

ANSWERS TO END-OF-CHAPTER PROBLEMS

CHAPTER 1

Quick Check

- a. False. Output growth was negative for advanced economies, zero for the world, and low but not negative for emerging and developing economies (see http://www.imf.org/external/datamapper/NGDP_RPCH@WEO/OEMDC/ADVEC/WEOWORLD).
- b. True. After the 2009 recession the GDP growth recovered, but it did so, on average, at a lower level than the previous period.

	2006	2007	2008	2009	2010	2011	2012	2013	2014
AE	3	2,7	0,1	-3,4	3,1	1,7	1,2	1,3	2,1
EDE	8	8,5	5,8	2,8	7,4	6,4	5,4	5,1	4,7
W	5,5	5,6	3	-0,1	5,4	4,3	3,5	3,5	3,6

AE: advanced economies

EDE: emerging and developing economies

W: world

Source: http://www.imf.org/external/datamapper/NGDP_RPCH@WEO/OEMDC/ADVEC/WEOWORLD

- c. True/Uncertain. Most stock markets recovered to their pre-recession levels but have retreated again since June 2016.
 - d. False. The unemployment rate in the United Kingdom has been low but not lower than the rates of some other European countries like Norway, Austria, and Germany since 2010.
 - e. False. There are problems with the statistics, but the consensus is that growth in China has been high.
 - f. False. European unemployment rates have been higher for several decades.
 - g. True.
 - h. It is true, but you have to compare using PPP to understand the real differences.
 - i. True. It is also the case in Europe and Japan.
2. a. More flexible labor market institutions may lead to lower unemployment, but there are questions about how precisely to restructure these institutions. The United Kingdom has restructured its labor market institutions to resemble more closely U.S. institutions and now has a lower unemployment rate than before the restructuring. On the other hand, Denmark and the Netherlands have relatively low unemployment rates while maintaining relatively generous social insurance programs for workers.
 - b. Although the Euro removed an obstacle (switching currencies to make transactions) to free trade between European countries, each country is forced to give up its own monetary policy.

Dig Deeper

3. a. This calculation is complicated by the fact that the data in China start in 2017 and the data in the United States start in 2018. Your spreadsheet needs to take that into account. The formula your spreadsheet will solve is:

$$\begin{aligned}
 20.5(1.022)^t &= 13.5(1.079)^{t+1} \\
 (20.5/13.5) &= (1.07)^{t+1}/(1.022)^t \\
 \ln(20.5/13.5)/[\ln(1.07)^{t+1}/(1.022)^t] & \\
 0.417 &= (t+1)(.076) - t(.021) \\
 t &\approx 6.21 \text{ years}
 \end{aligned}$$

Since China's output started in 2017 and the US output starts in 2018, in roughly 6 years after 2018, the two outputs are equal. That would be 2023. Thus in 2024, total output in China is larger than in the United States.

The spreadsheet that confirms this answer is:

Year	U.S. Output	China Output
2017		13.50
2018	20.50	14.57
2019	20.95	15.82
2020	21.41	17.18
2021	21.88	18.66
2022	22.36	20.26
2023	22.86	22.00
2024	23.36	23.90
2025	23.87	25.95
2026	24.40	28.18
2027	24.94	30.61
2028	25.48	33.24

- b. No. At current growth rates, total Chinese output will exceed U.S. output in 2024, but Chinese output per person (the Chinese standard of living) will still be less than U.S. output per person.
 - c. China has increased the amount of capital per person. This is possible in the United States. China has imported a lot of technology from the United States and other countries. This is more difficult to do in the United States since the number of technologies available for the United States to import that they do not already have is relatively smaller.
 - d. China does provide a model for other developing countries. Raising output per person by increasing capital per person and by importing technology is a sensible development strategy.
4. a. When the value of the level of output per hour increases from 100 in 2009 to 103.2 in 2010, the percentage rate of growth in 2010 is $((103.2-100)/100) \times 100 = 3.2\%$. This means for the same

hour of work, output per person rose by 3.2% in 2010. We call this increase the rate of (labor) productivity growth.

- b. The decade average growth rates of productivity are: 1970-79, 2.1%; 1980-89, 1.6%; 1990-99, 2.1%; 2000-2009, 2.6%; 2010-2017, 1.0%. Productivity growth averages from 2010 to 2017 is lower than any other recent 10-year period. The last decade with productivity growth less than 2 percent per year was the 1980s.
- c. This answer will vary with the issue of the Economic Report of the President used.

Explore Further

5. a/c. As of February 2019, there had been 6 occasions since 1960, quarter 2, with two consecutive quarters of negative economic growth. There are many quarters of negative economic growth. Seasonally adjusted annual percentage growth rates of GDP where two or more quarters in a row have negative growth are given below.

1969:4	-1.9	1981:4	-4.9
1970:1	-0.6	1982:1	-6.4
1974:3	-3.8	1990:4	-3.5
1974:4	-1.6	1991:1	-1.9
1975:1	-4.8	2008:3	-3.7
1980:2	-7.9	2008:4	-8.9
1980:3	-0.7	2009:1	-6.7
		2009:2	-0.7

The recession in 2008-09 had the largest fall in output (2008:4) and lasted 4 quarters. Other recessions lasted 2 or 3 quarters. The next largest quarterly fall in output was 1980:2.

6. a-b. Behavior of the unemployment rate over the 6 recessions above :

Recession (year and quarter)	Unemployment Rate in month prior to recession quarter	Unemployment rate in month at end of recession quarter	Change over recession	Unemployment rate peak after recession	Change from before recession to peak month
1969:4-1970:1	3.5	4.4	0.9	6.1 (Dec. 1970)	2.6
1974:3-1975:1	5.4	8.6	3.2	9.0 (May 1975)	3.6
1980:2-1980:3	6.3	7.5	1.2	7.5 (Sept. 1980)	1.2
1981:4-1982:1	7.6	9.0	1.4	10.8 (Dec. 1982)	3.2
1990:4-1991:1	5.9	6.8	0.9	7.8 (June 1992)	1.9
2008:3-2009:2	5.6	9.5	3.9	10.0 (Oct. 2009)	4.4

- a. The answers are in the table above.

