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Philip J. Romero and Jeffrey A. Edwards, *Editors*

Learning Macroeconomic Principles Using MAPLE

Hal W. Snarr

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Abstract

Economics has been dubbed the "dismal science" since Thomas Carlyle coined the phrase in 1849. The 2008 presidential candidate who said, "Economics is something that I've really never understood," probably sides with this view. So, why is economics so dismal to so many? Is it because it has become too mathematical? Is it because traditional textbooks fail to connect topics and models in a concise, cohesive, and meaningful way? Is it because the computer simulations that are used to teach economic principles "stifle students' imagination, contribute to a dependent learning style, and fail to stimulate interest in the subject matter" (Wetzstein 1988)? Or, is it because economists from different schools of economic thought rarely agree on anything? This book uses MAPLE and the simulation models that I developed in *Learning Basic Macroeconomics* (2014) to make teaching or learning economics not so dismal. MAPLE is ideally suited for this because it allows users to assemble and systematically combine the various models that form the aggregate market model, frees users from doing tedious calculations and algebraic manipulations, and is as easy to use as Microsoft Word. Building and analyzing the macroeconomic model using MAPLE is a fun way to learn the dismal science.

Keywords

aggregate demand, aggregate expenditure, austrian economics, computer simulation, consumption function, crowding-out, demand and supply, discount rate, dismal science fiscal policy, fiscal policy lags, fiscal policy multipliers, fractional reserve banking, free trade, interest on reserves, long run aggregate supply, maple 18, monetary policy, open market operations, rational expectations, required reserves ratio, short run aggregate supply, supply-side economics, the chicago school, the classical school, the federal funds market, the keynesian school

Contents

Acknowledgments

I am indebted to my wife Lynn. Her encouragement and support is much appreciated.

Introduction

The goal of this book is to make learning the dismal science[1] less dismal. Many people who study economics would probably agree with economics' lasting moniker, especially the 2008 presidential candidate who said: "Economics is something that I've really never understood." Learning economics is dismal to so many for many reasons. It is too mathematical, for some. Traditional textbooks fail to connect the principles, topics, and the many models in a concise, cohesive, and meaningful way. The computer simulations that are used to teach economic principles tend to "stifle students' imagination, contribute to a dependent learning style, and fail to stimulate interest in the subject matter" (Wetzstein 1988). Finally, the economic policies that are advocated by economists from various schools of economic thought are contradictory.

This book uses MAPLE and the simulation models derived by me in *Learning Basic Macroeconomics* (2014) to teach macroeconomic principles in a unique and fun way. The computer program, which is installed on computers in many college computer labs, or can be purchased directly from Maplesoft,[2] is ideally suited for modeling the economy and simulating the effects of economic and policy shocks. It allows users to assemble and systematically combine the various models that combine to form the aggregate market model of the economy, frees users from doing tedious calculations and algebraic manipulations, and is nearly as easy to use as Word. In addition, the flexibility of modeling with MAPLE allows readers to quickly and easily compare and contrast the effects of policy changes from the perspectives of the major schools of economic thought.

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[1] In *Fraser's Magazine for Town and Country*, Carlyle wrote the following in 1849 essay titled Occasional Discourse on the Negro Question (see http://www.efm.bris.ac.uk/het/carlyle/occasion.htm): "[Free market economics] finds the secret of this universe in "supply and demand," and reduces the duty of human governors to that of letting men alone . . . [It is] a dreary, desolate and, indeed, quite abject and distressing one; what we might call, by way of eminence, the dismal science."

[2] Students who are enrolled at an academic institution can purchase the student version of the program at https://webstore.maplesoft.com/product.aspx?id=485

Modeling and simulating the macroeconomy in MAPLE makes this book different from all the others out there. Instructors will find the method described in this book a useful alternative to the more traditional method of teaching macroeconomic principles, while students will discover a fun alternative to learning these principles.

This book is organized into three parts. Chapters 1 and 2 lay the foundation of the aggregate market model. More specifically, Chapter 1 gives readers a basic working knowledge of MAPLE, while Chapter 2 introduces basic economic principles, and provides readers with meaningful MAPLE practice. In chapters 3 and 4, the simulation is constructed using data, Keynesian theory, and MAPLE. The simulation model is applied using hypothetical numerical values to better understand how the economy responds to changes in policy and economic conditions. Although the simulation model is founded on Keynesian theory, because it is elegantly simplistic and politicians apply it when enacting stimulus bills, this book is not an endorsement of Keynesian economics. In the final part of this book, the model is applied to better understand fiscal policy in Chapter 5 and monetary policy in Chapter 6. Chapter 7 evaluates the performance of economic policy before and after the 2008 financial collapse.

CHAPTER 1

How to Use MAPLE

MAPLE is a powerful computer algebra system, developed and sold by Maplesoft, that is used in this book to build, graph, and analyze a mathematical model of the macroeconomy, known as the aggregate market model. The program is ideally suited for this because it allows users to assemble and systematically combine the various models that form the aggregate market model, frees users from doing tedious calculations and algebraic manipulations, and is nearly as easy to use as Microsoft Word. Without MAPLE, the modeling that is performed in this book would be difficult for those who struggle with mathematics. Once basic MAPLE syntax is understood, which is the focus of this chapter; readers will find using the program to perform the modeling in this book to be an effective and perhaps fun way to learn macroeconomics.

After opening MAPLE, users will see the image in Figure 1.1 displayed on the desktop of their computers. To begin doing math, click CLOSE in the bottom right-hand corner of the small STARTUP window

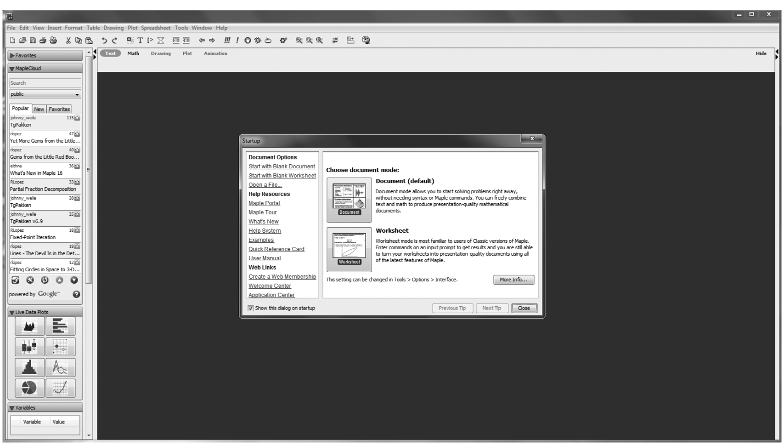
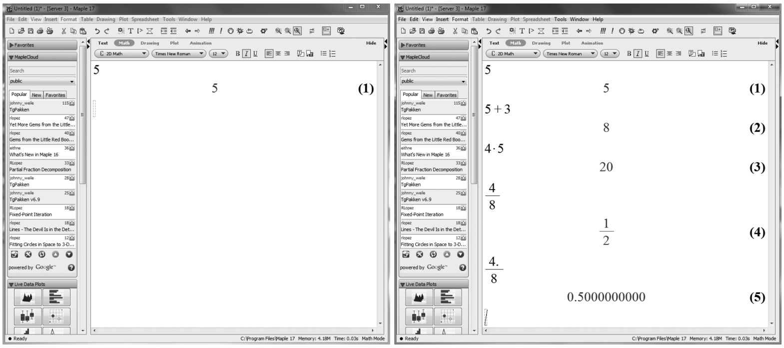


Figure 1.1 Launching MAPLE 18



(a) (b)

Figure 1.2 Getting started in MAPLE 18

that appears in the large dark gray area of the MAPLE window. This reveals the QUICK HELP window, which closes automatically if any number or letter is pressed on the keyboard. In Figure 1.2a, the number 5 key was pressed to close this window. When the ENTER key is pressed after number 5 is typed, MAPLE outputs the number in the center of the white page, and labels it, (1), in the right-hand margin. MAPLE displays input using black font, but uses blue font for output.

Figure 1.2b shows how a set of consecutive mathematical calculations are carried out in and displayed by MAPLE. The second input line asks MAPLE to add 5 and 3. Its output, 8, is labeled, (2). The third input line asks MAPLE to multiply 4 and 5. Although MAPLE displays the multiplication symbol as a dot between the two numbers, the operation is typed as 4*5. Once the asterisk is typed, MAPLE automatically replaces it with a dot. The final input lines ask MAPLE to divide 4 by 8. Once the forward slash is typed, MAPLE displays it as a division line directly below 4 in both input lines. MAPLE reduces 4/8 to 1/2 in output, (4). In output (5), the answer is reported as 0.5000000000 because a decimal point was placed after 4 in the input line.

For the sake of brevity, this book will not display screenshots of MAPLE. In addition, rather than presenting how MAPLE *displays* typed input, this book will show how input is *typed* into MAPLE. For example, the input commands and their respective outputs that are shown in Figure 1.2b will be displayed in this book as follows.

```
5
                    5
5+3
                    8
4*5
                    20
4/8
                    1/2
4./8
                    0.5
```

Graphing a line in MAPLE is straightforward. If the slope is 4 and the intercept is 8, pressing the ENTER key after typing the following defines an unnamed linear function.

```
4*x+8
                    4 x + 8
```

MAPLE's ditto operator, %, is the temporary name for the *previous* output. Its usefulness is demonstrated in the following exhibit.

```
%
                    4 x + 8
```

Thus, % is equivalent to the ANS function on a TI-83 calculator.[1] Ditto operator % is used again in the following **plot** command to graph $4x + 8$.[2]

```
plot(%,x=0..4,0..25)
```

The aforementioned command plots whatever % is *currently* defined to be, $4x + 8$ in this case, over values of *x,* from 0 to 4, and *y,* from 0 to 25. The graph is the upward sloping line in Figure 1.3.

[1] ANS is short for "answer." The ANS function is used to recall the last computed answer in the TI-83 calculator. This is done by pressing the 2nd key, and then the (–) key.

[2] Bold font will be used to identify MAPLE functions.

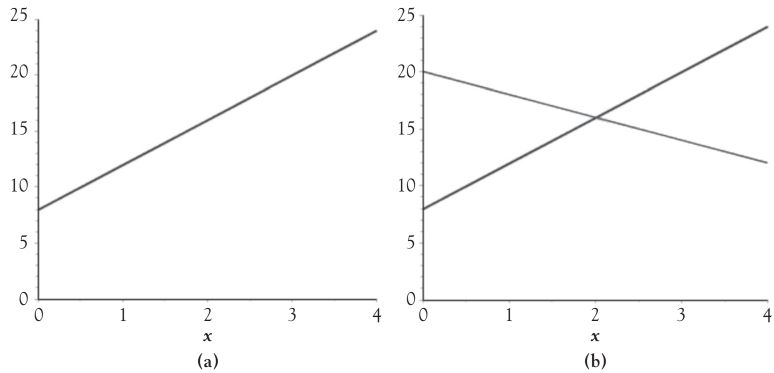


Figure 1.3 Graphing in MAPLE

Because % is the temporary name for the previous result, its use is limited if one wishes to graph multiple lines together. MAPLE's assignment operator, a colon followed by the equal sign, permits an expression like $4x + 8$ to be named. It can be named *Bob*, but is named y in the following exhibit because the vertical axis is universally referred to as the y-axis.

```
y:=4*x+8
```

$$4\,x + 8$$

Unless the program is restarted, MAPLE's **restart** command is executed, or y is reassigned, y and $4x + 8$ are one and the same. Replacing % in the prior **plot** command with y regraphs the upward sloping line shown in Figure 1.3a.

```
plot(y,x=0..4,0..25)
```

Working with the generic slope-intercept equation, $y = mx + b$, is much more flexible than a specific line like $y = 4x + 8$. To see this, give $mx + b$ the name "y." If the equal operator is mistakenly used instead of the assignment operator, the result is nonsense.

```
y=m*x+b
```

$$4\,x + 8 = m\,x + b$$

The left-hand side of the equation in the prior output is $4x + 8$, since y is still defined to be this expression. Using the assignment operator redefines y as $mx + b$.

```
y:=m*x+b
```

$$m\,x + b$$

In the following exhibit, the assignment operator is used to set slope *m* equal to 4 and intercept *b* equal to 8.

```
m:=4
```

$$4$$

```
b:=8
```

$$8$$

Pressing the ENTER key after typing *y* substitutes these values into *y*.

```
y
```

$$4\,x + 8$$

If *x* is set equal to 2, the value is substituted into $4x + 8$ when the ENTER key is pressed after typing *y*.

```
x:=2
```

$$2$$

```
y
```

$$16$$

The **unassign** command is used to return *x* to a variable, which restores *y* as expression $4x + 8$.

```
unassign('x')
```

$$x$$

```
y
```

$$4\,x + 8$$

In the following exhibit, $4x + 8$ is named Y0.

```
Y0:=y
```

$$4\,x + 8$$

If another line has an intercept equal to 20 and a slope of −2, the following commands generate a downward sloping line named Y1 that crosses the *y*-axis at 20.

```
b:=20:
m:=-2:
Y1:=y
                    -2 x + 20
```

Notice that the output of the first two commands in the aforementioned exhibit has been suppressed. This results from punctuating each of the input lines with a colon. These input lines can be more compactly entered on a single line provided there is at least one space between each assignment. This is demonstrated in the following exhibit.

```
b:=20: m:=-2:
Y1:=y
                    -2 x + 20
```

Y0 and Y1 are graphed together in Figure 1.1b using the following **plot** command, where Y0 is the upward sloping line and Y1 is the downward sloping line.

```
plot([Y0,Y1],x=0..4,0..25)
```

The intersection of the lines is found using the **solve** command. In the first input line in the following exhibit, the lines are set equal to each other. The second input line instructs MAPLE to solve the *previous* result, $4x + 8 = -2x + 20$, for x.

```
Y0=Y1
                4 x + 8 = -2 x + 20
solve(%,x)
                        2
```

To substitute this value into Y0 and Y1, x is set equal to the prior solution using the ditto operator, %.

```
x:=%
                                2
```

MAPLE automatically substitutes 2 into the lines when the ENTER key is pressed after typing Y0 and Y1. In either case, the height of the line is equal to 16.

```
Y0
                                16
Y1
                                16
```

Thus, the two lines in Figure 1.2b, named Y0 and Y1, intersect at $x = 2$ and $y = 16$.

MAPLE's **collect** command is very useful because it can be used to factor a specified variable. Suppose a mathematical system includes the following equations:

$$z = 3k + 4$$
$$y = 5k - 7 + z$$

If these relationships are defined in MAPLE, using the order in which they appear above, the right-hand side of the first equation, $3k + 4$, replaces z in the second when the ENTER key is pressed after defining the second relationship.

```
z:=3*k+4
                              3 k + 4
y:=5*k-7+z
                           3 k + 5 k - 3
```

Variable k is factored using the **collect** command in the following exhibit.

```
collect(%,k)
                              8 k - 3
```

All of the earlier variable definitions can be cleared by shutting down MAPLE, or using the **restart** command. Individual variables can be stripped of their values or mathematical expressions using the **unassign** command. Its use in the following exhibit clears only *z* and *y*.

```
unassign('z','y')
z
                                  z
y
                                  y
m
                                  -2
b
                                  20
x
                                  2
Y0
                                  16
Y1
                                  16
```

Using the **restart** command clears all definitions.

```
restart
z
                                  z
y
                                  y
m
                                  m
b
                                  b
x
                                  x
Y0
                                  Y0
Y1
                                  Y1
```

CHAPTER 2

Foundations of Macroeconomics

Macroeconomics analyzes how policy changes and economic shocks affect the economy as a whole. Because it is grounded in microeconomics, which studies issues that individuals and firms are concerned with, this chapter begins with an introduction to basic microeconomic principles. The production possibilities frontier (PPF) is used in the subsequent section to introduce macroeconomics, and to acquaint readers with concepts like GDP, potential output, unemployment, and the natural rate of unemployment. Since macroeconomic performance is assessed using these and other macrovariables, they are covered in great depth in the final section of this chapter.

Basic Microeconomic Principles

Microeconomics studies the behavior of individuals and firms. Firms seek maximum profits and individuals seek maximum satisfaction, or utility, but both are faced with constraints and scarce resources. For example, a cheese maker cannot sell its cheddar for *any* price it wants even if it is a *monopolist*, the only seller of a product. Likewise, it cannot buy milk from dairy farmers at any price it wants even if it is a *monopsonist*, the only buyer of a product.

Demand

The *demand curve*, or *demand*, is the force that prevents a firm from charging any price it wants. This is so because a product's demand represents the maximum price consumers are willing to pay for a given level of scarcity. The amount of a good or service that is purchased by a consumer at a given price is referred to as *quantity demanded*, which corresponds to a single point on demand. Thus, demand refers to a curve, and quantity demanded corresponds to a point on that curve.

The *Law of Demand* states that, all else being equal, the quantity demanded for a product declines as its price rises. The law is tested in a hypothetical experiment that asks people working near Main and Elm the question: With tacos selling at $1.25, how many hot dogs will you buy per week at a price of $6.50, or at $0.50? Table 2.1 shows hypothetical data from 875 respondents. The middle column indicates that respondents collectively demand 1,000 hot dogs when the price is $6.50. The point that corresponds to these values is labeled point A in Figure 2.1. In the right column of the table, survey participants collectively demand 7,000 hot dogs when the price drops to $0.50. These values correspond to point B in Figure 2.1. The line that connects the two points represents

Table 2.1 Hypothetical example of hot dog demand

Respondent's name (N = 875)	Quantity demanded at $P = 6.50$	Quantity demanded at $P = 0.50$
Tonya	0	18
George	0	6
Harold	4	9
⋮	⋮	⋮
Velma	0	1
Total	**1,000**	**7,000**

N, number of survey respondents; P, price in U.S. dollars

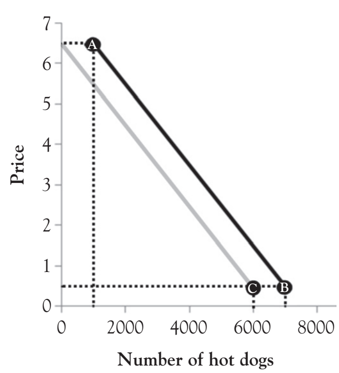


Figure 2.1 Hot dog demand

hot dog demand. It gives the *expected* quantity of hot dogs demanded for a given price. The *movement along demand* between points A and B indicates that the Law of Demand holds true.

Suppose the survey participants are then asked how their previous responses will change if the taco price falls to \$0.75, and the resulting data produce the gray line in Figure 2.1. This line represents final hot dog demand. Point C indicates that the *expected* quantity of hot dogs demanded drops by 1,000 per week when the price of tacos falls to \$0.75, holding the hot dog price constant at \$0.50. The gray and black lines model a *decrease in the demand* for hot dogs.

The equations for initial and final hot dog demand can be fit using the point-slope formula from algebra. The parallel lines in Figure 2.1 have the same slope. It is computed in the following exhibit using the changes in price and quantity from point A to point B.

```
Pa:=6.5:   Qa:=1000:
Pb:=0.5:   Qb:=7000:
m:=(Pb−Pa)/(Qb−Qa)
                                  −0.001
```

In the ensuing exhibit, point A and the slope are substituted into the point-slope formula.

```
P−Pa=m*(Q−Qa)
```

$$P - 6.5 = -0.001\ Q + 1$$

The **solve** command is used to solve the *previous* result for *P*, which adds 6.5 to both sides of the equation.

```
Pd:=solve(%,P)
```

$$-0.001\ Q + 7.5$$

This result is named Pd since it gives the prices along initial (black) demand in Figure 2.1. If point C had been used instead of point A, the process above would have given final (gray) demand in the figure.

The price of tacos falling to \$0.75 shifts hot dog demand leftward, reduces the quantity of hog dogs demanded, and increases the number of tacos that are purchased (by the law of demand). Since fewer hot dogs and more tacos are consumed when the taco price declines, the two goods are *substitutes*. If the fall in taco price had shifted hot dog demand rightward, the gray line would lie to the right of the black line, and the two goods would be *complements*.

Other factors shift demand. If the decline in hot dog demand was instead caused by an increase in consumer income, hot dogs would be an *inferior good*. If the decline in hot dog demand is caused by a decrease in consumer income, hot dogs would be a *normal good*. The decrease in hot dog demand can be caused by changes in *tastes and preferences*. A decrease in the neighborhood's *population* will decrease demand because the number of potential hot dog consumers is simply lower.

The *price elasticity of demand* measures consumers' sensitivity to price changes. It can be computed by dividing the price-quantity ratio at a point on demand by the line's slope (m). With a price-quantity ratio of $6.50 to 1,000 hot dogs at point A, price elasticity of demand is –6.5.

```
e=(Pa/Qa)/m
```

$$e = -6.5$$

At $6.50, the elasticity implies a price increase of 1 percent reduces hot dog consumption by 6.5 percent. Because the percent change in consumption is larger than the percent change in price, consumers are very sensitive to the price change, and demand is said to be *elastic* at $6.50. At point B, with 7,000 hot dogs consumed at $0.50, the elasticity is –0.07.

```
e=(Pb/Qb)/m
```

$$e = -0.07$$

At $0.50, the elasticity implies a price increase of 1 percent reduces hot dog consumption by 0.07 percent. Because the percent change in consumption is smaller than the percent change in price, consumers are very insensitive to the price change, and demand is said to be *inelastic* at $0.50. Thus, consumers get increasingly sensitive to rising prices.

Supply

While the demand curve models consumer behavior, the *supply curve* models firm behavior. The supply curve, or supply, is the section of the marginal cost curve that lies above the average variable cost curve.[1] Intuitively, supply gives the minimum price firms are willing to accept to produce a given amount of their product. The amount produced is referred to as the *quantity supplied*. Thus, supply refers to a curve, and quantity supplied corresponds to a point on that curve.

Supply slopes up because, according to the *Law of Supply*, a firm will generally increase output as its product's price rises. This is tested in the following hypothetical experiment: Suppose there is a database that tracks U.S. hot dog production at the city level, and *regression analysis*[2] is applied to the resulting data, which yields

$$P = 0.995 - 0.1T + 0.7W + 0.01R + 1P_b + 0.001Q$$

Variable T indicates a solar panel is installed on the cart's roof,[3] W is the wage paid to workers, R is the city regulation index, and P_b is the price of hot dog buns. The preceding equation is defined in MAPLE using the assignment operator, which is demonstrated below.

```
Ps:=0.995–0.1*T+0.7*W+0.01*R+1*Pb+0.001*Q
```

The function is named Ps because it gives the prices along supply that correspond to various hot dog production levels, holding all other factors constant.

To graph supply, all variables but P and Q are set equal to their means. This is done in the following exhibit, using hypothetical means.

```
T:=60:     W:=7.25:     R:=30:     Pb:=0.13:
```

[1] Marginal cost is the change in firm costs resulting from a 1-unit increase in output, while average variable cost is the firm's variable cost at a given level of output divided by that output level.

[2] Regression analysis is a statistical technique that is used to estimate linear functions.

[3] T equals 1 if a hot dog cart has a solar panel, but equals 0 if the panel is not installed.

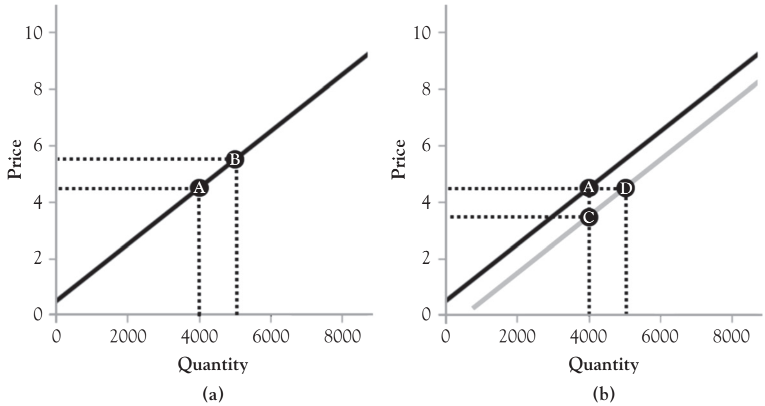


Figure 2.2 Hot dog supply

The means are substituted into the supply equation when the ENTER key is pressed after typing Ps.

```
Ps
```

$$0.001\ Q + 0.5$$

The ensuing **plot** command graphs hot dog supply, the black line in Figure 2.2, with technology, wages, regulations, and the prices of buns held constant at the assumed means.

```
plot(Ps,Q = 0..10000)
```

The coefficient of Q indicates how quantity supplied responds to a change in price, holding all other factors constant. Its value, 0.001, implies that the quantity supplied will increase by 1,000 hot dogs if the price increases by one dollar, which is demonstrated by the movement along supply from point A to B. At point A, 4,000 hotdogs are supplied at \$4.50. At point B, the price and quantity supplied have risen to \$5.50 and 5,000 hot dogs. Thus, the Law of Supply holds true.

Supply's other coefficients determine by how much and in what direction supply shifts. For example, the coefficient on the price of hot dog buns associates a one dollar decrease in the price of buns with hot dog supply shifting downward by one dollar, which is modeled by the shift from A to C in Figure 2.2b. Between these points, quantity supplied is held constant at 4,000 hot dogs. The downward shift in supply represents a *decrease in marginal cost*. Because the price of hot dogs is held constant at $4.50 from A to D in the figure, D is on the same curve as C, and the quantity of hot dogs supplied increases from 4,000 (at point A) to 5,000 (at point D), a decrease in marginal cost corresponds to an *increase in supply*. The coefficients of *R* and *W* associate more regulation and higher wages to lower supply, while *T*'s coefficient links technology adoption to greater supply.

Price elasticity of supply measures firms' sensitivity to a change in price. It can be computed by dividing the price-quantity ratio at a point on supply by the coefficient of *Q*, 0.001 in this case. At point B in Figure 2.2a, with a price-quantity ratio of $5.50 to 5,000 hot dogs, price elasticity of supply equals 1.1.

```
e=(5.50/5000)/(0.001)
```

$$e = 1.1$$

The elasticity implies that hot dog production will rise by 1.1 percent when the price increases by 1 percent.

The Law of Supply and Demand

The *Law of Supply and Demand* states that forces of supply and demand push the price of a good toward the price at which quantity supplied and quantity demanded are equal. Replacing Ps with [Pd0, Ps] in the previous **plot** command graphs initial hot dog demand against supply. The result is shown in Figure 2.3a. Point A in the figure is called the *equilibrium*. It is determined by first setting demand (Pd) equal to supply (Ps).

```
Ps=Pd
```

$$0.001\ Q + 0.5 = -0.001\ Q + 7.5$$

The following command *solves* the *previous* result for *Q* to determine the *equilibrium quantity*.

```
Q:=solve(%,Q)
```

$$3500$$

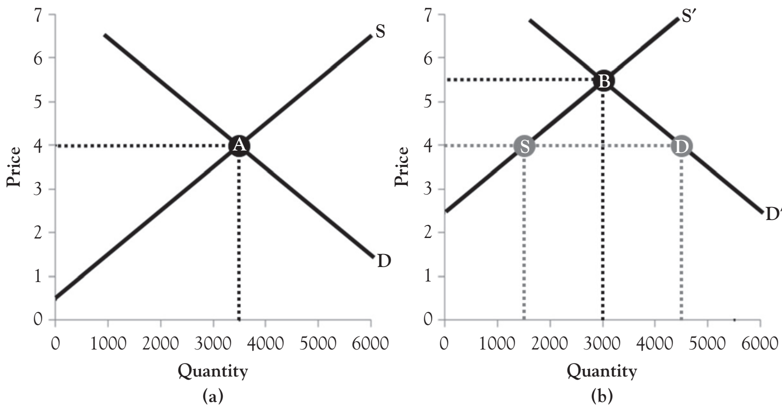


Figure 2.3 The law of supply and demand

Pressing the ENTER key after typing Ps substitutes the equilibrium quantity, 3,500 hot dogs, into supply.

```
Ps
                                   4
```

If Pd had been typed instead of Ps, the result would have been the same, four dollars. At this price, the number produced equals the amount purchased, and the hot dog market is said to have *cleared*.

In Figure 2.3b, hot dog demand has increased to D′ and supply has decreased to S′. If the price remains at four dollars, the market will not clear, which results in a *shortage* of 3,000 hot dogs, the difference in the quantities at points D and S. To prevent a stock out, vendors raise their prices to the new market clearing price of \$5.50. A *surplus* would have resulted instead had price exceeded its equilibrium, which is not shown. To shed a surplus, firms lower their prices to clear the market.

