the multiplier effect works, return to the example in which the current equilibrium in the Keynesian cross diagram is a real GDP of $700, or $100 short of the $800 needed to be at full employment, potential GDP. If the government spends $100 to close this gap, someone in the economy receives that spending and can treat it as income. Assume that those who receive this income pay 30% in taxes, save 10% of after-tax income, spend 10% of total income on imports, and then spend the rest on domestically produced goods and services.

As shown in the calculations in Figure B10 and Table B6, out of the original $100 in government spending, $53 is left to spend on domestically produced goods and services. That $53 which was spent, becomes income to someone, somewhere in the economy. Those who receive that income also pay 30% in taxes, save 10% of after-tax income, and spend 10% of total income on imports, as shown in Figure B10, so that an additional $28.09 (that is, 0.53 × $53) is spent in the third round. The people who receive that income then pay taxes, save, and buy imports, and the amount spent in the fourth round is $14.89 (that is, 0.53 × $28.09).
Figure B10 The Multiplier Effect

An original increase of government spending of $100 causes a rise in aggregate expenditure of $100. But that $100 is income to others in the economy, and after they save, pay taxes, and buy imports, they spend $53 of that $100 in a second round. In turn, that $53 is income to others. Thus, the original government spending of $100 is multiplied by these cycles of spending, but the impact of each successive cycle gets smaller and smaller. Given the numbers in this example, the original government spending increase of $100 raises aggregate expenditure by $213; therefore, the multiplier in this example is $213/$100 = 2.13.

<table>
<thead>
<tr>
<th>Original increase in aggregate expenditure from government spending</th>
<th>100</th>
</tr>
</thead>
<tbody>
<tr>
<td>Which is income to people throughout the economy: Pay 30% in taxes. Save 10% of after-tax income. Spend 10% of income on imports. Second-round increase of…</td>
<td>70 – 7 – 10 = 53</td>
</tr>
<tr>
<td>Which is $53 of income to people through the economy: Pay 30% in taxes. Save 10% of after-tax income. Spend 10% of income on imports. Third-round increase of…</td>
<td>37.1 – 3.71 – 5.3 = 28.09</td>
</tr>
<tr>
<td>Which is $28.09 of income to people through the economy: Pay 30% in taxes. Save 10% of after-tax income. Spend 10% of income on imports. Fourth-round increase of…</td>
<td>19.663 – 1.96633 – 2.809 = 14.89</td>
</tr>
</tbody>
</table>

Table B6 Calculating the Multiplier Effect

Thus, over the first four rounds ofaggregate expenditures, the impact of the original increase in government spending of $100 creates a rise in aggregate expenditures of $100 + $53 + $28.09 + $14.89 = $195.98. Figure B10 shows these total aggregate expenditures after these first four rounds, and then the figure shows the total aggregate expenditures after 30 rounds. The additional boost to aggregate expenditures is shrinking in each round of consumption. After about 10 rounds, the additional increments are very small indeed—nearly invisible to the naked eye. After 30 rounds, the additional increments in each round are so small that they have no practical consequence. After 30 rounds, the cumulative value of the initial boost in aggregate expenditure is approximately $213. Thus, the government spending increase of $100 eventually, after many cycles, produced an increase of $213 in aggregate expenditure and real GDP. In this example, the multiplier is $213/$100 = 2.13.

Calculating the Multiplier

Fortunately for everyone who is not carrying around a computer with a spreadsheet program to project the impact of an original increase in expenditures over 20, 50, or 100 rounds of spending, there is a formula for calculating the multiplier.

\[
\text{Spending Multiplier} = \frac{1}{1 - \text{MPC} \times (1 - \text{tax rate}) + \text{MPI}}
\]

The data from Figure B10 and Table B6 is:
• Marginal Propensity to Save (MPS) = 30%
• Tax rate = 10%
• Marginal Propensity to Import (MPI) = 10%

The MPC is equal to 1 – MPS, or 0.7. Therefore, the spending multiplier is:

\[
\text{Spending Multiplier} = \frac{1}{1 - (0.7 - (0.10)(0.7) - 0.10)}
\]

\[
= \frac{1}{0.47}
\]

\[
= 2.13
\]

A change in spending of $100 multiplied by the spending multiplier of 2.13 is equal to a change in GDP of $213. Not coincidentally, this result is exactly what was calculated in Figure B10 after many rounds of expenditures cycling through the economy.

The size of the multiplier is determined by what proportion of the marginal dollar of income goes into taxes, saving, and imports. These three factors are known as “leakages,” because they determine how much demand “leaks out” in each round of the multiplier effect. If the leakages are relatively small, then each successive round of the multiplier effect will have larger amounts of demand, and the multiplier will be high. Conversely, if the leakages are relatively large, then any initial change in demand will diminish more quickly in the second, third, and later rounds, and the multiplier will be small. Changes in the size of the leakages—a change in the marginal propensity to save, the tax rate, or the marginal propensity to import—will change the size of the multiplier.

Calculating Keynesian Policy Interventions

Returning to the original question: How much should government spending be increased to produce a total increase in real GDP of $100? If the goal is to increase aggregate demand by $100, and the multiplier is 2.13, then the increase in government spending to achieve that goal would be $100/2.13 = $47. Government spending of approximately $47, when combined with a multiplier of 2.13 (which is, remember, based on the specific assumptions about tax, saving, and import rates), produces an overall increase in real GDP of $100, restoring the economy to potential GDP of $800, as Figure B11 shows.

![Figure B11 The Multiplier Effect in an Expenditure-Output Model](image)

The power of the multiplier effect is that an increase in expenditure has a larger increase on the equilibrium output. The increase in expenditure is the vertical increase from AE₀ to AE₁. However, the increase in equilibrium output, shown on the horizontal axis, is clearly larger.

The multiplier effect is also visible on the Keynesian cross diagram. Figure B11 shows the example we have been discussing: a recessionary gap with an equilibrium of $700, potential GDP of $800, the slope of the aggregate expenditure function (AE₀) determined by the assumptions that taxes are 30% of income, savings are 0.1 of after-tax income, and imports are 0.1 of before-tax income. At AE₁, the aggregate expenditure function is moved up to reach potential GDP.
Now, compare the vertical shift upward in the aggregate expenditure function, which is $47, with the horizontal shift outward in real GDP, which is $100 (as these numbers were calculated earlier). The rise in real GDP is more than double the rise in the aggregate expenditure function. (Similarly, if you look back at Figure B9, you will see that the vertical movements in the aggregate expenditure functions are smaller than the change in equilibrium output that is produced on the horizontal axis. Again, this is the multiplier effect at work.) In this way, the power of the multiplier is apparent in the income–expenditure graph, as well as in the arithmetic calculation.

The multiplier does not just affect government spending, but applies to any change in the economy. Say that business confidence declines and investment falls off, or that the economy of a leading trading partner slows down so that export sales decline. These changes will reduce aggregate expenditures, and then will have an even larger effect on real GDP because of the multiplier effect. Read the following Clear It Up feature to learn how the multiplier effect can be applied to analyze the economic impact of professional sports.

### Clear It Up

How can the multiplier be used to analyze the economic impact of professional sports?

Attracting professional sports teams and building sports stadiums to create jobs and stimulate business growth is an economic development strategy adopted by many communities throughout the United States. In his recent article, “Public Financing of Private Sports Stadiums,” James Joyner of *Outside the Beltway* looked at public financing for NFL teams. Joyner’s findings confirm the earlier work of John Siegfried of Vanderbilt University and Andrew Zimbalist of Smith College.

Siegfried and Zimbalist used the multiplier to analyze this issue. They considered the amount of taxes paid and dollars spent locally to see if there was a positive multiplier effect. Since most professional athletes and owners of sports teams are rich enough to owe a lot of taxes, let’s say that 40% of any marginal income they earn is paid in taxes. Because athletes are often high earners with short careers, let’s assume that they save one-third of their after-tax income. However, many professional athletes do not live year-round in the city in which they play, so let’s say that one-half of the money that they do spend is spent outside the local area. One can think of spending outside a local economy, in this example, as the equivalent of imported goods for the national economy.

Now, consider the impact of money spent at local entertainment venues other than professional sports. While the owners of these other businesses may be comfortably middle-income, few of them are in the economic stratosphere of professional athletes. Because their incomes are lower, so are their taxes; say that they pay only 35% of their marginal income in taxes. They do not have the same ability, or need, to save as much as professional athletes, so let’s assume their MPC is just 0.8. Finally, because more of them live locally, they will spend a higher proportion of their income on local goods—say, 65%.

If these general assumptions hold true, then money spent on professional sports will have less local economic impact than money spent on other forms of entertainment. For professional athletes, out of a dollar earned, 40 cents goes to taxes, leaving 60 cents. Of that 60 cents, one-third is saved, leaving 40 cents, and half is spent outside the area, leaving 20 cents. Only 20 cents of each dollar is cycled into the local economy in the first round. For locally-owned entertainment, out of a dollar earned, 35 cents goes to taxes, leaving 65 cents. Of the rest, 20% is saved, leaving 52 cents, and of that amount, 65% is spent in the local area, so that 33.8 cents of each dollar of income is recycled into the local economy.

Siegfried and Zimbalist make the plausible argument that, within their household budgets, people have a fixed amount to spend on entertainment. If this assumption holds true, then money spent attending professional sports events is money that was not spent on other entertainment options in a given metropolitan area. Since the multiplier is lower for professional sports than for other local entertainment options, the arrival of professional sports to a city would reallocate entertainment
spending in a way that causes the local economy to shrink, rather than to grow. Thus, their findings seem to confirm what Joyner reports and what newspapers across the country are reporting. A quick Internet search for “economic impact of sports” will yield numerous reports questioning this economic development strategy.

Multiplier Tradeoffs: Stability versus the Power of Macroeconomic Policy

Is an economy healthier with a high multiplier or a low one? With a high multiplier, any change in aggregate demand will tend to be substantially magnified, and so the economy will be more unstable. With a low multiplier, by contrast, changes in aggregate demand will not be multiplied much, so the economy will tend to be more stable.

However, with a low multiplier, government policy changes in taxes or spending will tend to have less impact on the equilibrium level of real output. With a higher multiplier, government policies to raise or reduce aggregate expenditures will have a larger effect. Thus, a low multiplier means a more stable economy, but also weaker government macroeconomic policy, while a high multiplier means a more volatile economy, but also an economy in which government macroeconomic policy is more powerful.

Key Concepts and Summary

The expenditure-output model or Keynesian cross diagram shows how the level of aggregate expenditure (on the vertical axis) varies with the level of economic output (shown on the horizontal axis). Since the value of all macroeconomic output also represents income to someone somewhere else in the economy, the horizontal axis can also be interpreted as national income. The equilibrium in the diagram will occur where the aggregate expenditure line crosses the 45-degree line, which represents the set of points where aggregate expenditure in the economy is equal to output (or national income). Equilibrium in a Keynesian cross diagram can happen at potential GDP, or below or above that level.