- b. The recession from 2008:3 to 2009:2 resulted in an increase in unemployment of 4.4 percentage points. This is the largest increase.
7. a/b. Answers could vary with the data found. In the early part of 2019, the unemployment rate in the United Kingdom was lower than that in the European Union. The peak unemployment rate in the European Union in April 2013 was 11% and this fell as of the time of writing to around 6.7%. In Spain the peak unemployment rate in April 2013 was 26.3% and it falls to 14.7% in November 2017. Thus, the unemployment rate in Spain fell much more quickly than in the rest of Europe.

CHAPTER 2

Quick Check

1.
 - a. True/Uncertain. Real GDP increased by a factor of 5; nominal GDP increased by a factor of 38. We usually think of GDP in real terms
 - b. False.
 - c. True.
 - d. False. The level of the CPI means nothing. The rate of change of the CPI is one measure of inflation.
 - e. Uncertain. Which index is better depends on what we are trying to measure— inflation faced by consumers or by the economy as a whole.
 - f. True.
 - g. True.
 - h. False. There will always be job unemployment due to job switching and skill set mismatches.
 - i. False. The Phillips curve is a relation between inflation and the level of unemployment.
2.
 - a. No change. This transaction is a purchase of intermediate goods. The restaurant will process it with a meal sold.
 - b. +€100: personal consumption expenditure.
 - c. + ¥58 billion: gross private domestic fixed investment. Buying a plane manufactured in China instead of one from abroad will increase China's GDP by the value of the plane in yuan and decrease the import in \$ or in €.
 - d. -\$200 million: net imports.
 - e. No change for the European GDP. The jet was already counted when it was produced, i.e., when the European airline bought it new as an investment.
3.
 - a. The value of final goods = €15,000,000, the value of the cars.
 - b. 1st Stage: €12,000,000. 2nd Stage: $\text{€15,000,000} - \text{€12,000,000} = \text{€3,000,000}$.
GDP: $\text{€12,000,000} + \text{€3,000,000} = \text{€15,000,000}$.
 - c. Costs: $\text{€10,000,000} + \text{€1,000,000} = \text{€11,000,000}$.
Profit: $(\text{€12,000,000} - \text{€10,000,000}) + (\text{€15,000,000} - \text{€12,000,000} - \text{€1,000,000})$
 $= \text{€2,000,000} + \text{€2,000,000} = \text{€4,000,000}$.
GDP: $\text{€11,000,000} + \text{€4,000,000} = \text{€15,000,000}$.
4.
 - a. 2012 GDP: $10 (\$2,000) + 4(\$1,000) + 1000 (\$1) = \$25,000$
2013 GDP: $12 (\$3,000) + 6(\$500) + 1000 (\$1) = \$40,000$
Nominal GDP has increased by 60%.
 - b. 2012 real (2012) GDP: \$25,000
2013 real (2012) GDP: $12 (\$2,000) + 6 (\$1,000) + 1000 (\$1) = \$31,000$
Real (2013) GDP has increased by 24%.
 - c. 2012 real (2013) GDP: $10 (\$3,000) + 4 (\$500) + 1,000 (\$1) = \$33,000$
2013 real (2013) GDP: \$40,000.
Real (2013) GDP has increased by 21.2%.
 - d. The answers measure real GDP growth in different units. Neither answer is incorrect, just as measurement in inches is not more or less correct than measurement in centimeters.

5. a. 2012 base year:
 $\text{Deflator(2012)} = 1$; $\text{Deflator(2013)} = \$40,000/\$31,000 = 1.29$
Inflation = 29%
- b. 2013 base year:
 $\text{Deflator(2012)} = \$25,000/\$33,000 = 0.76$; $\text{Deflator(2013)} = 1$
 $\text{Inflation} = (1 - 0.76)/0.76 = .32 = 32\%$
- c. Analogous to 4d.
6. a. 2012 real GDP = $10(\$2,500) + 4(\$750) + 1000(\$1) = \$29,000$
2013 real GDP = $12(\$2,500) + 6(\$750) + 1000(\$1) = \$35,500$
- b. $(35,500 - 29,000)/29,000 = .224 = 22.4\%$
- c. Deflator in 2012 = $\$25,000/\$29,000 = .86$
Deflator in 2013 = $\$40,000/\$35,500 = 1.13$
Inflation = $(1.13 - .86)/.86 = .31 = 31\%$.
- d. Yes, see appendix for further discussion.
7. a. The cost of the consumer price basket in 2017 = JP¥ 63,860 + JP¥ 320,000 = JP¥ 383,860
b. The cost of the consumer price basket for the following years are:
2010: JP¥ 370,800; 2010: JP¥ 369,700; 2012: JP¥ 369,700; 2013: JP¥ 371,130;
2014: JP¥ 380,980; 2015: JP¥ 384,000; 2016: JP¥ 383,500; 2017: JP¥ 383,860
- c-d. The answers for (c) and (d) are:

Year	Consumer Price Index	Inflation Rate
2010	100	—
2011	99.70	-0.3%
2012	99.68	0.0%
2013	100.09	0.4%
2014	102.75	2.7%
2015	103.56	0.8%
2016	103.43	-0.1%
2017	103.52	0.1%