Free Markets versus Central Planning

Free-market capitalism is the antithesis of *central planning*. To demonstrate the difference, suppose Figure 2.3 represents the gasoline market in the southern region of the United States just before (Figure 2.3a) and just after (Figure 2.3b) a hurricane strikes. The rise in demand is due to consumer hoarding, while the decline in supply results from gulf coast oil rigs and gasoline refineries in the path of the hurricane being shut down and evacuated. The storm further disrupts supply by interrupting the distribution of gasoline over road and rail. In the figure, overall gasoline consumption falls from 3,500 (point A in Figure 2.3a) to 3,000 (point B in Figure 2.3b). The shocks raise the market price to $5.50. Thus, when markets are free from government intervention, the price is allowed to rise after a natural disaster, gasoline is conserved, and there is no shortage.

Now suppose Figure 2.3a represents the gasoline market in the west just after the hurricane hits the south, and Figure 2.3b represents the gasoline market in the south at that same moment in time. In a free-market economy, the large regional price differential encourages gasoline producers to shift gasoline supplies from west to south. The increase in southern supply and the decrease in western supply pushes the regional price differential toward zero. Once the (cost-adjusted) differential is zeroed, suppliers adjust inventory replenishment rates to keep it there. In free-market capitalism, self-interested, profit-maximizing firms shift more gasoline to the storm-ravaged southern economy, which makes western consumers share the burden of the natural disaster, and renders government disaster planning, like price controls, unnecessary. Adam Smith explains why this is so in *An Inquiry into the Nature and Causes of the Wealth of Nations*, writing: “It is not from the benevolence of the butcher, the brewer, or the baker that we expect our dinner, but from their regard to their own self-interest.”

If the gasoline price remains elevated for an extended period of time, consumers may trade gas guzzlers for fuel-efficient cars, and firms may drill for more crude oil, or introduce vehicles that are less costly to operate. All of these reduce the gasoline price, holding all other factors constant.

Under central planning, prices are set by government decrees. These can take the form of a *price ceiling* or *price floor*. Once again, suppose Figure 2.3 represents the southern gasoline market before (Figure 2.3a) and after (Figure 2.3b) a hurricane, and government sets a per gallon price ceiling of four dollars to *limit* the pain caused by the storm. This well-intentioned policy has an unintended consequence. According to the figure, a 3,000-gallon gasoline shortage hits the south. This is caused by the price ceiling being set at the prestorm market clearing price, which is $1.50 lower than the poststorm market clearing price. Although the price ceiling is an easy political sell at the moment it is enacted, discontent will build as the shortage it causes lengthens consumers' wait times. If the price ceiling is kept in place, and the shortage persists, government may ration gasoline by limiting the quantities consumers can purchase on days determined by the last character of their license plates.[4] When policy-induced shortages are severe, consumers cannot buy any gasoline at the artificially low price. This is why black markets[5] tend to form in centrally planned economies.

Price floors have unintended consequences, too. Price floors can result in excessive inventories. In low-skilled labor markets, hiking the minimum wage can increase the number of unemployed workers. The consequence of the 1980s' milk price floor raised the government's dehydrated milk inventory. To alleviate the problem, warped solutions like paying farmers to kill dairy cows or mixing dehydrated milk into the fresh milk supply were tried (Bovard 1991).

Introduction to Macroeconomics

The production possibilities frontier (PPF) is used to introduce macroeconomics, the study of issues affecting the economy as a whole. A PPF, which depicts different combinations of two products that an economy can produce using the best available technology and all available resources, is used to introduce GDP, potential output, unemployment, and the natural rate of unemployment. In a second PPF example, two linear PPFs are used to demonstrate the benefits of free trade. The section concludes with a final PPF example that is used to introduce government budget surpluses and deficits.

The Economics of Government Provided Healthcare

Figure 2.4 graphs a PPF for healthcare against the production of all other products. Point A is inefficient because resources and technology are underemployed. Points B, C, and D are attainable and efficient because the economy is utilizing all of its available resources and technology.

---

[4] See "A Government Imposed Disaster: Price Controls in the Wake of Sandy" by Benjamin Powell (*Huffington Post*, 11/05/2012)

[5] Examples of black markets include illegal services procured by pimps, or illegal stimulants sold by drug dealers.

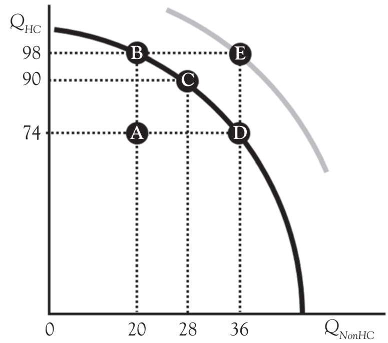


Figure 2.4 Modeling economic output

Q_{HC}, Quantity of healthcare units; Q_{NonHC}, Quantity of non-healthcare units

The point on the PPF where products' prices equal their marginal costs is said to be *allocatively efficient*. There is only one such point on the PPF, which is assumed to be point D. Although E is unattainable in the short run, it is attainable over the long run as the PPF shifts outward when new resources and technologies are discovered (or lands are conquered).

If the economy is at point A, it is producing 74 units of healthcare and 20 units of other goods. The dollar value of this is referred to as GDP. Because it is less than *potential output*, the value of economic output at points along the PPF, the economy is said to be in a *recessionary gap* at point A. In this situation, the *unemployment rate*, the share of the labor force that is unemployed and looking for work, exceeds the *natural rate of unemployment*, the rate that prevails at points along the PPF. If the economy moves to point D, no healthcare is given up to get the additional 16 units of other products. This might seem like society is getting something for nothing, a free lunch if you will, but is not because high unemployment at point A causes idle workers to bid down wages. This reduces firms' marginal costs, which leads to greater firm production, and pushes the economy from A to D. Thus, GDP tends to hover near the PPF in a free society.

With the economy at allocatively efficient point D, the decision to produce more of a good involves a *trade-off*. If government directs the economy to produce 16 more units of healthcare, society must give up 8 units of other products. This puts the economy at point C. The *opportunity cost*[6] of healthcare is computed by dividing the number of units of other goods that must be given up, 8 in this case, by the number of healthcare units gained, 16 in this case. Hence, from point D to C, it costs society an average of 0.5 units of other goods to produce an additional unit of healthcare. Suppose government nudges the economy from C to B because it believes even more healthcare is better. The move from C to B means that society gets 8 more units of healthcare, but gives up 8 units of other products. Thus, on average, the opportunity cost of an additional healthcare unit increases to 1 unit of all other goods. Thus, moving up along the PPF, from the right to the left, increases the cost of healthcare from 0.5 to 1. This results from the economy becoming increasingly specialized as more and more resources that are poorly suited to produce healthcare, such as economists with bad bedside manners, are being used to produce it.

The Economics of Free Trade

Figure 2.5 depicts two PPFs that model trade between Mississippi and Alabama. For simplicity, both economies produce tobacco or corn. The PPFs are assumed to be linear because the resources used to produce these goods are nearly identical. If both economies devote all of their resources to the production of tobacco, neither economy produces corn. In this situation, Mississippi produces 1,200 hogsheads of tobacco and Alabama produces 1,000. Because Mississippi produces more tobacco when both economies devote all of their resources to its production, Mississippi is said to have an *absolute advantage* in tobacco. If, on the other hand, both states devote all of their resources to the production of corn, the figure indicates that Mississippi produces 300 bushels of corn and Alabama produces 500. Hence, Alabama has an absolute advantage in corn. If an economy has the absolute advantage in both goods, it has an *absolute advantage in trade*, which is not the case here.

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[6] The opportunity cost of college does not include room and board because these expenses are paid whether or not a person goes to college. It does, however, include the earnings from a job that is forgone to attend college.

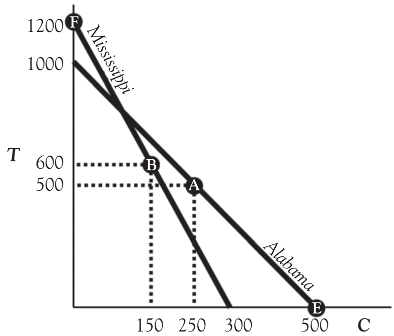

Figure 2.5 Modeling free trade

Trade and production decisions are based not on absolute advantage but on *comparative advantage*, which is the ability of a state to produce a product at a lower cost than the other. With regard to producing one more bushel of corn, the slopes of the PPFs, –4 for Mississippi and –2 for Alabama, indicate that Mississippi must give up four hogsheads of tobacco and Alabama must give up two. Hence, Alabama's opportunity cost of corn production is lower, which gives it the comparative advantage in corn. With regard to producing one more hogshead of tobacco, the inverses of the slopes, –0.25 for Mississippi and –0.5 for Alabama, indicate that Mississippi must give up 0.25 bushels of corn and Alabama must give up 0.5. Because Mississippi's cost of producing tobacco is lower than Alabama's, it has the comparative advantage in tobacco. Each state will have a comparative advantage in an industry even if one of them has the absolute advantage in trade—provided the PPFs are not parallel. When linear PPFs intersect, as they do in Figure 2.5, the states do not have the absolute advantage in trade, and the state with the absolute advantage in an industry has the comparative advantage in that same industry.

Suppose Alabama and Mississippi have erected trade barriers (import tariffs and quotas) in a trade war. The two states must devote resources to both industries, if their citizens wish to consume both goods. Assuming that the resources are split equally, Alabama produces 250 bushels of corn and 500 hogsheads of tobacco (point A), and Mississippi produces 150 bushels of corn and 600 hogsheads of tobacco (point B). If the prices of corn and tobacco are $2.50 per bushel and one dollar per hogshead, Alabama's GDP is $1,125 and Mississippi's is $975, which sums up to $2,100.

Suppose the states sign a free trade agreement. With Mississippi having the comparative advantage in tobacco, it produces 1,200 hogsheads of tobacco and no corn (point F). Because Alabama has the comparative advantage in corn, it produces 500 bushels of corn and no tobacco (point E). Free trade raises Alabama's GDP to $1,250, Mississippi's to $1,200, and total GDP to $2,450. Its costs, however, include Mississippi outsourcing corn jobs to Alabama, and Alabama outsourcing tobacco jobs to Mississippi. Opponents of free trade point this out when they argue against free trade pacts. When making this argument they fail to mention that free trade grows the industries the states have comparative advantages in. In the example, Mississippi's tobacco and Alabama's corn industries, which doubled in size, provide opportunities to displaced workers. Moreover, the additional income accruing in these states can be used to buy potatoes from Idaho, oranges from Florida, and MBAs from Massachusetts's Harvard University.

Government Budget Deficits Are the Norm

The *budget balance* is the difference between tax revenue (T) and government expenditures (G). When the budget balance is zero, expenditures equal tax revenue. If expenditures exceed tax revenue in a given year, the budget balance is negative, and the amount is called a *budget deficit*. Since it is financed with newly auctioned Treasury securities, budget deficits increase the national debt. If tax revenue exceeds expenditures in a given year, the budget balance is positive, and is called a *budget surplus*. Running budget surpluses pays down the national debt.

The *budget line* depicts the combinations of government services that produce balanced budgets. If government provides Q_h units of healthcare at $100 per unit and Q_m units of military protection at $120 per unit, its healthcare expenditure is $100Q_h$ and its military expenditure is $120Q_m$. Government expenditure is their sum, and is defined in the ensuing exhibit.

```
G:=100*Qh+120*Qm
```

If government collects $24,000 in taxes per citizen, the budget balance is given as follows:

```
24000=G
```

$$24{,}000 = 100\ Q_h + 120\ Q_m$$

Solving this for Q_h gives the budget in terms of military services provided by government.

```
solve(%,Qh)
```

$$240 - 1.2\ Q_m$$

The **plot** command in the following exhibit produces the graph of the budget in Figure 2.6.

```
plot(%,Qm=0..240)
```

Allocations of services along the budget line (points C and L) balance the budget, while a point inside the line (point S) represents a surplus.

To show why budget deficits are the rule rather than the exception in the United States, assume that liberal politicians get voted out of office if healthcare falls below 180 units, and conservatives get voted out if military protection falls below 150 units. If the rhetoric of politicians includes

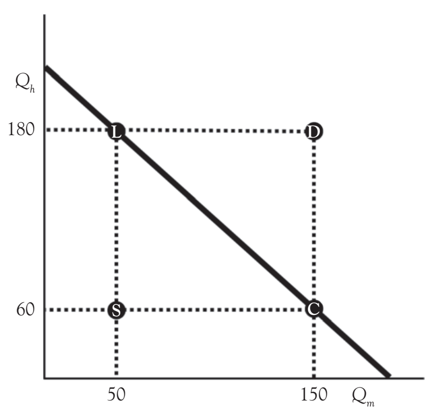

Figure 2.6 Modeling the fiscal budget balance

platitudes for balancing the budget, liberals will propose point L and conservatives will propose point C. If liberals are unwilling to compromise on healthcare spending and conservatives are unwilling to compromise on military spending, a deficit of $12,000 (point D) results because balanced budgets are not required by law. To politicians, this compromise is a free lunch of sorts. Conservative voters get the military they demanded and more healthcare than they asked for, liberal voters get the healthcare they demanded and more military protection than they asked for, and voters' taxes are not raised. Deficits, however, are not a free lunch. Treasury sells securities to cover them, which are paid back in the future by people who are currently too young to vote.

Macrovariables

Macrovariables like GDP, potential output, the unemployment rate, and the natural rate of unemployment are interrelated.[7] Accelerating economic growth increases real GDP relative to potential output. This pushes unemployment below its natural rate. As unemployment falls, labor markets tighten. This puts upward pressure on wages, as firms compete for fewer and fewer workers to keep pace with strong product demand. If firms are able to pass on higher production costs to consumers in the form of higher prices, interest rates may rise. Thus, knowing the definitions of the key macrovariables and understanding how they are measured is important.

Inflation

Textbooks define *inflation* as a general increase in the prices of products. This suggests that *anything* that causes prices to rise is inflationary. However, Milton Friedman (1970) argued that inflation arises from the money supply growing more rapidly than real GDP. Monetarists like Friedman claim that, because price spikes reduce the money that is available for products when the quantity of money is constant, expanding the money

[7] For brevity's sake, all data are from the Federal Reserve Economic Data unless otherwise noted.

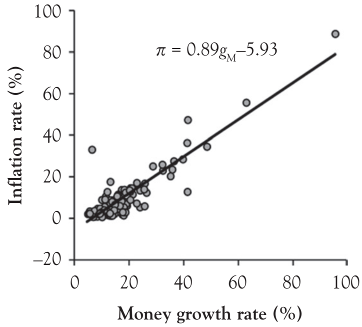

Figure 2.7 Inflation versus the growth in money

supply at an excessive rate allows all prices to adjust up. Figure 2.7 supports this view.[8] The figure indicates that, over the long run, inflation rises nearly one-for-one in the growth of a country's money supply.

However inflation is defined, it is measured by computing the growth rate in the *price level* (PL) from year to year. In the United States, the *Consumer Price Index* (CPI) is a common measure of inflation.[9] The CPI is an average price of products. The set of products used to compute this average is referred to as the *market basket*. It includes 80,000 products, divided into eight categories, with the largest being housing. Because consumers purchase several loaves of bread a month and a new television once in a while, items included in the market basket are weighted. Product weights, which can be thought of as the quantities of products purchased each month by the typical consumer, are determined by the Consumer Expenditure Survey. The weights are held constant for a few years to compare prices over time. Every month, each item in the market basket is priced in multiple locations, and then averaged over 30 metropolitan areas. For a given period, the total cost of the market basket

[8] International Financial Statistics data for 120 countries, averaged over the years 1996 to 2004, are used in Figure 2.7.

[9] The Personal Consumption Expenditure Price Index (PCEPI) is broader than the CPI because it includes the prices of all consumer products. The Federal Reserve monitors inflation using the core PCEPI, which is the PCEPI with food and energy prices excluded. The GDP Deflator Price Index (DPI) is broader than PCEPI because it includes the prices of all final goods and services produced domestically.

Table 2.2 Price level (PL), consumer price index (CPI), and inflation

Year	PL* ($)	CPI (%)	Inflation (%)
1982	543.47	97	6.6
1983	560.28	100	3.1
1984	582.69	104	4.0
⋮	⋮	⋮	⋮
2007	1,159.78	207	2.5
2008	1,204.60	215	3.9
2009	1,204.60	215	0.0
2010	1,221.41	218	1.4
2011	1,260.63	225	3.2

*The dollar-valued PLs are simulated from the CPI values that are from the BLS.

BLS, Bureau of Labor Statistics

is computed. It is the dollar-valued PL. Table 2.2 displays hypothetical dollar-valued PLs.

The Bureau of Labor Statistics does not publish the dollar-valued PL. Instead, it releases the CPI. The CPI equals the ratio of the PL for a given year and the PL in base year 1983, which is assumed to be $560.28 in Table 2.2. The following equation computes the CPI values listed in Table 2.2.

$$\text{CPI} = \frac{\text{PL}}{560.28}$$

The 1983 PL ($560.28) is plugged into this equation in the next exhibit

```
560.28/560.28
                                1.00
```

Multiplying this by 100 gives the 1983 CPI (100) that is listed in Table 2.2. The 2011 PL ($1,260.07) is plugged into the CPI equation to compute the 2011 CPI in the following exhibit.

```
1260.63/560.28
                              2.25
```

Subtracting the base year CPI (100) from the 2011 CPI (225) gives the *percent* increase in prices from 1983 to 2011. The difference, 125, indicates that prices rose by 125 percent in 28 years, which means that a taco costing $1 in 1983 is expected to cost $2.25 in 2011.

The annual percent change in the price index (PI) is the *inflation rate* (π), which can be computed using the following equation.

$$\pi = \frac{PI_{is}}{PI_{was}} - 1$$

Annual CPI inflation between 2011 and 2010 is found by substituting the price index in 2011 (2.25) and in 2010 (2.18) into the above equation.

```
2.25/2.18–1
                              0.032
```

Multiplying this by 100 gives the 2011 inflation rate listed in Table 2.2. Negative inflation is called *deflation*, which indicates that prices fell during a given year. *Disinflation* is present if inflation declines over time. The table indicates disinflation from 1982 to 1983, and from 2008 to 2009.

The yearly earnings printed on a worker's Internal Revenue Service Form W-2 is an example of a *nominal variable*. Over time, its value tends to rise for two primary reasons. First, Mincer's (1958) earnings function suggest that wages rise (at diminishing rates) as workers age because investments in human capital decline as returns on earlier investments rise. Second, modest steady inflation is a goal of the Federal Reserve, or the Fed. In order to compare values of a nominal variable over time, inflation must be stripped from it. A nominal variable that has been stripped of inflation is called a *real variable*. The following *real variable equation* converts nominal variable x_n into real variable x.

$$x = \frac{100}{\text{CPI}} \cdot x_n$$

This equation values variable *x* in 1983-dollars because the numerator of the preceding equation equals the value of the CPI in 1983.

The federal minimum wage rates in 1984 and 2010 cannot be compared because the first is in 1984-dollars and the other is in 2010-dollars. Plugging the 1984 values of the minimum wage ($3.35) and CPI (104) into the prior equation values the 1983 minimum wage in 1983-dollars.

```
(100/104)*3.35
                                   3.22
```

Plugging the 2010 values of the minimum wage ($7.25) and CPI (218) into the same equation values the 2010 minimum wage in 1983-dollars.

```
(100/218)*7.25
                                   3.33
```

The resulting *real* wages can be compared. The comparison implies that minimum wage workers were better off in 2010 than they were in 1984 because their wages were $0.11 higher in real terms.

Comparisons of a product's price through time do not have to be made with 1983-dollars. Any year's dollars can be used. For example, if one wishes to compare the price of a Hershey bar in 1936, $0.05 according to FoodTimeline.org, to its 2011 price, the 1936 price can be inflated to 2011-dollars. This is done by replacing the numerator of the real variable equation, the value of the CPI in 1983 (100), with the value of the CPI in 2011 (225).

$$x = \frac{225}{\text{CPI}} \cdot x_n$$

With the value of the CPI in 1936 equal to 14, the 1936 price is converted to 2011-dollars in the subsequent exhibit.

(225/14)*0.05

0.80

Since a Hershey bar cost about one dollar in 2011, in real terms, it was about $0.20 cheaper in 1936.

Interest Rates

The interest rate stated on a mortgage is an example of a nominal interest rate. It is the percentage of the principal that the borrower agrees to pay back each period until the loan matures. In the final period of the loan, the borrower pays the lender the final interest payment and the remaining principal. Interest compensates lenders for the time value of money. Instead of making the loan, the lender could have spent the amount buying consumer goods. Interest also compensates lenders for taking on risks.[10] Because short-term bonds are less risky than longer-term bonds, for a given set of attributes, a bond's interest rate generally rises with maturity. For a given type of security (e.g., those issued by the United States Treasury), plotting interest rates over maturity gives the yield curve, which tends to steepen as economic growth accelerates.

Although there are numerous nominal interest rates because risks vary across individuals and types of loans, there is only one in macroeconomics. It is determined in the loanable funds market. In this market, borrowers demand funds that are supplied by lenders, and borrowers pay lenders nominal interest rate i, which is the sum of real interest rate r and inflation rate π.

$$i = r + \pi$$

This equation suggests a one-for-one relationship between inflation and the nominal interest rate. The relationship is called the *Fisher effect.*

[10] Borrowers may default and collateral may have been overvalued (systematic risk), government may change regulation and tax rules before loans are paid off (regulatory risk), or future payments may be eroded by an unexpected jump in inflation or exchange rates (inflation risk).

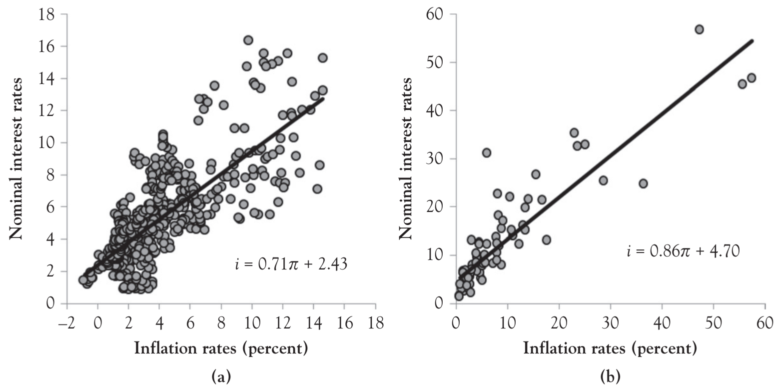

Figure 2.8 The Fisher effect

Figure 2.8a indicates that the interest rate on three-month U.S. Treasury bills increases by 0.71 percentage points when CPI inflation rises by 1 percentage point. Figure 2.8b provides stronger, international support for the Fisher effect.[11]

The yield on government-issued, inflation-indexed bonds is used to compute expected inflation. In the United States, these bonds are called *Treasury Inflation Protected Securities* (TIPS). The difference between the yields from conventional Treasuries and TIPS of the same maturity is called the *TIPS spread.* It is the market's valuation of expected inflation. If the TIPS spread is 3.5 percent and the nominal rate of interest is 1 percent, the real rate of interest is –2.5 percent.

Economic Growth

GDP is the market value of all final goods and services produced domestically during the year. It can be computed using the production, aggregate expenditure, or income methods, which are illustrated in the example summarized in Table 2.3. The production method sums up the value added by each firm. Osgood Farm's value added is equal to its revenue, \$118, because its raw material purchases were 0. For IdaWa Fries, value added is \$82 because its \$166 in revenue has to be adjusted

[11] International Financial Statistics data for 75 countries, averaged over the period 1996 to 2004 are used in Figure 2.8b.

Table 2.3 The production, income, and expenditure methods of computing GDP

Firm	Value	Production	Income	Expenditure
Osgood Farm				
Wages paid to employees	50		50	
Taxes paid to government	16		16	
Raw materials	0			
Revenue received from sale of potatoes				
Potatoes sold to consumers	34			34
Potatoes sold to other firms	84	118		
Profit	52		52	
IdaWa Fries				
Wages paid to employees	33		33	
Taxes paid to government	10		10	
Potatoes purchased from Osgood Farm	84			
Revenue received from sale of french fries	166	82		166
Profit	39		39	
Total		**200**	**200**	**200**

for the $84 in potatoes that were purchased from Osgood Farm. The income method sums up incomes from labor ($50 and $33) and capital ($52 and $39), and the taxes government collects, which extracted $16 from Osgood Farm and $10 from IdaWa Fries. The aggregate expenditure method sums up consumer, business, government, and net foreigner expenditures, and all but consumer expenditures are zero. Here, consumer expenditures, $200, account for 100 percent of GDP. All three methods give the same value of GDP because production equals income, which equals expenditure.

Calculating GDP is messy. In a given year, legal and illegal final products are produced domestically, and most transactions are recorded, but others are not. The purchases of stocks and bonds do not show up in GDP, but the commissions earned from these sales do. War and natural disasters overstate GDP because money spent rebuilding structures destroyed by bombs and Mother Nature could have been used to expand factories.

Product quality improvements understate GDP because newer and older models are treated the same. Because used cars, previously owned homes, and items sold in yard sales were produced in prior years, these transactions are excluded from GDP. Intermediate goods like computer chips and tires are excluded too because these are installed on final products sold at a future date. Illegal goods and services like crack and prostitution are excluded because drug dealers and pimps do not report annual sales to government.[12] GDP does not include unpaid household production and leisure because receipts do not accompany these activities.[13] Not all unrecorded transactions are excluded from GDP. Those that are included are called *imputations*. Between 2005 and 2012, imputations accounted for 16.5 percent of GDP.[14] Imputations include job perks like employer-provided parking spaces and the proportion of vegetables, fruits, and meat farmers keep to feed their families. Owner-occupied housing is the largest imputation. It is based on the idea that homeowners are essentially renting their homes to themselves.

Nominal GDP (denoted as GDP_n) is equal to the economy's output for a given year valued in that year's prices, whereas *real GDP* is that output valued in base year 2005 prices. If firms sell only to consumers, intuitively, both of these definitions can be expressed as

$$\text{GDP}_\text{n} = P_{2012}^{\text{Potatoes}} \cdot Q_{2012}^{\text{Potatoes}} + P_{2012}^{\text{Milk}} \cdot Q_{2012}^{\text{Milk}} + P_{2012}^{\text{Gas}} \cdot Q_{2012}^{\text{Gas}} + \cdots$$

$$\text{GDP} = P_{2005}^{\text{Potatoes}} \cdot Q_{2012}^{\text{Potatoes}} + P_{2005}^{\text{Milk}} \cdot Q_{2012}^{\text{Milk}} + P_{2005}^{\text{Gas}} \cdot Q_{2012}^{\text{Gas}} + \cdots$$

The first equation computes 2012 nominal GDP because 2012 output is valued in 2012 prices, while the second is 2012 real GDP because 2012 output is valued in base year 2005 prices. Although nominal GDP rises if prices or quantities rise, real GDP rises only if quantities rise because

[12] The estimated value of these transactions is 8 percent to 19 percent of GDP, according to estimates published in Johnson, Kaufmann, and Zoido-Lobaton (1998); Schneider and Enste (2000); and Dell'Annoa and Solomon (2008).

[13] Chadeau (1992) estimates that household production is about 45 percent of GDP.

[14] U.S. Bureau of Economic Analysis, "Table 2.6.12. National Income and Product Accounts" (accessed 3/25/14).

prices are "chained" to the base year. In practice, the nominal GDP equation works but the real GDP equation does not due to products being improved and replaced over time.

The real variable equation that is used to strip inflation from nominal wages and prices is modified to convert nominal GDP to real GDP. The GDP Deflator Price Index (DPI) is used instead of CPI since it is an average price of all final goods and services produced domestically.

$$x = \frac{100}{\text{DPI}} \cdot x_n$$

Substituting the 2011 values of nominal GDP ($15.08 trillion) and DPI (113.4) into this equation yields the value of real GDP in 2011 that is reported in Table 2.4.

```
(100/113.4)*15.08
                    13.3
```

Repeating this calculation for the other years in the table gives the remaining values of real GDP. Real GDP is less than its nominal value prior to 2005, equal to its nominal value in 2005, but greater than its nominal value after 2005. Thus, stripping inflation from GDP *inflates* it to 2005-dollars in years prior to 2005, but *deflates* it thereafter.

Table 2.4 Nominal GDP, real GDP, and economic growth

Year	Nominal GDP (trillions)	DPI (%)	Real GDP (trillions)	Growth (%)
2004	11.85	97.8	12.24	3.38
2005	12.62	100.0	12.62	3.10
2006	13.38	103.2	12.97	2.77
2007	14.03	106.2	13.21	1.85
2008	14.29	108.6	13.16	−0.38
2009	13.97	109.5	12.76	−3.04
2010	14.50	111.0	13.06	2.35
2011	15.08	113.4	13.30	1.84

DPI, Deflator Price Index; GDP, gross domestic product.