The consumption function shows the upward-sloping relationship between national income and consumption. The marginal propensity to consume (MPC) is the amount consumed out of an additional dollar of income. A higher marginal propensity to consume means a steeper consumption function; a lower marginal propensity to consume means a flatter consumption function. The marginal propensity to save (MPS) is the amount saved out of an additional dollar of income. It is necessarily true that MPC + MPS = 1. The investment function is drawn as a flat line, showing that investment in the current year does not change with regard to the current level of national income. However, the investment function will move up and down based on the expected rate of return in the future. Government spending is drawn as a horizontal line in the Keynesian cross diagram, because its level is determined by political considerations, not by the current level of income in the economy. Taxes in the basic Keynesian cross diagram are taken into account by adjusting the consumption function. The export function is drawn as a horizontal line in the Keynesian cross diagram, because exports do not change as a result of changes in domestic income, but they move as a result of changes in foreign income, as well as changes in exchange rates. The import function is drawn as a downward-sloping line, because imports rise with national income, but imports are a subtraction from aggregate demand. Thus, a higher level of imports means a lower level of expenditure on domestic goods.

In a Keynesian cross diagram, the equilibrium may be at a level below potential GDP, which is called a recessionary gap, or at a level above potential GDP, which is called an inflationary gap.

The multiplier effect describes how an initial change in aggregate demand generated several times as much as cumulative GDP. The size of the spending multiplier is determined by three leakages: spending on savings, taxes, and imports. The formula for the multiplier is:

\[
\text{Multiplier} = \frac{1}{1 - (\text{MPC} \times (1 - \text{tax rate}) + \text{MPI})}
\]

An economy with a lower multiplier is more stable—it is less affected either by economic events or by government policy than an economy with a higher multiplier.

Self-Check Questions

Exercise B1

Sketch the aggregate expenditure-output diagram with the recessionary gap.
Solution
The following figure shows the aggregate expenditure-output diagram with the recessionary gap.

![Figure B12](image)

Exercise B2
Sketch the aggregate expenditure-output diagram with an inflationary gap.

Solution
The following figure shows the aggregate expenditure-output diagram with an inflationary gap.

![Figure B13](image)

Exercise B3
An economy has the following characteristics:

\[ Y = \text{National income} \]
Taxes = T = 0.25Y
C = Consumption = 400 + 0.85(Y – T)
I = 300
G = 200
X = 500
M = 0.1(Y – T)

Find the equilibrium for this economy. If potential GDP is 3,500, then what change in government spending is needed to achieve this level? Do this problem two ways. First, plug 3,500 into the equations and solve for G. Second, calculate the multiplier and figure it out that way.

**Solution**

First, set up the calculation.

\[ AE = 400 + 0.85(Y - T) + 300 + 200 + 500 - 0.1(Y - T) \]
\[ AE = Y \]

Then insert Y for AE and 0.25Y for T.

\[ Y = 400 + 0.85(Y - 0.25Y) + 300 + 200 + 500 - 0.1(Y - 0.25Y) \]
\[ Y = 1400 + 0.6375Y - 0.075Y \]
\[ 0.4375Y = 1400 \]
\[ Y = 3200 \]

If full employment is 3,500, then one approach is to plug in 3,500 for Y throughout the equation, but to leave G as a separate variable.

\[ Y = 400 + 0.85(3500 - 0.25(3500)) + 300 + G + 500 + 0.1(3500 - 0.25(3500)) \]
\[ 3500 = 400 + 0.85(3500 - 0.25(3500)) + 300 + G + 500 - 0.1(3500 - 0.25(3500)) \]
\[ G = 3500 - 400 - 2231.25 - 1300 - 500 + 262.5 \]
\[ G = 331.25 \]

A G value of 331.25 is an increase of 131.25 from its original level of 200.

Alternatively, the multiplier is that, out of every dollar spent, 0.25 goes to taxes, leaving 0.75, and out of after-tax income, 0.15 goes to savings and 0.1 to imports. Because (0.75)(0.15) = 0.1125 and (0.75)(0.1) = 0.075, this means that out of every dollar spent: 1 – 0.25 – 0.1125 – 0.075 = 0.5625.

Thus, using the formula, the multiplier is:

\[ \frac{1}{1 - 0.5625} = 2.2837 \]

To increase equilibrium GDP by 300, it will take a boost of 300/2.2837, which again works out to 131.25.

**Exercise B4**

Table B7 represents the data behind a Keynesian cross diagram. Assume that the tax rate is 0.4 of national income; the MPC out of the after-tax income is 0.8; investment is $2,000; government spending is $1,000; exports are $2,000 and imports are 0.05 of after-tax income. What is the equilibrium level of output for this economy?

<table>
<thead>
<tr>
<th>National Income</th>
<th>After-tax Income</th>
<th>Consumption I + G + X</th>
<th>Minus Imports</th>
<th>Aggregate Expenditures</th>
</tr>
</thead>
<tbody>
<tr>
<td>$8,000</td>
<td></td>
<td>$4,340</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$9,000</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Table B7**
Solution

The following table illustrates the completed table. The equilibrium level is italicized.

<table>
<thead>
<tr>
<th>National Income</th>
<th>After-tax Income</th>
<th>Consumption</th>
<th>I + G + X</th>
<th>Minus Imports</th>
<th>Aggregate Expenditures</th>
</tr>
</thead>
<tbody>
<tr>
<td>$8,000</td>
<td>$4,800</td>
<td>$4,340</td>
<td>$5,000</td>
<td>$240</td>
<td>$9,100</td>
</tr>
<tr>
<td>$9,000</td>
<td>$5,400</td>
<td>$4,820</td>
<td>$5,000</td>
<td>$270</td>
<td>$9,550</td>
</tr>
<tr>
<td>$10,000</td>
<td>$6,000</td>
<td>$5,300</td>
<td>$5,000</td>
<td>$300</td>
<td>$10,000</td>
</tr>
<tr>
<td>$11,000</td>
<td>$6,600</td>
<td>$5,780</td>
<td>$5,000</td>
<td>$330</td>
<td>$10,450</td>
</tr>
<tr>
<td>$12,000</td>
<td>$7,200</td>
<td>$6,260</td>
<td>$5,000</td>
<td>$360</td>
<td>$10,900</td>
</tr>
<tr>
<td>$13,000</td>
<td>$7,800</td>
<td>$46,740</td>
<td>$5,000</td>
<td>$4,390</td>
<td>$11,350</td>
</tr>
</tbody>
</table>

Table B8

The alternative way of determining equilibrium is to solve for Y, where Y = national income, using:

\[ Y = AE = C + I + G + X - M \]

\[ Y = 500 + 0.8(Y - T) + 2,000 + 1,000 + 2,000 - 0.05(Y - T) \]

Solving for Y, we see that the equilibrium level of output is \( Y = 10,000 \).

Exercise B5

Explain how the multiplier works. Use an MPC of 80% in an example.

Solution

The multiplier refers to how many times a dollar will turnover in the economy. It is based on the Marginal Propensity to Consume (MPC) which tells how much of every dollar received will be spent. If the MPC is 80% then this means that out of every one dollar received by a consumer, $0.80 will be spent. This $0.80 is received by another person. In turn, 80% of the $0.80 received, or $0.64, will be spent, and so on. The impact of the multiplier is diluted when the effect of taxes and expenditure on imports is considered. To derive the multiplier, take the \( 1/1 - F \); where F is equal to percent of savings, taxes, and expenditures on imports.

Review Questions

Exercise B6

What is on the axes of an expenditure-output diagram?
Exercise B7
What does the 45-degree line show?

Exercise B8
What determines the slope of a consumption function?

Exercise B9
What is the marginal propensity to consume, and how is it related to the marginal propensity to import?

Exercise B10
Why are the investment function, the government spending function, and the export function all drawn as flat lines?

Exercise B11
Why does the import function slope down? What is the marginal propensity to import?

Exercise B12
What are the components on which the aggregate expenditure function is based?

Exercise B13
Is the equilibrium in a Keynesian cross diagram usually expected to be at or near potential GDP?

Exercise B14
What is an inflationary gap? A recessionary gap?

Exercise B15
What is the multiplier effect?

Exercise B16
Why are savings, taxes, and imports referred to as “leakages” in calculating the multiplier effect?

Exercise B17
Will an economy with a high multiplier be more stable or less stable than an economy with a low multiplier in response to changes in the economy or in government policy?

Exercise B18
How do economists use the multiplier?

Critical Thinking Questions

Exercise B19
What does it mean when the aggregate expenditure line crosses the 45-degree line? In other words, how would you explain the intersection in words?

Exercise B20
Which model, the AD/AS or the AE model better explains the relationship between rising price levels and GDP? Why?

Exercise B21
What are some reasons that the economy might be in a recession, and what is the appropriate government action to alleviate the recession?

Exercise B22
What should the government do to relieve inflationary pressures if the aggregate expenditure is greater than potential GDP?

Exercise B23
Two countries are in a recession. Country A has an MPC of 0.8 and Country B has an MPC of 0.6. In which country will government spending have the greatest impact?

Exercise B24
Compare two policies: a tax cut on income or an increase in government spending on roads and bridges. What are both the short-term and long-term impacts of such policies on the economy?

Exercise B25
What role does government play in stabilizing the economy and what are the tradeoffs that must be considered?

Exercise B26
If there is a recessionary gap of $100 billion, should the government increase spending by $100 billion to close the gap? Why? Why not?

Exercise B27
What other changes in the economy can be evaluated by using the multiplier?

References


ANSWER KEY

Chapter 1

1. Scarcity means human wants for goods and services exceed the available supply. Supply is limited because resources are limited. Demand, however, is virtually unlimited. Whatever the supply, it seems human nature to want more.

2. 100 people / 10 people per ham = a maximum of 10 hams per month if all residents produce ham. Since consumption is limited by production, the maximum number of hams residents could consume per month is 10.

3. She is very productive at her consulting job, but not very productive growing vegetables. Time spent consulting would produce far more income than it what she could save growing her vegetables using the same amount of time. So on purely economic grounds, it makes more sense for her to maximize her income by applying her labor to what she does best (i.e. specialization of labor).

4. The engineer is better at computer science than at painting. Thus, his time is better spent working for pay at his job and paying a painter to paint his house. Of course, this assumes he does not paint his house for fun!

5. There are many physical systems that would work, for example, the study of planets (micro) in the solar system (macro), or solar systems (micro) in the galaxy (macro).

6. Draw a box outside the original circular flow to represent the foreign country. Draw an arrow from the foreign country to firms, to represents imports. Draw an arrow in the reverse direction representing payments for imports. Draw an arrow from firms to the foreign country to represent exports. Draw an arrow in the reverse direction to represent payments for imports.

7. There are many such problems. Consider the AIDS epidemic. Why are so few AIDS patients in Africa and Southeast Asia treated with the same drugs that are effective in the United States and Europe? It is because neither those patients nor the countries in which they live have the resources to purchase the same drugs.

8. Public enterprise means the factors of production (resources and businesses) are owned and operated by the government.