- e. Inflation was negative in 2011 and in 2016. These negative rates relate to the decrease in economic growth of Japan during the period. Since December 2010, Japan's economic policy (the "Abenomics" named after the elected Prime Minister, Shinzo Abe) focuses on boosting economic growth and increasing inflation.
- f. Due to the decline in the international price of oil since 2014, inflation decreased in 2014 and 2015, and consumers could have increased their consumption of other products. However, in Japan, private consumption of goods decreased in 2014 and 2015. This means that consumption is not only determined by the level of price but by several other factors, notably by consumer's expectations, which will be discussed further in subsequent chapters of the book.
- g. In 2010, a household was able to buy one basket of goods and services with JPY 371,000. In 2017, with the same amount, a household was able to buy less than one basket (0.96 baskets) because the purchasing power of money declined by 3.6% during this period. To ensure that their purchasing power does not decline, households can negotiate with their employers to increase wages by at least by 3.6%. This is why many trade unions and employers index wages and salaries to inflation.
- h. The Bank of Japan has adopted a technique called inflation targeting, which is usually used to control inflation and keep prices stable. However, in the framework of Japan's Abenomics policy, the bank set the target for the annual inflation rate of the CPI at 2% not to limit inflation but to target the level of inflation, as moderate inflation is considered to be a condition for growth.
- i. Core inflation is lower than the CPI in general. During the period 2010–2017, energy and food prices declined. The prices of other items in the basket of goods and services must have declined more than oil and agricultural produce prices have.

Year	Core Inflation Price Index	Core Inflation Rate	Inflation rate
2010	100	-	-
2011	99.2	-0.8	-0.3
2012	98.8	-0.4	0.0
2013	98.6	-0.2	+ 0.4
2014	99.3	+ 0.7	+ 2.7
2015	100.2	+ 0.9	+ 0.8
2016	100.3	+ 0.1	-0.1
2017	101.2	+ 0.9	+ 0.1

8. a. Usual output growth is positive as population grows and output per worker grows.
b. The unemployment rate rises more in a year when output growth is -2%.
c. The unemployment rate at which inflation rate is 2% is about 5.5%, considerably larger than zero. You solve the Phillips curve expression $2 = 2.93 - 0.17 u$ for the value of u .
d. The slope does not, by itself, tell us much about whether one economy is better than another.

Assuming the constant in the Phillips curve remains at 2.93, then the Phillips curve with a slope of 0.5 and a constant term of 2.93, finds target inflation hit at an unemployment rate of 1.86%. If the constant term remains at 2.93 and the slope is 0.1, then the Phillips curve with a slope of 0.1 and a constant term of 2.93, finds target inflation hit at an unemployment rate of 9.3%. You can make an argument that the economy with 1.86% unemployment is better than one with 9.3% unemployment. But it is both the slope and the constant term of the Phillips curve that determine the value of the unemployment rate where target inflation is achieved.

Dig Deeper

9. a. The quality of a routine checkup improves over time. Checkups may now include electrocardiograms (ECGs or EKGs), for example. Medical services are particularly affected by this feature since there are continuous improvements in medical technology.
b. The new method represents a 10% quality increase.
c. There is a 5% true price increase. The other 10% represents a quality increase. The quality-adjusted price of checkups using the new method is only 5% higher than checkups using the old method last year.
d. You need to know the relative value of checkups for ageing people with and without ultra-sounds in the year the new method is introduced. Still, since everyone chooses the new method, we can say that the quality-adjusted price of checkups has risen by less than 15%. Some of the observed 15% increase represents an increase in quality.
10. a. Measured GDP increases by $\$10 + \$12 = \$22$. (Strictly, this involves mixing the final goods and income approaches to GDP. Assume here that the \$12 per hour of work creates a final good worth \$12.)
b. No. The true value of your decision to work should be less than \$22. If you choose to work, the economy produces the value of your work plus a takeout meal. If you choose not to work, presumably the economy produces a home-cooked meal. The extra output arising from your choice to work is the value of your work plus any difference in value between takeout and home-cooked meals. In fact, however, the value of home-cooked meals is not counted in GDP. (Of course, there are other details. For example, the value of groceries used to produce home-cooked meals would be counted in GDP. Putting such details aside, however, the basic point is clear.)

Explore Further

11. a. The Great Recession had a larger recessionary impact than the European Sovereign Debt Crisis of 2010–2015, in terms of GDP growth and reduction in the price level.
b. The unemployment level was higher during the European Sovereign Debt Crisis.
c. The enterprise death rate was slightly higher than the birth rate during the two recessions, leading to lower GDP growth rates and rising levels of unemployment.

CHAPTER 3

Quick Check

1.
 - a. True.
 - b. False. Government spending including transfers and interest was 33% of GDP.
 - c. False. The propensity to consume must be less than one for our model to make sense.
 - d. True. There are good reasons to interpret a large drop in consumer confidence as a reduction in c_0 .
 - e. True.
 - f. False. The equilibrium condition in the goods market requires production to be equal to the demand for goods, assuming inventory investment is equal to zero.
 - g. False. The increase in equilibrium output is one times the multiplier.
 - h. False. The higher the propensity to consume the higher the output.
2.
 - a. $Y = 480 + (0.5)(Y - 70) + 110 + 250 = €1610$ billion
 - b. $Y_D = 1610 - 70 = €1540$ billion
 - c. $C = 480 + 0.5(1540) = €1250$ billion
3.
 - a. Private saving = $Y - C - T = 1610 - 1250 - 70 = €290$ billion. Public Saving = $T - G = -€180$ billion (budget deficit). National saving equals private plus public saving, or 110. National savings equals investment. So, investment is €110 billion.
 - b. Total demand = $C + I + G = 1250 + 110 + 250 = €1610$ billion. As a result, production also increases to maintain equilibrium.
 - c. Multiplier = $1/(1 - 0.5) = 2$. Since the multiplier is 2, when government spending increases by €50 billion, the equilibrium output will increase by €100 billion. When output increases, disposable income increases, raising consumption. Therefore, Y_D will rise by €100 billion and C will rise by €50 billion. The government will increase fiscal spending to increase equilibrium output and boost economic growth.