With inflation stripped from real GDP, it can be used to compare economic output from year to year. *Economic growth*, the annual percent change in real GDP, is a common method of comparing real GDP from year to year. It can be computed using the following equation.

$$g = \frac{\text{GDP}_{\text{is}}}{\text{GDP}_{\text{was}}} - 1$$

Substituting what real GDP *is* in 2007 ($13.21 trillion) and what it *was* a year earlier ($12.97 trillion) into this equation gives the 2007 growth rate.

```
13.21/12.97–1
                                  0.0185
```

Multiplying this by 100 gives the 2007 growth rate that is listed in Table 2.4. Applying the same equation to nominal GDP values over the same period gives a nominal GDP growth rate of 4.9 percent. The difference in the two growth rates equals 2007 inflation. This will generally be the case for all years.

The economy is *expanding* when economic growth is positive, but is *contracting* when growth is negative. Most textbooks define a *recession* as two consecutive quarters of negative growth, and a *persistent* one as a *depression*. In the United States, the National Bureau of Economic Research (NBER) dates recessions, and defines a recession as "a significant decline in economic activity spread across the economy, lasting more than a few months, normally visible in real GDP, real income, employment, industrial production, and wholesale-retail sales." The black line in Figure 2.9 plots economic growth (g) over a three-decade period, while the vertical gray bars mark the last five U.S. recessions. The figure shows economic growth accelerating, peaking, declining, and bottoming out five times. This cycling is called the *business cycle*.

The well-being of a nation's citizenry is difficult to measure. Ideally, it would be measured by the quality of one's life and that of his or her loved ones. In reality it is measured by *per capita GDP*, the ratio of real GDP and the size of the population. For a given nation, per capita GDP, one of

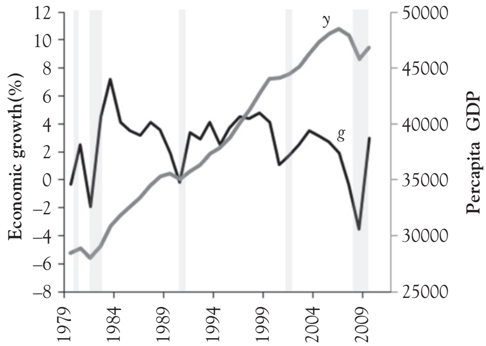

Figure 2.9 Economic growth (g) and per capita GDP (y)

many measures of its standard of living,[15] grows when its economic growth rate exceeds its population growth rate. The gray line in Figure 2.9 graphs U.S. per capita GDP over time (*y*). In 2010, real GDP was $46,844 per American, which is below its high of $48,532 in 2007 but much higher than what it was 10 years earlier, $44,081.

Unemployment

The Current Population Survey (CPS) is used to compile labor force statistics for the United States. Each month, members of 60,000 households are interviewed. Every person in the survey who is 16 years or older is in the *working age population* (WAP), provided they are not jailed, hospitalized, institutionalized, or in the armed forces. Members of the WAP are *employed* (*E*) during the reference week[16] if they worked at least one hour for pay, worked in their own businesses, or performed at least 15 hours of unpaid work in family-owned businesses. Individuals in the WAP who quit their jobs or get laid off or fired are counted among the *unemployed* (*U*),

[15] Investopedia.com defines standard of living as "[t]he level of wealth, comfort, material goods and necessities available to a certain socioeconomic class in a certain geographic area."

[16] The CPS reference week is the one that contains the 12th day of the month. If the week containing the 5th of December is entirely in the month, it is the reference week for December (see www.census.gov/cps/methodology).

Table 2.5 Labor force, employment, and unemployment

Year	Average L* (millions)	Average E* (millions)	U (millions)	u (%)
2003	146.50	137.73	8.77	5.99
2004	147.38	139.24	8.14	5.52
2005	149.29	141.71	7.58	5.08
2006	151.41	144.42	6.99	4.62
2007	153.12	146.05	7.07	4.62
2008	154.32	145.37	8.95	5.80
2009	154.19	139.89	14.30	9.27
2010	153.89	139.07	14.82	9.63
2011	153.62	139.87	13.74	8.95

* Civilian Labor Force (L) and Civilian Employment (E) from Bureau of Labor Statistics.

provided they looked for work during the reference period.[17] The *civilian labor force* (L) equals the level of employment plus the unemployment level.

The *unemployment rate* is the share of the labor force that is unemployed and looking for work. It is computed by dividing the unemployment level by the size of the labor force, or with the following equation.

$$u = 1 - \frac{E}{L}$$

The equation indicates that the unemployment rate will fall if employment rises or the labor force shrinks. Table 2.5 indicates that from 2010 to 2011, the labor force fell from 153.89 million to 153.62 million as employment rose from 139.07 million to 139.87 million. Plugging these values into the prior equation gives the 2010 and 2011 unemployment rates that are listed in Table 2.5.

```
1−139.07/153.89
                                0.0963
1−139.87/153.62
                                0.0895
```

[17] The reference period is the reference week and the preceding three-week period.

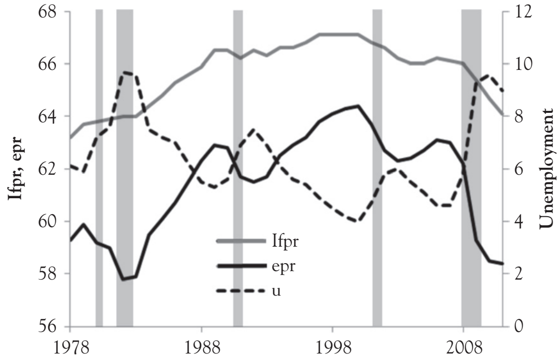

Figure 2.10 Labor force participation, employment, and unemployment rates

The decline in unemployment occurred for two reasons. Overall employment rose, which is considered a healthy labor market signal, as the labor force shrank.

Figure 2.10 plots the labor force participation rate (lfpr = *L*/WAP), employment-to-population ratio (epr = *E*/WAP), and unemployment over time. According to it, labor force participation and employment are near 30-year lows, while unemployment is just under a 30-year high. The figure shows the labor force continuing to fall as employment leveled off after 2008. It also indicates that unemployment fluctuates around a long-run trend that is known as the natural rate of unemployment. The difference between the two rates is called *cyclical unemployment*.

A Synthesis

If John Donne (1572–1631) had been an economist rather than the poet and lawyer that he was, he would have likely concluded that no macroeconomic indicator "is an island, entire of itself, each is a piece of the continent, a part of the main," meaning, indicators are intertwined. For example, accelerating growth pushes real GDP beyond its potential and unemployment below its natural rate. Falling unemployment puts upward pressure on wages as firms compete for fewer and fewer workers. If firms can pass higher costs to consumers, inflation will rise.

Figure 2.11a shows how the gap between real GDP (the black line) and its potential (the gray line) evolves. From 2009 onward, real GDP

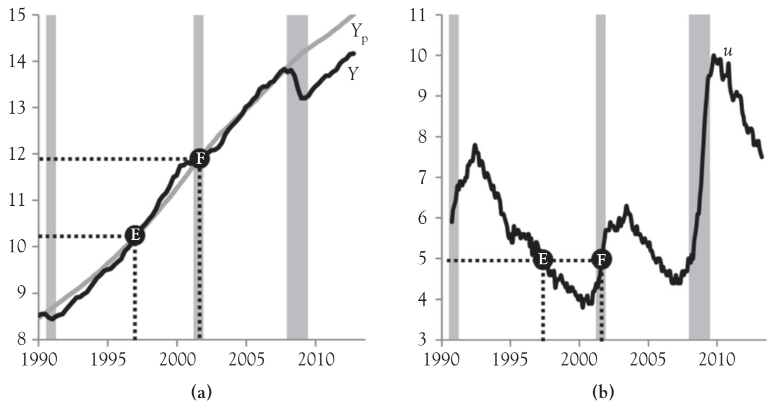

Figure 2.11 ***Graphs of potential GDP (Y_p), real GDP (Y), and unemployment (u)***

is well below its potential. In 1996 and 2002, real GDP and potential output intersect at points E and F, suggesting that the economy was at full employment in these years. At points E and F in Figure 2.11b, unemployment is about 5 percent, which implies that the natural rate of unemployment for 1996–2002 is in the neighborhood of 5 percent.

The preceding discussion implies that real GDP and unemployment are linked. This relationship is called *Okun's Law*, and is shown in Figure 2.12*a.* The figure plots annual growth of quarterly real GDP against the annual change in quarterly unemployment for 1948–2012. Point A implies that a growth rate of 7.3 percent will prevail if unemployment declines by 2 percentage points. This is perhaps due to idle workers bidding down wages when unemployment is high, which lowers firms' marginal costs and increases product supply curves.

The line in Figure 2.12*b* is called the *Phillips curve*. It indicates a trade-off between inflation and unemployment from 1958 to 1969. It vanishes when additional years are included in Figure 2.13a. This was due to the large fluctuations in inflation expectations that began in 1969. The *augmented Phillips curve***,** the line in Figure 2.13b, accounts for these fluctuations. It shows the relationship between unemployment and the expected *change* in inflation. Point B indicates that inflation is expected to rise by 1.6 points when unemployment is 3.5 percent, whereas point

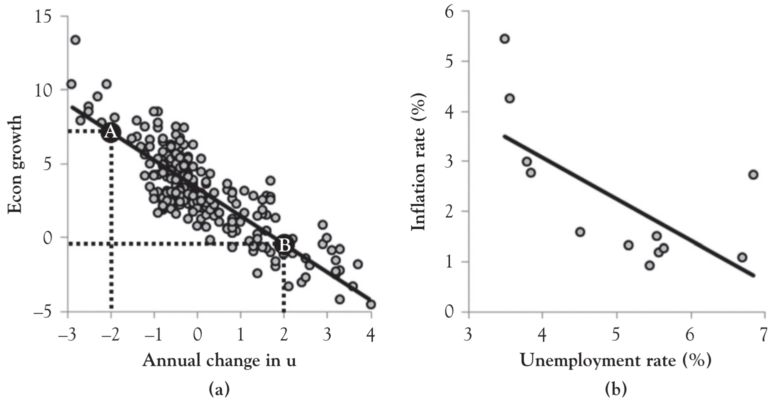

Figure 2.12 Okun's law and the Phillips curve

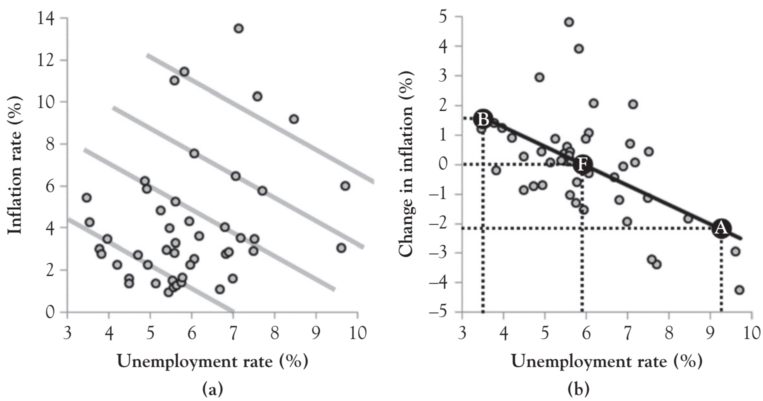

Figure 2.13 The Slayed phillips and augmented phillips curves

A suggests that inflation is expected to decline by 2.1 percentage points when unemployment is 9.2 percent. Point F implies that inflation is not expected to change when unemployment is 5.9 percent, which suggests that the natural rate of unemployment is 5.9.

CHAPTER 3

Aggregate Expenditure

Aggregate expenditure (AE), summarized in the final column of Table 2.3, is the sum of consumer expenditures; new home sales and firm investments in new buildings, equipment, tools, and inventory; government purchases of goods and services; and net exports (NX). This definition implies that a recession triggered by a cutback in consumer or firm expenditure can be offset one-for-one with a boost in government expenditure. This notion is the core of Keynesian economics, and assumes the last dollar government spent building the "Bridge to Nowhere" (Utt 2005) is as productive as the last dollar spent improving computer processors, motion picture sound and visual effects, or the aerodynamics of passenger jets. In his 1974 Nobel Prize acceptance speech, F.A. Hayek said that this kind of thinking has "made a mess of things … [because] it leads to the belief that we can permanently assure full employment by maintaining total money expenditure at an appropriate level." Despite this and other criticisms, Keynesian economics remains relevant because government expenditure and total employment are strongly correlated,[1] it justifies politicians cutting taxes and "spending public monies on projects that yield some demonstrable benefits to their constituents" (Buchanan and Wagner 1999), and its simple elegance makes it easy to teach and understand.

Consumption Expenditure

The *consumption function* is the heart of Keynesian economics. It models the relationship between disposable income (DI) and consumer expenditure (*C*). Real personal consumption expenditure and real disposable

[1] Using quarterly, seasonally adjusted data for the period 1959 to 2013, the correlation between total federal government expenditures and civilian employment is 0.91.

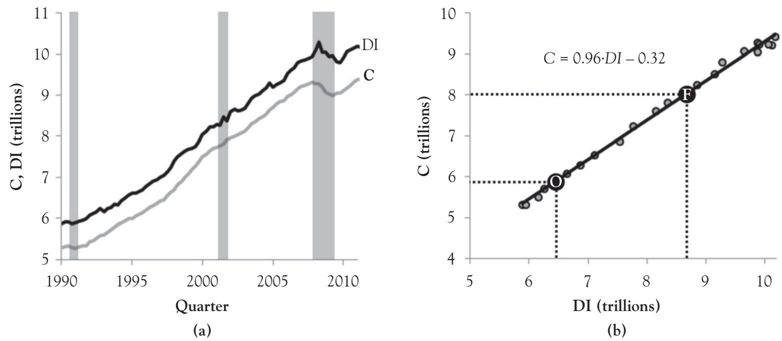

Figure 3.1 Graphs of DI, consumption, and DI versus consumption

personal income are graphed in Figure 3.1a, with recessions indicated by gray bars. The figure shows the variables moving together through time. They fell together during the 1991 recession, but returned to their prerecession trends by 1997. The variables remained on these trends through the 2001 recession, and to the start of the 2008 recession. After plummeting, both began upward trends by the end of the 2008 recession—but on much lower trajectories than what had prevailed. The Bush tax rebates of 2001 and 2008 caused spikes in DI, but neither appears to have had any effect on consumption.

The annual averages of DI and consumption are scatter-plotted in Figure 3.1b. The data points lie very close to a line that is called the consumption function. From point O to F, consumption increases by \$2.21 trillion, and DI increases by \$2.3 trillion. The ratio of these values, 0.96, is the line's slope, which is called the *marginal propensity to consume* (mpc). It suggests that consumers spend \$0.96 of each additional dollar of DI received. The line's intercept is referred to as *autonomous consumption* (A) because it models consumer expenditures that are independent of DI. The general form of the consumption function is given by the following linear equation.

$$C = \text{mpc} \cdot \text{DI} + A$$

The equation in Figure 3.1b indicates that autonomous consumption is –0.32, which is problematic because consumption cannot be negative when DI is 0. The value of autonomous consumption is immaterial here because it is assumed to be a collection of factors that are exogenous.[2] These factors include consumer wealth (W), expected future consumer income (Y_e), the PL, and the real rate of interest (r). An increase in consumer wealth or expected future income, or a decrease in the PL or real rate of interest increases consumption for a given level of DI. Changes in autonomous factors are modeled by their linear combination in the following exhibit.

```
A:=W+Ye–PL–r:
```

The expression that A is defined to be in the preceding exhibit is automatically substituted into the consumption function when the following command is executed in MAPLE:

```
C:=mpc*DI+A
```

The result is called *simulated consumption*, which is given below.

$$C = \underbrace{\text{mpc}}_{\text{slope}} \cdot \text{DI} + \underbrace{W + Y_e - \text{PL} - r}_{\text{intercept}}$$

Simulated consumption can be graphed once the slope and the autonomous factors in the intercept are assigned assumed initial values. Suppose wealth equals \$8 trillion, expected future income is \$12 trillion, the PL equals \$14.5 thousand, the real rate of interest is 3.5 percent, and the mpc is 0.75. The units of measure are ignored in simulated consumption.

```
W:=8:     Ye:=12:     PL:=14.5:     r:=3.5:     mpc:=0.75:
```

MAPLE substitutes these values into simulated consumption when the ENTER key is pressed after C is typed. This result is assigned the name C0 to identify it as initial consumption.

[2] An exogenous factor is an independent variable whose value is unaffected by the model. A is used here to set the model's initial and final conditions.

```
C0:=C
                              0.75 DI + 2
```

The consumption function *shifts* when one of the four factors in its intercept changes. Because the PL and real rate of interest are *subtracted* in the intercept of the simulated consumption, a decrease (increase) in either factor shifts consumer expenditure upward (downward). Since wealth and expected future income are added in the intercept, an increase (decrease) in either shifts consumer expenditure upward (downward). Suppose, for example, that expected future income falls from $12 trillion to $11 trillion after stock markets begin bearish trends. The following command makes this change.

```
Ye:=11:
```

Pressing the ENTER key after typing *C* replaces the initial value of expected future income ($12 trillion) with its final value ($11 trillion). The result is assigned the name C1 to identify it as final consumption.

```
C1:=C
                              0.75 DI + 1
```

The decrease in expected future income reduces simulated consumption's intercept by 1. The subsequent **plot** command graphs initial and final consumption in Figure 3.2a.

```
plot([C0, C1],DI=0..10)
```

If DI is equal to $8 trillion, as shown in Figure 3.2a, the decline in future expected income shifts consumption downward, which causes consumer spending to fall from $8 trillion (point O) to $7 trillion (point F).

The *simulated consumption model* combines the consumption function with a 45-degree line. The following **plot** command graphs this model in Figure 3.2b at the assumed initial values.

```
plot([DI, C0],DI=0..10)
```

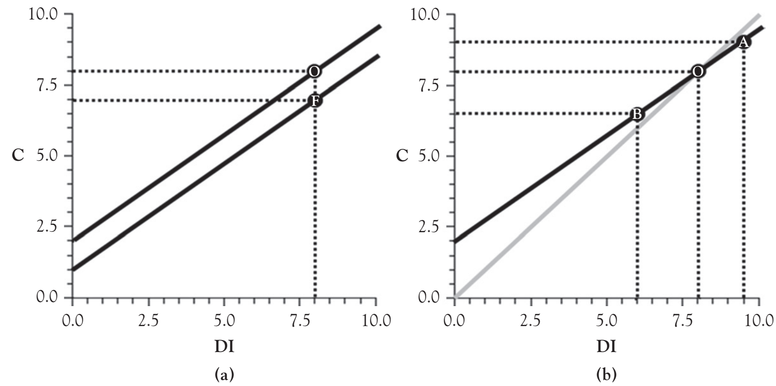

Figure 3.2 Shifts and movements along the consumption function

Including DI with C0 in the brackets tells MAPLE to graph the 45-degree (gray) line with the initial (black) consumption line. The two lines are graphed over values of DI from 0 to $10 trillion. When the consumption function crosses the 45-degree line, as it does at point O, *consumer savings* is 0 because DI and consumption equal. Savings is $0.5 trillion at point A because DI is $9.5 trillion and consumption is $9 trillion. Consumers save at points along the consumption function that lie below the 45-degree line. Point B is above the 45-degree line because consumption exceeds DI, indicating that dissaving occurs at points on the consumption function that lie above the 45-degree line.

Consumption can be expressed in terms of real GDP because DI can be defined as real GDP (Y) minus net tax revenue (T). When simulated consumption is in terms of Y rather than DI, it will be referred to as *simulated consumer expenditure*, and is given next.

$$C = \underbrace{\text{mpc}}_{\text{slope}} \cdot Y + \underbrace{W + Y_e - \text{PL} - r - \text{mpc} \cdot T}_{\text{intercept}}$$

Like simulated consumption, simulated consumer expenditure shifts up (down) when wealth or expected future income increases (decreases), or after a fall (rise) in the PL or real rate of interest. It also shifts up (down) when taxes are cut (raised). The following exhibit defines DI and assigns net tax revenue an initial value of $3 trillion.

```
DI:=Y–T:
 T:=3:
```

Pressing the ENTER key after typing *C* substitutes the prior assignments into simulated consumption, and gives simulated consumer expenditure.

```
C
                    0.75 Y – 1.25
```

This result represents final simulated consumer expenditure because expected future income is currently set equal to its final value of $11 trillion. To derive initial simulated consumer expenditure, future expected income is reset to its initial value of $12 trillion.

```
Ye:=12:
 C
                    0.75 Y – 0.25
```

The preceding two exhibits show that simulated consumer expenditure shifts by the same amount that simulated consumption shifts by when the value of a shared factor in their intercepts changes.

Net Foreigner Expenditure

NX is the difference between exports (*X*), the value of products produced within the boundaries of the United States but sold in other countries, and imports (*M*), products produced overseas but purchased within the boundaries of the United States.

Figure 3.3 shows imports increasing with real GDP. This is because higher real GDP means Americans generally have more income to spend on products produced here and abroad. The data points, which correspond to the 1990 to 2007 period, lie very close to the line that is referred to as the *import function*. Its slope, the change in imports over the change

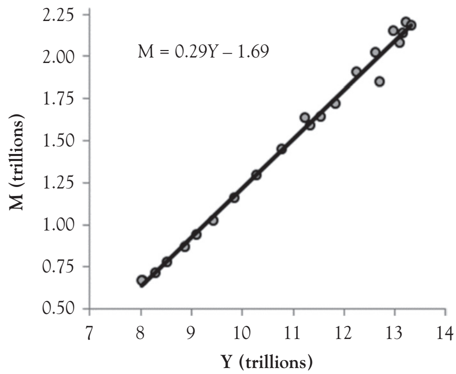

Figure 3.3 Imports (M) versus real GDP (Y)

in real GDP, equals 0.29. It is called the *marginal propensity to import* (mpm), and implies that each additional dollar of real GDP increases imports by $0.29. Although the intercept of the import function in the figure is –1.69, it is assumed to be 0 because a nation cannot import products if real GDP is 0. *Simulated imports* is defined in the following exhibit. It has a slope equal to the mpm and an intercept equal to 0.

```
M:=mpm*Y
```

$$\text{mpm}\ Y$$

Unlike imports, the value of exports is assumed to be exogenous. This is reasonable because the GDP of other nations determines how much their citizens spend on goods produced within the boundaries of the United States.

As mentioned previously NX is the difference between exports and imports.

```
NX:=X−M
```

When this command is executed, MAPLE replaces *M* with the expression it was defined to be, mpm *Y*. The resulting equation is called *simulated net foreigner expenditure*:

$$\text{NX} = X - \text{mpm}\cdot Y$$

Simulated net foreigner expenditure can be graphed after exports and the mpm are assigned values. Suppose the mpm is 0.25 and the United States exports $2 trillion in goods and services. The units of measure are ignored in simulated net foreigner expenditure.

```
mpm:=0.25:    X:=2:
```

MAPLE substitutes these values into simulated net foreigner expenditure when the ENTER key is pressed after NX is typed in MAPLE.

```
NX
                    2 – 0.25 Y
```

When real GDP is substituted into the preceding expression, the resulting value is called the *trade balance*. If real GDP is $15 trillion, the trade balance is –$1.75 trillion. Since this is negative, a *trade deficit* is present. A *trade surplus* is present when the trade balance is positive.

Aggregate Expenditure

AE is the sum of consumer expenditure, NX, government purchases of goods and services (G), new home sales (H), and firm investments in new buildings, tools, equipment, and inventories (F).[3] AE cannot be graphed until G, F, and H are set equal to their assumed initial values. Suppose these are $3 trillion, $1.25 trillion, and $1.5 trillion, respectively. The units of measure are ignored in the simulation.

```
G:=3:    F:=1.25:    H:=1.5:
```

When AE is defined in the following exhibit, the assumed values of G, F and H, initial simulated consumer expenditure, and initial simulated net foreigner are added together.

[3] Although, new home sales (H) and firm investments (F) are included in investment expenditure (I), they are not in this book because I is reserved in MAPLE for the imaginary number, the square root of −1.

```
AE:=C+F+H+G+NX
```

$$7.5 + 0.5\,Y$$

This result is named AE0 to identify it as initial AE in the following exhibit.

```
AE0:=AE
```

$$7.5 + 0.5\,Y$$

The *AE model* combines AE with a 45-degree line. The following **plot** command graphs the initial AE model in Figure 3.4a.

```
plot([AE0,Y],Y=0..20)
```

Including *Y* with AE0 in the brackets tells MAPLE to graph the 45-degree (gray) line with the initial (black) AE line. The figure shows how AE rises as real GDP increases from 0 to $20 trillion, holding all other factors constant. Point O in the figure is called the *Keynesian equilibrium*. It is where the AE line crosses the 45-degree line. At point O, AE and real GDP equal $15 trillion.

The AE model is not in equilibrium at A or B in Figure 3.4a. Aggregate planned expenditure is $13 trillion and real GDP is $11 trillion at point B. The difference is caused by consumers, government, and foreigners buying more goods than they had planned to purchase. This triggers an unplanned drop in inventories that signals firms that business is picking up. Firms accommodate higher product demand by boosting inventory replenishment rates and production, which induces a *movement along* the AE line until the economy reaches the Keynesian equilibrium at point O.

Conversely, at point A, real GDP exceeds aggregate planned expenditure because consumers, government, and foreigners are buying fewer goods than they had planned to purchase. These expenditure cutbacks cause an unplanned increase in inventories, signaling firms that business is slowing. Firms respond to lower demand by cutting inventory replenishment rates and production. This pushes real GDP down toward the Keynesian equilibrium at point O.

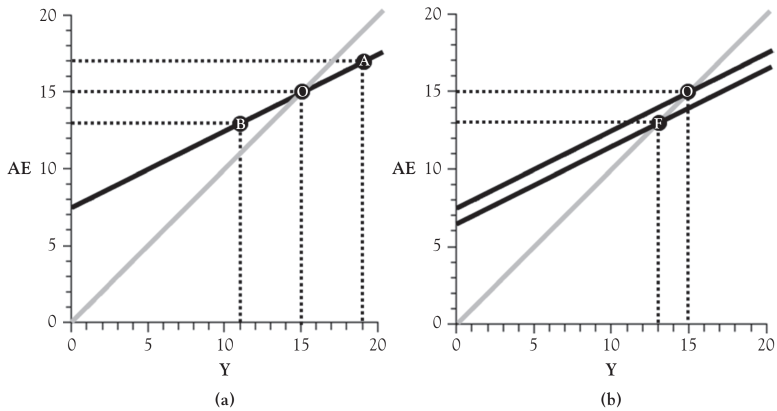

Figure 3.4 Movement along and shifts in AE

If AE's factors are stripped of their numerical values, the result is *simulated AE*:[4]

$$AE = \underbrace{(\text{mpc} - \text{mpm})}_{\text{slope}} \cdot Y + \underbrace{W + Y_e + X + H + F + G - r - \text{mpc} \cdot T - \text{PL}}_{\text{intercept}}$$

The intercept of the prior equation models the autonomous factors that shift AE. The downward shift in AE from point O to point F in Figure 3.4b results when a change in an autonomous factor reduces the value of simulated AE's intercept. Because the PL, the real interest rate, and net tax revenue are subtracted in simulated AE's intercept, a rise in any of these factors shifts AE downward. Since consumer wealth, exports, expected future consumer income, firm investments, new home sales, and government expenditure are added in simulated AE's intercept, a fall in one of these factors shifts AE downward. For example, consider the \$1-trillion fall in expected future income that shifted consumption downward in Figure 3.2:

```
Ye:=11:
```

[4] Executing the following MAPLE commands strips AE's factors of their numerical values and yields simulated AE.

```
unassign('W','Ye','r','PL','X','G','T','H','F','mpm','mpc')
collect(AE,Y)
```

Pressing the ENTER key after typing AE replaces initial expected future income ($12 trillion) with its final value ($11 trillion) in simulated AE. The result is named AE1 to identify it as final AE.

```
AE1:=AE
                    6.5 + 0.5 Y
```

The following **plot** command graphs initial and final AE and the gray 45-degree line in Figure 3.4b.

```
plot([Y,AE0,AE1],Y=0..20)
```

The decline in future expected income that shifts AE to point F in Figure 3.4b causes real GDP to decline from $15 trillion to $13 trillion. This reduces imports from $3.75 trillion to $3.25 trillion, and lowers the trade deficit from $1.75 trillion to $1.25 trillion. The decline in the trade deficit is not welcomed news because it resulted from a contraction in the economy.