9. The United States is a large country economically speaking, so it has less need to trade internationally than the other countries mentioned. (This is the same reason that France and Italy have lower ratios than Belgium or Sweden.) One additional reason is that each of the other countries is a member of the European Union, where trade between members occurs without barriers to trade, like tariffs and quotas.

Chapter 2

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 0.50/2 = .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 .25 (the inverse of the opportunity cost of a burger). With the new, higher price of bus tickets, the opportunity cost rises to $1/$2 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 all of his budget on bus tickets, he can now afford only half as many, so the vertical 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.
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.

Chapter 3

1. Since $1.60 per gallon is above the equilibrium price, the quantity demanded would be lower at 550 gallons and the quantity supplied would be higher at 640 gallons. (These results are due to the laws of demand and supply, respectively.) The outcome of lower Qd and higher Qs would be a surplus in the gasoline market of 640 – 550 = 90 gallons.

2. To make it easier to analyze complex problems. *Ceteris paribus* allows you to look at the effect of one factor at a time on what it is you are trying to analyze. When you have analyzed all the factors individually, you add the results together to get the final answer.

3. 
   a. An improvement in technology that reduces the cost of production will cause an increase in supply. Alternatively, you can think of this as a reduction in price necessary for firms to supply any quantity. Either way, this can be shown as a rightward (or downward) shift in the supply curve.
   b. An improvement in product quality is treated as an increase in tastes or preferences, meaning consumers demand more paint at any price level, so demand increases or shifts to the right. If this seems counterintuitive, note that demand in the future for the longer-lasting paint will fall, since consumers are essentially shifting demand from the future to the present.
   c. An increase in need causes an increase in demand or a rightward shift in the demand curve.
   d. Factory damage means that firms are unable to supply as much in the present. Technically, this is an increase in the cost of production. Either way you look at it, the supply curve shifts to the left.

4. 
   a. More fuel-efficient cars means there is less need for gasoline. This causes a leftward shift in the demand for gasoline and thus oil. Since the demand curve is shifting down the supply curve, the equilibrium price and
quantity both fall.

b. Cold weather increases the need for heating oil. This causes a rightward shift in the demand for heating oil and thus oil. Since the demand curve is shifting up the supply curve, the equilibrium price and quantity both rise.

c. A discovery of new oil will make oil more abundant. This can be shown as a rightward shift in the supply curve, which will cause a decrease in the equilibrium price along with an increase in the equilibrium quantity. (The supply curve shifts down the demand curve so price and quantity follow the law of demand. If price goes down, then the quantity goes up.)

d. When an economy slows down, it produces less output and demands less input, including energy, which is used in the production of virtually everything. A decrease in demand for energy will be reflected as a decrease in the demand for oil, or a leftward shift in demand for oil. Since the demand curve is shifting down the supply curve, both the equilibrium price and quantity of oil will fall.

e. Disruption of oil pumping will reduce the supply of oil. This leftward shift in the supply curve will show a movement up the demand curve, resulting in an increase in the equilibrium price of oil and a decrease in the equilibrium quantity.

f. Increased insulation will decrease the demand for heating. This leftward shift in the demand for oil causes a movement down the supply curve, resulting in a decrease in the equilibrium price and quantity of oil.

g. Solar energy is a substitute for oil-based energy. So if solar energy becomes cheaper, the demand for oil will decrease as consumers switch from oil to solar. The decrease in demand for oil will be shown as a leftward shift in the demand curve. As the demand curve shifts down the supply curve, both equilibrium price and quantity for oil will fall.

h. A new, popular kind of plastic will increase the demand for oil. The increase in demand will be shown as a rightward shift in demand, raising the equilibrium price and quantity of oil.

5. Step 1. Draw the graph with the initial supply and demand curves. Label the initial equilibrium price and quantity. Step 2. Did the economic event affect supply or demand? Jet fuel is a cost of producing air travel, so an increase in jet fuel price affects supply. Step 3. An increase in the price of jet fuel caused a decrease in the cost of air travel. We show this as a downward or rightward shift in supply. Step 4. A rightward shift in supply causes a movement down the demand curve, lowering the equilibrium price of air travel and increasing the equilibrium quantity.

6. Step 1. Draw the graph with the initial supply and demand curves. Label the initial equilibrium price and quantity. Step 2. Did the economic event affect supply or demand? A tariff is treated like a cost of production, so this affects supply. Step 3. A tariff reduction is equivalent to a decrease in the cost of production, which we can show as a rightward (or downward) shift in supply. Step 4. A rightward shift in supply causes a movement down the demand curve, lowering the equilibrium price and raising the equilibrium quantity.

7. A price ceiling (which is below the equilibrium price) will cause the quantity demanded to rise and the quantity supplied to fall. This is why a price ceiling creates a shortage.

8. A price ceiling is just a legal restriction. Equilibrium is an economic condition. People may or may not obey the price ceiling, so the actual price may be at or above the price ceiling, but the price ceiling does not change the equilibrium price.

9. A price ceiling is a legal maximum price, but a price floor is a legal minimum price and, consequently, it would leave room for the price to rise to its equilibrium level. In other words, a price floor below equilibrium will not be binding and will have no effect.

10. Assuming that people obey the price ceiling, the market price will be below equilibrium, which means that Qd will be more than Qs. Buyers can only buy what is offered for sale, so the number of transactions will fall to Qs. This is easy to see graphically. By analogous reasoning, with a price floor the market price will be above the equilibrium price, so Qd will be less than Qs. Since the limit on transactions here is demand, the number of transactions will fall to Qd. Note that because both price floors and price ceilings reduce the number of transactions, social surplus is less.

11. Because the losses to consumers are greater than the benefits to producers, so the net effect is negative. Since the
lost consumer surplus is greater than the additional producer surplus, social surplus falls.

**Chapter 4**

1. Changes in the wage rate (the price of labor) cause a movement along the demand curve. A change in anything else that affects demand for labor (e.g., changes in output, changes in the production process that use more or less labor, government regulation) causes a shift in the demand curve.

2. Changes in the wage rate (the price of labor) cause a movement along the supply curve. A change in anything else that affects supply of labor (e.g., changes in how desirable the job is perceived to be, government policy to promote training in the field) causes a shift in the supply curve.

3. Since a living wage is a suggested minimum wage, it acts like a price floor (assuming, of course, that it is followed). If the living wage is binding, it will cause an excess supply of labor at that wage rate.

4. Changes in the interest rate (i.e., the price of financial capital) cause a movement along the demand curve. A change in anything else (non-price variable) that affects demand for financial capital (e.g., changes in confidence about the future, changes in needs for borrowing) would shift the demand curve.

5. Changes in the interest rate (i.e., the price of financial capital) cause a movement along the supply curve. A change in anything else that affects the supply of financial capital (a non-price variable) such as income or future needs would shift the supply curve.

6. If market interest rates stay in their normal range, an interest rate limit of 35% would not be binding. If the equilibrium interest rate rose above 35%, the interest rate would be capped at that rate, and the quantity of loans would be lower than the equilibrium quantity, causing a shortage of loans.

7. b and c will lead to a fall in interest rates. At a lower demand, lenders will not be able to charge as much, and with more available lenders, competition for borrowers will drive rates down.

8. a and c will increase the quantity of loans. More people who want to borrow will result in more loans being given, as will more people who want to lend.

9. A price floor prevents a price from falling below a certain level, but has no effect on prices above that level. It will have its biggest effect in creating excess supply (as measured by the entire area inside the dotted lines on the graph, from D to S) if it is substantially above the equilibrium price. This is illustrated in the following figure.

![Price Floor Diagram](image)

It will have a lesser effect if it is slightly above the equilibrium price. This is illustrated in the next figure.
It will have no effect if it is set either slightly or substantially below the equilibrium price, since an equilibrium price above a price floor will not be affected by that price floor. The following figure illustrates these situations.

10. A price ceiling prevents a price from rising above a certain level, but has no effect on prices below that level. It will have its biggest effect in creating excess demand if it is substantially below the equilibrium price. The following figure illustrates these situations.
When the price ceiling is set substantially or slightly above the equilibrium price, it will have no effect on creating excess demand. The following figure illustrates these situations.

11. Neither. A shift in demand or supply means that at every price, either a greater or a lower quantity is demanded or supplied. A price floor does not shift a demand curve or a supply curve. However, if the price floor is set above the equilibrium, it will cause the quantity supplied on the supply curve to be greater than the quantity demanded on the demand curve, leading to excess supply.

12. Neither. A shift in demand or supply means that at every price, either a greater or a lower quantity is demanded or supplied. A price ceiling does not shift a demand curve or a supply curve. However, if the price ceiling is set below the equilibrium, it will cause the quantity demanded on the demand curve to be greater than the quantity supplied on the supply curve, leading to excess demand.
Chapter 5

1. From point B to point C, price rises from $70 to $80, and Qd decreases from 2,800 to 2,600. So:

   \[
   \text{% change in quantity} = \frac{2600 - 2800}{2600 + 2800} \times 100
   \]

   \[
   = \frac{-200}{2700} \times 100
   \]

   \[
   = -7.41
   \]

   \[
   \text{% change in price} = \frac{80 - 70}{80 + 70} \times 100
   \]

   \[
   = \frac{10}{150} \times 100
   \]

   \[
   = 13.33
   \]

   Elasticity of Demand = \[
   \frac{-7.41}{13.33} = 0.56
   \]

   The demand curve is inelastic in this area; that is, its elasticity value is less than one. Answer from Point D to point E:

   \[
   \text{% change in quantity} = \frac{2200 - 2400}{2200 + 2400} \times 100
   \]

   \[
   = \frac{-200}{2300} \times 100
   \]

   \[
   = -8.7
   \]

   \[
   \text{% change in price} = \frac{100 - 90}{100 + 90} \times 100
   \]

   \[
   = \frac{10}{190} \times 100
   \]

   \[
   = 10.53
   \]

   Elasticity of Demand = \[
   \frac{-8.7}{10.53} = 0.83
   \]

   The demand curve is inelastic in this area; that is, its elasticity value is less than one. Answer from Point G to point H:

   \[
   \text{% change in quantity} = \frac{1600 - 1800}{1700}
   \]

   \[
   = \frac{-200}{1700} \times 100
   \]

   \[
   = -11.76
   \]

   \[
   \text{% change in price} = \frac{130 - 120}{125}
   \]

   \[
   = \frac{10}{125} \times 100
   \]

   \[
   = 8.00
   \]

   Elasticity of Demand = \[
   \frac{-11.76}{8.00} = -1.47
   \]

   The demand curve is elastic in this interval.