Dig Deeper

4.
 - a. Y increases by $1/(1-c_1)$
 - b. Y decreases by $c_1/(1-c_1)$
 - c. The answers differ because spending affects demand directly, but taxes affect demand indirectly through consumption, and the propensity to consume is less than one.
 - d. The change in Y equals $1/(1-c_1) - c_1/(1-c_1) = 1$. Balanced budget changes in G and T do change output.
 - e. The propensity to consume has no effect because the balanced budget tax increase aborts the multiplier process. Y and T both increase by one unit, so disposable income, and hence consumption, do not change.
5.
 - a. $Y = c_0 + c_1 Y_D + I + G$ implies $Y = [1/(1 - c_1 + c_1 t_1)][c_0 - c_1 t_0 + I + G]$

- b. The multiplier $= 1/(1 - c_1 + c_1 t_1) < 1/(1 - c_1)$, so the economy responds less to changes in autonomous spending when t_1 is positive. After a positive change in autonomous spending, the increase in total taxes (because of the increase in income) tends to lessen the increase in output. After a negative change in autonomous spending, the fall in total taxes tends to lessen the decrease in output.
- c. Because of the automatic effect of taxes on the economy, the economy responds less to changes in autonomous spending than in the case where taxes are independent of income. Since output tends to vary less (to be more stable), fiscal policy is called an automatic stabilizer.
6. a. $Y = [1/(1 - c_1 + c_1 t_1)][c_0 - c_1 t_0 + I + G]$
- b. $T = t_0 + t_1[1/(1 - c_1 + c_1 t_1)][c_0 - c_1 t_0 + I + G]$
- c. Both Y and T decrease.
- d. If G is cut, Y decreases even more. A balanced budget requirement amplifies the effect of the decline in c_0 . Therefore, such a requirement is destabilizing.
7. a. In the diagram representing goods market equilibrium, the ZZ line shifts up. Output increases.
- b. There is no effect on the diagram or on output.
- c. The ZZ line shifts up and output increases. Effectively, the transfer increases consumption in the economy at all levels of output.
- d. The propensity to consume is likely to be higher for low-income taxpayers. Therefore, tax cuts will be more effective at stimulating output if they are directed toward low-income taxpayers.
8. a.
$$Y = C + I + G$$

$$Y = [1/(1 - c_1 - b_1)][c_0 - c_1 T + b_0 + G]$$
- b. Including the $b_1 Y$ term in the investment equation increases the multiplier. Increases in autonomous spending now creates a multiplier effect through two channels: consumption and investment. For the multiplier to be positive, the condition $c_1 + b_1 < 1$ is required.
- c. When $c_1 + b_1$ is greater than one there is no multiplier effect. When total spending exceeds one the formula is nonsensical. The multiplier should be $1/((1 - (c_1 + b_1)))$. So, when $c_1 + b_1$ is greater than one the multiplier is negative, which does not make sense. Another way of looking at this concept is saving must equal investment in a closed Economy. In a closed economy $c_1 + b_1$ can never be greater than one.
- d. Output increases by b_0 times the multiplier. Investment increases by the change in b_0 plus b_1 times the change in output. The change in business confidence leads to an increase in output, which induces an additional increase in investment. Since investment

increases, and saving equals investment, saving must also increase. The increase in output leads to an increase in saving.

Explore Further

9.
 - a. Output will fall.
 - b. Since output falls, investment will also fall. Public saving will not change. Private saving will fall, since investment falls, and investment equals saving. Since output and consumer confidence fall, consumption will also fall.
 - c. Output, investment, and private saving would have risen.
 - d. Clearly this logic is faulty. When output is low, what is needed is an attempt by consumers to spend more. This will lead to an increase in output, and therefore—somewhat paradoxically—to an increase in private saving. Note, however, that with a linear consumption function, the private saving rate (private saving divided by output) will fall when c_0 rises.
10.
 - a. Percentage change in GDP = $176.5 - 281.44 / 281.44 \times 100 = -37.29\%$.
 - b. Multiplier = $1/1 - 0.6 = 2.5$; to avoid the decline of GDP by €104.94, autonomous expenditure should have increased by €41.976 or $\text{€}104.94 / 2.5$.
 - c. Further cuts in government expenditure would have had a greater multiplier effect on the slowdown of GDP, further accelerating the economic meltdown.
 - d. GDP increases by $15.5 \times 2.5 = \text{€}38.75$ billion.
11.
 - a. Equilibrium output will fall in the short run.
 - b. A cut in G will have a larger impact on equilibrium GDP than the same size increase in T.
 - c. The statement is accurate for any value of the marginal propensity to consume.
 - d. As the deficit is reduced, the value of c_0 increases as consumer confidence increases. This will increase equilibrium GDP.
12.
 - a. 2.8%
 - b. \$136.4 B (2012 dollars)
 - c. If the MPC is 0.6, the tax multiplier in the simplest model is $(0.6 / (1 - 0.6)) = 0.6 / 0.4 = 1.5$. Thus, the increase in real GDP using this multiplier would be \$204.6B (2012 dollars).
 - d. Since overall real GDP grew by \$500B, the proportion of the increase is $204.6 / 500 = 40.9\%$.
 - e. It does not support this argument. \$206.4 B is 1.1% of 18,000B. Total growth was 2.8%. If normal growth is 2%, and 1.1% comes from the tax cut, then only 1.7% of growth was normal. There is no “extra growth” that we need the confidence argument to account for. If normal growth were only 1%, the tax cut at 1.1% and normal growth of 1% accounts for 2.1% of the 2.8% growth. The remaining 0.7% may be the result of increased confidence.