Fiscal Policy Multipliers

The simulated AE model indicates that real GDP will increase if government expenditure is raised or net tax revenue is lowered, holding all other AE factors constant. A deliberate change to government expenditure or net tax revenue is called *discretionary fiscal policy*. Because net tax revenue and government expenditure were both assumed to be $3 trillion, the fiscal budget is balanced at point F in Figure 3.4b. If taxes are cut or government expenditure is raised to push the economy back to point O, the equilibrium that had prevailed before the fall in expected future income, a budget deficit results.

The *government expenditure multiplier* is the increase in real GDP that results when government spends an additional dollar to stimulate the economy. With the economy at point F, suppose government expenditure is raised by $0.5 trillion.

```
G:=G+0.5
                    3.5
```

Pressing the ENTER key after typing AE automatically replaces government expenditure's initial value (\$3 trillion) with its final value (\$3.5 trillion) in simulated AE.

```
AE
                    7 + 0.5 Y
```

The change in fiscal policy raises AE's intercept from 6.5 to 7. This shifts AE up to a point along the 45-degree line that is halfway between O and F, which is not shown. Thus, real GDP increases by \$1 trillion after government expenditure was raised by \$0.5 trillion. Taking the ratio of the two yields a government expenditure multiplier equal to 2. This value implies that real GDP increases by two dollars for each additional dollar government spends.

The *tax cut multiplier* is the amount GDP increases by when taxes are cut by a dollar, holding all else constant. Suppose government decides to follow up its increase in its expenditures by cutting taxes by \$0.667 trillion.

```
T:=T–0.667
                    2.333
```

Pressing the ENTER key after typing AE makes this substitution.

```
AE
                    7.5 + 0.5 Y
```

Together, the fiscal policy changes restore AE's intercept to its initial value of 7.5, which shifts AE back to the line that passed through point O in Figure 3.4b. By itself, the tax cut increases real GDP by an additional \$1 trillion. Dividing this increase by the \$0.667 trillion tax cut gives a multiplier of −1.5, which implies that real GDP rises by \$1.50 for each one dollar cut in taxes.

Although the back-to-back fiscal policies raise real GDP by a total of \$2 trillion, doing this results in a budget deficit of \$1.167 trillion that is financed with government securities. For this reason, some advocate for a balanced approach. The *balanced-budget multiplier* is the value by which real GDP increases when government spending and net tax revenue are raised by equal amounts. Instead of cutting taxes by $0.667 trillion, suppose government had decided to increase taxes by the same amount it raised expenditures. This fiscal policy keeps the budget balanced and increases the value of AE's intercept. Before this fiscal policy is adopted, the $1 trillion decline in expected future income had put the economy at point F in Figure 3.4b. After the balanced approach is enacted, the intercept of AE rises slightly (from 6.5 to 6.625). The graph of the resulting AE equation is not shown in the figure because the shift is so slight. The slight change to AE means that real GDP rises slightly from $13 trillion (at point F) to $13.25 trillion.

The balanced approach raises real GDP by $0.25 trillion, and appears to be costless because it keeps the fiscal budget balanced. However, the approach assumes that entrepreneurialism and work are unaffected by higher marginal tax rates. The effect of the balanced-budget multiplier depends on the value of the mpc. Theoretically, the balanced-budget multiplier is slightly positive when the mpc is less than 1, but is 0 when the mpc equals 1. In practice, however, the balanced-budget multiplier is probably slightly negative because empirical estimates of tax-cut multipliers are generally larger than empirical estimates of government-expenditure multipliers.[5]

The tax-cut and government-expenditure multipliers beckon politicians to provide stimulus during recessions. These multipliers are, however, overstated due to the PL being held constant at $14.5 thousand in Figure 3.4b. This is not an issue in Keynesian economics because it assumes prices and wages are sticky in the short run. In the next chapter, these multipliers are compared to their counterparts in the aggregate market model, which allows for short-run adjustments to the PL.

Introduction to Aggregate Demand

Aggregate demand (AD) is the relationship between real GDP demanded and the PL, holding all other influences on expenditure plans constant.

[5] The tax-cut multiplier is estimated at 3 in Romer and Romer (2010), and estimates of the government-spending multiplier are between 0.8 and 1.5 (Ramey 2011).

It is derived graphically from the AE model in a theoretical experiment that holds all AE factors but the PL constant. In the previous section, the economy was returned to its initial state at point O in Figure 3.4b when government raised its expenditures by \$0.5 trillion and cut taxes by \$0.667 trillion. At point O, with the initial PL equal to \$14.5 thousand, initial real GDP is \$15 trillion. These values correspond to point O in Figure 3.5. To derive AD, the PL must be changed. If it rises to \$15.5 thousand, simulated AE's intercept declines to 6.5.

```
PL:=15.5:
AE
```
$$6.5 + 0.5\ Y$$

The graph of AE in the preceding exhibit passes through point F in Figure 3.4b. At this point, the final PL is \$15.5 thousand and final real GDP is \$13 trillion. Point F in this figure corresponds to point F in Figure 3.5, and the line connecting it to point O is AD.

The equation for the AD line in Figure 3.5 can be derived by returning PL to a variable,

```
unassign('PL')
```

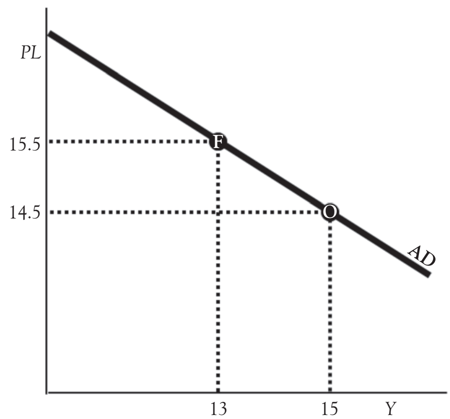

Figure 3.5 Derived aggregate demand

imposing the Keynesian equilibrium condition,

```
Y=AE
```

$$Y = 22 + 0.5\ Y - \mathrm{PL}$$

and solving the preceding equation for PL.

```
solve(%,PL)
```

$$-0.5\ Y + 22$$

The result gives the PL along the AD line graphed in Figure 3.5. To verify, substitute $13 trillion and $15 trillion into the expression in the above exhibit. The expression gives a PL of $15.5 thousand when it is evaluated at $13 trillion, but gives $14.5 thousand when it is evaluated at $15 trillion.

CHAPTER 4

The Aggregate Market Model

The *aggregate market model* combines aggregate demand (AD) with aggregate supply (AS), which has short-run and long-run components. Short-run aggregate supply (SRAS) is the relationship between the PL and real GDP supplied, holding all other production plans constant in the short run. Long-run aggregate supply (LRAS) is the value of potential output (Y_p) in the short run. While SRAS and AD determine the PL and real GDP, the gap between real GDP and potential output determines unemployment.

Simulated AD

In the final section of Chapter 3, AD was derived graphically and algebraically from AE in two thought experiments. In both of these experiments, all AE factors but PL were held constant at their assumed initial values, and Keynesian equilibrium condition AE = Y was imposed. In the first experiment, the assumed value of PL was increased. This caused real GDP to fall. The resulting pairs of points were used to plot the line in Figure 3.5. Because this line represents the relationship between the PL and the quantity of real GDP demanded, holding all other influences on spending plans constant, it is AD by definition. In the second experiment, the PL was stripped of its numerical value using the **unassign** command, and the resulting model was then solved for PL. If the second experiment is replicated on simulated AE, the result is *simulated AD*:

$$\mathrm{PL_d} = \underbrace{(\mathrm{mpc} - \mathrm{mpm} - 1)}_{\text{slope}} \cdot Y + \underbrace{W + Y_\mathrm{e} + X + H + F + G - r - \mathrm{mpc} \cdot T}_{\text{intercept}}$$

To derive simulated AD, AE's factors are first stripped of their numerical values.

```
unassign('mpc','mpm','W','Ye','X','H','F','G','r','T')
```

Next, the Keynesian equilibrium condition is imposed on simulated AE.

```
Y=AE
```

$$Y = (\text{mpc} - \text{mpm})\ Y + W + Y_e + X + H + F + G - r - \text{mpc}\ T - \text{PL}$$

The result is then solved for PL, which is named PLd because it gives the PL along AD, holding all other influences on spending plans constant.

```
PLd:=solve(%,PL)
```

$$(\text{mpc} - \text{mpm})\ Y + W + Y_e + X + H + F + G - r - \text{mpc}\ T - Y$$

Finally, the **collect** command is used to factor *Y* in the prior result.

```
collect(%,Y)
```

$$(\text{mpc} - \text{mpm} - 1)\ Y + W + Y_e + X + H + F + G - r - \text{mpc}\ T$$

Simulated AD is mathematically equivalent to the AD line in Figure 3.5. To show this, set all of the AE factors, but the PL, equal to their assumed initial values.

```
mpc:=0.75:     W:=8:    r:=3.5:    G:=3:       Ye:=12:
mpm:=0.25:     T:=3:    H:=1.5:    F:=1.25:    X:=2:
```

These values are substituted into simulated AD when the following command is executed.

```
PLd0:=PLd
```

$$-0.5 \cdot Y + 22$$

The result is named PLd0 to identify it as initial AD. It is identical to the AD equation derived in the final section of Chapter 3.

Simulated AD *shifts* when one of the factors in its intercept changes. Because the real interest rate and net tax revenue are subtracted in simulated AD's intercept, a decrease (increase) in either shifts AD upward (downward). Since consumer wealth, expected future consumer income, government expenditure, exports, firm investments, and new home sales

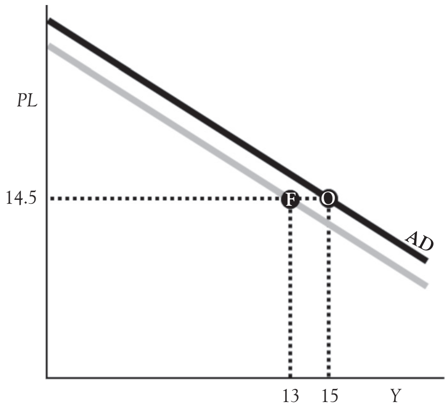

Figure 4.1 Decreased AD

are added in simulated AD's intercept, an increase (decrease) in any of these shifts AD upward (downward). To demonstrate this, consider the example in the previous chapter that assumed that expected future consumer income fell to \$11 trillion.

```
Ye:=11:
```

Pressing the ENTER key after typing PLd replaces the initial value of expected future consumer income (\$12 trillion) with its final value (\$11 trillion) in simulated AD.

```
PLd1:=PLd
```

$$-0.5 \cdot Y + 21$$

The result is named PLd1 to identify it as final AD. MAPLE's **plot** command can be used to graph initial (black) AD and final (gray) AD in Figure 4.1.

Long-Run Aggregate Supply

Real GDP is determined by labor (L), technology and entrepreneurial talent (Z), land and natural resources (R), and physical capital (K). The economy's *production function*, which describes how these factors are combined to produce real GDP, is assumed to be the simple equation defined in the following exhibit.

```
Y:=Z*sqrt(K*R*L)
```

$$Z\sqrt{R \cdot K \cdot L}$$

Because all of the production factors (Z, R, K, and L) are adjustable over the long run, the previous equation can be thought of as the *long-run production function*.

In the short run, all production factors, but the number of laborers, are fixed. The number of laborers is not fixed because members of the working age population are employed, underemployed, unemployed, discouraged, or busy with household production. Suppose the real value of physical capital, technology and entrepreneurial talent, and land and natural resources are initially equal to \$0.4 trillion, 1.25 percent, and \$2.5 trillion, respectively. When these values are substituted into the production function, the result is the *short-run production function*.

```
K:=0.4:    Z:=1.25:    R:=2.5:
Y
```

$$1.25\sqrt{L}$$

The **plot** command can be used to graph the short-run production function shown in Figure 4.2a.

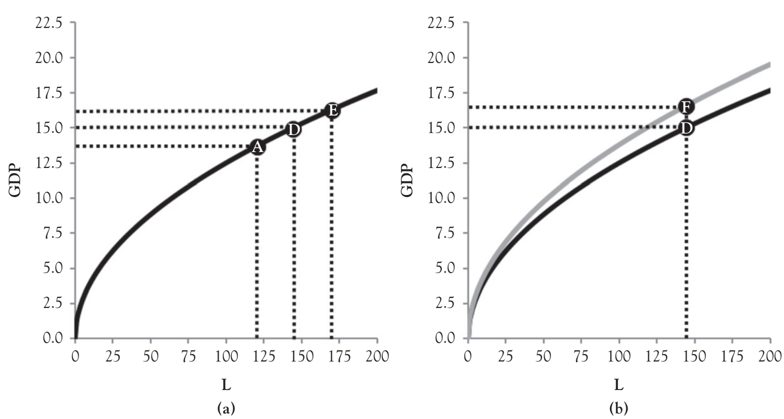

Figure 4.2 The short run production function

The short-run production function bends because firms' production lines get increasingly crowded as more and more labor is added. This principle is called the *law of diminishing marginal productivity*. Crowding on production lines is due to physical capital, technology and entrepreneurial talent, and land and natural resources being constant in the short run. If the number of laborers equals 121 million, the economy is at point A and real GDP is $13.75 trillion.

```
L:=121:
Y
                                13.75
```

If 23 million unemployed workers find employment, the number of laborers rises to 144 million, and the economy moves to point D as real GDP increases by $1.25 trillion. If 25 million more people find work, the economy moves to point E, which increases real GDP by another $1.25 trillion. Dividing the increase in GDP by the corresponding increase in labor gives the *marginal product of labor*, which is $54,348 per worker from A to D, and $50,000 per worker from D to E. Marginal product of labor *diminishes* for any set of three consecutive points plotted along the production function.

Evaluating the short-run production function at the size of the labor force (L_f) gives the short-run value of *potential output* (Y_p). If the economy is at point D in Figure 4.2a and the labor force is 144 million workers strong, potential output equals real GDP, $15 trillion. Because the labor force equals the number of laborers at point D, the unemployment rate is 0 percent. This is unrealistic because workers can be frictionally or structurally unemployed. Frictional unemployment arises for voluntary reasons like job dissatisfaction, family moves, or better employment prospects elsewhere. Frictional unemployment is not surplus labor, and can be viewed as beneficial because the economy is healthier when workers take the time to find jobs best suited for their skills. Structural unemployment is a persistent surplus of labor caused by a binding minimum wage in low-skilled labor markets, unemployment insurance (UI) compensation, Supplemental Nutrition Assistance Program (SNAP) and labor unions. Some of it comes from automation, which generates an endless cycle of job creation and job destruction. Some structural unemployment is viewed as beneficial because it increases wages above market wages, which raises productivity and job satisfaction (Shapiro and Stiglitz 1984). Summing frictional and structural unemployment levels gives the natural level of unemployment (U_n).

To reconcile the aforementioned conundrum, the short-run production function is transformed by viewing labor (L) as the employment level (E) plus the natural level of unemployment. Suppose the natural level of unemployment is 9 million. With the size of the labor force equaling 144 million, the natural rate of unemployment is 9 divided by 144, or 6.25 percent. If the employment level is 135 million, the unemployment rate equals the natural rate of unemployment. The difference in these two rates is called cyclical unemployment. It is equal to 0 when real GDP equals its potential. In this situation, the economy is at point D in Figure 4.2a. If the employment level declines to 112 million, unemployment rises to 22.22 percent, cyclical unemployment increases to 15.97 percent, real GDP falls to $13.75 trillion, and the economy slips to point A. If the employment level rises to 139 million, unemployment falls to 3.47 percent, cyclical unemployment declines to –2.78 percent, real GDP increases to $15.207 trillion, and the economy slides up along the production function between points D and E.

Although the size of the labor force is a long-run variable, a shock can shift it in the short run. A temporary extension of UI compensation to 99 weeks can knock the labor force participation rate off of its long-run trend for a couple of years. A shift in a demographic trend, on the other hand, can put the labor force participation rate on a different long-run trajectory. For example, the aging of the baby-boomer generation means that an increasing number of workers born between 1946 and 1964 are leaving the labor force as more and more retire.[1] Figure 2.10 shows this occurring just after the labor force participation rate peaked in 2000. Over time, such changes tend to slow potential output's growth rate.

Like the size of the labor force, technology and entrepreneurial talent, land and natural resources, physical capital, and the number of laborers

[1] The U.S. Census Bureau considers a baby-boomer to be a person who was born between mid-1946 and 1964.

adjust over the long run. Stripping these variables of their assumed numerical values using the **unassign** command allows them to do so, and turns the short-run production function back into the long-run production function.

```
unassign('Z','R','K','L')
Y
```

$$Z\sqrt{R \cdot K \cdot L}$$

The long-run production becomes *simulated potential output* when L is replaced with L_f.

```
L:=Lf:
Yp:=Y
```

$$Z\sqrt{R \cdot K \cdot L_f}$$

At the assumed initial values of technology and entrepreneurial talent (1.25 percent), the real value of physical capital ($0.4 trillion), the real value of land and natural resources ($2.5 trillion), and the size of the labor force (144 million workers), simulated potential output is $15 trillion.

```
Z:=1.25:   K:=0.4:   R:=2.5:   Lf:=144:
Yp
```

15

Because potential output equals $15 trillion whether the PL is 0 or $22 thousand dollars, plotting these points generates a vertical line when graphed with AD. This line is LRAS because it represents the value of what real GDP *should* be when the economy is at full employment. In MAPLE, LRAS must be graphed as a line segment. Since vertical line segments have maximum heights, LRAS's maximum height is set equal to simulated AD's intercept, 22, for simulation purposes. Combining this with potential output in the following command gives *simulated LRAS*.

```
LRAS: = [[Yp,0], [Yp,22]]
```

[[15, 0], [15, 22]]

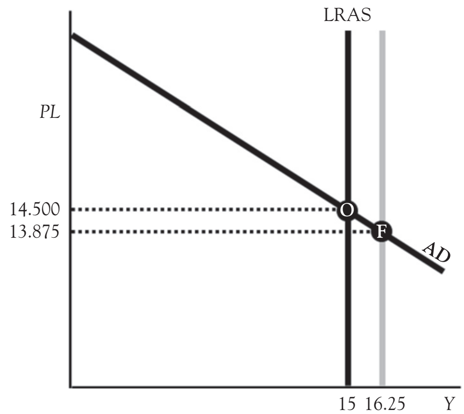

Figure 4.3 AD and LRAS

The ensuing **plot** command graphs initial (black) LRAS and initial (black) AD in Figure 4.3.

```
plot([LRAS,PLd0],Y=0..20)
```

Initial LRAS begins at the point that corresponds to $15 trillion of real GDP and a PL of 0, and ends at the point that corresponds to the same level of real GDP and a PL of $22 thousand.

If physical capital, technology and entrepreneurial talent, or land and natural resources rise, the economy's production possibilities frontier (PPF) shifts outward from D to E in Figure 2.4. If this rotates the production function from D to F in Figure 4.2b, LRAS shifts to the gray line that passes through point F in Figure 4.3, which lowers the PL and raises real GDP. Thus, greater entrepreneurialism, investment in physical capital, advances in technology, and the discovery of new resources are deflationary.

Short-Run Aggregate Supply

Although LRAS is independent of the PL, SRAS is not. It is the relationship between real GDP supplied and the PL, holding all other influences on production plans constant in the short run. SRAS is shifted by several exogenous variables, including the long-run production factors that determine potential output, and short-run factors like the nominal wage rate (w), the nominal prices of other production inputs (p), and supply-side taxes (t) (Bade and Parkin 2009). With SRAS's slope generically defined as b, *simulated SRAS* is given by

$$PL_s = \underbrace{b}_{\text{slope}} \cdot Y + \underbrace{w + p + t - b \cdot Y_p}_{\text{intercept}}$$

Pressing the ENTER key after typing the following defines simulated SRAS in MAPLE.

```
PLs:=b*Y+w+p+t–b*Yp
```

Simulated SRAS can be graphed and analyzed after the slope and short-run factors are assigned assumed initial values. Suppose the nominal wage rate, the nominal price of other production factors, the supply-side tax rate, and slope are seven dollars per hour, three dollars per hour, nine percent, and one, respectively.

```
w:=7:    p:=3:    t:=9:    b:=1:
```

With initial potential output set to $15 trillion, the following exhibit defines initial SRAS.

```
PLs0:=PLs
```

$$Y + 4$$

It is named PLs0 to identify it as initial SRAS, and is graphed in Figure 4.4 with AD and LRAS.

The intersection of SRAS and AD is the short-run equilibrium. Equilibrium real GDP is found by first setting AD equal to SRAS.

```
PLd0=PLs0
```

$$-0.5 \cdot Y + 22 = Y + 4$$

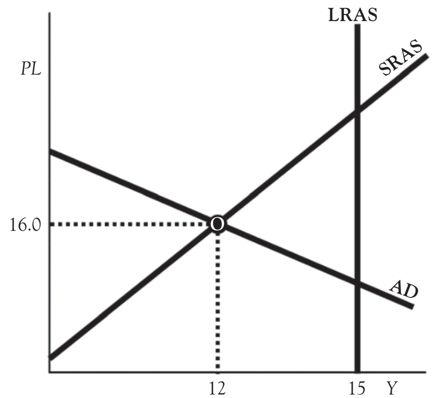

Figure 4.4 AD, LRAS, and SRAS

Solving the preceding result for *Y* gives equilibrium real GDP, $12 trillion.

```
solve(%,Y)
                                12
```

Plugging this value into either equation gives the equilibrium PL, $16 thousand. The two values comprise the equilibrium at point O in Figure 4.4. Since the point is to the left of LRAS, real GDP is less than its potential, and the economy is said to be in a recessionary gap. In this situation, unemployment is greater than its natural rate. If point O had been to the right of LRAS, the economy would have been in an inflationary gap, real GDP would have exceeded its potential, and unemployment would have been below its natural rate. Over the long run, SRAS and AD intersect at a point that lies on LRAS, real GDP equals its potential, and unemployment equals its natural rate because aggregate resource markets equilibrate in the long run.

A change in a short-run production factor *shifts* SRAS but not LRAS. For example, suppose government *temporarily* reduces supply-side taxes by 2 percentage points.[2]

```
t:=t–2:
```

[2] Since Congress cannot bind future Congresses, supply-side tax cuts are temporary.

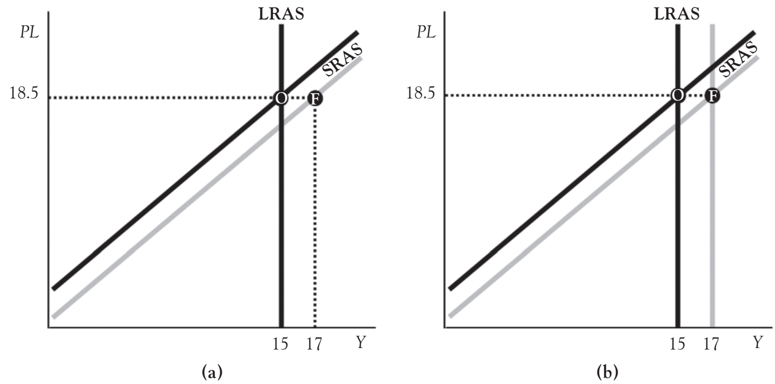

Figure 4.5 Change in a short run production factor versus a change in a long run production factor

Pressing the ENTER key after typing Y_p and after typing PLs demonstrates that the temporary reduction in the supply-side tax rate affects only SRAS.

Yp	
	15
PLs	
	$Y + 2$

Final and initial SRAS are graphed with LRAS in Figure 4.5a. The temporary cut in the supply-side tax rate temporarily reduces firms' marginal costs, shifting SRAS temporarily to the gray line. If the PL is held constant at \$18.5 thousand, real GDP supplied rises from \$15 trillion (point O) to \$17 trillion (point F). The temporary supply-side tax cut will put the economy in an inflationary gap. Because nominal wage rate (*w*) and nominal prices of other production inputs (*p*) are added in SRAS's intercept, a decline in either of these has a similar effect on SRAS as a temporary reduction in the supply-side tax rate.

Unlike short-run factors, an increase in long-run factors (technology and entrepreneurial talent, physical capital, land and natural resources, and the size of the labor force) shifts LRAS and SRAS. Consider a change in immigration policy that boosts the labor force by 40.96 million workers. After resetting the supply-side tax rate to its assumed initial value of

9 percent, the labor force is increased by 40.96 million workers in the following exhibit.

```
t:=9:
L:=L+40.96:
```

Executing the ensuing MAPLE commands demonstrate how liberalized immigration policy affects SRAS and LRAS.

Yp

$$17$$

PLs

$$Y+2$$

Potential output increases to $17 trillion. Because potential output is subtracted in simulated SRAS, its change reduces SRAS's intercept from 4 to 2. The final (gray) SRAS and LRAS lines are graphed with the initial (black) SRAS and LRAS lines in Figure 4.5b. These shifts are *permanent* unless immigrant workers are deported at a future date. Like an increase in the size of the labor force, increases in land and natural resources, technology and entrepreneurial talent, and physical capital shift SRAS and LRAS to the right by the same amounts.

The Aggregate Market Model

The aggregate market model is comprised of AD, SRAS, and LRAS, and is graphed in Figure 4.4. It is widely taught in macroeconomic principles courses because it accommodates Keynesians, who focus on the demand side and are concerned with short-run fluctuations, and classical economists, who emphasize the supply side and are concerned with the long-run health of the economy. A more appropriate name for this model is the aggregate *product* market because GDP is the value of final goods and services produced domestically, and aggregate financial and aggregate resource markets are at work in the background. The aggregate financial market provides the money that buyers use to purchase GDP supplied, while the aggregate resource market provides the inputs to produce GDP.

The aggregate market model is useful in understanding how the economy adjusts to economic or policy shocks. At point O in Figure 4.6a, the aggregate market is in a short-run equilibrium called a recessionary gap. In the absence of SNAP, Medicaid, unemployment insurance compensation, and a minimum wage, there is much pressure on wages to fall because unemployment is high. In the movie *Cinderella Man*, James J. Braddock's (played by Russell Crowe) reservation wage fell when he had to work on the docks after losing his boxing license. With workers bidding down the wage rate, the arrow above w in the following equation shows how SRAS self-adjusts from O to B.

$$PL_s = \underbrace{b}_{\text{slope}} \cdot Y + \underbrace{\overset{\downarrow}{w} + p + t - b \cdot Y_p}_{\text{intercept}}$$

At point B, the economy remains in a recessionary gap due to slackness in other resource markets. This pushes the price of other production inputs down. The arrow above p in the following equation illustrates how SRAS self-adjusts to point F.

$$PL_s = \underbrace{b}_{\text{slope}} \cdot Y + \underbrace{w + \overset{\downarrow}{p} + t - b \cdot Y_p}_{\text{intercept}}$$

At point F, the output gap is eliminated without government intervention.

Allowing SRAS to self-adjust is in line with *laissez-faire* economic policy. Self-adjusting SRAS reduced the PL from $16 thousand (at point O in Figure 4.6a) to $14.5 thousand (at point F in Figure 4.6a). This is why a recessionary gap is sometimes called a deflationary gap. The gap closes slowly if Medicaid, unemployment insurance compensation, SNAP, and the minimum wage raise workers' reservation wages. This is why wages tend to be sticky in the short run.

At point O in Figure 4.6b, the aggregate market is in a short-run equilibrium called an *inflationary gap*. The name is appropriate because there is upward pressure on prices when unemployment is too low due to real GDP exceeding its potential. When the economy is beyond its PPF, as it is here, resources are overemployed. The tightness in the resource markets

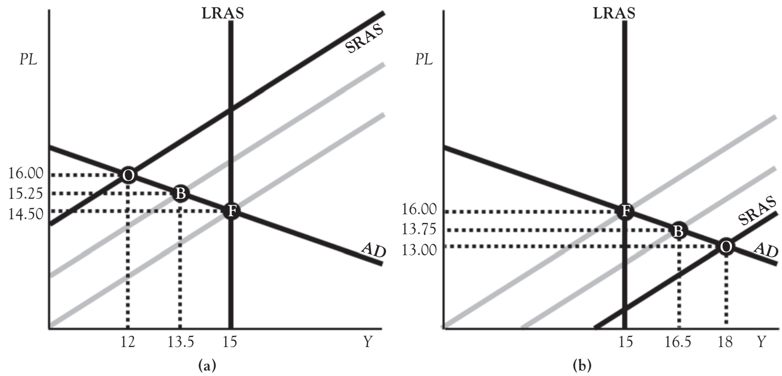

Figure 4.6* A *SRAS self-adjustment

causes firms to bid up wage rates as they try to hire more workers to keep up with rising product demand. The arrow above *w* in the ensuing equation illustrates how SRAS self-adjusts to point B.

$$PL_s = \underbrace{b \cdot}_{\text{slope}} Y + \underbrace{\overset{\uparrow}{w} + p + t - b \cdot Y_p}_{\text{intercept}}$$

The economy is still in an inflationary gap at point B. This pushes the prices of other production inputs up. The arrow above *p* in the following equation illustrates how SRAS self-adjusts to point F.

$$PL_s = \underbrace{b \cdot}_{\text{slope}} Y + \underbrace{w + \overset{\uparrow}{p} + t - b \cdot Y_p}_{\text{intercept}}$$

At point F, the inflationary gap is eliminated without government intervention. Laissez-faire policy results in inflation as self-adjusting SRAS pushes the PL up from \$13 thousand (at point O in Figure 4.6b) to \$16 thousand (at point F in Figure 4.6b).