2. From point J to point K, price rises from $8 to $9, and quantity rises from 50 to 70. So:
% change in quantity = \( \frac{70 - 50}{(70 + 50) ÷ 2} \times 100 \)
\[ = \frac{20}{60} \times 100 \]
\[ = 33.33\% \]

% change in price = \( \frac{9 - 8}{(9 + 8) ÷ 2} \times 100 \)
\[ = \frac{1}{8.5} \times 100 \]
\[ = 11.76\% \]

Elasticity of Supply = \( \frac{33.33\%}{11.76\%} \)
\[ = 2.83 \]

The supply curve is elastic in this area; that is, its elasticity value is greater than one. From point L to point M, the price rises from $10 to $11, while the Qs rises from 80 to 88:

% change in quantity = \( \frac{88 - 80}{(88 + 80) ÷ 2} \times 100 \)
\[ = \frac{8}{84} \times 100 \]
\[ = 9.52\% \]

% change in price = \( \frac{11 - 10}{(11 + 10) ÷ 2} \times 100 \)
\[ = \frac{1}{10.5} \times 100 \]
\[ = 9.52\% \]

Elasticity of Demand = \( \frac{9.52\%}{9.52\%} \)
\[ = 1.0 \]

The supply curve has unitary elasticity in this area. From point N to point P, the price rises from $12 to $13, and Qs rises from 95 to 100:

% change in quantity = \( \frac{100 - 95}{(100 + 95) ÷ 2} \times 100 \)
\[ = \frac{5}{97.5} \times 100 \]
\[ = 5.13\% \]

% change in price = \( \frac{13 - 12}{(13 + 12) ÷ 2} \times 100 \)
\[ = \frac{1}{12.5} \times 100 \]
\[ = 8.0\% \]

Elasticity of Supply = \( \frac{5.13\%}{8.0\%} \)
\[ = 0.64 \]

The supply curve is inelastic in this region of the supply curve.

3. The demand curve with constant unitary elasticity is concave because the absolute value of declines in price are not identical. The left side of the curve starts with high prices, and then price falls by smaller amounts as it goes down toward the right side. This results in a slope of demand that is steeper on the left but flatter on the right, creating a curved, concave shape.

4. The constant unitary elasticity is a straight line because the curve slopes upward and both price and quantity are increasing proportionally.

5. Carmakers can pass this cost along to consumers if the demand for these cars is inelastic. If the demand for these cars is elastic, then the manufacturer must pay for the equipment.

6. If the elasticity is 1.4 at current prices, you would advise the company to lower its price on the product, since a
decrease in price will be offset by the increase in the amount of the drug sold. If the elasticity were 0.6, then you
would advise the company to increase its price. Increases in price will offset the decrease in number of units sold, but
increase your total revenue. If elasticity is 1, the total revenue is already maximized, and you would advise that the
company maintain its current price level.

7. The percentage change in quantity supplied as a result of a given percentage change in the price of gasoline.

8. 

\[
\text{Percentage change in quantity demanded} = \frac{(\text{change in quantity})}{(\text{original quantity})} \times 100 \\
= \frac{22 - 30}{(22 + 30)/2} \times 100 \\
= -8/26 \times 100 \\
= -30.77
\]

\[
\text{Percentage change in income} = \frac{(\text{change in income})}{(\text{original income})} \times 100 \\
= \frac{38,000 - 25,000}{(38,000 + 25,000)/2} \times 100 \\
= 13/31.5 \times 100 \\
= 41.27
\]

In this example, bread is an inferior good because its consumption falls as income rises.

9. The formula for cross-price elasticity is \% change in Qd for apples / \% change in P of oranges. Multiplying both
sides by \% change in P of oranges yields: \% change in Qd for apples = cross-price elasticity \times \% change in P of
oranges = 0.4 \times (-3\%) = -1.2\%, or a 1.2 \% decrease in demand for apples.

Chapter 6

1. GDP is C + I + G + (X – M). GDP = $2,000 billion + $50 billion + $1,000 billion + ($20 billion – $40 billion) =
$3,030

2.

a. Hospital stays are part of GDP.
b. Changes in life expectancy are not market transactions and not part of GDP.
c. Child care that is paid for is part of GDP.
d. If Grandma gets paid and reports this as income, it is part of GDP, otherwise not.
e. A used car is not produced this year, so it is not part of GDP.
f. A new car is part of GDP.
g. Variety does not count in GDP, where the cheese could all be cheddar.
h. The iron is not counted because it is an intermediate good.

3. From 1980 to 1990, real GDP grew by \((8,225.0 – 5,926.5)/(5,926.5) = 39\%\). Over the same period, prices increased
by \((72.7 – 48.3)/(48.3/100) = 51\%\). So about 57\% of the growth \(51/(51 + 39)\) was inflation, and the remainder: \(39/(51 + 39) = 43\%\)
was growth in real GDP.

4. Two other major recessions are visible in the figure as slight dips: those of 1973–1975, and 1981–1982. Two other
recessions appear in the figure as a flattening of the path of real GDP. These were in 1990–1991 and 2001.

5. 11 recessions in approximately 70 years averages about one recession every six years.

6. The table lists the “Months of Contraction” for each recession. Averaging these figures for the post-WWII
recessions gives an average duration of 11 months, or slightly less than a year.

7. The table lists the “Months of Expansion.” Averaging these figures for the post-WWII expansions gives an average
expansion of 60.5 months, or more than five years.

8. Yes. The answer to both questions depends on whether GDP is growing faster or slower than population. If
population grows faster than GDP, GDP increases, while GDP per capita decreases. If GDP falls, but population falls
faster, then GDP decreases, while GDP per capita increases.
9. Start with Central African Republic’s GDP measured in francs. Divide it by the exchange rate to convert to U.S. dollars, and then divide by population to obtain the per capita figure. That is, $1,107,689$ million francs / $284.681$ francs per dollar / $4.862$ million people = $800.28$ GDP per capita.

10.
   a. A dirtier environment would reduce the broad standard of living, but not be counted in GDP, so a rise in GDP would overstate the standard of living.
   b. A lower crime rate would raise the broad standard of living, but not be counted directly in GDP, and so a rise in GDP would understate the standard of living.
   c. A greater variety of goods would raise the broad standard of living, but not be counted directly in GDP, and so a rise in GDP would understate the rise in the standard of living.
   d. A decline in infant mortality would raise the broad standard of living, but not be counted directly in GDP, and so a rise in GDP would understate the rise in the standard of living.

Chapter 7

1. The Industrial Revolution refers to the widespread use of power-driven machinery and the economic and social changes that resulted in the first half of the 1800s. Ingenious machines—the steam engine, the power loom, and the steam locomotive—performed tasks that would have taken vast numbers of workers to do. The Industrial Revolution began in Great Britain, and soon spread to the United States, Germany, and other countries.

2. Property rights are the rights of individuals and firms to own property and use it as they see fit. Contractual rights are based on property rights and they allow individuals to enter into agreements with others regarding the use of their property providing recourse through the legal system in the event of noncompliance. Economic growth occurs when the standard of living increases in an economy, which occurs when output is increasing and incomes are rising. For this to happen, societies must create a legal environment that gives individuals the ability to use their property to their fullest and highest use, including the right to trade or sell that property. Without a legal system that enforces contracts, people would not be likely to enter into contracts for current or future services because of the risk of non-payment. This would make it difficult to transact business and would slow economic growth.

3. Yes. Since productivity is output per unit of input, we can measure productivity using GDP (output) per worker (input).

4. In 20 years the United States will have an income of $10,000 \times (1 + 0.01)^{20} = $12,201.90$, and South Korea will have an income of $10,000 \times (1 + 0.04)^{20} = $21,911.23$. South Korea has grown by a multiple of $2.1$ and the United States by a multiple of $1.2$.

5. Capital deepening and technology are important. What seems to be more important is how they are combined.

6. Government can contribute to economic growth by investing in human capital through the education system, building a strong physical infrastructure for transportation and commerce, increasing investment by lowering capital gains taxes, creating special economic zones that allow for reduced tariffs, and investing in research and development.

7. Public education, low investment taxes, funding for infrastructure projects, special economic zones

8. A good way to think about this is how a runner who has fallen behind in a race feels psychologically and physically as he catches up. Playing catch-up can be more taxing than maintaining one’s position at the head of the pack.

9.
   a. No. Capital deepening refers to an increase in the amount of capital per person in an economy. A decrease in investment by firms will actually cause the opposite of capital deepening (since the population will grow over time).
   b. There is no direct connection between an increase in international trade and capital deepening. One could imagine particular scenarios where trade could lead to capital deepening (for example, if international capital
inflows—which are the counterpart to increasing the trade deficit—lead to an increase in physical capital investment), but in general, no.
c. Yes. Capital deepening refers to an increase in either physical capital or human capital per person. Continuing education or any time of lifelong learning adds to human capital and thus creates capital deepening.

10. The advantages of backwardness include faster growth rates because of the process of convergence, as well as the ability to adopt new technologies that were developed first in the “leader” countries. While being “backward” is not inherently a good thing, Gerschenkron stressed that there are certain advantages which aid countries trying to “catch up.”

11. Capital deepening, by definition, should lead to diminished returns because you’re investing more and more but using the same methods of production, leading to the marginal productivity declining. This is shown on a production function as a movement along the curve. Improvements in technology should not lead to diminished returns because you are finding new and more efficient ways of using the same amount of capital. This can be illustrated as a shift upward of the production function curve.

12. Productivity growth from new advances in technology will not slow because the new methods of production will be adopted relatively quickly and easily, at very low marginal cost. Also, countries that are seeing technology growth usually have a vast and powerful set of institutions for training workers and building better machines, which allows the maximum amount of people to benefit from the new technology. These factors have the added effect of making additional technological advances even easier for these countries.

Chapter 8

1. The population is divided into those “in the labor force” and those “not in the labor force.” Thus, the number of adults not in the labor force is 237.8 – 153.9 = 83.9 million. Since the labor force is divided into employed persons and unemployed persons, the number of unemployed persons is 153.9 – 139.1 = 14.8 million. Thus, the adult population has the following proportions:
   • 139.1/237.8 = 58.5% employed persons
   • 14.8/237.8 = 6.2% unemployed persons
   • 83.9/237.8 = 35.3% persons out of the labor force

2. The unemployment rate is defined as the number of unemployed persons as a percentage of the labor force or 14.8/153.9 = 9.6%. This is higher than the February 2015 unemployment rate, computed earlier, of 5.5%.

3. Over the long term, the U.S. unemployment rate has remained basically the same level.

4.
   a. Nonwhites
   b. The young
   c. High school graduates

5. Because of the influx of women into the labor market, the supply of labor shifts to the right. Since wages are sticky downward, the increased supply of labor causes an increase in people looking for jobs (Qs), but no change in the number of jobs available (Qe). As a result, unemployment increases by the amount of the increase in the labor supply. This can be seen in the following figure. Over time, as labor demand grows, the unemployment will decline and eventually wages will begin to increase again. But this increase in labor demand goes beyond the scope of this problem.
6. The increase in labor supply was a social demographic trend—it was not caused by the economy falling into a recession. Therefore, the influx of women into the work force increased the natural rate of unemployment.

7. New entrants to the labor force, whether from college or otherwise, are counted as frictionally unemployed until they find a job.