CHAPTER 4

Quick Check

1. a. True.
b. True.
c. False.
d. True.
e. True.
f. False.
g. False.
h. False.
2. a. $i = 0.01, M^d = €9,600$ billion
 $i = 0.05, M^d = €8,000$ billion
b. When it is independent of the interest rate, an increase or decrease in income leads to the same percentage increase or decrease in money demand. This effect is independent of the interest rate.
Money demand and interest rates have an inverse relationship. As the interest rate rises, money demand declines. However, households' demand for bonds would decrease when bonds pay lower interest, making money demand more attractive.
c. If nominal income declines by 20%, it amounts to €40,000 billion.
When $i = 0.01, M^d = €7,680$. Money demand falls by 20%.
When $i = 0.05, M^d = €6,400$ and money demand falls by 20%.
d. In such cases, central banks should lower the interest rate to increase money demand.
3. a. $i = 100/\$P_B - 1; i = 33\%; 18\%; 5\%$ when $\$P_B = \$75; \$85; \95 .
b. When the bond price rises, the interest rate falls.
c. $\$P_B = 100/(1.08) \approx \93
4. a. $\$8,000 = \$10,000 - \$40,000i$. Therefore, $I = 0.05$ or 5%.
b. $M^s = \$8,000$
 $M^d = \$40,000(0.25 - 0.1) = \$6,000$
Excess $M^s = \$2,000$
To decrease money supply by \$2,000 and reach the equilibrium interest rate, the central bank should follow a contractionary open market operations policy.

Dig Deeper

5. a. $B^D = 50,000 - 60,000 (.35 - i)$
If the interest rate increases by 10 percentage points, bond demand increases by \$6,000.
- b. An increase in wealth increases bond demand, but has no effect on money demand, which depends on income (a proxy for transactions demand).
- c. An increase in income increases money demand, but decreases bond demand, since we

implicitly hold wealth constant.

- d. First of all, the use of “money” in this statement is colloquial. “Income” should be substituted for “money.” Second, when people earn more income, their wealth does not change right away. Thus, they increase their demand for money and decrease their demand for bonds.
6. a. Essentially, as interest rates rise, new bonds are issued at the higher interest rate, making bonds previously issued at lower rates less attractive, driving down their market prices, and vice-versa. This is even more pronounced when interest rates are negative.
b. The demand for money goes down when interest rates rise and goes up when interest rates fall. This is even more pronounced when interest rates are negative.
Central banks would choose to lower interest rates in the negative domain to stimulate their economies and reverse price deflation. Low interest rates stimulate lending and urge consumers to borrow more, spend more, and save less. Negative interest rates also tend to lower the value of the domestic currency, making exports cheaper and more competitive in global markets.
7. a. \$16 is withdrawn on each trip to the bank.
Money holdings are \$16 on day one; \$12 on day two; \$8 on day three; and \$4 on day four.

b. Average money holdings are $(\$16 + \$12 + \$8 + \$4)/4 = \$10$.

c. \$8 is withdrawn on each trip to the bank.
Money holdings are \$8, \$4, \$8, and \$4.

d. Average money holdings are \$6.

e. \$16 is withdrawn on each trip to the bank. Money holdings are \$0, \$0, \$0, and \$16.

f. Average money holdings are \$4.

g. Based on these answers, ATMs and credit cards have reduced money demand.
8. a. All money is in checking accounts, so demand for central bank money equals demand for reserves. Therefore, demand for central bank money = $0.1(\$Y)(.8 - 4i)$.

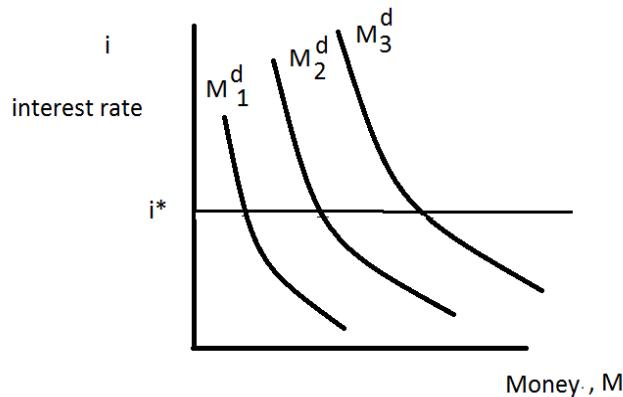
b. $\$100B = 0.1(\$5,000B)(.8 - 4i)$
 $i = 15\%$

c. Since the public holds no currency,
money multiplier = 1/reserve ratio = $1/.1 = 10$.
 $M = (10)\$100B = \$1,000B$
 $M = M^d$ at the interest derived in part (b).

d. If H increases to \$300B the interest rate falls to 5%.

e. The interest rate falls to 5%, since when H equals \$300B, $M=(10)\$300B=\$3,000B$.

9. The table is filled in below:



Initial Money Demand Curve for real income Y and price level P				Final Money Demand Curve for real income Y and price level P				Action required by the Fed to maintain an interest rate at i^*
Initial M^d curve	Y	P	\$Y	Final M^d curve	Y	P	\$Y	Explanation
M^d_2	250	100	250	M^d_3	300	105	315	The Fed must increase the money supply as nominal income rises — both real income and prices rise
M^d_2	200	80	160	M^d_3	250	100	250	Increase the money supply as nominal income rises—both real income and prices rise
M^d_2	250	100	250	M^d_3	300	100	300	Increase the money supply as nominal income rises. Prices do not change but real income rises
M^d_2	250	100	250	M^d_1	200	95	190	Decrease the money supply as nominal income falls – both real income and prices fall
M^d_2	250	100	250	M^d_1	275	80	220	Here prices fall and real income rises. However, prices fall by 20% and real income rises by 10%. This combination means nominal income falls and the Fed will have to decrease the money supply to keep the interest rate the same

10. Choosing the quantity of money or choosing the interest rate

- a. $100 = 5000(0.08 - 0.4i)$
 $i = 15\%$
- b. The central bank should set the interest rate at 5%.