Fiscal Policy Multipliers Revisited

High unemployment in a recessionary gap and rising prices in an inflationary gap can inflict economic pain on voters. Since upset voters are more likely to vote than satisfied voters (Harpuder 2003), politicians feel compelled to act when the economy is in either output gap. In Figure 3.4b, the \$0.5 trillion increase in government expenditure and the subsequent \$0.667 trillion tax cut stimulate AE. These back-to-back fiscal policies boosted real GDP from its dip to \$13 trillion to \$15 trillion, the value that had prevailed prior to a \$1 trillion decline in expected future income. This effect, however, rests on the PL being held constant in the AE model. If SRAS is perfectly elastic, or has a slope equal to zero, the PL is constant in the aggregate market model, and the multipliers in this model would be identical to their counterparts in the AE model.

In this chapter, the PL is allowed to adjust in the short run because SRAS slopes up. In Figure 4.7a, the PL and real GDP at point O are \$16 thousand and \$12 trillion, respectively. AD shifts to point B when government expenditure is raised by \$0.5 trillion. The arrow above *G* in the equation next shows the effect of this on AD.

$$\mathrm{PL_d} = \underbrace{(\mathrm{mpc} - \mathrm{mpm} - 1)}_{\text{slope}} \cdot Y + \underbrace{W + Y_e + X + H + F + \overset{\uparrow}{G} - r - \mathrm{mpc} \cdot T}_{\text{intercept}}$$

At the moment the increase in government expenditure is injected into the economy, the PL remains at \$16 thousand between points O and B, and real GDP demanded at point B exceeds real GDP supplied at point O. The resulting \$1 trillion excess in real GDP demanded pushes the PL up to \$16.333 thousand at point C. Instead of real GPD rising from \$12 trillion to \$13 trillion, as it did in Chapter 3, it rises to just \$12.33 trillion. Dividing the rise in real GDP by the increase in government spending gives a multiplier of just 0.667.

Figure 4.7b shows what happens if the increase in government expenditure is followed by a \$0.667 trillion tax cut. The arrow above the ensuing equation models the tax cut.

$$\mathrm{PL_d} = \underbrace{(\mathrm{mpc} - \mathrm{mpm} - 1)}_{\text{slope}} \cdot Y + \underbrace{W + Y_e + X + H + F + G - r - \mathrm{mpc} \cdot \overset{\downarrow}{T}}_{\text{intercept}}$$

At the moment the tax cut is injected into the aggregate market depicted in Figure 4.7, the PL remains at \$16.333 thousand between points C and D, and real GDP demanded at D exceeds real GDP supplied at C. The tax-cut multiplier was equal to –1.5 in Chapter 3 because the

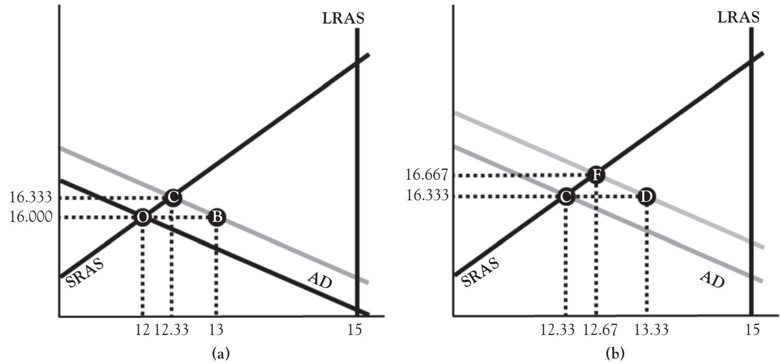

Figure 4.7 Fiscal policy in the aggregate market model

$0.667 trillion tax cut triggered multiple increases in real GDP totaling $1 trillion. The $1 trillion excess in real GDP demanded, however, pushes the PL up to $16.667 thousand at point F. As such, real GDP rises from $12.33 trillion to just 12.67. Dividing the rise in real GDP—from point C to point F—by the size of the tax cut gives a multiplier of just 0.5.

The preceding analysis implies that fiscal policy is not as effective as it appears to be in the AE model. The aggregate market multipliers are *less* than one because the absolute value of AD's slope was assumed to be *less* than that of SRAS. If the absolute value of AD's slope had been *larger* than that of SRAS, the multipliers would have been *larger* than one, but less than their counterparts in the AE model. If SRAS's slope is *equal* to 0, the aggregate market multipliers are *identical* to their counterparts in the AE model. Thus, fiscal policy is increasingly inflationary and ineffective (at closing output gaps) as the slope of SRAS increases. Despite this, fiscal stimulus is sold as a means to close a recessionary gap. This is perhaps due to the resulting budget deficit being financed with bonds that mature after the politicians who enacted the policy have retired.

The Business Cycle

The *business cycle* refers to the irregular fluctuations in real GDP around its long-run trend, which are plotted in Figure 2.7a. The figure shows real GDP below its long-run trend for the period preceding point E and above it between points E and F. From the Great Recession onward, real GDP has been trending in a deep rut that is parallel to potential output.

The business cycle has two phases, *expansion* and *contraction*. An expansion is a period of increasing real GDP, while a contraction is a period of declining real GDP. Since expansions are the norm and contractions are the exception, the long-run average growth rate of real GDP is positive. The transition from expansion to contraction is called the peak, and the transition from contraction to expansion is called the trough. The early portion of an expansion is called the recovery. Although rapid and deep contractions are historically followed by robust recoveries, the Great Recession of 2007 to 2009 was followed by a historically weak recovery.

Because GDP's long-run trend represents its potential output through time, the economy is at full employment when real GDP crosses over it, as it does at points E and F in Figure 2.7a. Inflationary pressures build as real GDP climbs further and further above its long-run trend, which is the case for periods between points E and F. The aggregate market model equilibrates in inflationary gaps during such periods. Conversely, deflationary pressures build as real GDP dips further and further below its long-run trend. This was the case during the 1991 recession, but deflationary pressures subsided during the periods between the recession's end and point E. Over this period, the aggregate market model equilibrated in recessionary gaps.

Real GDP's bumpy ride along its long-run trend is due to AS and AD shocks.[3] Supply-side shocks include changes in nominal wages or prices of other inputs to production, technology, government policies promoting or inhibiting entrepreneurialism, subsidies and taxation, regulations, natural disasters and wars, and immigration policies. Demand-side shocks include changes in consumer wealth or expected future income, government purchases, exports, interest rates, investment expenditure, and taxes. The shocks can produce positive or negative effects.

Figure 4.8 shows the effect of a negative shock on the economy that is at full employment. In Chapter 3, the decline in expected future income, from $12 trillion to $11 trillion, triggered a $2 trillion decline in real GDP. Figure 3.4b portrays this as a sudden change, but Figure 4.8 shows the economy *eventually* converging to point F. If SRAS is perfectly elastic, the speed of convergence depends on the slope of AE. The assumed initial

[3] Samuelson's (1939) multiplier-accelerator model, which assumes consumption depends on last year's income and investment is proportional to the change in consumption, produces a cyclical response to a surge in expenditure.

\$1 trillion drop in expected future income shifts AE from O to I_1. The decline in AE causes real GDP to fall by the same amount. This is modeled in Figure 4.8a as the horizontal move from I_1 to the 45-degree line. Since AE's slope implies that each \$1 decline in income reduces planned expenditure by \$0.5, AE falls in a second iteration by \$0.5 trillion. With the economy at I_2, this process repeats itself in progressively smaller steps until the economy converges to F. Figure 4.8b indicates that the business cycle has reached a trough in period 4.

Figure 4.9 shows the effect of a positive shock on the economy that is in a trough in period 4. Although real GDP and AE converge at F

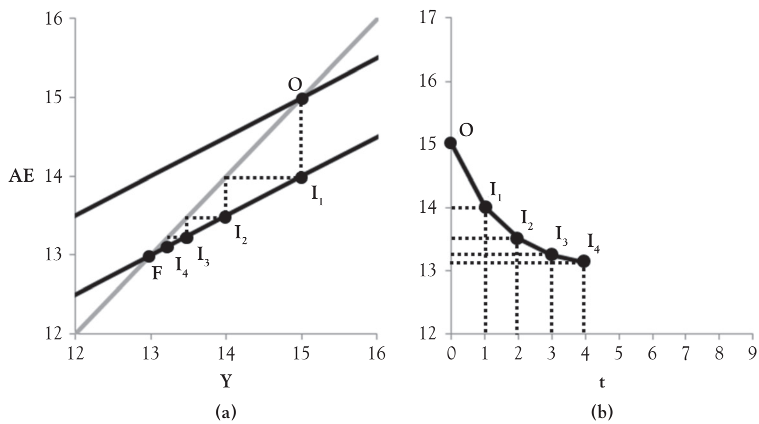

Figure 4.8 ***The trough of the business cycle***

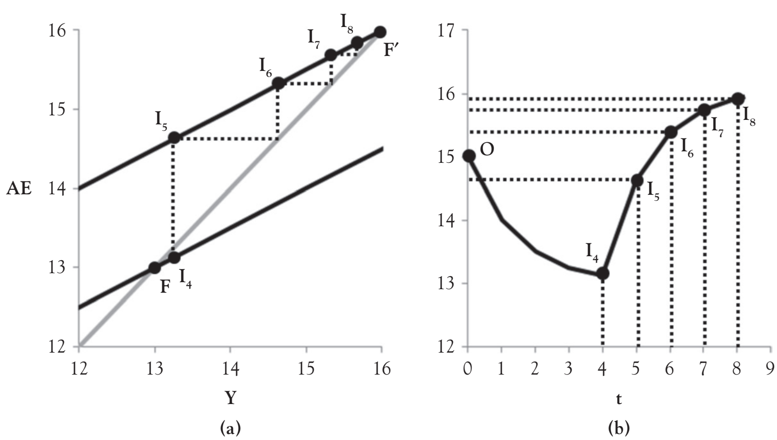

Figure 4.9 The expansion of the business cycle

in Figure 4.8, Figure 4.9 shows the economy bouncing off the bottom before it reaches this point. Suppose the bounce from I_4 to I_5 is caused by the Fed cutting interest rates, resulting in a drop in the real rate of interest and a jump in investment expenditure. At I_5, aggregate planned expenditure is $1.5 trillion higher than real GDP, which increases by an equal amount due to firms raising production after observing unplanned drops in inventories. The $1.5 trillion increase in real GDP is modeled in the figure as a horizontal move from I_5 to the 45-degree line. Since AE's slope implies that $0.50 of each extra dollar of income received is spent in the economy, AE rises by an additional $0.75 trillion. With the economy at I_6, the process repeats itself in progressively smaller steps until the economy converges to F′. Figure 4.9b shows the business cycle in a robust recovery from period 4 to 5. The subsequent expansion begins to fade as the economy nears a peak in period 8.

CHAPTER 5

Fiscal Policy

Discretionary fiscal policy is the deliberate change in government expenditure or tax rates to affect changes to real GDP and unemployment. It was deemed ineffective in the aggregate market model but not in the AE model. The disagreement arises from how the models treat the PL. In the aggregate market model shown in Figure 5.1a, SRAS slopes up. When expansionary fiscal policy is adopted, the PL rises as AD shifts up along SRAS. The higher PL dampens fiscal policy's expansionary effect on real GDP. In the AE model, the PL is held constant when analyzing the effects of expansionary fiscal policy. This assumption is carried over to the aggregate market model shown in Figure 5.1b by assuming that SRAS is perfectly elastic.

The slope of SRAS splits macroeconomics into two major schools of thought: the long-run model of classical economics shown in Figure 5.1a and the short-run Keynesian model shown in Figure 5.1b. In the classical model, SRAS slopes up, intersects AD at LRAS due to resource markets clearing over the long run, and is shown in gray to stress the triviality of the short run. In Keynesian economics, prices and wages are assumed to be

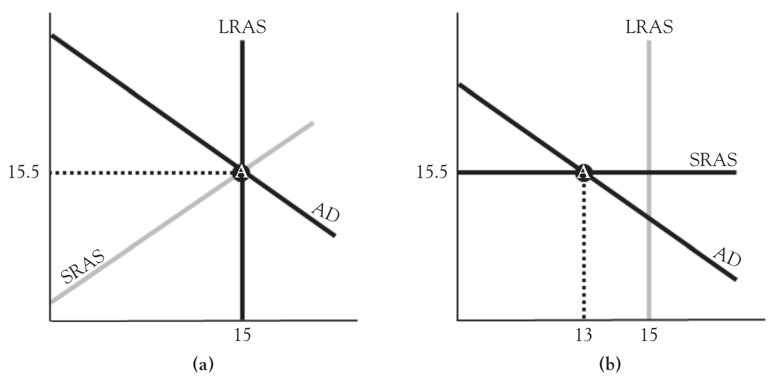

Figure 5.1 Classical economics versus Keynesian economics

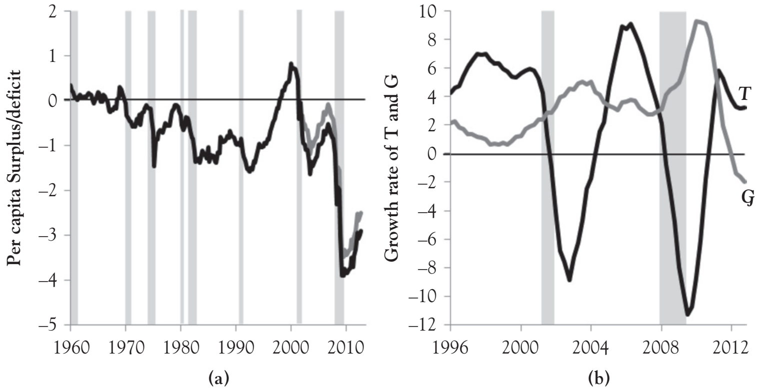

Figure 5.2 The fiscal budget balance, growth in T, and growth in G

rigid in the short run. This makes SRAS elastic, inhibits resource markets from clearing, and makes recessionary gaps persistent. Stubbornly high unemployment in a recessionary gap or rising prices in an inflationary gap beckon elected officials and the Fed to alleviate these short-run hardships with fiscal policy. The emphasis the Keynesian school of economics places on closing short-run output gaps is why the LRAS is shown in gray in Figure 5.1b.

The Fiscal Budget

Whether discretionary fiscal policy is used to reduce high unemployment in a recessionary gap or corral accelerating prices and wages in an inflationary gap, it is enacted by affecting deliberate changes in the fiscal budget balance. The black line in Figure 5.2a is the trend in the real value of the fiscal budget balance, the difference in net tax revenue and government expenditure ($T - G$). It is stated in per capita terms to allow for year-to-year comparisons because the economy and population expand together through time.[1] In a given quarter, a budget deficit occurs when the budget balance is negative, which causes the trend in the figure to track below the horizontal axis. A deficit is financed by the U.S. Treasury selling securities,

[1] GDP can be used as a divisor but its fluctuations overstate deficits in recessions and surpluses in expansions.

which adds to the national debt. The national debt, roughly $17 trillion in 2013 (Boccia, Fraser, and Goff 2013), is paid down with budget surpluses. To run a surplus, government cuts expenditure or collects more taxes until the budget balance is positive. This pushes the trend above the figure's horizontal axis.

Prior to the Nixon administration, budget surpluses were common, and budget deficits tended to be small, relative to the size of the population. Eisenhower, Kennedy, and Johnson all presided over surpluses, all of which pale in comparison to Clinton's. Per capita budget deficits began a fairly consistent downward trend in the Johnson administration. Prior to the Great Recession, represented by the right-most gray bar in Figure 5.2, the largest per-capita deficits occurred in Ford's second full quarter and during the father and son Bush administrations. The largest per capita budget deficit was recorded near the end of the Great Recession.

With the gray bars in Figure 5.2a indicating recessions, the figure shows that the budget balance peaks at the start of recessions, bottoms out at the start of recoveries, and rapidly shrinks in expansions. The figure shows the celebrated Clinton surplus and its disappearance were driven in part by the business cycle. It peaked in the second quarter of 1999, declined in Clinton's last two quarters, and continued to fall in his successor's first quarter, the start of the 2001 recession.

Figure 5.2b disaggregates the budget balance into its two components. The gray line shows how per-capita government expenditure grew over the 1996 to 2013 period. After six consecutive quarters of fairly low steady growth in government expenditure, the growth rate increased substantially between 1999 and the start of the 2001 recession. The acceleration in earmarks[2] (Utt 1999) and the business cycle were perhaps the largest drivers of this. Twenty-six days after the 9/11 attacks, the $1 trillion war on terror was launched (Belasco 2011). Subtracting its annual average from the budget balance gives the gray line in Figure 5.2a. The enactment of the $3.1 trillion 2009 budget, the Troubled Asset Relief

[2] An earmark is legislative provision that directs a specified amount of money to a project or an organization in a senator's home state or representative's home district. It is associated with "pork barrel" legislation.

Program (TARP), the omnibus and other appropriations bills, and tax rebates in the final year of the Bush administration coincided with the growth in government expenditure jumping to 4 percent. That was followed by an even larger acceleration in government expenditure after the Obama administration enacted the American Recovery and Reinvestment Act and the Omnibus Appropriations Act months apart during its first year.

The black line in Figure 5.2b shows per capita tax revenue growth for the 1996 to 2013 period. The growth in tax revenue peaked at 7 percent in 1997, and then fell to 6 percent in 2000. By the start of the 2001 recession, it had plummeted to −9 percent. This drop occurred before the Economic Growth and Tax Relief Reconciliation Act (EGTRRA) tax rebate checks were mailed, which occurred in the third quarter of 2001 (Snow 2001). At the end of the first year of the 2002 to 2006 phase-in of EGTRRA's tax rate reductions, the growth in tax revenue bottomed out at −9 percent. The 2003 Jobs and Growth Tax Relief Reconciliation Act (JGTRRA) moved the income tax rate reductions scheduled for 2006 under EGTRRA to 2003. By 2005, tax revenue was growing by about 9 percent. At the end of 2010, with the rate cuts set to expire, the Obama administration extended them by 2 years. Between 2010 and 2011, per-capita tax revenue growth increased by about 10 percentage points.

Budget deficits are financed by the U.S. Treasury selling securities to banks, other nations' central banks, large corporations, the Fed, and others in periodic auctions. Although these securities are auctioned and redeemed by the Treasury in what is called the *primary market*, holders can sell them before they mature in the *secondary market*. In 2012, the Treasury conducted 264 auctions worth $8 trillion.[3] This amount is about eight times larger than that year's budget deficit because the auctions were large enough to cover the deficit, pay interest payments, and retire maturing securities.

Since late 1998, the Treasury has used "uniform-price" auctions to sell securities. For a given uniform-price auction, all bids at successively lower prices are accepted until the predetermined offering amount is reached. The price at which the offering amount is reached is called the

[3] See "How Treasury Auctions Work." (n.d.).

"stop-out" price. All bidders bidding at or above the stop-out price pay this price. For example, suppose a billion-dollar auction of a zero-coupon security with a \$100 face value (*FV*) and a maturity (*n*) of one year ends with a stop-out price (*P*) of \$98.91.

```
FV:=100:   n:=1:   P:=98.91:
```

These values are substituted into the security's yield equation, $i = (FV/P)^{1/n} - 1$, when the ENTER key is pressed after the equation is typed in MAPLE.

```
i:=(FV/P)^(1/n)–1
                              0.01102019
```

The yield on the security is 0.011, or 1.1 percent. Since the security sold for \$98.91 and the auction was set to raise \$1 billion, 10.11 million of them must be issued. The Treasury would have to issue 10.09 million securities had the stop-out price been \$99.11 instead.

```
P:=99.11:
i
                              0.009
```

At the higher price the interest rate falls to 0.009, or 0.9 percent. Changing the stop-out price demonstrates that the price of the security and its interest rate are inversely related.

Expansionary Fiscal Policy

Expansionary fiscal policy is a deliberate increase in the federal budget deficit that is financed with Treasury securities. It is a cut in taxes, an increase in government expenditure, or both. The arrows above *G* and *T* in the following equation show how expansionary fiscal policy affects AD.

$$PL_d = \underbrace{(\text{mpc} - \text{mpm} - 1)}_{\text{slope}} \cdot Y + \underbrace{W + Y_e - r - \text{mpc} \cdot \overset{\downarrow}{T} + X + H + F + \overset{\uparrow}{G}}_{\text{intercept}}$$

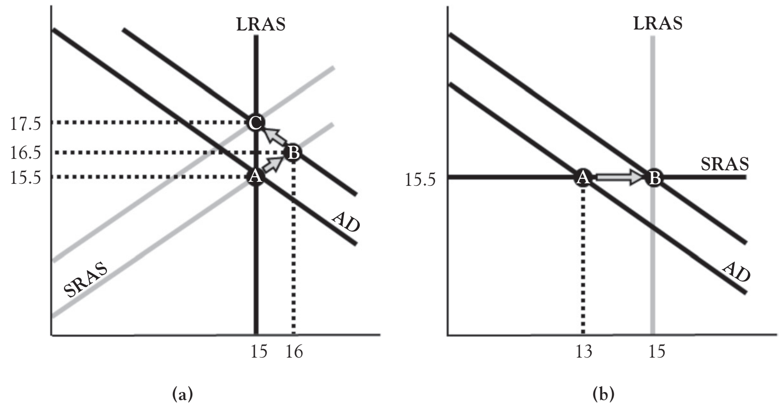

Figure 5.3 Expansionary fiscal policy in the classical and Keynesian schools

Increasing the budget deficit increases AD's intercept, which shifts AD from point A to point B in Figure 5.3.

In the long-run classical model of Figure 5.3a, the economy is initially at point A. Unemployment is equal to its natural rate at this point because real GDP is equal to its potential. Expansionary fiscal policy puts the economy in an *induced inflationary gap* at point B. At this point labor markets are tight because unemployment is below its natural rate. If the Fed does not offset fiscal stimulus with tighter money, firms bid wages up. The prices of other production inputs are bid up, too, due to the heavy utilization of facilities and overemployment of resources. The arrows above *w* and *p* in the following equation show how the model self-adjusts.

$$PL_s = \underbrace{b \cdot Y}_{\text{slope}} + \underbrace{\overset{\uparrow}{w} + \overset{\uparrow}{p} + t - b \cdot Y_p}_{\text{intercept}}$$

The increase in the value of SRAS's intercept shifts SRAS from point B to C. At point C, wages and prices of other inputs to production no longer change because resource markets have equilibrated. With real GDP equal to its potential, the PL settles at $17.5 thousand. Thus, in classical economics, expansionary fiscal policy is inflationary, has no effect on real GDP, and increases the budget deficit, which adds to the national debt.

In the short run Keynesian model of Figure 5.3b, the economy is in a recessionary gap because SRAS and AD intersect at a point that is to the left of LRAS (point A). SRAS is also perfectly elastic because Keynesian economics assumes that wages and prices are rigid in the short run. This makes nominal wage rate (w) and nominal prices of other production inputs (p) fixed parameters. Expansionary fiscal policy that increases government expenditure, cuts taxes, or both increases the size of the budget deficit and AD's intercept. The figure shows that the budget deficit is just enough to close the $2 trillion recessionary gap. Thus, expansionary fiscal policy returns the economy to full employment, is not inflationary, but raises the national debt by the amount of the budget deficit.

Restrictive Fiscal Policy

Restrictive fiscal policy reduces (increases) the federal budget deficit (surplus). It is an increase in taxes, a cut in government expenditure, or both. The national debt is reduced if the change is large enough to generate a fiscal budget surplus. The arrows above G and T in the ensuing equation show how restrictive fiscal policy affects AD.

$$PL_d = \underbrace{(\text{mpc} - \text{mpm} - 1)}_{\text{slope}} \cdot Y + \underbrace{W + Y_e - r - \text{mpc} \cdot \overset{\uparrow}{T} + X + H + F + \overset{\downarrow}{G}}_{\text{intercept}}$$

Reducing (increasing) the budget deficit (surplus) reduces AD's intercept, which shifts AD from point A to point B in Figure 5.4.

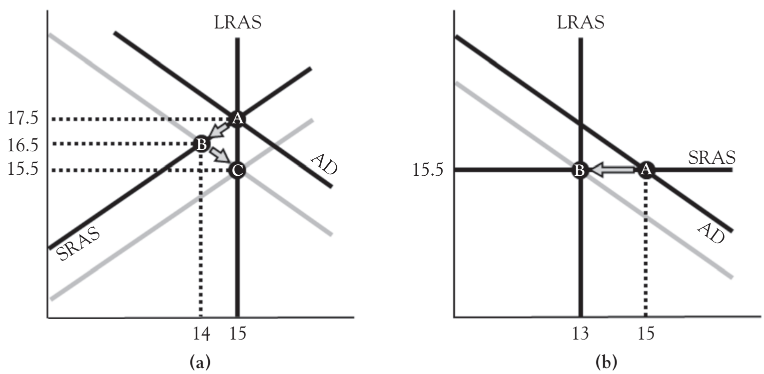

Figure 5.4 Restrictive fiscal policy in the classical and Keynesian schools

In the long-run classical model of Figure 5.4a, the economy is initially at point A. Unemployment is equal to its natural rate at this point because real GDP is equal to its potential output. Restrictive fiscal policy puts the economy in an *induced recessionary gap* at point B. At this point, unemployment is above is natural rate, which means facilities are underutilized and resources are underemployed. Wages and the prices of other inputs can fall because government does not intervene in markets in the classical model. The arrows above *w* and *p* in the following equation show how the model self-adjusts.

$$PL_s = \underbrace{b}_{\text{slope}} \cdot Y + \underbrace{\overset{\downarrow}{w} + \overset{\downarrow}{p} + t - b \cdot Y_p}_{\text{intercept}}$$

As wages and prices of production inputs fall, SRAS self-adjusts to point C. As real GDP returns to its potential, the PL drops to \$15.5 thousand. Thus, in classical economics, restrictive fiscal policy has no effect on real GDP and is deflationary.

The Keynesian model in Figure 5.4b is in an inflationary gap at point A. Restrictive fiscal policy that reduces government expenditure, raises taxes, or both reduces the size of the budget deficit and AD's intercept. The figure shows that the reduction in the budget deficit is just enough to close the \$2 trillion inflationary gap. Thus, restrictive fiscal policy returns the economy to full employment and is not deflationary. If it was large enough to turn a budget deficit into a budget surplus, the resulting surplus can be used to pay down the budget deficit that was used to close the recessionary gap in Figure 5.3b.

Shortcomings of Fiscal Policy

Although discretionary fiscal policy is deemed effective in the Keynesian model, in practice, it is futile. Because forecasting is difficult and gets increasingly unreliable the further into the future predictions are made, overshooting or undershooting an output gap is likely. If the fiscal stimulus is too small in Figure 5.3b, AD will shift along SRAS to a point between A and B. This leaves the economy in a smaller recessionary gap. If the initial stimulus is too large with the economy at point A, AD will shift along SRAS to a point to the right of point B. This induces an inflationary gap, and requires a withdrawal of stimulus or tighter money from the Fed to prevent SRAS from *eventually* self-adjusting upward due to resources being overemployed.

Even if the size of discretionary fiscal stimulus is predictable, there are delays in its implementation. It takes time to observe that the economy is in a recessionary gap because GDP and unemployment are not observed in the present. In addition, several months of observations are needed to make an accurate prognosis. After a problem has been diagnosed, it takes time to decide on a course of action because Congress must debate, compromise, amend, and vote on the action to be taken. When the president's party does not control both chambers of Congress, adopting fiscal policy is very challenging. Even if the president's party controls the House and Senate, the Senate minority can stop legislation if it gets at least 41 senators to support a filibuster. After fiscal policy is signed into law by the president, its effects are further delayed by revenue from new taxes being collected a year or more after the change was made, or by bureaucratic red tape that includes departments altering budgets, adjusting spending habits, and screening grant or transfer applicants. Sometimes its implementation is purposely lagged by several years. EGTRRA is a great example of this. Even the theory of multipliers implies that the benefits of fiscal stimulus take time to unwind.