Chapter 9

1. To compute the amount spent on each fruit in each year, you multiply the quantity of each fruit by the price.
   • 10 apples × 50 cents each = $5.00 spent on apples in 2001.
   • 12 bananas × 20 cents each = $2.40 spent on bananas in 2001.
   • 2 bunches of grapes at 65 cents each = $1.30 spent on grapes in 2001.
   • 1 pint of raspberries at $2 each = $2.00 spent on raspberries in 2001.

   Adding up the amounts gives you the total cost of the fruit basket. The total cost of the fruit basket in 2001 was $5.00 + $2.40 + $1.30 + $2.00 = $10.70. The total costs for all the years are shown in the following table.

<table>
<thead>
<tr>
<th>Year</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>2001</td>
<td>$10.70</td>
</tr>
<tr>
<td>2002</td>
<td>$13.80</td>
</tr>
<tr>
<td>2003</td>
<td>$15.35</td>
</tr>
<tr>
<td>2004</td>
<td>$16.31</td>
</tr>
</tbody>
</table>

2. If 2003 is the base year, then the index number has a value of 100 in 2003. To transform the cost of a fruit basket each year, we divide each year’s value by $15.35, the value of the base year, and then multiply the result by 100. The price index is shown in the following table.

<table>
<thead>
<tr>
<th>Year</th>
<th>Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>2001</td>
<td>69.71</td>
</tr>
<tr>
<td>2002</td>
<td>89.90</td>
</tr>
<tr>
<td>2003</td>
<td>100.00</td>
</tr>
<tr>
<td>2004</td>
<td>106.3</td>
</tr>
</tbody>
</table>

   Note that the base year has a value of 100; years before the base year have values less than 100; and years after have values more than 100.

3. The inflation rate is calculated as the percentage change in the price index from year to year. For example, the inflation rate between 2001 and 2002 is \((84.61 - 69.71) / 69.71 \approx 0.2137 = 21.37\%\). The inflation rates for all the years are shown in the last row of the following table, which includes the two previous answers.
4. Begin by calculating the total cost of buying the basket in each time period, as shown in the following table.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Apples</td>
<td>10</td>
<td>$0.50</td>
<td>$5.00</td>
<td>$0.75</td>
<td>$7.50</td>
<td>$0.85</td>
<td>$8.50</td>
<td>$0.88</td>
<td>$8.80</td>
</tr>
<tr>
<td>Bananas</td>
<td>12</td>
<td>$0.20</td>
<td>$2.40</td>
<td>$0.25</td>
<td>$3.00</td>
<td>$0.25</td>
<td>$3.00</td>
<td>$0.29</td>
<td>$3.48</td>
</tr>
<tr>
<td>Grapes</td>
<td>2</td>
<td>$0.65</td>
<td>$1.30</td>
<td>$0.70</td>
<td>$1.40</td>
<td>$0.90</td>
<td>$1.80</td>
<td>$0.95</td>
<td>$1.90</td>
</tr>
<tr>
<td>Raspberries</td>
<td>1</td>
<td>$2.00</td>
<td>$2.00</td>
<td>$1.90</td>
<td>$1.90</td>
<td>$2.05</td>
<td>$2.05</td>
<td>$2.13</td>
<td>$2.13</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td>$10.70</td>
<td>$13.80</td>
<td>$15.35</td>
<td>$16.31</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Price Index</td>
<td>69.71</td>
<td></td>
<td></td>
<td>84.61</td>
<td></td>
<td>100.00</td>
<td></td>
<td>106.3</td>
<td></td>
</tr>
<tr>
<td>Inflation Rate</td>
<td></td>
<td></td>
<td>21.37%</td>
<td>18.19%</td>
<td></td>
<td>6.3%</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The rise in cost of living is calculated as the percentage increase: \((2244 - 2120) / 2120 = 0.0585 = 5.85\%\).

5. Since the CPI measures the prices of the goods and services purchased by the typical urban consumer, it measures the prices of things that people buy with their paycheck. For that reason, the CPI would be the best price index to use for this purpose.

6. The PPI is subject to those biases for essentially the same reasons as the CPI is. The GDP deflator picks up prices of what is actually purchased that year, so there are no biases. That is the advantage of using the GDP deflator over the CPI.

7. The calculator requires you to input three numbers:
   - The first year, in this case the year of your birth
   - The amount of money you would want to translate in terms of its purchasing power
   - The last year—now or the most recent year the calculator will accept

   My birth year is 1955. The amount is $1. The year 2012 is currently the latest year the calculator will accept. The simple purchasing power calculator shows that $1 of purchases in 1955 would cost $8.57 in 2012. The website also explains how the true answer is more complicated than that shown by the simple purchasing power calculator.

8. The state government would benefit because it would repay the loan in less valuable dollars than it borrowed. Plus, tax revenues for the state government would increase because of the inflation.

9. Higher inflation reduces real interest rates on fixed rate mortgages. Because ARMs can be adjusted, higher inflation
leads to higher interest rates on ARMs.

10. Because the mortgage has an adjustable rate, the rate should fall by 3%, the same as inflation, to keep the real interest rate the same.

Chapter 10

1. The stock and bond values will not show up in the current account. However, the dividends from the stocks and the interest from the bonds show up as an import to income in the current account.

2. It becomes more negative as imports, which are a negative to the current account, are growing faster than exports, which are a positive.

3. a. Money flows out of the Mexican economy.  
b. Money flows into the Mexican economy.  
c. Money flows out of the Mexican economy.

4. GDP is a dollar value of all production of goods and services. Exports are produced domestically but shipped abroad. The percent ratio of exports to GDP gives us an idea of how important exports are to the national economy out of all goods and services produced. For example, exports represent only 14% of U.S. GDP, but 50% of Germany’s GDP.

5. Divide $542 billion by $1,800 billion.

6. Divide $400 billion by $16,800 billion.

7. The trade balance is the difference between exports and imports. The current account balance includes this number (whether it is a trade balance or a trade surplus), but also includes international flows of money from global investments.

8. a. An export sale to Germany involves a financial flow from Germany to the U.S. economy.  
b. The issue here is not U.S. investments in Brazil, but the return paid on those investments, which involves a financial flow from the Brazilian economy to the U.S. economy.  
c. Foreign aid from the United States to Egypt is a financial flow from the United States to Egypt.  
d. Importing oil from the Russian Federation means a flow of financial payments from the U.S. economy to the Russian Federation.  
e. Japanese investors buying U.S. real estate is a financial flow from Japan to the U.S. economy.

9. The top portion tracks the flow of exports and imports and the payments for those. The bottom portion is looking at international financial investments and the outflow and inflow of monies from those investments. These investments can include investments in stocks and bonds or real estate abroad, as well as international borrowing and lending.

10. If more monies are flowing out of the country (for example, to pay for imports) it will make the current account more negative or less positive, and if more monies are flowing into the country, it will make the current account less negative or more positive.

11. Write out the national savings and investment identity for the situation of the economy implied by this question:

\[
\text{Supply of capital} = \text{Demand for capital} \\
S + (M - X) + (T - G) = I \quad \text{If domestic savings increases and} \\
\text{Savings} + \text{(trade deficit)} = \text{(government budget surplus)} = \text{Investment}
\]

nothing else changes, then the trade deficit will fall. In effect, the economy would be relying more on domestic capital and less on foreign capital. If the government starts borrowing instead of saving, then the trade deficit must rise. In effect, the government is no longer providing savings and so, if nothing else is to change, more investment funds must arrive from abroad. If the rate of domestic investment surges, then, ceteris paribus, the trade deficit must also rise, to
provide the extra capital. The ceteris paribus—or “other things being equal”—assumption is important here. In all of these situations, there is no reason to expect in the real world that the original change will affect only, or primarily, the trade deficit. The identity only says that something will adjust—it does not specify what.

12. The government is saving rather than borrowing. The supply of savings, whether private or public, is on the left side of the identity.

13. A trade deficit is determined by a country’s level of private and public savings and the amount of domestic investment.

14. The trade deficit must increase. To put it another way, this increase in investment must be financed by an inflow of financial capital from abroad.

15. Incomes fall during a recession, and consumers buy fewer good, including imports.

16. A booming economy will increase the demand for goods in general, so import sales will increase. If our trading partners’ economies are doing well, they will buy more of our products and so U.S. exports will increase.

17. 
   a. Increased federal spending on Medicare may not increase productivity, so a budget deficit is not justified.
   b. Increased spending on education will increase productivity and foster greater economic growth, so a budget deficit is justified.
   c. Increased spending on the space program may not increase productivity, so a budget deficit is not justified.
   d. Increased spending on airports and air traffic control will increase productivity and foster greater economic growth, so a budget deficit is justified.

18. Foreign investors worried about repayment so they began to pull money out of these countries. The money can be pulled out of stock and bond markets, real estate, and banks.

19. A rapidly growing trade surplus could result from a number of factors, so you would not want to be too quick to assume a specific cause. However, if the choice is between whether the economy is in recession or growing rapidly, the answer would have to be recession. In a recession, demand for all goods, including imports, has declined; however, demand for exports from other countries has not necessarily altered much, so the result is a larger trade surplus.

20. Germany has a higher level of trade than the United States. The United States has a large domestic economy so it has a large volume of internal trade.

21. 
   a. A large economy tends to have lower levels of international trade, because it can do more of its trade internally, but this has little impact on its trade imbalance.
   b. An imbalance between domestic physical investment and domestic saving (including government and private saving) will always lead to a trade imbalance, but has little to do with the level of trade.
   c. Many large trading partners nearby geographically increases the level of trade, but has little impact one way or the other on a trade imbalance.
   d. The answer here is not obvious. An especially large budget deficit means a large demand for financial capital which, according to the national saving and investment identity, makes it somewhat more likely that there will be a need for an inflow of foreign capital, which means a trade deficit.
   e. A strong tradition of discouraging trade certainly reduces the level of trade. However, it does not necessarily say much about the balance of trade, since this is determined by both imports and exports, and by national levels of physical investment and savings.

Chapter 11

1. In order to supply goods, suppliers must employ workers, whose incomes increase as a result of their labor. They use this additional income to demand goods of an equivalent value to those they supply.
2. When consumers demand more goods than are available on the market, prices are driven higher and the additional opportunities for profit induce more suppliers to enter the market, producing an equivalent amount to that which is demanded.

3. Higher input prices make output less profitable, decreasing the desired supply. This is shown graphically as a leftward shift in the AS curve.

4. Equilibrium occurs at the level of GDP where AD = AS. Insufficient aggregate demand could explain why the equilibrium occurs at a level of GDP less than potential. A decrease (or leftward shift) in aggregate supply could be another reason.

5. Immigration reform as described should increase the labor supply, shifting SRAS to the right, leading to a higher equilibrium GDP and a lower price level.

6. Given the assumptions made here, the cuts in R&D funding should reduce productivity growth. The model would show this as a leftward shift in the SRAS curve, leading to a lower equilibrium GDP and a higher price level.

7. An increase in the value of the stock market would make individuals feel wealthier and thus more confident about their economic situation. This would likely cause an increase in consumer confidence leading to an increase in consumer spending, shifting the AD curve to the right. The result would be an increase in the equilibrium level of GDP and an increase in the price level.