- c. Lowering interest rates and buying treasuries from the market are both examples of an expansionary monetary policy. While lower interest rates simply increase money supply by €300 billion, open market operations will expand money supply by a multiplied factor.
11. Monetary policy in a liquidity trap
- \$20 B
 - \$20 B
 - Yes, the central bank can continue to increase the money supply. But interest rates will not fall any further.
 - Figure 1 in the Focus Box “The Liquidity Trap in Action” shows many years where the interest rate remained at zero while the money supply continuously expanded.

Explore Further

12. a. The mandate of the Deutsche Bundesbank is price stability. This mandate is usually decided upon in coordination with the European Central Bank. The two conventional monetary policy tools used by the Deutsche Bundesbank as well as the member central banks of the European Central Bank are interest rates and open market operations.
- b. Answers will vary.

CHAPTER 5

Quick Check

- a. True.
b. True.
c. False. The IS curve is downward sloping because an increase in the interest rate decreases the demand for goods at any level of output, leading to a decrease in the equilibrium level of output.
d. False. The balanced budget multiplier is positive (it equals one), so the *IS* curve shifts right.
e. True.
f. False. As you move along the horizontal LM curve, as output rises, the demand for real money rises and the central bank must increase the supply of real money to keep the interest rate constant.
g. False. The real money supply falls when the nominal money supply is constant and the price level rises.
h. True. The nominal money supply rose by 10%. The price level rose by 2%. The ratio M/P increased.
i. False. The level of output will rise and at the same interest rate along the horizontal LM curve, investment will rise
- a.
$$Y = [1/(1 - c_1)][c_0 - c_1 T + I + G]$$
The multiplier is $1/(1 - c_1)$.

b. $Y = [1/(1 - c_1 - b_1)][c_0 - c_1 T + b_0 - b_2 i + G]$

The multiplier is $1/(1 - c_1 - b_1)$. Since the multiplier is larger than the multiplier in part (a), the effect of a change in autonomous spending is bigger than in part (a). An increase in autonomous spending now leads to an increase in investment as well as consumption.

- c. You simply replace the interest rate from the expression in (b) with its policy value \bar{i} ,

$$Y = [1/(1 - c_1 - b_1)][c_0 - c_1 T + b_0 - b_2 \bar{i} + G].$$
 - d. See Figure 5-5 on page 114 for an example of an IS-LM diagram in equilibrium for a given interest rate.
3. a. The *IS* curve shifts left. Output falls at the same interest rate. Investment, which depends positively on the level of output and negatively on the interest rate, also falls. The interest rate remains the same. Output falls. So, investment falls.

b. From the answer to 2(b), $Y = [1/(1 - c_1 - b_1)][c_0 - c_1 T + b_0 - b_2 \bar{i} + G]$

c. $I = b_0 + b_1 Y - b_2 i = b_0 + b_1 [1/(1 - c_1 - b_1)][c_0 - c_1 T + b_0 - b_2 \bar{i} + G] - b_2 \bar{i}$

This is obtained by substitution of the equilibrium level of income into the equation for investment. You could simplify the expression by collecting terms if desired.

- d. From part (b), the equilibrium level of income is $Y = [1/(1 - c_1 - b_1)][c_0 - c_1 T + b_0 - b_2 \bar{i} + G]$. This value is substituted into the LM relation so that

$$\frac{M}{P} = d_1 \{ [1/(1 - c_1 - b_1)][c_0 - c_1 T + b_0 - b_2 \bar{i} + G] \} - d_2 \bar{i}$$

This term could also be simplified by collecting terms if desired.

4. a. The real money supply is on the left-hand side of the equation
- b. The demand for real money is on the right-hand side of the equation
- c. The function $L(i)$ is a downward sloping line. Its value increases as the interest rate falls.
- d. The horizontal axis needs to be relabeled as the real money supply. The variable that shifts the demand for real money is real income. If real income is larger, the real money demand function shifts to the right.
- e. (1) The real money demand function will shift rights as Y rises. To keep the interest rate constant, the central bank must increase the real money supply.
(2) The real money demand function will shift left as Y falls. To keep the interest rate constant, the central bank must decrease the real money supply
5. a.
$$Y = C + I + G = 100 + 0.3(Y - 100) + 150 + 0.2Y - 1000i + 200$$

$$Y = 840 - 2000i$$

- b. Substitute the interest rate of 3% (numerical value .03) into $Y = 840 - 2000 \times (.03) = 780$.
- c. Now, substitute both the equilibrium income of 780 and the interest rate of 3% into the right-hand side of the real money demand expression.
 $(M/P) = 1560 - (.03 \times 4000) = 1440$.
- d. $C=304; I=276; G=200; C+I+G=780$.
- e. $Y = 795; C = 308.5; I = 286.5$. The increase in the money supply decreases the interest rate. Consumption and investment increase because output increases and interest rates decrease.
- f. At the initial rate of 3%, Y equals 980 when G is increased to 300. A fiscal expansion increases output. Consumption increases ($C = 364$) because output increases. When the central bank keeps interest rates at 3% then investment increases ($I = 316$) as output increases.

Dig Deeper

- 6. Firms deciding how to use their own funds will compare the return on bonds to the return on investment. When the interest rate on bonds increases, bonds become more attractive, and firms are more likely to use their funds to purchase bonds, rather than to finance investment projects.
- 7.
 - a. Most governments used generous fiscal stimulus packages to stimulate growth. Other governments suffering from huge fiscal budget deficits found it difficult to raise funds to finance government spending, and so they simply resorted to cutting taxes in the hope of boosting household consumption and investment spending. Both reduction in taxes and fiscal spending shift the IS curve to the right. The increase in M shifts the LM curve down. Output increases in both cases, but the impact is higher on government spending than on tax cuts due to the high multiplier effect.
 - b. The Great Financial Crisis was probably the worst recession encountered by the global economy in modern times. The policy mix differed among countries. Many nations realized that the severity of the crisis required their central banks to step in with expansionary monetary policies and that their governments should borrow to increase their spending. If fiscal budgets did not allow for this, the governments had to cut taxes. Some central banks that had their interest rates close to zero were unable to lower interest rates drastically and resorted to excessive fiscal spending in addition to using unconventional tools of expansionary monetary policy. The expansionary monetary and fiscal policies tried to steer global the economy out of the recession, but the severity of the crisis and the contagion effects made the recovery process slow.
- 8.
 - a. The central bank keeps the interest rate constant. Fiscal policy is expansionary as either G is increased or T is decreased. Investment will increase as output rises.
 - b. The central bank will cut interest rates as the fiscal authorities either reduces G or raises T (or both).
- 9.
 - a. The IS curve shifts left. The value of the parameter c_0 falls. Output falls.