Figure 5.5 shows how poorly timed discretionary fiscal policy can destabilize the economy. SRAS slopes upward because stagflation[4] in the 1970s implies that wages and prices are not as rigid as Keynesian economics assumes they are. At point A, unemployment is equal to its natural rate because real GDP and its potential are equal. Suppose an investment slump makes firms reluctant to expand their operations. The arrow above *F* shows how the slump affects AD.

$$\mathrm{PL_d} = \underbrace{(\mathrm{mpc} - \mathrm{mpm} - 1)}_{\text{slope}} \cdot Y + \underbrace{W + Y_e - r - \mathrm{mpc} \cdot T + X + H + \overset{\downarrow}{F} + G}_{\text{intercept}}$$

If the decline in the intercept causes AD to shift from point A to B, real GDP falls to $14.8 trillion. As unemployment rises, voters implore

[4] Stagflation is high inflation, high unemployment, and sluggish economic growth.

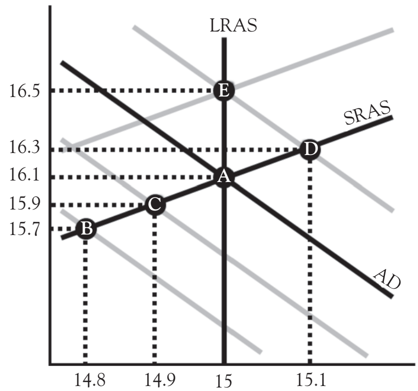

Figure 5.5 Expansionary fiscal policy in the presence of policy lags

elected officials to take action. Complying with this is difficult because certain politicians support a temporary boost in government expenditure while others back tax cuts. As Congress debates a plan of action, suppose good economic news overseas sparks a rally in United States stock markets, which in turn raises consumer wealth (W) just enough to push AD to point C. The arrow above W in the following equation illustrates this effect.

$$\mathrm{PL_d} = \underbrace{(\mathrm{mpc} - \mathrm{mpm} - 1)}_{\text{slope}} \cdot Y + \underbrace{\overset{\uparrow}{W} + Y_e - r - \mathrm{mpc} \cdot T + X + H + F + G}_{\text{intercept}}$$

With the economy at point C, suppose the House and Senate start reconciling their stimulus bills. As this continues, the increase in consumer wealth boosts expected future income (Y_e) enough to push AD to point A. The arrow in the ensuing equation shows how AD is affected by this.

$$\mathrm{PL_d} = \underbrace{(\mathrm{mpc} - \mathrm{mpm} - 1)}_{\text{slope}} \cdot Y + \underbrace{W + \overset{\uparrow}{Y_e} - r - \mathrm{mpc} \cdot T + X + H + F + G}_{\text{intercept}}$$

The increases in consumer wealth and expected future income are enough to return the economy to full employment at point A. If this happens before the fiscal stimulus is injected into the economy, repealing a hard-fought stimulus bill is not going to happen. After the president signs the bill, consumers receive tax cuts and firms get paid for filling orders for new public works projects, and AD shifts from point A to D. If the Fed fails to offset this with tighter money, overemployment of labor and high resource and facility utilization causes firms to bid up wages and prices of other inputs. These shift SRAS up to point E. Thus, poorly timed fiscal policy adds to the national debt, is inflationary, and, in the end, does not affect real GDP or unemployment.

Discretionary fiscal policy has domestic and international consequences, too. Suppose a tax cut and an increase in government expenditure is able to close the recessionary gap shown in Figure 5.6a. Since these actions increase the budget deficit, government must borrow funds in the *loanable funds market* depicted in Figure 5.6b. Savers supply loanable funds when they purchase bonds from governments and firms. The price of loanable funds is nominal interest rate *i*, which is used to compute interest paid to savers. If it is 0 percent, demanders will want to borrow a lot of these funds, but savers will not supply them. As the nominal interest rate rises, the shortage in funds declines as borrowers demand fewer funds and savers supply more. The shortage disappears when the nominal interest rate reaches its equilibrium of 2.5 percent at point A. At the moment government borrows to finance the budget deficit, loanable funds demand (D_{LF}) shifts from A to B. With loanable funds supply (S_{LF}) held constant, higher demand pushes interest rates to 3.5 percent at point B.

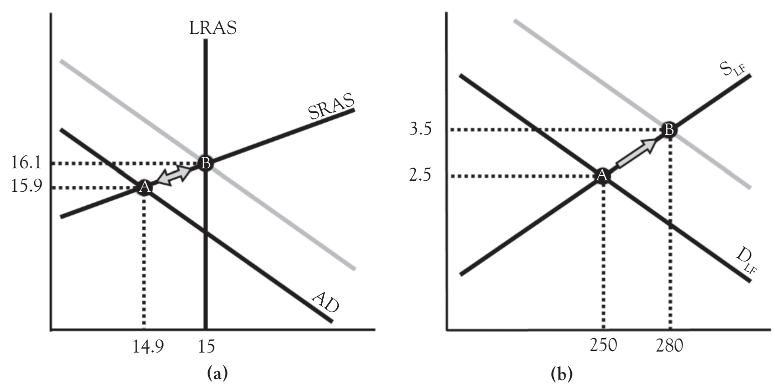

Figure 5.6 Fiscal policy and the crowding-out effect

Foreign and domestic capital are attracted to U.S. securities when real interest rate r is pushed up by the higher nominal interest rate.[5] With domestic capital flowing to U.S. securities, less is being invested in plants and equipment (F), and homes (H). Foreign capital flowing into the United States reduces the amount of capital that is invested in other countries. The decline in private investment, here and abroad, caused by greater U.S. government borrowing is called *crowding out*. Since U.S. securities are purchased in dollars, foreign investors swap their currencies for dollars, which causes the dollar to appreciate. This makes U.S. products more expensive abroad, which reduces U.S. exports (X). The arrows in the following equation model the consequences of increased government borrowing.

$$PL_d = \underbrace{(\text{mpc} - \text{mpm} - 1)}_{\text{slope}} \cdot Y + \underbrace{W + Y_e - \overset{\uparrow}{r} - \text{mpc} \cdot \overset{\downarrow}{T} + \overset{\downarrow}{X} + \overset{\downarrow}{H} + \overset{\downarrow}{F} + \overset{\uparrow}{G}}_{\text{intercept}}$$

Although increasing the size of the budget deficit (higher G and lower T) shifts AD from point A to B as shown in Figure 5.6a, crowding out (higher r and lower X, H, and F) shifts AD back to point A. Hence, the intended consequence of fiscal policy is accompanied by unintended domestic consequences, higher interest rates and lower investment expenditure, and an unintended international consequence, a reduction in exports caused by an appreciating dollar.

Although Keynesian economics advocates for countercyclical changes in the budget balance to smooth the business cycle, the continual adjustment of tax rates and expenditures makes it difficult for individuals and firms to plan for the future. Not knowing what tax rates will be next year, in two years, or in five years makes computing expected returns difficult. This retards economic activity and job creation (Meltzer 2012) and hinders long-run economic growth.

Oddly enough, politicians need not take action when the economy slips into recession because there are *automatic fiscal stabilizers* at work in the economy. Automatic stabilizers are countercyclical effects that are

[5] The real and nominal rates of interest have moved together from the early 1980s and beyond (Mishkin 2010).

not hindered by legislative delays. Examples of these include progressive income taxation, unemployment insurance compensation, and SNAP. As growth accelerates, incomes rise. This means that more and more people are paying an increasing proportion of income in taxes because they find themselves in higher and higher income tax brackets. At the margin, this dampens consumption expenditure, which limits the upswing in the business cycle. As the economy approaches the trough in the business cycle, more and more people are paying less in income taxes—because they find themselves in lower and lower income tax brackets—or are receiving unemployment insurance compensation or SNAP payments. As the deficit automatically widens without legislative delay, immediate stimulus is injected into the economy, which pushes real GDP back toward its potential level. The additional tax revenue accruing to the Treasury during an expansion automatically pays down the fiscal deficit resulting from an economic contraction.

The Supply-Side View

At the end of World War II, the views of John Maynard Keynes and F.A. Hayek split economics into two camps. Unlike Keynes, Hayek argued for limited government, economic freedom, and personal responsibility. While Keynes's view dominated mainstream economic thought and policy formation in the decades following the war, Hayek's views helped revive classical economics. As this was going on, shifting inflation expectations of the 1970s ushered in stagflation. This revealed that prices and wages were not as rigid as Keynesian theory had assumed. As a result, the aggregate market model with upward sloping SRAS became the standard in macroeconomic principles textbooks.

In *The Way the World Works*, after attributing high tax rates and monetary policy to the stagflation of the 1970s, Jude Wanniski made the case for *supply-side economics*. The theory emphasizes *permanent* reductions in tax rates and regulations, which fuel continual increases in production capabilities over time. This pushes LRAS and SRAS outward at a pace higher than what would have prevailed under a regime of continuous fiscal policy adjustment. Because the three curves of the aggregate market model equilibrate over the long run, AD shifts outward to keep up

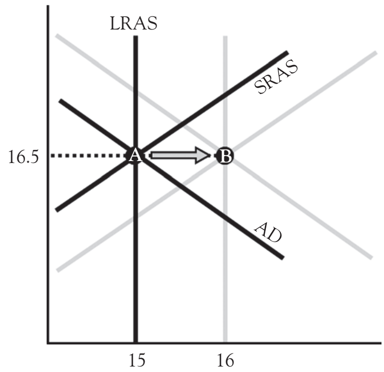

Figure 5.7 Supply-side fiscal policy

with LRAS and SRAS,[6] which is shown in Figure 5.7. The figure implies supply-side economic policy results in zero inflation and ever-expanding GDP.

The marginal tax rate is crucial in supply-side economics. If the tax rate is 100 percent, people will not work and firms will not produce, resulting in zero taxes being collected. Conversely, people and firms pay zero income taxes when the tax rate is 0 percent. Thus, tax revenue rises and then falls as the tax rate is raised from 0 to 100 percent. This relationship is called the *Laffer curve*.[7] It was the topic being discussed by Ferris's economics teacher, played by Ben Stein in 1986's *Ferris Bueller's Day Off*, during his infamous day off from high school.

The empirical laffer curves graphed in Figure 5.8 show how tax revenue and the top marginal tax rate relate over time in the United States.[8] According to the left-side figure, tax revenue as a percentage of GDP is maximized when the tax rate is 50 percent. The figure on the right, however, implies that per capita tax revenue reaches a maximum when the tax rate is less than 25 percent. Although both curves suggest cutting *high* tax

[6] This is a take on *Say's Law*, which Keynes rephrased as "supply creates its own demand" (Keynes 1936).

[7] Although the curve is named after economists Arthur Laffer, Laffer acknowledged that Ibn Khaldun, a 14th Century philosopher, first observed the relationship centuries ago. (Laffer 2004).

[8] The figure uses quarterly data covering the 1954 to 2012 period. These data are from FRED and TaxFoundation.org

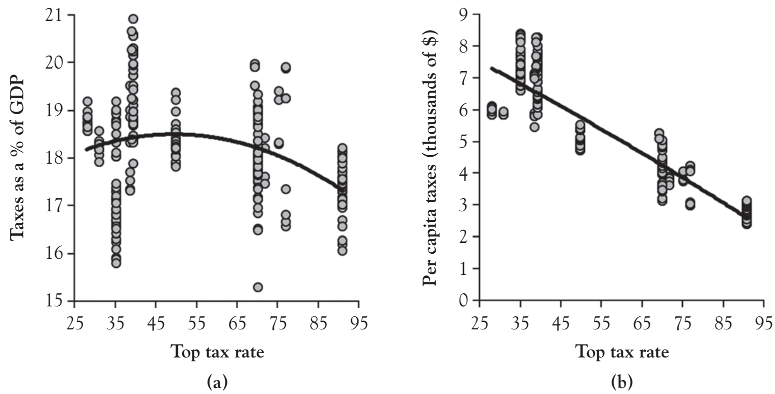

Figure 5.8 Empirical laffer curves

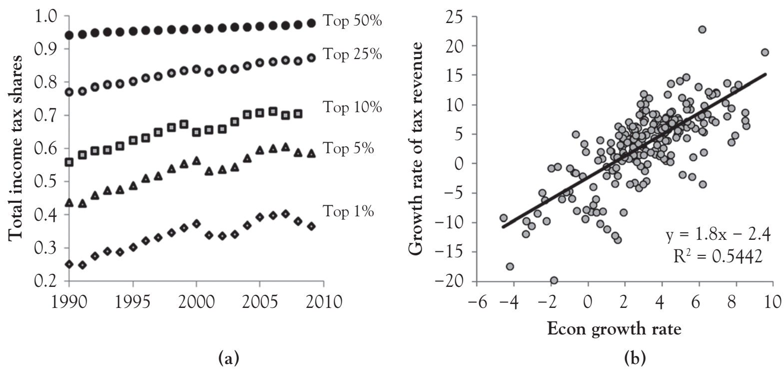

Figure 5.9 Tax burden, and growth in T versus GDP growth

rates raises tax revenue, the left curve implies that this only works up to a point.

Figure 5.9a[9] confirms the Laffer effect. It shows that the tax burden of those in the top three income brackets has risen over time. From 2003, the year the EGTRRA tax cuts were completely phased in, to the year preceding the Great Recession, the burden of taxation rose by 5 to 7 percentage points for those in the top two income tax brackets.

The Laffer curve implies that there is a limit to the amount of taxes that can be collected from taxpayers in the short run. Thus, government

[9] The data are from TaxFoundation.org.

cannot provide services costing more than this limit unless it runs a budget deficit. Elected officials interested in balancing the fiscal budget and providing services exceeding the Laffer maximum can do so only if they enact policies that shift the curve up. *Permanent* reductions in tax rates and regulations expand the long-run productive capacity of the economy. This in turn shifts the economy's production possibilities frontier outward, rotates the short-run production function counterclockwise, and shifts LRAS to the right. If this policy achieves a sustainable economic growth rate of 5 percent, annual tax revenue is expected to grow at a rate of about 7 percent, according to Figure 5.9b.

Since Congress cannot bind future Congresses to the policies it enacts,[10] supply-side economic policy, in practice, is discretionary. Thus, negative evaluations of it are actually indictments of discretionary fiscal policy.

The Chicago School's View

Hayek's views also helped shape the Chicago school, which is associated with the following tenets: Markets allocate resources more efficiently than do governments, monopolies are created by government regulation, and central banks should maintain low and steady rates of money growth. The Chicago school views fiscal policy as ineffective because households form *rational expectations*.[11] If households do not expect that their taxes will be raised to retire the bonds used to finance today's budget deficit, fiscal stimulus shifts AD toward point B in Figure 5.10a.

Recent experience, however, suggests that households form *rational expectations*.[12] If so, households expect that tax rates will be raised in the future to pay off today's budget deficit. This reduces expected future consumer income (Y_e). In addition, when government borrows more to cover a budget deficit, demand for loanable funds shifts from A to B as in

[10] Congress lowered the top marginal tax rate to 28 percent in 1986, but raised it to 31 percent in 1990.

[11] Robert Lucas won the Nobel Prize in economics in 1995 for his work on rational expectations.

[12] According to Shilling (2010), households saved 80 percent of the tax rebates from Economic Stimulus Act of 2008.

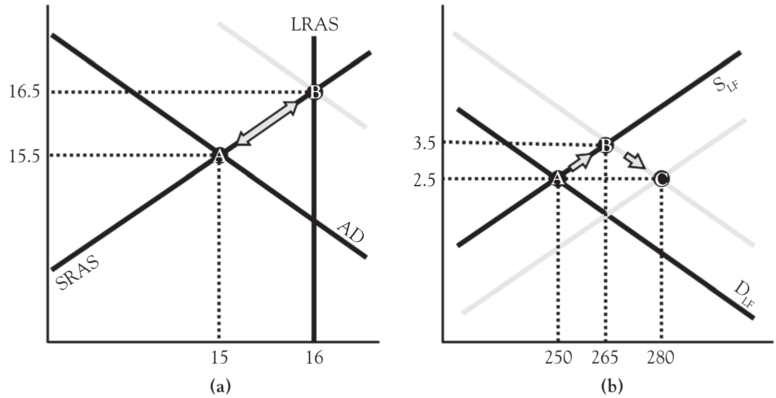

Figure 5.10 Fiscal policy in the presence of rational expectations

Figure 5.10b. If households save tax rebates and paychecks earned from public works projects to pay higher future taxes, loanable funds supply shifts from B to C. This keeps interest rates at 2.5 percent. If expected inflation is steady, real interest rates and investment expenditure are constant. The arrows in the following equation show how rational expectations offset fiscal stimulus.

$$PL_d = \underbrace{(mpc - mpm - 1)}_{\text{slope}} \cdot Y + \underbrace{W + \overset{\downarrow}{Y_e} - r - mpc \cdot \overset{\downarrow}{T} + X + H + F + \overset{\uparrow}{G}}_{\text{intercept}}$$

Fiscal stimulus would shift AD to point B in Figure 5.10a, but the decline in expected future income pushes AD back toward point A. Thus, fiscal policy has no effect on interest rates, real GDP, and unemployment.

The Austrian School's View

The 1871 publication of Carl Menger's *Principles of Economics* established the Austrian school of economics. Unlike its cousins—supply-side economics and the Chicago school, which acknowledge a limited role for government in the economy—Austrian economics adheres to classical liberalism. To Austrian economists, macroeconomics is an oxymoron because, to them, the appropriate unit of analysis is the individual. This, however, does not preclude Austrians from commenting on macroeconomic issues.

Austrians view the injection of fiscal stimulus into the economy as treating the symptoms of economic malaise rather than being its cure.[13] The Austrian prescription for persistently high unemployment would be painful to low-skilled workers in the short run because it involves the elimination of the policies that make wages and prices rigid. The rigidities are a result of government interventions that raise low-skilled laborers' reservation wages, which include unemployment insurance compensation (Layard, Nickell, and Jackman 1991), the minimum wage and pro-labor policy (Barro 1988), public assistance (Borjas 2012), and price controls present in farm bills (Bakst and Katz 2013). If artificially low mortgage rates and easy credit terms trapped low-skill workers in homes in high unemployment states after the housing bubble burst, they cannot move to low-unemployment states.

After regulations, subsidies, and other government interventions are repealed, the Austrian solution to recessionary and inflationary gaps is laissez-faire policy. Under such a system, prices are allowed to fluctuate. This is an important result in Austrian economics because flexible prices send important signals to self-interested agents. For example, consider the upward pressure on wages and the prices of production inputs that is present when unemployment is too low in an inflationary gap. Although mainstream economics is open to interventions that would close the gap, intervention can inhibit cost-saving innovations. This is due to firms not being able to pass the increased costs of production on to consumers when faced with stiff competition here and abroad. Instead, firms employee people who are paid to innovate around rising production costs. Thus, rather than SRAS decreasing, as it does in mainstream macroeconomics, LRAS shifts out to meet it and AD. As the gap closes, unemployment adjusts up to its natural rate as workers are replaced by labor-saving technologies.

Although economic prosperity is linked to core tenets of Austrian economics, namely economic and political freedom, this school of thought is routinely dismissed or marginalized by mainstream economists (e.g., Krugman 2013). This is the case despite prices falling, quality rising,

[13] Government interventions begetting government intervention is a key point in Mises (1996) and Hayek (2007).

and consumer choice increasing over the long run in markets that are relatively free of government intervention (e.g., Lasik eye surgery, cellular phones, tablets, Internet, electronics, software, and computers). On the other hand, inflation, stagnant quality, inefficiency, *or* moral hazard are typical of industries regulated, managed, or owned by government (e.g., healthcare services, health insurance, landline telephones prior to the breakup of Ma Bell, banking, education, and the post office). Thus, it is surprising that the Austrian view has not gained wider acceptance. This is perhaps due to mainstream economics offering sellable solutions to recession. While Austrian economics leaves people to their own devices when unemployment is high, mainstream economics does not. Keynesian solutions, like public works projects, extensions to unemployment insurance compensation, and payroll tax cuts, are well received among working-class voters. Supply-side and Chicago school policy prescriptions, like capital gain tax rate cuts, low interest rates, and reduced regulation, appeal to investors and entrepreneurs.

Fiscal Policy and Economic Performance

The persistence of budget deficits in Figure 5.2 suggests that they are politically popular. Between 1998 and 1999, the growth rate of government expenditure held steady at 1 percent, but rose linearly from 1 percent in 1999 to 5 percent in 2003. The growth in government spending remained near this elevated rate through 2004 even though the recession had ended three years earlier. Meanwhile, EGTRRA's temporary tax rate reductions were not fully phased in until 2003. In 2008 and 2009, the Bush and Obama administrations enacted stimulus bills, and bailed out corporations and banks using funds from TARP to rescue the United States' "financial system from almost certain meltdown [and help] avoid the feared second Great Depression" (Weller 2012).

Due to policy lag, past values of annual budget deficits should impact current economic growth. However, correlations between economic growth rates and quarterly lags of the growth rate of the budget balance are essentially zero. A similar story plays out when correlations of economic growth rates and lags of the per capita budget balance are computed. The strongest correlation occurs when the per capita bud-

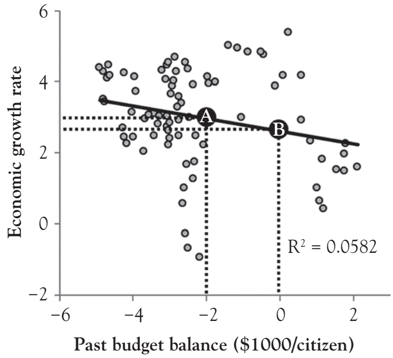

Figure 5.11 Economic growth versus lagged fiscal budget balance

get balance is lagged by eight quarters. This relationship is shown in Figure 5.11 for the 1986 to 2005 period. The trendline in the figure implies that raising the budget deficit by $2,000 per citizen leads to a modest 0.35 percentage-point increase in economic growth two years later. Given the weak correlation between growth and lags of these budget measures, and the budget balance's modest effect, will other policies be pursued? Perhaps not, because higher government spending and lower taxes directly benefit voters, and elected officials are long gone when the bonds that financed their policies mature.

CHAPTER 6

Monetary Policy

Monetary policy is the process by which a nation's central bank manipulates the supply of money to achieve full employment, maintain a low rate of inflation, or both. In the United States, the central bank is the Fed. Although the Chicago school advocates for central banks to pursue low and steady rates of money growth, the Fed historically has targeted interest rates to fulfill its dual mandate of full employment and low stable inflation.[1] For most of its history, the Fed has used the discount rate (i_d), the reserve requirement ratio (rrr), and its primary policy lever, open market operations, to achieve these objectives. In 2006, Congress gave the Fed an additional monetary tool, paying interest on reserves (i_{or}).[2] In Operation Twist (Censky 2011), the Fed deviated from purchasing short-term government debt to buying longer-term securities to push down long-term interest rates, and spur on home sales and firm investment. Unlike fiscal policy, the Fed can change the quantity of money circulating in the economy immediately using the preceding tools to curb inflation or combat high unemployment.

Money

Before money was invented, barter was used to exchange goods and services. Barter is increasingly inefficient as trade and production become more and more complex. For example, a potato farmer who cannot find anyone looking to trade a plow horse for sacks of potatoes must find someone who needs potatoes and has something horse owners need.

[1] Congress restated the Federal Reserve's objectives when it amended The Federal Reserve Act in 1977.

[2] Although interest on reserves was set to begin in 2011 (see the Financial Services Regulatory Relief Act of 2006), Congress moved its implementation up three years to help combat the 2008 financial crisis (see the Emergency Economic Stabilization Act of 2008).

Horse owners have a different problem. Unlike a sack of potatoes, a horse cannot be converted into smaller units to be exchanged for an ice cream sundae—unless it is butchered. None of these products is a good store of value because ice cream melts, potatoes rot, and horses age. Thus, money spontaneously arose to facilitate such exchanges.[3]

Money is anything that is accepted as payment for products and repayment of debts, a standard unit of account, and a store of value. The least marketable forms of money were "one by one rejected until at last only a single commodity remained, which was universally employed as a medium of exchange" (Mises 1953). The winner of this contest is divisible, transportable, difficult to counterfeit, and durable. Items ranging from mollusk shells, buckskins, and gold have served as money. In 1994's *The Shawshank Redemption*, cigarettes were used to buy posters and playing cards. In 2011's *In Time*, time is literally money that is used to buy immortality.

While coins were first minted between 700 and 500 BC (Weatherford 1997), the first paper money, chiao-tzu, was issued in tenth-century Szechwan, China (Lui 1983). It was a bank receipt for iron coins deposited in Szechwan banks. When the Szechwan government took control of this money in 1023, chiao-tzu became the world's first *fiat money*, money backed not by a commodity but by government decree. In 1694, the Bank of England began issuing receipts named the British Pound. The notes circulated as money because the bearer could redeem them in gold. The notes became fiat money when the United Kingdom abandoned the gold standard in 1931.[4] Turning the dollar into fiat money began when President Franklin D. Roosevelt signed the Emergency Banking Act of 1933, which ended the gold standard for domestic exchanges. The gold standard for foreign exchanges ended in 1971 when President Nixon issued Executive Order 11615. Meanwhile, "In God We Trust" began appearing on U.S. paper money in 1957.[5] Hence, presidents from Roosevelt to Nixon

---

[3] "When the inhabitants of one country became more dependent on those of another, and they imported what they needed, and exported what they had too much of, money necessarily came into use."—Aristotle in *Politics*.

[4] See "A Brief History of Banknotes." (n.d.).

[5] See "History of 'In God We Trust'." (2011).

essentially removed the "l" in "gold" on the dollar to slowly transition it from the gold standard to the God standard.

Money Creation

The quantity of money that circulates in the economy grows (declines) when bank lending rises (falls). The U.S. banking system evolved from the medieval goldsmiths who discovered this process after they began storing gold for consumers and merchants for fees. Table 6.1a shows a hypothetical T-account for a sixteenth-century London goldsmith, whose first gold coin deposit was made by John in the amount of 200 coins. The amount is recorded on both sides of the T-account. The value on the left is called *reserves* because the coins are held on *reserve* for the depositor. The value on the right is called *demand deposits* because the *depositor* can *demand* his coins at any time.

Storing gold is profitable because John is willing to pay to have his coins safely kept in the goldsmith's safe. Storing coins at home or carrying them around is risky, and depositing them at the goldsmith is

Table 6.1 Sixteenth-century London goldsmith T-accounts

Assets	Liabilities
Reserves	*Demand deposits*
200	200 (John)

(a)

Assets	Liabilities
Reserves	*Demand deposits*
1,000	200 (John)
	150 (Adam)
	250 (Sally)
	275 (Jane)
	125 (Tony)

(b)

Assets	Liabilities
Reserves	*Demand deposits*
100	200 (John)
Loans	150 (Adam)
900 (James)	250 (Sally)
	275 (Jane)
	125 (Tony)

(c)

Assets	Liabilities
Reserves	*Demand deposits*
1,000	200 (John)
Loans	150 (Adam)
900 (James)	250 (Sally)
	275 (Jane)
	125 (Tony)
	400 (Bill)
	500 (Jill)

(d)

not too inconvenient because it is located near ale houses and shops. Table 6.1b shows what happens when word spreads of the goldsmith's trustworthiness. As others deposit their coins at the goldsmith, his assets and liabilities swell to 1,000 coins. As he collects increasingly more storage fees, his wealth and earnings soar. After observing this, James inquires about borrowing 900 of the coins from the goldsmith to turn his alehouse into an inn. The goldsmith will agree to the request if he *believes*: (a) depositors will not withdraw their coins during the life of the loan, (b) the inn will be profitable, and (c) James is willing and able to pay back the *principal*, the borrowed coins, plus *interest*, compensation for taking on the risk.

Since gold coins are the property of depositors, lending them out to others could be viewed as being unscrupulous. To overcome this, the goldsmith offers to pay depositors interest. If the *net interest margin*, the difference between the rate borrowers pay and the rate depositors receive, is negative, the goldsmith makes a loss. Even if the net interest margin is positive, the goldsmith may hesitate to make the loan because the coins can be withdrawn at any time. The goldsmith, however, can protect himself by paying a higher rate of interest to depositors who agree to keep their coins in his safe for the life of loans. Such a deposit is called a *time deposit*.

Table 6.1c shows the immediate effect of the goldsmith agreeing to give James the one-year loan. Reserves dropped to 100 coins because 900 were handed over to James, who then paid 500 coins to Jill for building materials and 400 coins to Bill for his labor. After being paid, Jill and Bill deposit *their* coins at the goldsmith, which is illustrated in Table 6.1d. Even though there are only 1,000 coins in the safe, demand deposits increase to 1,900. The ratio of these numbers is called the *reserves ratio*. It indicates that 53 percent of reserves are backing demand deposits.