8. Since imports depend on GDP, if Mexico goes into recession, its GDP declines and so do its imports. This decline in our exports can be shown as a leftward shift in AD, leading to a decrease in our GDP and price level.

9. Tax cuts increase consumer and investment spending, depending on where the tax cuts are targeted. This would shift AD to the right, so if the tax cuts occurred when the economy was in recession (and GDP was less than potential), the tax cuts would increase GDP and “lead the economy out of recession.”

10. A negative report on home prices would make consumers feel like the value of their homes, which for most Americans is a major portion of their wealth, has declined. A negative report on consumer confidence would make consumers feel pessimistic about the future. Both of these would likely reduce consumer spending, shifting AD to the left, reducing GDP and the price level. A positive report on the home price index or consumer confidence would do the opposite.

11. A smaller labor force would be reflected in a leftward shift in AS, leading to a lower equilibrium level of GDP and higher price level.

12. Higher EU growth would increase demand for U.S. exports, reducing our trade deficit. The increased demand for exports would show up as a rightward shift in AD, causing GDP to rise (and the price level to rise as well). Higher GDP would require more jobs to fulfill, so U.S. employment would also rise.

13. Expansionary monetary policy shifts AD to the right. A continuing expansionary policy would cause larger and larger shifts (given the parameters of this problem). The result would be an increase in GDP and employment (a decrease in unemployment) and higher prices until potential output was reached. After that point, the expansionary policy would simply cause inflation.

14. Since the SRAS curve is vertical in the neoclassical zone, unless the economy is bordering the intermediate zone, a decrease in AS will cause a decrease in the price level, but no effect on real economic activity (for example, real GDP or employment).

15. Because the SRAS curve is horizontal in the Keynesian zone, a decrease in AD should depress real economic activity but have no effect on prices.

Chapter 12

1.
a. An increase in home values will increase consumption spending (due to increased wealth). AD will shift to the right and may cause inflation if it goes beyond potential GDP.
b. Rapid growth by a major trading partner will increase demand for exports. AD will shift to the right and may cause inflation if it goes beyond potential GDP.
c. Increased profit opportunities will increase business investment. AD will shift to the right and may cause inflation if it goes beyond potential GDP.
d. Higher interest rates reduce investment spending. AD will shift to the left and may cause recession if it falls below potential GDP.
e. Demand for cheaper imports increases, reducing demand for domestic products. AD will shift to the left and may be recessionary.

2.

a. A tax increase on consumer income will cause consumption to fall, pushing the AD curve left, and is a possible solution to inflation.
b. A surge in military spending is an increase in government spending. This will cause the AD curve to shift to the right. If real GDP is less than potential GDP, then this spending would pull the economy out of a recession. If real GDP is to the right of potential GDP, then the AD curve will shift farther to the right and military spending will be inflationary.
c. A tax cut focused on business investment will shift AD to the right. If the original macroeconomic equilibrium is below potential GDP, then this policy can help move an economy out of a recession.
d. Government spending on healthcare will cause the AD curve to shift to the right. If real GDP is less than potential GDP, then this spending would pull the economy out of a recession. If real GDP is to the right of potential GDP, then the AD curve will shift farther to the right and healthcare spending will be inflationary.

3. An inflationary gap is the result of an increase in aggregate demand when the economy is at potential output. Since the AS curve is vertical at potential GDP, any increase in AD will lead to a higher price level (i.e. inflation) but no higher real GDP. This is easy to see if you draw AD\(_1\) to the right of AD\(_0\).

4. A decrease in government spending will shift AD to the left.

5. A decrease in energy prices, a positive supply shock, would cause the AS curve to shift out to the right, yielding more real GDP at a lower price level. This would shift the Phillips curve down toward the origin, meaning the economy would experience lower unemployment and a lower rate of inflation.

6. Keynesian economics does not require microeconomic price controls of any sort. It is true that many Keynesian economic prescriptions were for the government to influence the total amount of aggregate demand in the economy, often through government spending and tax cuts.

7. The three problems center on government’s ability to estimate potential GDP, decide whether to influence aggregate demand through tax changes or changes in government spending, and the lag time that occurs as Congress and the President attempt to pass legislation.

Chapter 13

1. No, this statement is false. It would be more accurate to say that rational expectations seek to predict the future as accurately as possible, using all of past experience as a guide. Adaptive expectations are largely backward looking; that is, they adapt as experience accumulates, but without attempting to look forward.

2. An unemployment rate of zero percent is presumably well below the rate that is consistent with potential GDP and with the natural rate of unemployment. As a result, this policy would be attempting to push AD out to the right. In the short run, it is possible to have unemployment slightly below the natural rate for a time, at a price of higher inflation, as shown by the movement from E\(_0\) to E\(_1\) along the short-run AS curve. However, over time the extremely low unemployment rates will tend to cause wages to be bid up, and shift the short-run AS curve back to the left. The result would be a higher price level, but an economy still at potential GDP and the natural rate of unemployment, as determined by the long-run AS curve. If the government continues this policy, it will continually be pushing the price
level higher and higher, but it will not be able to achieve its goal of zero percent unemployment, because that goal is inconsistent with market forces.

3. The statement is accurate. Rational expectations can be thought of as a version of neoclassical economics because it argues that potential GDP and the rate of unemployment are shaped by market forces as wages and prices adjust. However, it is an “extreme” version because it argues that this adjustment takes place very quickly. Other theories, like adaptive expectations, suggest that adjustment to the neoclassical outcome takes a few years.

4. The short-term Keynesian model is built on the importance of aggregate demand as a cause of business cycles and a degree of wage and price rigidity, and thus does a sound job of explaining many recessions and why cyclical unemployment rises and falls. The neoclassical model emphasizes aggregate supply by focusing on the underlying determinants of output and employment in markets, and thus tends to put more emphasis on economic growth and how labor markets work.

**Chapter 14**

1. As long as you remain within the walls of the casino, chips fit the definition of money; that is, they serve as a medium of exchange, a unit of account, and a store of value. Chips do not work very well as money once you leave the casino, but many kinds of money do not work well in other areas. For example, it is hard to spend money from Turkey or Brazil at your local supermarket or at the movie theater.

2. Many physical items that a person buys at one time but may sell at another time can serve as an answer to this question. Examples include a house, land, art, rare coins or stamps, and so on.

3. The currency and checks in M1 are easiest to spend. It is harder to spend M2 directly, although if there is an automatic teller machine in the shopping mall, you can turn M2 from your savings account into an M1 of currency quite quickly. If your answer is about “credit cards,” then you are really talking about spending M1—although it is M1 from the account of the credit card company, which you will repay later when you credit card bill comes due.

4. 
   a. Neither in M1 or M2
   b. That is part of M1, and because M2 includes M1 it is also part of M2
   c. Currency out in the public hands is part of M1 and M2
   d. Checking deposits are in M1 and M2
   e. Money market accounts are in M2

5. A bank’s assets include cash held in their vaults, but assets also include monies that the bank holds at the Federal Reserve Bank (called “reserves”), loans that are made to customers, and bonds.

6. 
   a. A borrower who has been late on a number of loan payments looks perhaps less likely to repay the loan, or to repay it on time, and so you would want to pay less for that loan.
   b. If interest rates generally have risen, then this loan made at a time of relatively lower interest rates looks less attractive, and you would pay less for it.
   c. If the borrower is a firm with a record of high profits, then it is likely to be able to repay the loan, and you would be willing to pay more for the loan.
   d. If interest rates in the economy have fallen, then the loan is worth more.

**Chapter 15**

1. Longer terms insulate the Board from political forces. Since the presidency can potentially change every four years, the Federal Reserve’s independence prevents drastic swings in monetary policy with every new administration and allows policy decisions to be made only on economic grounds.

2. Banks make their money from issuing loans and charging interest. The more money that is stored in the bank’s vault, the less is available for lending and the less money the bank stands to make.
3. The fear and uncertainty created by the suggestion that a bank might fail can lead depositors to withdraw their money. If many depositors do this at the same time, the bank may not be able to meet their demands and will, indeed, fail.

4. The bank has to hold $1,000 in reserves, so when it buys the $500 in bonds, it will have to reduce its loans by $500 to make up the difference. The money supply decreases by the same amount.

5. An increase in reserve requirements would reduce the supply of money, since more money would be held in banks rather than circulating in the economy.

6. Contractionary policy reduces the amount of loanable funds in the economy. As with all goods, greater scarcity leads a greater price, so the interest rate, or the price of borrowing money, rises.

7. An increase in the amount of available loanable funds means that there are more people who want to lend. They, therefore, bid the price of borrowing (the interest rate) down.

8. In times of economic uncertainty, banks may worry that borrowers will lose the ability to repay their loans. They may also fear that a panic is more likely and they will need the excess reserves to meet their obligations.

9. If consumer optimism changes, spending can speed up or slow down. This could also happen in a case where consumers need to buy a large number of items quickly, such as in a situation of national emergency.

Chapter 16

1. 
   a. The British use the pound sterling, while Germans use the euro, so a British exporter will receive euros from export sales, which will need to be exchanged for pounds. A stronger euro will mean more pounds per euro, so the exporter will be better off. In addition, the lower price for German imports will stimulate demand for British exports. For both these reasons, a stronger euro benefits the British exporter.
   b. The Dutch use euros while the Chileans use pesos, so the Dutch tourist needs to turn euros into Chilean pesos. An increase in the euro means that the tourist will get more pesos per euro. As a consequence, the Dutch tourist will have a less expensive vacation than he planned, so the tourist will be better off.
   c. The Greek use euros while the Canadians use dollars. An increase in the euro means it will buy more Canadian dollars. As a result, the Greek bank will see a decrease in the cost of the Canadian bonds, so it may purchase more bonds. Either way, the Greek bank benefits.
   d. Since both the French and Germans use the euro, an increase in the euro, in terms of other currencies, should have no impact on the French exporter.

2. Expected depreciation in a currency will lead people to divest themselves of the currency. We should expect to see an increase in the supply of pounds and a decrease in demand for pounds. The result should be a decrease in the value of the pound vis-à-vis the dollar.

3. Lower U.S. interest rates make U.S. assets less desirable compared to assets in the European Union. We should expect to see a decrease in demand for dollars and an increase in supply of dollars in foreign currency markets. As a result, we should expect to see the dollar depreciate compared to the euro.

4. A decrease in Argentine inflation relative to other countries should cause an increase in demand for pesos, a decrease in supply of pesos, and an appreciation of the peso in foreign currency markets.

5. The problem occurs when banks borrow foreign currency but lend in domestic currency. Since banks’ assets (loans they made) are in domestic currency, while their debts (money they borrowed) are in foreign currency, when the domestic currency declines, their debts grow larger. If the domestic currency falls substantially in value, as happened during the Asian financial crisis, then the banking system could fail. This problem is unlikely to occur for U.S. banks because, even when they borrow from abroad, they tend to borrow dollars. Remember, there are trillions of dollars in circulation in the global economy. Since both assets and debts are in dollars, a change in the value of the dollar does not cause banking system failure the way it can when banks borrow in foreign currency.
6. While capital flight is possible in either case, if a country borrows to invest in real capital it is more likely to be able to generate the income to pay back its debts than a country that borrows to finance consumption. As a result, an investment-stimulated economy is less likely to provoke capital flight and economic recession.