- b. The level of consumption falls with the fall in output. There is a lower level of output and a lower level of c_0 . Both factors lead to a decline in consumption.

The analysis of investment is more complex. Investment will also fall. Investment depends on output and the interest rate. The interest rate is unchanged. Output falls. Investment must fall.

Finally, we analyze the level of saving. The level of savings at the same income would rise as c_0 falls. But we are not at the same level of output. So, one factor raises savings and the other factor lowers savings. We saw private investment fell. If we started with a balanced budget and continued to have a balanced budget so $G = T$, we can use expression (3.10) to conclude that savings must also have fallen. If there was no change in G or T , then the same argument is made, the decline in private investment must be accompanied by a decline in private saving.

10. a. This fiscal consolidation reduces G by 50 units and increases T by 50 units. Public savings rises from -100 to 0. Private saving remains the same at 300 units both pre and post policy. Investment rises to 300. Since Y falls, this can only occur if the fiscal consolidation is accompanied by an interest rate reduction.
- b. This fiscal consolidation reduces G by 100 units and leaves T unchanged. Public savings rises from -100 to 0. Private saving falls to 250 units. Investment rises to 250 units. Since Y falls, investment can only rise if the fiscal consolidation is accompanied by an interest rate reduction.
- c. This fiscal consolidation leaves G at 300 units and increases T by 100 units. Public savings rises from -100 to 0. Private saving falls from 200 units in the pre-policy equilibrium to 195 units in the post-policy equilibrium. Investment falls to 195 units. Since investment falls with income, in this policy combination, the interest rate could rise, fall or stay the same. The fiscal consolidation is not accompanied by an increase in investment.

Explore Further

11. a. The fall in G and the increase in T shift the *IS* curve to the left. If the Federal Reserve did not change interest rates, Y would fall. Thus, to keep output at the same level, the Federal Reserve must cut interest rates and the *LM* curve will shift down. Investment will increase since output remains the same and interest rates are lower.
- b. Receipts rose, outlays fell, and the budget deficit fell.
- c. On September 4, 1992, the FOMC reduced the intended federal funds rate by 25 basis points. Subsequent changes in federal funds rate over the period 1993-2000 are given below. Monetary policy became more expansionary from 1995 to 1998.

Changes in the Intended Federal Funds Rate

September 4, 1992	3	March 25, 1997	5.5
February 4, 1994	3.25	September 29, 1998	5.25

March 22, 1994	3.5	October 15, 1998	5
April 18, 1994	3.75	November 17, 1998	4.75
May 17, 1994	4.25	June 30, 1999	5
August 16, 1994	4.75	August 24, 1999	5.25
November 15, 1994	5.5	November 16, 1999	5.5
February 1, 1995	6	February 2, 2000	5.75
July 6, 1995	5.75	March 21, 2000	6
December 19, 1995	5.5	May 16, 2000	6.5
January 31, 1996	5.25		

- d. In real terms, investment was 11.9% of GDP in 1992 and increased every year over the period to reach 17.6% of GDP in 2000.
- e. Over the period 1993-2000, the average annual growth rate of GDP per person was 2.6%. Over the period first four years of the period, the average annual growth rate was 2%; over the second four years, the average annual growth rate was 3.2%. The postwar average growth rate of income per person in the United States (1946 to 2018) was about 2%. (Series for annual real GDP per capita in FRED data base is A939RX0Q048SBEA – 1947 value 14118; 2018 value 56912 measured in chained 2012 dollars.)
12. a. The primary sector contribution has declined while the secondary and tertiary sector contributions have gradually increased. Labor-intensive light industries have significantly contributed to export-oriented growth.
- b. The global economic slowdown has reduced the level of Chinese exports. The Chinese government has been devaluing the yuan to boost exports. Since 2014, the appreciation of the yuan's exchange rate has provided the required price incentives to shift investments away from expanding the export capacity of China and redirecting them toward sectors that serve domestic consumers.
- c. Investment has had the highest growth rate, but since 2014, consumption has been growing faster than investment and the contribution of export to growth has become negative.
- d. During the last two decades, the development of China has been underpinned by the growth of the coastal regions. In 2015, seven regions, not limited to the coastal regions, had a growth rate exceeding 9% : Tianjin, Fujian, Jiangxi, Guizhou, Chongqing, and Tibet.

CHAPTER 6

Quick Check

1. a. False. Nominal interest rates are expressed in dollars; real rates in goods.
- b. True.
- c. False, by 2019 the policy interest rate was higher than zero.
- d. Uncertain. The statement is true when the nominal rate of interest does not change.

- e. False. Bonds vary significantly in terms of default risk.
 f. True.
 g. True.
 h. False. There could be a change in the risk premium.
 i. True.
 j. True.
 k. True.
 l. False. Prices fell significantly beginning in 2006.
 m. True.
 n. True.
2. a. The exact real interest rate in France = $1.017/1.008 - 1 = 0.89\%$. The exact real rate in Switzerland = $1.017/1.005 - 1 = 1.19\%$.
 b. The approximate real interest rate in France = $1.7\% - 0.8\% \approx 0.9\%$. The approximate real interest rate in Switzerland = $1.7\% - 0.5\% \approx 1.2\%$.
 c. The real interest rates in both countries differ due to higher inflation risk components in the French real interest rate. Other possibilities include the effects of the currency risk of the euro compared to that of the Swiss franc in addition to the transaction costs involved in currency arbitrage.