A self-imposed reserves ratio is called the *desired reserves ratio*. Its value arises over time, via trial and error. Suppose the goldsmith learns that a reserves ratio of 0.2 is enough to balance outflows (gold withdrawals and gold payments from new loans) with inflows (new gold deposits and loan payoffs in gold) under *normal* economic conditions. Since the inverse of 0.2 is 5, the goldsmith will make loans until demand deposits swell to five

Table 6.2 Banking before and after reserve requirements were imposed

Assets	Liabilities
Reserves 10,000 *Loans* 40,000	*Demand deposits* 50,000

(a)

Assets	Liabilities
Reserves 5,000 (*required*) 5,000 (excess) *Loans* 18,000 (*consumer*) 12,000 (*business*) 10,000 (*securities*)	*Demand deposits* 50,000

(b)

times the number of gold coins that are held in reserve. This is shown in Table 6.2a. With 10,000 coins physically held in the goldsmith's safe, he comfortably makes loans worth 40,000 coins to villagers and merchants. This inflates the value of demand deposits to 50,000 coins. The paper receipts issued by the goldsmith circulate as money because villagers and merchants consider the receipts to be as good as gold, and the goldsmith always has enough coins to handle withdrawals. The receipts are more convenient than coins because they can be folded, and their use eliminates trips to the goldsmith.

The afore-described system is called *fractional reserve banking* because reserves are a *fraction* of demand deposits. Such a system is inherently risky because bank profits increase as the reserves ratio falls. Consider the previous goldsmith example. As his banking operations expand, he works less and less as an artisan and increasingly more as a banker. Balancing his T-account and reviewing loan applications is time consuming but necessary. If the economy overperforms for a longer-than-expected period of time, it may give him a false sense of security. As such, he may lower his desired reserves ratio to 0.1. After doing this, just 10,000 coins are backing 100,000 in demand deposits. If he continues to charge an annual interest rate of 5 percent, interest payments increase by 125 percent when his desired reserves ratio falls from 0.2 to 0.1. His new position is more profitable but riskier. An unexpected event like the Little Ice Age (1560–1850) that killed English vineyards will wipe him out. A collapse in winery revenues slows coin deposits and increases the number of coin withdrawals as vineyard workers relocate to France. After 10,000 coins are withdrawn, the remaining 90,000 coin receipts are worthless.

In the United States' fractional reserve banking system, the Fed currently imposes a *required reserves ratio* (rrr) of 0.1 on *checkable demand deposits* (*D*). This makes banks' T-accounts slightly different from the goldsmith's. Reserves and loans are still listed on the asset side, but reserves are split into *required reserves* and *excess reserves*. Table 6.2b illustrates this difference. For purposes of comparison, the figure assumes that the bank's inflows and outflows are balanced, with a desired reserves ratio of 0.2. This means that the bank voluntarily lends out all but $10,000 of the $50,000 in checkable demand deposits. The bank's outstanding loans of $40,000 are split among loans to government (in the form of securities), consumers (for homes and autos), and businesses. With bank reserves equaling $10,000 and the rrr set at 0.1, the bank's required reserves and excess reserves each equal $5,000.

While lending in the prior goldsmith example increased the supply of money in a few steps, infinitely many progressively smaller loans are made in the *simple multiple deposit creation* model found in most textbooks. In the simplest version of this model, banks do not hold excess reserves, and no one holds currency. Suppose Fred deposits $1,000 he found buried in his backyard. At the moment Fred finds the money, the money supply increases by $1,000. With an rrr of 0.1, Fred's bank must hold $100 of the $1,000 deposit in reserve. This allows the bank to lend George $900 to buy a TV. The money supply increases by $900 at the moment the bank deposits the loan into George's checking account. If George immediately swipes his debit card at Biggie-Mart to buy a $900 TV, the bank moves $900 from George's account to Biggie-Mart's. At that moment, the money supply does not change. Because the bank is required to hold $90 of the $900 deposit as reserves, it can lend the rest to Carol. At the moment the $810 is deposited in her checking account, the money supply increases for a second time. Lending money into existence continues, increasing by $729 in the third round of lending, by $0.03 in the 100th round, by *almost* zero in round 150, and *exactly* zero after infinitely many rounds. Fred's $1,000 deposit raises demand deposits to $1,900 after the first round, to $2,710 after the second, to $3,439 after third, to $9,999.76 after the 100th, *almost* $10,000 after the 150th, and *exactly* $10,000 after infinitely many. Because the increase in demand deposits equals Fred's $1,000 cash injection divided by the rrr, 1/rrr is the *simple money multiplier*.

The *money multiplier* is the increase in money circulating in the economy for each dollar the Fed adds to reserves. It is 1/rrr, provided no one holds cash and banks convert all excess reserves into loans. However, individuals and firms hold currency for some transactions, which means that borrowers tend to convert a small portion of checkable deposits into currency. This is called the *currency ratio* (c), and is equal to the ratio of currency (C) to checkable demand deposits (D). Banks also hold cash. It is called excess reserves, and some banks hold more than others. The ratio of excess reserves (R_e) to checkable deposits is called the *excess reserves ratio* (err). When banks and others hold cash, the money multiplier is given by[6]

$$m = \frac{c + 1}{\text{err} + \text{rrr} + c}$$

If the err equals 0.1, the rrr is 0.1, and currency ratio is 0.05, the money multiplier is 4.2. This means that, for each dollar the Fed adds to reserves, the money supply increases by $4.20. If the Fed removes a dollar instead, the money circulating in the economy falls by $4.20. Thus, banks can lend money into and out of existence.

Unforeseen events and economic cycles affect the potency of the Fed's injections and withdrawals of reserves. A shock to the economy caused by a terrorist attack or a natural disaster can induce depositors to convert demand deposits into cash and banks to hold more excess reserves. If the currency ratio and err rise to 0.4 and 0.8, respectively, the money multiplier dips to 1.08 and the potency of monetary policy declines by 74 percent. When the economy grows robustly, banks tend to make more loans. This pushes the currency ratio and err toward zero, which raises the money multiplier and potency of monetary policy.

---

[6] The monetary base (MB) is the sum of currency in circulation (C) and reserves, which is excess reserves (R_e) plus required reserves ($\text{rrr}\cdot D$). With $\text{M1} = C + D$, the money multiplier is derived as follows.

$$m = \text{M1}/\text{MB} = (C + D)/(\text{rrr}\cdot D + R_e + C) = (C/D + 1)/(\text{rrr} + R_e/D + C/D)$$
$$= (c + 1)/(\text{rrr} + \text{err} + c)$$

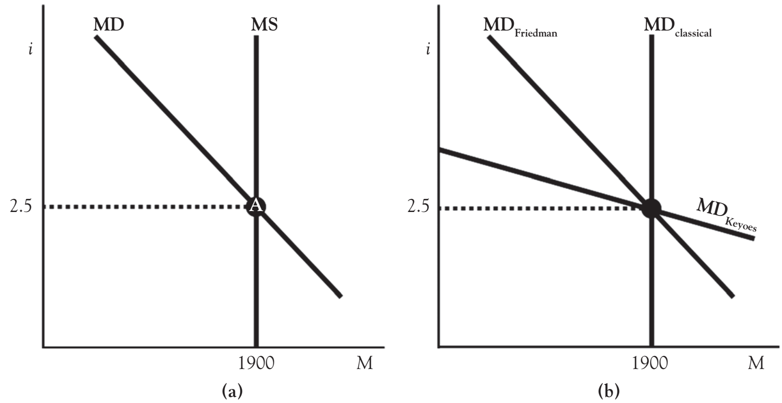

Figure 6.1 Demand for money and the market for money

The Market for Money

If holding money or buying bonds are the only stores of wealth,[7] the nominal rate of interest determined in the loanable funds market (Figure 5.6b) is the same rate that is determined by equating money demand and supply in the *market for money* (Figure 6.1a).[8] The loanable funds market is ideal for studying discretionary fiscal policy and changes in expected inflation, while the market for money is better suited for analyzing the effects of monetary policy, financial innovation, and changes in income, the PL, and nominal wages.

Money supply is assumed to be perfectly inelastic in Figure 6.1a because mainstream economics assumes that the supply of money increases (decreases) when the Fed injects (withdraws) reserves into (from) the banking system. The Fed raises the money supply by buying government securities owned by banks, which pass the new money through to consumers and firms via new loans. This view, *exogenous money theory*, has been challenged by post-Keynesians and other heterodox economists. According to their *endogenous money theory*, banks make loans whether they have the reserves to do so or not because they

[7] This is an assumption of Keynes's (1936) liquidity preference theory.
[8] The market for money and the money market are not the same because the money market determines the price of securities with maturities of one year or less (e.g., T-bills, municipal anticipation notes, commercial paper, etc.).

know that the Fed will supply the needed reserves to avoid a banking crisis. Under either view, an increase in money, whether it is created by bank lending or by the Fed injecting reserves into the banking system, shifts money supply to the right in Figure 6.1a.

Money demand is the relationship between the nominal interest rate and the quantity of money held by the public. The benefit of holding an additional dollar is smaller when one starts with $2,000 rather than $2. Holding that additional dollar is costly too because interest is forgone and inflation reduces its buying power. Thus, the nominal rate of interest is the price of holding money. As it rises, the quantity of money held falls. Paper and coin money held in wallets and piggy banks, under couch cushions and car seats, and in businesses' petty cash drawers, Traveler's checks, and checkable deposits are included in M1. Adding savings deposits and money market mutual funds to M1 yields a broader definition of money called M2.

Money demand evolved from the classical school's *equation of exchange*, $M \cdot V = Y \cdot \mathrm{PL}$. It implies that the quantity of money demanded rises after an increase in the PL, a rise in real GDP (Y), or a decline in velocity (V), which is the number of times a dollar is used to buy products in a given period. Thus, in classical economics, money demand is inelastic with respect to the nominal rate of interest. As such, it is graphed as a vertical line in Figure 6.1b. On the other hand, Keynes's liquidity preference theory's speculative motive links the quantity of money held to the nominal interest rate. This suggests that money demand is elastic with respect to the nominal rate of interest. This is why it is graphed as the relatively flat line in the figure. Friedman's refinement of the equation of exchange reconciles the two views. His model replaced real GDP with permanent income, the average of current real GDP and expected future income. The inclusion of expected future income provides a link between interest rates and the quantity of money demanded.[9] However, in his view, the quantity of money held is not as elastic as it is in the Keynesian view. This is due to wealth being stored in not only money and bonds, but also in stocks, and the returns on these assets generally rise and fall

[9] Empirical studies conclude that the quantity of money held depends on the nominal rate of interest (Laidler 1993).

together. Thus, Friedman's money demand represents the compromise that is labeled "$MD_{Friedman}$" in the figure.

The *equilibrium* in the market for money occurs at the intersection of money demand and money supply, point A in Figure 6.1a. When the nominal interest rate is above its equilibrium, the quantity of money supplied exceeds the quantity of money demanded, which means people are holding too much money. To rid themselves of it, they buy financial assets like bonds. This increases the demand for bonds, which increases their prices. Since bond prices and interest rates are negatively related, the nominal interest rate falls until the quantities of money supplied and money demanded equate. When the quantity of money demanded exceeds the quantity supplied, the interest rate is below its equilibrium. This means that people are holding too little money and seek more by selling bonds. This reduces bond prices and pushes nominal interest rates up until the quantities of money demanded and supplied equate.

The Federal Funds Market

The Fed was established in 1913 and is charged with regulating banks, supervising the payments system, and being a lender of last resort in times of financial emergencies. The system is comprised of 12 district banks, and is managed by the Board of Governors (BOG). Each member serves staggered 14-year terms, cannot serve more than one complete term, and cannot be removed for political reasons. Every four years, one of them is chosen to chair the BOG and the Federal Open Market Committee (FOMC).

The FOMC meets once every 6 weeks to keep unemployment and inflation in check. To do this, the FOMC controls reserves in the federal funds market using the discount rate, the reserve requirement ratio, open market operations, and interest on reserves. In the absence of discount lending and paying interest on reserves, the market for money in Figure 6.1a and the federal funds market in Figure 6.2a look very similar.

The quantity of reserves demanded is the sum of required reserves and the quantity of excess reserves demanded. Required reserves is the total checkable demand deposits in the banking system multiplied by the rrr.

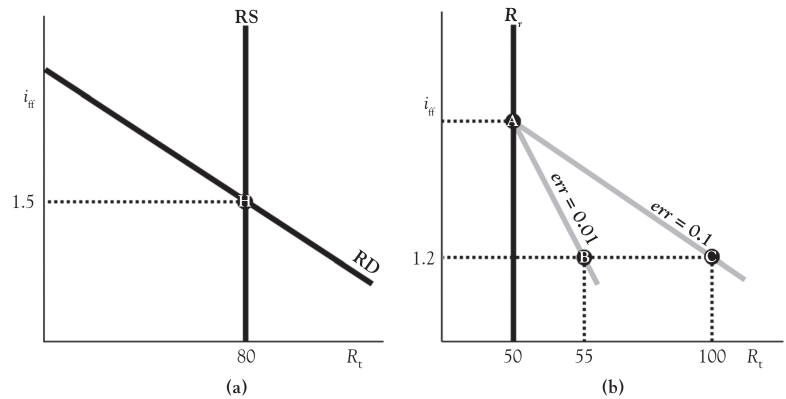

Figure 6.2 Historic mode in the federal funds market and derivation of reserves demand

For example, when the rrr is 0.1 and checkable demand deposits equal $500 billion, the quantity of required reserves is $50 billion.

The quantity of excess reserves demanded depends on many factors. Early macroeconomists attributed high excess reserves during the Great Depression to too few worthy loan opportunities (Frost 1971). This was perhaps due to poor economic growth and New Deal wage and price controls interfering with pricing signals that may have stifled innovation and entrepreneurialism. The quantity of excess reserves demanded varies inversely with deposit potential (Frost 1971), the maximum deposit level that can be maintained with no excess reserves and no vault cash. It declines in real GDP because, as the economy expands, default risk falls and consumer and business lending rises. It varies with overdraft fees the Fed charges banks for not covering daily transactions (Edwards 1997), and jumps up when the Fed adjusts the rrr (up or down) due to heightened uncertainty (Dow 2001). Excess reserves spike following bank panics (Friedman and Schwartz 1963) that are caused by natural disasters, acts of war, or economic shocks at home or abroad. Because the prior factors are assumed constant within a given day, they are lumped into shock *s*.

In addition to the aforementioned factors, the quantity of excess reserves demanded and the federal funds rate (i_{ff}) are negatively related (Poole 1968). Holding excess reserves insures against withdrawals, but doing so has a cost. For a bank with a given level of excess reserves, the cost of insuring against withdrawals increases as the federal funds rate rises. By holding excess reserves, the bank is foregoing the opportunity to lend excess reserves to other banks needing to meet reserve requirements. So, in other words, required reserves are analogous to auto liability insurance because both are minimum legal levels, and holding excess reserves is akin to adding collision and comprehensive coverage to an automobile insurance policy. For simplicity, assume the relationship between excess reserves (R_e) and the federal funds rate is given by

$$R_e = -i_{ff} + s$$

Adding excess reserves ($-i_{ff} + s$) to required reserves ($\text{rrr} \cdot D$) yields total reserves (R_t):

$$R_t = -i_{ff} + s + \text{rrr} \cdot D$$

Solving this for the federal funds rate gives reserves demand:

$$i_{ff} = -R_t + s + \text{rrr} \cdot D$$

Although the preceding equation suggests that reserves demand has a slope of –1, Figure 6.2b suggests that the slope is related to the err. At all three points in the figure, required reserves total \$50 billion because checkable deposits are \$500 billion and the rrr is 0.1. At point A, banks do not hold excess reserves because the high federal funds rate makes holding them too expensive. Subtracting required reserves from total reserves at points B and C gives excess reserves of \$5 billion at point B and \$50 billion at point C. Dividing these values by checkable deposits gives an err of 0.01 at point B and 0.1 at point C. Thus, the steeper line is associated with a smaller err. Accounting for this in the previous equation gives *simulated reserves demand*:

$$i_{ff} = \underbrace{-a}_{\text{slope}} \cdot R_t + \underbrace{s + \text{rrr} \cdot D}_{\text{intercept}}$$

where slope *a* is inversely related to the err. Parameter *a* measures banks' *aversion* to holding excess reserves. For simulation purposes, it is scaled between 0 and 1 and gets closer and closer to 1 as bank lending becomes increasingly *aggressive*. Simulated reserves demand is defined in MAPLE as follows:

```
iff:=–a*Rt+s+rrr*D:
```

In addition to the rrr being 0.1 and checkable demand deposits being \$500 billion, suppose the aversion to holding reserves (*a*) is 0.8, and shock *s* is 15.5.[10] Executing the following commands give reserves demand, labeled RD in Figure 6.2a.

```
D:=500:    rrr:=0.1:    a:=0.8:    s:=15.5:
iff
```

$$-0.8R_t + 65.5$$

Prior to 2003, the discount rate was set below the federal funds rate. This situation is called *historic mode*. When the federal funds market is in historic mode there is an incentive for banks to borrow from the Fed instead of other banks. The Fed deterred this by requiring banks to exhaust all other credit sources and justify their credit needs, and by auditing banks that abused the discount window. Ninety years after its founding, the Fed began setting the discount rate 1 percentage point above its target for the federal funds rate. This kinks reserves supply, which is shown in Figure 6.3a. The kink occurs at point K, indicating that the discount rate (i_d) is 2.5 percent and the Fed's i_{ff} target is 1.5 percent.

The kinked *simulated reserves supply curve* has two parts. The vertical part is the sum of nonborrowed reserves (R_n) and borrowed reserves (R_b). It is defined in the following exhibit. It tells MAPLE to draw a vertical line at total reserves, which equals $R_b + R_n$, from zero up to the discount rate (i_d).

```
V:=[[Rb+Rn, 0], [Rb+Rn, id]]:
```

[10] The value shock *s* takes on is inconsequential, but changes in it are not. As such, its value is chosen to attune reserves demand. Given the values of the other parameters, assuming it is 15.5 fits demand to point H in Figure 6.2a.

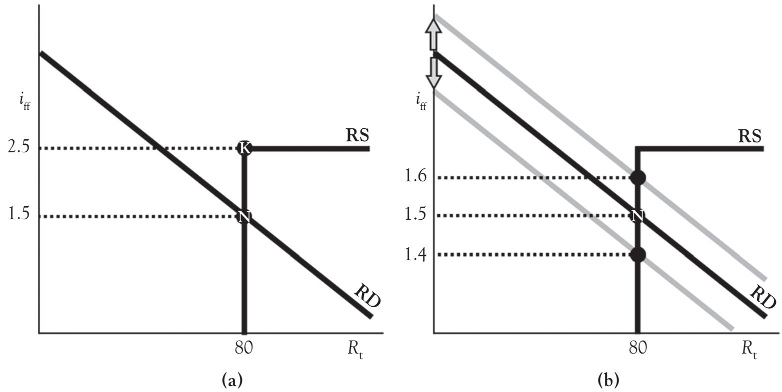

Figure 6.3 Normal mode in the federal funds market

The horizontal section of reserves supply is the discount rate. It is defined in the ensuing exhibit. It tells MAPLE to draw a horizontal line segment at a height equal to the assumed value of the discount rate (i_d) from total reserves ($R_b + R_n$) to 200, which is four times larger than required reserves in the continuing numerical example.

```
H: = [[Rb+Rn,id], [200,id]]:
```

The horizontal and vertical parts of reserve supply are combined in the following exhibit:

```
RS:=[V,H]:
```

If nonborrowed reserves, borrowed reserves, and the discount rate are 0, \$80 billion, and 2.5 percent, respectively, the following commands plot reserves supply and demand in Figure 6.3a.

```
Rb:=0:    Rn:=80:    id:=2.5:
plot([RS,iff],R=0..100)
```

When reserves demand intersects the vertical section of supply, as it does at point N in Figure 6.3a, the federal funds market is in *normal mode*. It remains in normal mode as long as reserves demand crosses the vertical section of reserves supply. Normal fluctuations in real GDP cause checkable deposits to fluctuate, and this causes the intercept of reserves demand to oscillate.

$$i_{ff} = \underbrace{-a}_{\text{slope}} \cdot R_t + \underbrace{s + \text{rrr} \cdot \overset{\updownarrow}{D}}_{\text{intercept}}$$

If the oscillations are slight, demand shifts up and down along the vertical section of reserves supply. According to Figure 6.3b, when this happens, the federal funds market remains in normal mode, reserves remain at \$80 billion, and the federal funds rate cycles between 1.4 percent and 1.6 percent.

A bank panic has two effects. Demand flattens as aversion to holding excess reserves (*a*) falls. After demand flattens, it shifts rightward because the panic causes *s* to jump in value.

$$i_{ff} = \underbrace{-\overset{\downarrow}{a}}_{\text{slope}} \cdot R_t + \underbrace{\overset{\uparrow}{s} + \text{rrr} \cdot D}_{\text{intercept}}$$

The effects of the bank panic are shown in Figure 6.4a. The new equilibrium, point E, is on the horizontal section of reserves supply. This is *emergency mode*. At point E, banks demand \$81 billion in reserves, but only \$80 billion are supplied. If the Fed, the lender of last resort, does not

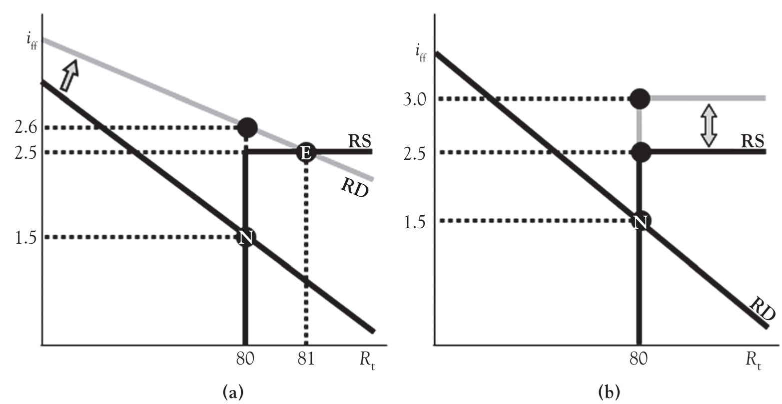

Figure 6.4 Emergency mode in the federal funds market and adjustment of the rrr

accommodate this demand, the federal funds rate will rise to 2.6 percent. To prevent this, the Fed lends banks the $1 billion that is lacking. This raises borrowed reserves to $1 billion, total reserves to $81 billion, and limits the increase in the federal funds rate to 2.5 percent, which equals the discount rate.

Monetary Policy

The Fed currently regulates the federal funds market to maintain unemployment between 5 percent and 6 percent and inflation near 2 percent. Because the Fed cannot directly control unemployment, inflation, and economic growth, it targets money growth or interest rates by injecting or pulling reserves from the federal funds market. Because monetarists like Milton Friedman advocate for low, steady, stable money growth, targeting money aligns with the classical school and its focus in the long run. Targeting interest rates is embraced by Keynesians because a reduction in interest rates boosts AD via greater investment. Austrian economists would consider targeting money the lesser of two evils because artificially low interest rates lead to malinvestment and speculative economic bubbles.[11] The Fed uses several tools to target interest rates or money growth.

Discount lending is an emergency monetary policy tool. Figure 6.4b shows the effect of the Fed adjusting the *discount rate* between 2.5 percent and 3.0 percent. The figure shows that small adjustments to the discount rate have no effect on reserves or the federal funds rate.

Adjusting the rrr has an effect similar to that of a bank panic. Raising it shifts reserves demand outward. Because the change injects uncertainty into the banking system, shock *s* spikes up and aversion to holding excess reserves (*a*) falls.

$$i_{ff} = \underbrace{-\overset{\downarrow}{a}}_{\text{slope}} \cdot R_t + \underbrace{\overset{\uparrow}{s} + \overset{\uparrow}{\text{rrr}} \cdot D}_{\text{intercept}}$$

[11] Austrian Business Cycle Theory (ABCT) predicts that asset bubbles are caused by easy credit and central banks keeping interest rates too low for too long. Hayek won the 1974 Nobel Prize in part for his contribution to ABCT.

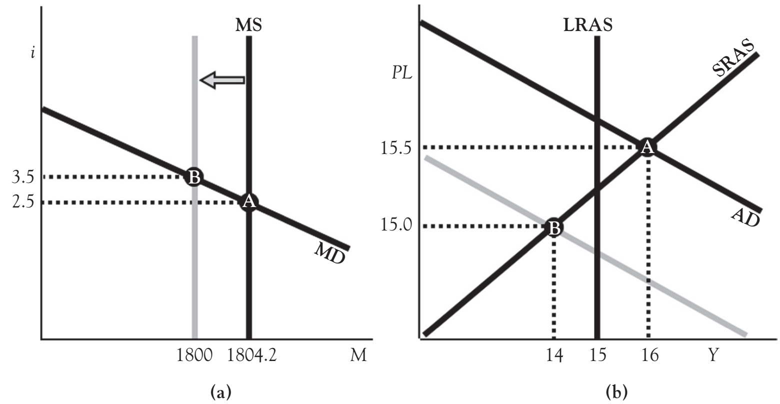

Figure 6.5 Effects of adjusting the rrr

The three effects make predictions difficult because they flatten and increase reserves demand, as shown in Figure 6.4a. Although the figure shows reserves rising, the money supply falls due to the higher rrr reducing the money multiplier. The decline in the money supply in Figure 6.5a increases nominal interest rate *i*, which raises the real interest rate (*r*) if expected inflation does not change. An increase in the real rate of interest dampens private investment (*H* and *F*). It also strengthens the dollar, which reduces exports (*X*).

$$\mathrm{PL_d} = \underbrace{(\mathrm{mpc} - \mathrm{mpm} - 1)}_{\text{slope}}\, Y + \underbrace{G - \mathrm{mpc}T + \overset{\downarrow}{X} - \overset{\uparrow}{r} + W + Y_e + \overset{\downarrow}{H} + \overset{\downarrow}{F}}_{\text{intercept}}$$

Figure 6.5b indicates that the net effect of hiking the rrr moves the economy from an inflationary gap (point A) to a recessionary gap (point B).

Suppose the Fed lowers the rrr instead. This decreases reserves demand. However, this is offset by the uncertainty that a cut in the rrr triggers. The heightened uncertainty causes shock *s* to jump up in value, which raises reserves demand. In addition, aversion to holding excess reserves declines, which flattens reserves demand. The latter two effects may or may not offset the direct effect of lowering the rrr. Thus, predicting the outcome of a reduction in the rrr is more difficult than raising it.[12]

[12] This is perhaps why the rrr is rarely adjusted. It was last changed on 4/2/1992 (www.federalreserve.gov).

Interest rates adjust when the Fed sells and buys Treasuries. These transactions are called *open market operations*. They were discovered by accident. During World War I, Federal Reserve District Banks earned substantial interest on loans made to banks. The deflationary recession of 1920 to 1921 allowed banks to pay off most of these loans. Left with declining income streams, District Banks began buying Treasuries from banks to cover their costs. The uncoordinated purchases led to a huge expansion in the money supply. In response to that discovery, the Fed formed what is now known as the FOMC. Due to its proximity to world financial markets, the New York District Bank conducts open market operations on behalf of the FOMC.

Suppose the Fed decides to lower its target for the federal funds rate from 1.5 percent (point A in Figure 6.6a) to 0.3 percent (point B in Figure 6.6a) to stimulate the economy out of a recessionary gap. To do this, it buys securities from banks. This is called an *open market purchase*. In Figure 6.6a, the \$1.5 billion open market purchase increases the quantity of nonborrowed reserves by the same amount, and pushes the federal funds from 1.5 percent to its new target of 0.30 percent. In accordance with its 2003 policy change, the Fed lowers the discount rate from 2.5 percent to 1.3 percent. If the money multiplier is 4.2, the \$1.5 billion increase in reserves is expected to increase the money supply by \$6.3 billion and reduce the nominal interest rate to 1.25 percent, according to Figure 6.6b.