7. A contractionary monetary policy, by driving up domestic interest rates, would cause the currency to appreciate. The higher value of the currency in foreign exchange markets would reduce exports, since from the perspective of foreign buyers, they are now more expensive. The higher value of the currency would similarly stimulate imports, since they would now be cheaper from the perspective of domestic buyers. Lower exports and higher imports cause net exports (EX – IM) to fall, which causes aggregate demand to fall. The result would be a decrease in GDP working through the exchange rate mechanism reinforcing the effect contractionary monetary policy has on domestic investment expenditure. However, cheaper imports would stimulate aggregate supply, bringing GDP back to potential, though at a lower price level.

8. For a currency to fall, a central bank need only supply more of its currency in foreign exchange markets. It can print as much domestic currency as it likes. For a currency to rise, a central bank needs to buy its currency in foreign exchange markets, paying with foreign currency. Since no central bank has an infinite amount of foreign currency reserves, it cannot buy its currency indefinitely.

9. Variations in exchange rates, because they change import and export prices, disturb international trade flows. When trade is a large part of a nation’s economic activity, government will find it more advantageous to fix exchange rates to minimize disruptions of trade flows.

Chapter 17

1. The government borrows funds by selling Treasury bonds, notes, and bills.

2. The funds can be used to pay down the national debt or else be refunded to the taxpayers.

3. Yes, a nation can run budget deficits and see its debt/GDP ratio fall. In fact, this is not uncommon. If the deficit is small in a given year, than the addition to debt in the numerator of the debt/GDP ratio will be relatively small, while the growth in GDP is larger, and so the debt/GDP ratio declines. This was the experience of the U.S. economy for the period from the end of World War II to about 1980. It is also theoretically possible, although not likely, for a nation to have a budget surplus and see its debt/GDP ratio rise. Imagine the case of a nation with a small surplus, but in a recession year when the economy shrinks. It is possible that the decline in the nation’s debt, in the numerator of the debt/GDP ratio, would be proportionally less than the fall in the size of GDP, so the debt/GDP ratio would rise.

4. Progressive. People who give larger gifts subject to the higher tax rate would typically have larger incomes as well.

5. Corporate income tax on his profits, individual income tax on his salary, and payroll tax taken out of the wages he pays himself.

6. individual income taxes

7. The tax is regressive because wealthy income earners are not taxed at all on income above $113,000. As a percent of total income, the social security tax hits lower income earners harder than wealthier individuals.

8. As debt increases, interest payments also rise, so that the deficit grows even if we keep other government spending constant.

9. 
   a. As a share of GDP, this is false. In nominal dollars, it is true.
   b. False.
   c. False.
   d. False. Education spending is much higher at the state level.
   e. False. As a share of GDP, it is up about 50.
   f. As a share of GDP, this is false, and in real dollars, it is also false.
g. False.
h. False; it’s about 1%.
i. False. Although budget deficits were large in 2003 and 2004, and continued into the later 2000s, the federal government ran budget surpluses from 1998–2001.
j. False.

10. To keep prices from rising too much or too rapidly.

11. To increase employment.

12. It falls below because less tax revenue than expected is collected.

13. Automatic stabilizers take effect very quickly, whereas discretionary policy can take a long time to implement.

14. In a recession, because of the decline in economic output, less income is earned, and so less in taxes is automatically collected. Many welfare and unemployment programs are designed so that those who fall into certain categories, like “unemployed” or “low income,” are eligible for benefits. During a recession, more people fall into these categories and become eligible for benefits automatically. The combination of reduced taxes and higher spending is just what is needed for an economy in recession producing below potential GDP. With an economic boom, average income levels rise in the economy, so more in taxes is automatically collected. Fewer people meet the criteria for receiving government assistance to the unemployed or the needy, so government spending on unemployment assistance and welfare falls automatically. This combination of higher taxes and lower spending is just what is needed if an economy is producing above its potential GDP.

15. Prices would be pushed up as a result of too much spending.

16. Employment would suffer as a result of too little spending.

17. Monetary policy probably has shorter time lags than fiscal policy. Imagine that the data becomes fairly clear that an economy is in or near a recession. Expansionary monetary policy can be carried out through open market operations, which can be done fairly quickly, since the Federal Reserve’s Open Market Committee meets six times a year. Also, monetary policy takes effect through interest rates, which can change fairly quickly. However, fiscal policy is carried out through acts of Congress that need to be signed into law by the president. Negotiating such laws often takes months, and even after the laws are negotiated, it takes more months for spending programs or tax cuts to have an effect on the macroeconomy.

18. The government would have to make up the revenue either by raising taxes in a different area or cutting spending.

19. Programs where the amount of spending is not fixed, but rather determined by macroeconomic conditions, such as food stamps, would lose a great deal of flexibility if spending increases had to be met by corresponding tax increases or spending cuts.

**Chapter 18**

1. We use the national savings and investment identity to solve this question. In this case, the government has a budget surplus, so the government surplus appears as part of the supply of financial capital. Then:

   \[
   \text{Quantity supplied of financial capital} = \text{Quantity demanded of financial capital}
   \]

   \[
   S + (T - G) = I + (X - M)
   \]

   \[
   600 + 200 = I + 100
   \]

   \[
   I = 700
   \]

2. a. Since the government has a budget surplus, the government budget term appears with the supply of capital. The following shows the national savings and investment identity for this economy.

   \[
   \text{Quantity supplied of financial capital} = \text{Quantity demanded of financial capital}
   \]

   \[
   S + (T - G) = I + (X - M)
   \]
b. Plugging the given values into the identity shown in part (a), we find that \((X – M) = 0\).

c. Since the government has a budget deficit, the government budget term appears with the demand for capital.
You do not know in advance whether the economy has a trade deficit or a trade surplus. But when you see that the quantity demanded of financial capital exceeds the quantity supplied, you know that there must be an additional quantity of financial capital supplied by foreign investors, which means a trade deficit of 2000. This example shows that in this case there is a higher budget deficit, and a higher trade deficit.

\[
\begin{align*}
S + (M – X) &= I + (G – T) \\
4000 + 2000 &= 5000 + 1000
\end{align*}
\]

3. In this case, the national saving and investment identity is written in this way:

\[
\begin{align*}
\text{Quantity supplied of financial capital} &= \text{Quantity demanded of financial capital} \\
(T – G) + (M – X) + S &= I
\end{align*}
\]

The increase in the government budget surplus and the increase in the trade deficit both increased the supply of financial capital. If investment in physical capital remained unchanged, then private savings must go down, and if savings remained unchanged, then investment must go up. In fact, both effects happened; that is, in the late 1990s, in the U.S. economy, savings declined and investment rose.

4. Ricardian equivalence means that private saving changes to offset exactly any changes in the government budget. So, if the deficit increases by 20, private saving increases by 20 as well, and the trade deficit and the budget deficit will not change from their original levels. The original national saving and investment identity is written below. Notice that if any change in the \((G – T)\) term is offset by a change in the \(S\) term, then the other terms do not change. So if \((G – T)\) rises by 20, then \(S\) must also increase by 20.

\[
\begin{align*}
\text{Quantity supplied of financial capital} &= \text{Quantity demanded of financial capital} \\
S + (M – X) &= I + (G – T) \\
130 + 20 &= 100 + 50
\end{align*}
\]

5. In the last few decades, spending per student has climbed substantially. However, test scores have fallen over this time. This experience has led a number of experts to argue that the problem is not resources—or is not just resources by itself—but is also a problem of how schools are organized and managed and what incentives they have for success. There are a number of proposals to alter the incentives that schools face, but relatively little hard evidence on what proposals work well. Without trying to evaluate whether these proposals are good or bad ideas, you can just list some of them: testing students regularly; rewarding teachers or schools that perform well on such tests; requiring additional teacher training; allowing students to choose between public schools; allowing teachers and parents to start new schools; giving student “vouchers” that they can use to pay tuition at either public or private schools.

6. The government can direct government spending to R&D. It can also create tax incentives for business to invest in R&D.

**Chapter 19**

1. The answers are shown in the following two tables.

<table>
<thead>
<tr>
<th>Region</th>
<th>GDP (in millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>East Asia</td>
<td>$10,450,032</td>
</tr>
<tr>
<td>Latin America</td>
<td>$5,339,390</td>
</tr>
<tr>
<td>South Asia</td>
<td>$2,288,812</td>
</tr>
<tr>
<td>Europe and Central Asia</td>
<td>$1,862,384</td>
</tr>
<tr>
<td>Middle East and North Africa</td>
<td>$1,541,900</td>
</tr>
</tbody>
</table>
East Asia appears to be the largest economy on GDP basis, but on a per capita basis it drops to third, after Europe and Central Asia and Sub-Saharan Africa.

2. A region can have some of high-income countries and some of the low-income countries. Aggregating per capita real GDP will vary widely across countries within a region, so aggregating data for a region has little meaning. For example, if you were to compare per capital real GDP for the United States, Canada, Haiti, and Honduras, it looks much different than if you looked at the same data for North America as a whole. Thus, regional comparisons are broad-based and may not adequately capture an individual country’s economic attributes.

3. The following table provides a summary of possible answers.

<table>
<thead>
<tr>
<th>Region</th>
<th>GDP (in millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sub-Saharan Africa</td>
<td>$1,287,650</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Region</th>
<th>GDP Per Capita (in millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>East Asia</td>
<td>$5,246</td>
</tr>
<tr>
<td>Latin America</td>
<td>$1,388</td>
</tr>
<tr>
<td>South Asia</td>
<td>$1,415</td>
</tr>
<tr>
<td>Europe and Central Asia</td>
<td>$9,190</td>
</tr>
<tr>
<td>Middle East and North Africa</td>
<td>$4,535</td>
</tr>
<tr>
<td>Sub-Saharan Africa</td>
<td>$6,847</td>
</tr>
<tr>
<td>High-Income Countries</td>
<td>Middle-Income Countries</td>
</tr>
<tr>
<td>-----------------------</td>
<td>-------------------------</td>
</tr>
<tr>
<td>• Foster a more educated workforce</td>
<td>• Invest in technology, human capital, and physical capital</td>
</tr>
<tr>
<td>• Create, invest in, and apply new technologies</td>
<td>• Provide incentives of a market-oriented economic context</td>
</tr>
<tr>
<td>• Adopt fiscal policies focused on investment, including investment in human capital, in technology, and in physical plant and equipment</td>
<td>• Work to reduce government economic controls on market activities</td>
</tr>
<tr>
<td>• Create stable and market-oriented economic climate</td>
<td>• Deregulate the banking and financial sector</td>
</tr>
<tr>
<td>• Use monetary policy to keep inflation low and stable</td>
<td>• Reduce protectionist policies</td>
</tr>
<tr>
<td>• Minimize the risk of exchange rate fluctuations, while also encouraging domestic and international competition</td>
<td></td>
</tr>
</tbody>
</table>

4. Low-income countries must adopt government policies that are market-oriented and that educate the workforce and population. After this is done, low-income countries should focus on eradicating other social ills that inhibit their growth. The economically challenged are stuck in poverty traps. They need to focus more on health and education and create a stable macroeconomic and political environment. This will attract foreign aid and foreign investment. Middle-income countries strive for increases in physical capital and innovation, while higher-income countries must work to maintain their economies through innovation and technology.

5. If there is a recession and unemployment increases, we can call on an expansionary fiscal policy (lower taxes or increased government spending) or an expansionary monetary policy (increase the money supply and lower interest rates). Both policies stimulate output and decrease unemployment.

6. Aside from a high natural rate of unemployment due to government regulations, subsistence households may be counted as not working.

7. Indexing wage contracts means wages rise when prices rise. This means what you can buy with your wages, your standard of living, remains the same. When wages are not indexed, or rise with inflation, your standard of living falls.

8. An increase in government spending shifts the AD curve to the right, raising both income and price levels.

9. A decrease in the money supply will shift the AD curve leftward and reduce income and price levels. Banks will have less money to lend. Interest rates will increase, affecting consumption and investment, which are both key determinants of aggregate demand.

10. Given the high level of activity in international financial markets, it is typically believed that financial flows across borders are the real reason for trade imbalances. For example, the United States had an enormous trade deficit in...
the late 1990s and early 2000s because it was attracting vast inflows of foreign capital. Smaller countries that have attracted such inflows of international capital worry that if the inflows suddenly turn to outflows, the resulting decline in their currency could collapse their banking system and bring on a deep recession.

11. The demand for the country’s currency would decrease, lowering the exchange rate.

Chapter 20

1. False. Anything that leads to different levels of productivity between two economies can be a source of comparative advantage. For example, the education of workers, the knowledge base of engineers and scientists in a country, the part of a split-up value chain where they have their specialized learning, economies of scale, and other factors can all determine comparative advantage.

2. Brazil has the absolute advantage in producing beef and the United States has the absolute advantage in autos. The opportunity cost of producing one pound of beef is 1/10 of an auto; in the United States it is 3/4 of an auto.

3. In answering questions like these, it is often helpful to begin by organizing the information in a table, such as in the following table. Notice that, in this case, the productivity of the countries is expressed in terms of how many workers it takes to produce a unit of a product.

<table>
<thead>
<tr>
<th>Country</th>
<th>One Sweater</th>
<th>One Bottle of wine</th>
</tr>
</thead>
<tbody>
<tr>
<td>France</td>
<td>1 worker</td>
<td>1 worker</td>
</tr>
<tr>
<td>Tunisia</td>
<td>2 workers</td>
<td>3 workers</td>
</tr>
</tbody>
</table>

In this example, France has an absolute advantage in the production of both sweaters and wine. You can tell because it takes France less labor to produce a unit of the good.

4. 
   a. In Germany, it takes fewer workers to make either a television or a video camera. Germany has an absolute advantage in the production of both goods.
   b. Producing an additional television in Germany requires three workers. Shifting those three German workers will reduce video camera production by 3/4 of a camera. Producing an additional television set in Poland requires six workers, and shifting those workers from the other good reduces output of video cameras by 6/12 of a camera, or 1/2. Thus, the opportunity cost of producing televisions is lower in Poland, so Poland has the comparative advantage in the production of televisions. Note: Do not let the fractions like 3/4 of a camera or 1/2 of a video camera bother you. If either country was to expand television production by a significant amount—that is, lots more than one unit—then we will be talking about whole cameras and not fractional ones. You can also spot this conclusion by noticing that Poland’s absolute disadvantage is relatively lower in televisions, because Poland needs twice as many workers to produce a television but three times as many to produce a video camera, so the product with the relatively lower absolute disadvantage is Poland’s comparative advantage.
   c. Producing a video camera in Germany requires four workers, and shifting those four workers away from television production has an opportunity cost of 4/3 television sets. Producing a video camera in Poland requires 12 workers, and shifting those 12 workers away from television production has an opportunity cost of two television sets. Thus, the opportunity cost of producing video cameras is lower in Germany, and video cameras will be Germany’s comparative advantage.
   d. In this example, absolute advantage differs from comparative advantage. Germany has the absolute advantage in the production of both goods, but Poland has a comparative advantage in the production of televisions.
   e. Germany should specialize, at least to some extent, in the production of video cameras, export video cameras, and import televisions. Conversely, Poland should specialize, at least to some extent, in the production of televisions, export televisions, and import video cameras.
5. There are a number of possible advantages of intra-industry trade. Both nations can take advantage of extreme specialization and learning in certain kinds of cars with certain traits, like gas-efficient cars, luxury cars, sport-utility vehicles, higher- and lower-quality cars, and so on. Moreover, nations can take advantage of economies of scale, so that large companies will compete against each other across international borders, providing the benefits of competition and variety to customers. This same argument applies to trade between U.S. states, where people often buy products made by people of other states, even though a similar product is made within the boundaries of their own state. All states—and all countries—can benefit from this kind of competition and trade.

6. a. Start by plotting the points on a sketch diagram and then drawing a line through them. The following figure illustrates the average costs of production of semiconductors.

![Graph of average cost of production of semiconductors](image.png)

The curve illustrates economies of scale by showing that as the scale increases—that is, as production at this particular factory goes up—the average cost of production declines. The economies of scale exist up to an output of 40,000 semiconductors; at higher outputs, the average cost of production does not seem to decline any further.

b. At any quantity demanded above 40,000, this economy can take full advantage of economies of scale; that is, it can produce at the lowest cost per unit. Indeed, if the quantity demanded was quite high, like 500,000, then there could be a number of different factories all taking full advantage of economies of scale and competing with each other. If the quantity demanded falls below 40,000, then the economy by itself, without foreign trade, cannot take full advantage of economies of scale.

c. The simplest answer to this question is that the small country could have a large enough factory to take full advantage of economies of scale, but then export most of the output. For semiconductors, countries like Taiwan and Korea have recently fit this description. Moreover, this country could also import semiconductors from other countries which also have large factories, thus getting the benefits of competition and variety. A slightly more complex answer is that the country can get these benefits of economies of scale without producing semiconductors, but simply by buying semiconductors made at low cost around the world. An economy, especially a smaller country, may well end up specializing and producing a few items on a large scale, but then trading those items for other items produced on a large scale, and thus gaining the benefits of economies of scale by trade, as well as by direct production.

7. A nation might restrict trade on imported products to protect an industry that is important for national security. For example, nation X and nation Y may be geopolitical rivals, each with ambitions of increased political and economic strength. Even if nation Y has comparative advantage in the production of missile defense systems, it is unlikely that nation Y would seek to export those goods to nation X. It is also the case that, for some nations, the production of a particular good is a key component of national identity. In Japan, the production of rice is culturally very important.
It may be difficult for Japan to import rice from a nation like Vietnam, even if Vietnam has a comparative advantage in rice production.

**Chapter 21**

1. This is the opposite case of the Work It Out feature. A reduced tariff is like a decrease in the cost of production, which is shown by a downward (or rightward) shift in the supply curve.

2. A subsidy is like a reduction in cost. This shifts the supply curve down (or to the right), driving the price of sugar down. If the subsidy is large enough, the price of sugar can fall below the cost of production faced by foreign producers, which means they will lose money on any sugar they produce and sell.

3. Trade barriers raise the price of goods in protected industries. If those products are inputs in other industries, it raises their production costs and then prices, so sales fall in those other industries. Lower sales lead to lower employment. Additionally, if the protected industries are consumer goods, their customers pay higher prices, which reduce demand for other consumer products and thus employment in those industries.

4. Trade based on comparative advantage raises the average wage rate economy-wide, though it can reduce the incomes of import-substituting industries. By moving away from a country’s comparative advantage, trade barriers do the opposite: they give workers in protected industries an advantage, while reducing the average wage economy-wide.

5. By raising incomes, trade tends to raise working conditions also, even though those conditions may not (yet) be equivalent to those in high-income countries.

6. They typically pay more than the next-best alternative. If a Nike firm did not pay workers at least as much as they would earn, for example, in a subsistence rural lifestyle, they may never come to work for Nike.

7. Since trade barriers raise prices, real incomes fall. The average worker would also earn less.

8. Workers working in other sectors and the protected sector see a decrease in their real wage.

9. If imports can be sold at extremely low prices, domestic firms would have to match those prices to be competitive. By definition, matching prices would imply selling under cost and, therefore, losing money. Firms cannot sustain losses forever. When they leave the industry, importers can “take over,” raising prices to monopoly levels to cover their short-term losses and earn long-term profits.

10. Because low-income countries need to provide necessities—food, clothing, and shelter—to their people. In other words, they consider environmental quality a luxury.

11. Low-income countries can compete for jobs by reducing their environmental standards to attract business to their countries. This could lead to a competitive reduction in regulations, which would lead to greater environmental damage. While pollution management is a cost for businesses, it is tiny relative to other costs, like labor and adequate infrastructure. It is also costly for firms to locate far away from their customers, which many low-income countries are.

12. The decision should not be arbitrary or unnecessarily discriminatory. It should treat foreign companies the same way as domestic companies. It should be based on science.

13. Restricting imports today does not solve the problem. If anything, it makes it worse since it implies using up domestic sources of the products faster than if they are imported. Also, the national security argument can be used to support protection of nearly any product, not just things critical to our national security.

14. The effect of increasing standards may increase costs to the small exporting country. The supply curve of toys will shift to the left. Exports will decrease and toy prices will rise. Tariffs also raise prices. So the effect on the price of toys is the same. A tariff is a “second best” policy and also affects other sectors. However, a common standard across countries is a “first best” policy that attacks the problem at its root.
15. A free trade association offers free trade between its members, but each country can determine its own trade policy outside the association. A common market requires a common external trade policy in addition to free trade within the group. An economic union is a common market with coordinated fiscal and monetary policy.

16. International agreements can serve as a political counterweight to domestic special interests, thereby preventing stronger protectionist measures.

17. Reductions in tariffs, quotas, and other trade barriers, improved transportation, and communication media have made people more aware of what is available in the rest of the world.

18. Competition from firms with better or cheaper products can reduce a business’s profits, and may drive it out of business. Workers would similarly lose income or even their jobs.

19. Consumers get better or less expensive products. Businesses with the better or cheaper products increase their profits. Employees of those businesses earn more income. On balance, the gains outweigh the losses to a nation.
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Economic Growth


**Unemployment**


**Inflation**

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**The International Trade and Capital Flows**


The Aggregate Demand/Aggregate Supply Model


The Keynesian Perspective


The Neoclassical Perspective


Money and Banking


Monetary Policy and Bank Regulation


**Exchange Rates and International Capital Flows**


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**International Trade**


Globalization and Protectionism


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