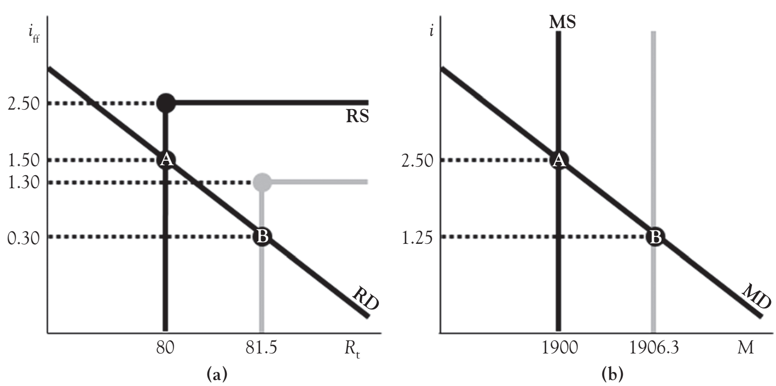

Figure 6.6 Open market purchase and its effect on the market for money

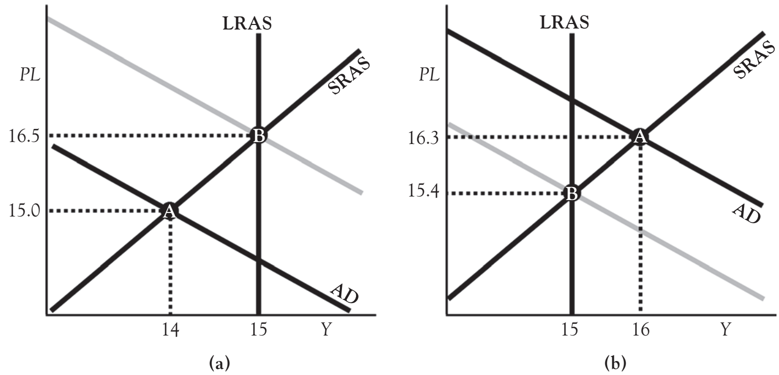

Figure 6.7 The effects of open market operations on the aggregate market model

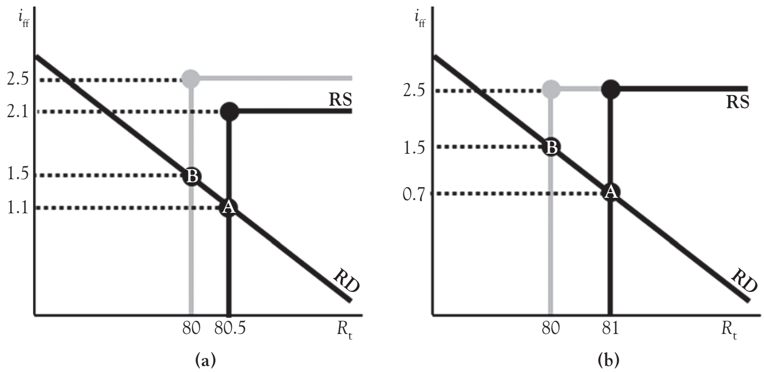

Figure 6.8 Open market sales

The open market purchase affects AD in several ways. If inflation remains unchanged, the decline in the nominal interest rate decreases the real rate. This raises private investment, and lowers the value of the dollar, which boosts exports (*X*). Collectively, these effects shift AD from A to B as shown in Figure 6.7a, which closes the output gap, reduces unemployment, and causes the PL to rise from \$15 thousand to \$16.5 thousand.

An *open market sale* is used to close an inflationary gap, like the one at point A in Figure 6.7b. It involves the Fed selling previously purchased Treasuries to banks. In Figure 6.8a, the federal funds rate is increased from 1.1 percent (point A) to 1.5 percent (point B) by a sale that reduces the quantity of reserves to \$80 billion. With a money multiplier of 4.2, the $0.5 billion decrease in reserves lowers the supply of money by $2.1 billion. This increases the nominal interest rate, which raises real rates, if expected inflation is stable. Higher interest rates reduce private investment, and raise the value of the dollar as foreign investors use dollars to buy U.S. securities. The appreciating dollar makes American goods more expensive overseas, which reduces U.S. exports. These effects shift AD from A to B in Figure 6.7b, which closes the output gap, lowers the PL, and raises unemployment.

Oscillations in reserves are normal. At point A in Figure 6.8b, one such fluctuation has the federal funds rate at 0.7 percent, which is below its target of 1.5 percent. To push the rate back up to the target, the Fed conducts an open market sale of $1 billion. However, in doing this, the money supply falls by $4.2 billion, assuming a money multiplier of 4.2. Although only one open market operation is used in this example, the New York District Bank constantly sells and buys Treasuries to keep the federal funds rate near its target. In doing this, the Fed causes money supply variations via multiple deposit creation. If instead the Fed targets money, it injects and withdraws reserves to keep money growing at a steady pace. This causes interest rates to fluctuate. Thus, the Fed can target interest rates *or* money growth, not both.

Near the beginning of the Fed's rescue of the financial system in 2008, it began paying *interest on reserves* (i_{or}), which is a price floor on the federal funds rate. From the 2008 collapse of Lehman Brothers to the spring of 2010, the Fed's holdings of securities rose by roughly $1.7 trillion (Zumbrun 2013). If the Fed had not begun paying interest on reserves, the example depicted in Figure 6.9a shows that its unprecedented purchases of mortgage-backed securities and Treasuries would have resulted in a negative federal funds rate. Paying interest on reserves kinks reserves demand at D in Figure 6.9b because banks prefer earning that rate for the reserves they hold at the Fed rather than a negative rate they would have earned lending reserves to other banks. The federal funds market is in *crisis mode* when it equilibrates at point C.

Crisis mode has several interesting consequences. It allows the Fed to buy and sell securities without affecting changes in the federal funds rate. This is so because reserves supply slides left and right as the Fed conducts open market operations. Kinking reserves demand at a near zero interest

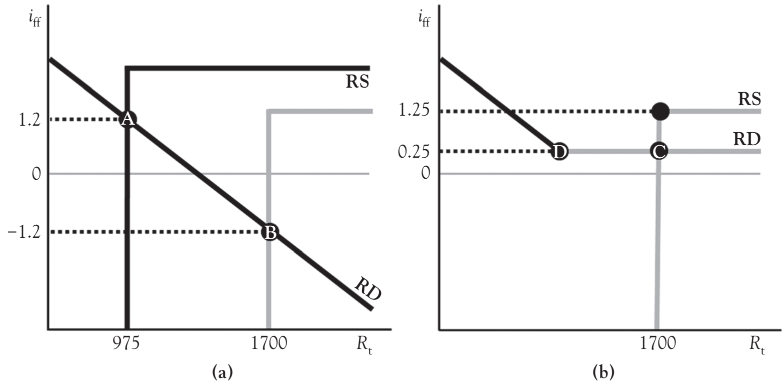

Figure 6.9 Crisis mode in the federal funds market

rate also allows the Fed to buy or sell securities without affecting changes in the money supply. According to Frost (1971), the federal funds market is in a liquidity trap when reserves demand is very elastic and the federal funds rate is below 0.5 percent. The flat section of reserves demand in Figure 6.9b mimics the elastic section of the reserve demand curve Frost observed.

Monetary Policy in Practice

As demonstrated earlier, the Fed can target interest rates or money growth, not both. If it targets interest rates, it uses open market sales and purchases to keep a fluctuating federal funds rate near its target. This causes the money supply to contract and expand via multiple deposit creation. On the other hand, the normal ebbs and flows of money demand and reserves demand can cause interest rates to fluctuate *if* the Fed follows Milton Friedman's monetary rule of low and steady money growth. In theory, this can cause real GDP to cycle around potential output as AD undulates around LRAS and SRAS. Since accelerating inflation and high unemployment upsets voters, money targeting is a harder sell, politically.

The Fed has mostly targeted interest rates in the post–World War II era. Between 1952 and 1969, the Fed explicitly targeted interest rates. Figure 6.10a indicates that annual M2 growth dropped to about 2 percent during the recessions at the beginning and end of the 1960s. In

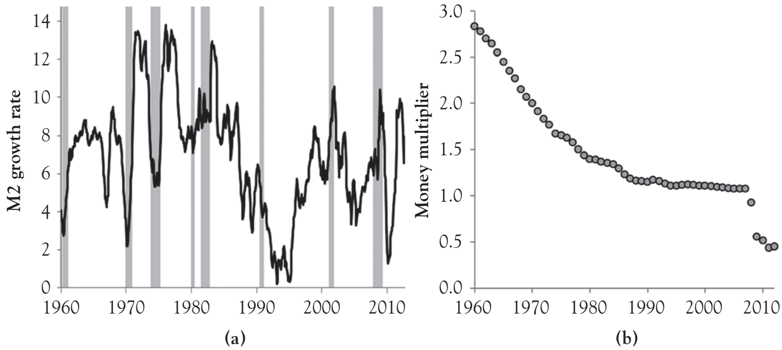

Figure 6.10 Graphs of M2 growth and the money multiplier

between the two recessions, money growth increased by a factor of 4. This results from the Fed conducting substantial open market purchases to keep interest rates low for an extended period of time during a long economic expansion. Between the two recessions, each dollar that the Fed injected into reserves raised the money supply by about $2.74, according to Figure 6.10b.[13] The resulting high rate of money growth fans inflationary flames. Although inflation floated near 1.3 percent from 1959 to 1964, it rose from 1.1 percent in the third quarter of 1964 to 6.2 percent by first quarter of 1970. This is a consequence Friedman (1968) foresaw when interest rates are kept too low for too long.

Although monetary targeting was the Fed's stated policy in 1970 when Arthur Burns became its chair, it continued to target interest rates. This is evident in Figure 6.10a. Money growth was more volatile during the 1970s than it had been during the 1960s. Money growth peaked near 14 percent during expansions and fell to 6 percent during the recession of the mid-1970s. The procyclical monetary policy caused inflation expectations to fluctuate wildly. This slayed the Phillips curve, and spurred on an inflation spiral that Paul Volcker was charged with tackling when he was appointed to head the Fed in 1979.

Unlike his predecessors, Volcker's monetary policy was countercyclical, which is evident in Figure 6.10a. His targeting of bank reserves

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[13] Figure 6.11b shows estimates of the money multiplier for 1960 to 2012. The estimates were computed using annual averages of R_e, D, C, and R_R from the Federal Reserve Economic Database.

yielded relatively low volatility in money growth. It also caused the rate of growth in money to increase through the recessions of the early 1980s. During the subsequent expansion, money growth generally fell from its high of nearly 13 percent at the beginning of the 1980s to 0.3 percent by the second month of 1993. Money growth was a bit more volatile during this period than it had been during the previous recession.

The high federal funds rate at the beginning of the 1980s is associated with persistently high unemployment. This was not unintended because the augmented Phillips curve in Figure 2.13b predicts inflation will fall by 2 percentage points per year when unemployment remains elevated at around 9 percent. The high, persistent unemployment lowered inflation from 13 percent in 1980 to 11 percent in a year, 9 percent in two years, and 4 percent by 1984.

After Alan Greenspan was appointed to chair the Fed in 1987, the Fed began targeting interest rates again. Near the end of 1992, the Fed set the federal funds rate to 3 percent, where it remained until early 1994. Figure 6.11a shows that this was followed by a precipitous decline in unemployment. The Fed responded by raising the federal funds rate to 6 percent in 1995 and held it there until 1998. However, as unemployment continued to fall, the Fed bumped the funds rate up to 6.5 percent. A sharp rise in unemployment ensued. To right the ship, the Fed dropped the funds rate to 2 percent near the end of 2001. Unemployment stabilized, but it began another marked decline. In 2004, as unemployment continued to fall, the Fed raised the federal funds rate from 1 percent to 5.25 percent.

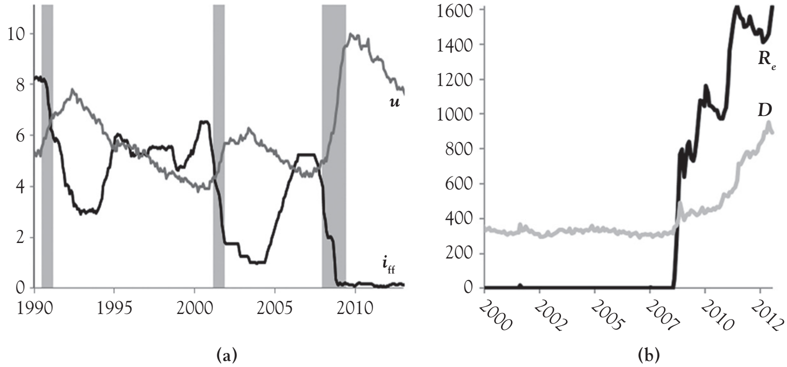

***Figure 6.11** Graphs of i_{ff}, u, R_e, and D*

About halfway through that process, Ben Bernanke was picked to head the Fed. After bottoming out a few months prior to the start of the Great Recession, unemployment exploded. The Fed responded by zeroing the federal funds rate with trillions of new reserves.

With banks holding about $1.6 trillion in excess reserves (see Figure 6.11b), and the Fed owning roughly $3 trillion in securities, the seeds of future inflation have been sowed. Although the persistent output gap and continued weakness in labor markets is keeping inflation at bay, robust economic growth at some point in the future will make banks more optimistic and less averse to holding excess reserves. The excess reserves would result in $1.8 trillion more money circulating in the economy, if the money multiplier returns to its pre-Great Recession level of about 1.1 (see Figure 6.10b). To keep the inflation genie in the bottle, the Fed will have to raise interest on reserves while selling off some of the securities it owns. However, if it sells too many, too fast, the Fed would flood the economy with trillions of new dollars. Because banks can buy securities from whomever they want, the Fed and the U.S. Treasury would be competing for the same buyers. With Figure 2.8 indicating a nearly one-for-one relationship between inflation and money growth, future inflation could be substantial.

History is littered with examples of hyperinflation. Larry Allen's (2009) *The Encyclopedia of Money* discusses 21 such examples. Prior to the 1917 Bolshevik Revolution, hyperinflation resulted in prices rising two to three times faster than wages. After the Bolsheviks took power hyperinflation exploded from 92,300 percent for the period 1913 to 1919 to 64,823,000,000 percent for the period 1913 to 1923. In 1914, there were 6.3 billion marks circulating in the German economy, but by 1923, there were 17,393 billion. A newspaper costing one mark in May 1922 cost 1,000 marks 16 months later and 70 million marks a year-and-a-half later. Erich Maria Remarque's *The Black Obelisk* describes how hyperinflation adversely affected the German people, writing: "Workmen are given their pay twice a day now—in the morning and in the afternoon, with a recess of a half-hour each time so that they can rush out and buy things—for if they waited a few hours the value of their money would drop." Customers rolled wheelbarrows full of money to the grocery store, the cost of meals at restaurants were negotiated before orders were placed, and paper money was baled like hay to heat one's home. Although it took about four days for prices to double with inflation at its worst in Germany, prices doubled in 34 and 25 hours in 1994 Yugoslavia and 2008 Zimbabwe, respectively (Hanke 2009).

CHAPTER 7

What Have We Learned?

In a 2010 Bloomberg Television interview, Alan Greenspan said, "The general notion the Fed was propagator of the [housing] bubble by monetary policy does not hold up to the evidence . . . . Everybody missed it [and the 2008 financial crisis]—academia, the Federal Reserve, all regulators." To rescue the economy from the financial crisis and the deep, persistent recessionary gap that followed, the Fed took unprecedented action that quadrupled the Fed's balance sheet[1] and raised excess reserves by 3,100 percent. This was matched by extraordinary fiscal policy enacted by the Bush administration, and continued under the Obama administration, which pushed the budget deficit, in per capita terms, to levels that were more than twice the previous record. Even though record fiscal and monetary stimulus was unable to put a dent in the deep recessionary gap and appears to be reflating asset bubbles (Ro 2013),[2] most economists in the 2012 National Association for Business Economics policy survey said that they wanted fiscal or monetary policy to continue.[3] A year later, economists in that same survey said that monetary policy was about right.[4] Thus, little seems to have been learned.

The problem arises from how mainstream economic theory is being and has been applied. Although monetarism and supply-side economics are *politically* lumped with the Austrian school, given the way in which these schools are applied, grouping them with the Keynesian school is perhaps more appropriate. Consider Milton Friedman's monetarist rule that calls for slow money growth (Willoughby 2013). Compared to interest rate targeting, his rule is welcomed by classicalists because it lessens

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[1] The Fed's balance sheet has grown from $869 billion on August 8, 2007, to $3470 billion on June 10, 2013. See www.federalreserve.gov/monetarypolicy/bst_recenttrends.htm

[2] *See "Albert Edwards: "General Motors Executive Warns of Impending Auto Bubble" by Staff at http://freebeacon.com (10/8/2013)*

[3] See http://nabe.com/survey/policy/1209

[4] See http://nabe.com/Policy_Survey_August_2013

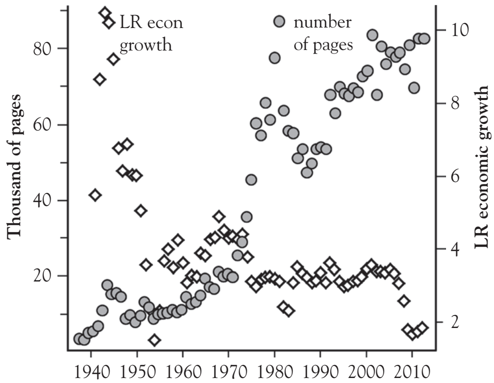

Figure 7.1 Number of pages in the Federal Register and long run (LR) economic growth

economic uncertainty, which improves the economy's long-run growth path. Although Austrian economists consider his rule to be the lesser of two evils, they view his acknowledgment that the Fed is here to stay as an endorsement of sorts. This has contributed to the vast support the Fed receives from policy makers, politicians, journalists, and economists. With its detractors sidelined, the Fed wields much influence over economic matters. As such, it is not bound by Freidman's rule. Instead, the Fed mostly targets interest rates to manage short-run output gaps rather than toe Friedman's line. In this light, it is not surprising that Austrian economists view Friedman as the guy who put the kids in charge of the candy store (e.g., Rothbard 2002). Thus, monetarism, in practice, is more Keynesian than classical. The same can be said of supply-side economics because Congress cannot bind future Congresses to low permanent tax rates it enacts.

In *The Road to Serfdom*, Hayek points out that the unintended consequences of a government intervention are addressed with more interventions. Since each of these has consequences, policy makers find themselves continuously intervening in the economy to right the wrongs of previous do-gooders. Figure 7.1 shows that the accumulation of government interventions, as proxied by the number of pages of federal regulations,[5] has stalled long-run (LR) economic growth.[6]

[5] Office of the Federal Register, Federal Register and CFR Publications Statistics.
[6] In Figure 7.1, long-run economic growth is the 10-year moving average of annual economic growth rates.

The Austrian prescription is not popular because it involves repealing institutions and regulations that most believe are necessary. The most notable are the legislation and regulations that keep the Fed and fractional reserve banking in place. Fractional reserve banking works well as long as depositors don't drain their checking accounts. This implies that the money that is lent into existence can vanish at a moment's notice. For example, the bank panic sparked by the Lehman Brothers collapse put the federal funds market in emergency mode. The resulting shortage in reserves was filled with discount loans, which spiked 578 percent in a week's time.

Prior to the Lehman collapse, artificially low interest rates and relaxed credit standards set the stage for the housing bubble. Rather than expanding or opening up businesses, Americans used leverage to speculate in housing markets. Leverage is great for home buyers as long as home values appreciate. Consider a home that is purchased for $200,000 today and sold for $220,000 a year later. Return on investment (ROI) is 10 percent if cash (no leverage) is used to buy it. However, if it is purchased with a simple, one-year, 5 percent loan, ROI is 30 percent with 20 percent down (80 percent leverage) or 505 percent with 1 percent down (99 percent leverage). The widespread use of leverage drove home demand ever higher. As supply caught up, home prices crested and yields on heavily leveraged homes declined to zero. When prices started declining, the yields on leveraged properties were negative.

Following the recommendations of mainstream economics keeps in place the policies that led to the financial crisis. Federal backstops, like Federal Deposit Insurance Corporation, the Fed being the lender of last resort, the too-big-to-fail doctrine, and Fannie Mae and Freddie Mac, create *moral hazard*. That is, lenders make riskier loans than they would have otherwise made. For example, with interest at historically low rates, credit unions are hesitant to make 30-year fixed-rate mortgages, but large national banks are not. Credit unions have to be better stewards of their depositors' money because they are too small to be bailed out, and understand that their net interest margin will be negative if future demand deposit rates rise above the rates on 30-year fixed-rate mortgages that were made years earlier.

Although Greenspan said that *everybody* failed to predict the housing bubble and the financial crisis, this is not so according to Axel

Leijonhufvud. In 2008 he wrote, "Operating an interest-targeting regime keying on the CPI, the Fed was lured into keeping interest rates far too low far too long. The result was inflation of asset prices combined with a general deterioration of credit … a variation on the Austrian overinvestment theme" (Leijonhufvud 2008). Randal Forsyth concurred, writing the following in *Barron's* on March 12, 2009, "The Austrians were the ones who could see the seeds of collapse in the successive credit booms, aided and abetted by Fed policies" (Forsyth 2009).

So, how did the Austrian school of economics foresee what everybody else missed?

Roger Garrison's (2001) Austrian macroeconomic model, which he calls Capital Based Macroeconomics (CBM), explains how asset bubbles form and subsequently burst. CBM combines the Hayekian triangle (Hayek 1935, 1939) with disaggregated labor markets, the loanable funds framework, and a production possibilities frontier (PPF) that models consumption and investment expenditure as a trade-off.

The key element of CBM is the disaggregation of production into stages. Consider a three-stage economy that produces high-order capital goods (e.g., rubber and steel) in the first stage of production, medium-order capital goods (e.g., tires and engines) in the middle stage, and low-order consumer goods (e.g., cars and pickups) in the final stage. This implies that expenditures on high-order capital goods (I_1) happened two periods ago, expenditures on medium-order capital goods (I_2) occurred last period, and expenditures on consumer goods (C) occur in the present. Mainstream macroeconomics ignores this intertemporal allocation of resources. Since the goods produced in a given stage derive their value from being inputs in the next stage, high-order capital good expenditure is less than medium-order capital good expenditure, which is less than consumer expenditure. With I_1 less than I_2 and I_2 less than C, the stages of production form the Hayekian triangle with heights equal to I_1 in the first stage, I_2 in the second stage, and C in the final stage.

Unlike mainstream macroeconomics, investment expenditure ($I_1 + I_2$) and consumption (C) are modeled as trade-offs in CBM using a PPF. Over the long run, the PPF shifts outward when investment increases but is stationary when investment is stagnant. If the economy is at a point on the PPF and consumers become increasing thrifty, savings increases and consumer expenditure falls. This causes the economy to move down along its PPF, which raises investment expenditure. Because the increase in firm investment increases the productive capacity of the economy, the economy's PPF shifts outward by the start of period 2. Thus, Keynes's paradox of thrift does not hold since the increase in savings here is associated with economic growth.[7]

The loanable funds market is helpful in understanding why the paradox of thrift does not hold. In the earlier example, consumers saved more as they became more forward looking. Preferring to substitute consumption today for greater consumption in the future increases the supply of loanable funds. At the moment this happens, there is an excess supply of loanable funds, which disappears when the nominal rate of interest reaches its new lower equilibrium. If resource markets are allowed to clear, the economy moves down along its PPF. The decline in consumer expenditures reduces firms' revenues, which is modeled by the Hayekian triangle flattening. Firms innovate around this by cutting final-stage production costs and restructuring capital to develop new products. The increase in investments that are used to reallocate capital is a response to the decline in interest rates. These new investments add a fourth stage of production, which widens the Hayekian triangle.

The aggregate labor market of mainstream macroeconomics is disaggregated by production stages in CBM. When expenditures in the final stage drop after consumers decide to save more, labor demand falls in that stage. This lowers that stage's wage rate and employment level. However, the decline in consumer expenditure is offset as the restructuring of capital investments adds a stage of production. The investments that pour into the newly formed first stage of production require workers. Thus, employment and wage losses in the final stage are offset by employment and wage gains in the labor market of the newly formed first stage. As displaced workers from the final stages of production migrate to earlier stages, the higher wages in early stages and lower wages in final stages equalize.

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[7] "Thrift may be the handmaiden of Enterprise. But equally she may not. And, perhaps, even usually she is not." (Keynes 1930).

After capital restructuring is complete and saving-induced investments have worked their way through the economy, the economy has added a stage of production and the PPF has shifted outward. Thus, increased savings pays dividends in future periods. Consumption and investment expenditure are greater than their values in the first period. The now higher levels of consumption and stage-specific investment stretch the Hayekian triangle upward.

The aforementioned restructuring and the economic growth that results from it occur only if markets are allowed to work. Market interventions like social security, unemployment insurance compensation, minimum wage laws, SNAP, Social Security disability and retirement programs, and interest rate setting reduce consumer saving, and make wages, prices, and interest rates sticky. In the presence of these market interventions, SRAS is unable to self-correct in a recessionary gap, which keeps unemployment persistently high. The unintended consequences of these government interventions require additional interventions, the fiscal and monetary stimulus that is enacted during recessions. When the Fed performs large open market purchases to close a recessionary gap, the new reserves create new money. The purchases increase the supply of loanable funds and lower nominal interest rates. The lower rates reduce savings, and artificially raise investment and consumption. The artificial changes in investment and consumption, which Austrian economists call malinvestment and overconsumption, push the economy beyond its PPF. Austrians refer to this as the boom. It is unsustainable. Because credit standards have been relaxed and interest rates have been held too low, too long, consumers and firms use leverage to compete for the economy's increasingly limited resources. As such, asset prices accelerate, causing yields and inflation expectations to rise. To dampen inflation expectations, the Fed withdraws stimulus. When this happens, asset bubbles pop, yields on heavily leveraged assets are negative, investors and consumers are underwater—and the boom becomes the bust.

So, whom should we trust?

About the Author

Hal W. Snarr currently teaches at Westminster College, which is located in Salt Lake City, Utah. He graduated from Naval Nuclear Power School, has bachelor's degrees in business and mathematics, and earned a PhD in economics from Washington State University. His teaching career began in the U.S. Navy when he was selected to teach at Nuclear Power Training Unit near Idaho Falls, Idaho. In graduate school, he taught courses ranging from College Algebra to Sports Economics to Econometrics. He has taught microeconomic theory and mathematical economics in the American Economic Association Summer Program at Duke University. He regularly teaches or has taught macroeconomic principles, labor economics, and business statistics, and has published papers in economics and economic education.

Hal's undergraduate and graduate training is largely quantitative. He took mathematics courses for fun while finishing his first undergraduate degree in business. After thoroughly enjoying the calculus sequence, linear algebra, and differential equations, he decided to pursue a master of science in mathematics at Idaho State University. During this experience, he taught college algebra, began using MAPLE, and took a course in mathematical economics. He enjoyed this course so much that he decided to transfer to a PhD program in economics. As a mathematician taking and teaching economics courses, he developed models like the ones used in this book to help him excel as an instructor and as a graduate student. The models were polished and adapted for MAPLE and Microsoft Excel© during his tenure as an associate professor of economics at North Carolina A&T State University.

Today, Hal continues to teach macroeconomic principles using these models. His YouTube channel, The Snarr Institute, and website, www.halsnarr.com, are used to deliver lectures on macroeconomic principles and other topics in statistics and economics. His present set of macroeconomics YouTube videos demonstrates how the models contained in this book are built and analyzed by hand. He has also written a complete set of algorithmic homework assignments that can be delivered using course management software like Blackboard© or Canvas©. Instructors wishing to use this question bank may contact him directly via his email address, halsnarr@yahoo.com.

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Learning Macroeconomic Principles Using MAPLE

Hal W. Snarr

Economics has been dubbed the "dismal science" since Thomas Carlyle coined the phrase in 1849. The 2008 presidential candidate who said, "Economics is something that I've really never understood," probably sides with this view. So, why is economics so dismal to so many? Is it because it has become too mathematical? Is it because traditional textbooks fail to connect topics and models in a concise, cohesive, and meaningful way? Is it because the computer simulations that are used to teach economic principles "stifle students' imagination, contribute to a dependent learning style, and fail to stimulate interest in the subject matter" (Wetzstein 1988)? Or, is it because economists from different schools of economic thought rarely agree on anything?

This book uses MAPLE and the simulation models that I developed in *Learning Basic Macroeconomics* (2014) to make teaching or learning economics more favorable. MAPLE is ideally suited for this because it allows users to assemble and systematically combine the various models that form the aggregate market model, frees users from doing tedious calculations and algebraic manipulations, and is as easy to use as Microsoft WORD. Building and analyzing the macroeconomic model using MAPLE is a fun way to learn the dismal science of economics.

Hal W. Snarr currently teaches at Westminster College, located in Salt Lake City, Utah. He graduated from Naval Nuclear Power School, has bachelor's degrees in both business and mathematics, and earned a PhD in economics from Washington State University. His teaching career began in the U.S. Navy, and today, Hal has a YouTube channel (The Snarr Institute) and website (www.halsnarr.com), used to deliver lectures on macroeconomic principles and other topics in statistics and economics.

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