3. The table is filled in:

Situation	nominal policy interest rate	expected inflation	real policy interest rate	risk premium	nominal borrowing interest rate	real borrowing interest rate
A	3	0	3	0	3	3
B	4	2	2	1	5	3
C	0	2	-2	4	4	2
D	4	3	1	2	6	3
E	0	-2	2	3	3	5

- a. Situation C and E
 b. Situation C and E
 c. Situation C has the highest risk premium. Default and risk aversion.
 d. When expected inflation is negative, real rates are higher than nominal rates. High real rates depress aggregate demand. Aggregate demand and output are likely to be low at the Zero Lower Bound.

4. a.

Assets	Liabilities	
Bank Assets	100	Checking Deposits 80

	Net Worth
Capital	20

- b. The value of the bank's capital falls to 10. The leverage ratio is 9.
 - c. If the deposits of the bank are insured by the government, then the health of the bank is irrelevant to the depositors. So, there is no need to withdraw funds from the bank.
 - d. The balance sheet is identical to the one in part (a), except that short-term credit replaces checking deposits
 - e. If lenders are nervous about the solvency of the bank, they will not be willing to provide short-term credit to the bank at low interest rates.
 - f. The bank must sell assets. If many banks are in this position and selling the same kind of assets, the value of these assets will fall. This will worsen the value of bank capital and make lenders more nervous.
- 5.
- a. The real interest rate on the axis is the real policy rate.
 - b. That value is 2%. The real policy interest rate is 2% .
 - c. The central bank would have to lower the nominal policy interest rate by 1% .
 - d. No, the position of the IS curve depends on the real borrowing interest rate. Expected inflation does change that rate since expected inflation is part of the definition of a real rate of interest.
 - e. No, the position of the LM curve is defined by the real policy rate of interest. A change in expected inflation does not, in itself, shift that curve. The central bank is taking expected inflation into account in setting a real policy rate of interest
 - f. No, the risk premium does not shift the LM curve. It is horizontal at the real policy rate of interest which does not incorporate the risk premium
 - g. Yes. At the same real policy rate of interest, the real borrowing rate of interest rises. There is less investment and the IS curve shifts left (or down).
 - h. If the increase in the risk premium causes the IS curve to shift to the left, a tax decrease or an increase in government spending could be used to shift the IS curve back to the right by the same amount. The level of output would not change
 - i. The central bank could reduce the real policy rate of interest so the LM curve shifts down.

Dig Deeper

6. a. The following are the objectives of the central banks in adopting a negative interest rate policy:
- To boost investment by lowering lending rate of the banking system and at the same time improve the creditworthiness of the borrower.
 - Decrease sleeping cash deposit of the banking system in the central bank
 - Decrease exchange rate pressure (Denmark, Switzerland). See <https://www.imf.org/en/Publications/Policy-Papers/Issues/2017/08/03/pp080317-negative-interest-rate-policies-initial-experiences-and-assessments>
- b. The real rate of interest is negative whenever expected inflation is larger than the nominal policy rate of interest. Holding cash entails some costs: it can be lost or stolen; safe storage is expensive; large cash transactions may or may not be illegal in some jurisdictions.
- c. Commercial banks can obtain cheaper short-term funding from central banks. Competition among banks generally leads them to pass on these lower costs to their clients through lower lending rates. Lower policy rates improve the wealth and cash flow of potential borrowers, making these more creditworthy and requiring lower risk premia on loans.
- d. At the beginning of 2018, most Western countries have low nominal interest rate and negative real interest rate.

7. a.

Assets	Liabilities	
Securitized Assets	50	Short Term Credit
Troubled Assets	50	
Net Worth		
Capital		20

- b. In principle, the bank's capital has a value between -5 and 15. But in practice the equity holders can't lose more than their original investment, so the negative values are really zero values.
- c. If the government pays 25 for the troubled assets, the value of bank capital will be -5. The government would have to pay at least 30 for the troubled assets to ensure a nonnegative value of bank capital. If the government pays 45 for the assets, but the true value is lower, taxpayers bear the cost of the mistaken valuation.

- d.

Assets	Liabilities	
Troubled Assets	25	Short Term Credit

Securitized Assets	50	
Treasury Bonds	25	Net Worth
		Capital 20

Bank capital is now 20, and the bank is not insolvent.

- e. Direct infusion of capital improves the solvency of the bank. Buying troubled assets does not, unless the government is willing to buy the assets at above current market prices. Buying troubled assets at best provides the bank liquidity (because Treasury bonds, which are easier to sell, substitute for troubled assets).
8. a. The interest rate on the risky bond and the non-risky (safe) bond are the same.
- b. Solve $(1 - p) = (1 + .03) / (1 + .08)$ for p. $p = .05$, or the probability of bankruptcy is 5%
- c. Solve $(1 + .04) = (1 - .01)(1 + .04 + x)$ for x. $x = .01$. The borrowing rate is .05
- d. Solve $(1 + .04) = (1 - .05)(1 + .04 + x)$ for x. $x = .055$. The borrowing rate is 9.5%
- e. The formula would have a positive value where the zero appears in p times zero [written p (0) above] now appears. The key is that value of the bond in bankruptcy will be much less than $(1 + i + x)$. So, the possibility of bankruptcy will still create positive values of x.
9. a. The risk premium is likely to fall. The IS curve will shift to the right. This will increase output and can be thought of as a sort of macroeconomic policy.
- b. The risk premium is likely to fall. The IS curve would shift right and output would increase. Quantitative easing becomes a policy option when the nominal policy interest rate (the federal funds rate) is zero.
- c. Strictly speaking, the increase in expected inflation does not directly affect the level of the real policy rate EXCEPT when the nominal policy rate remains constant. In Figure 6-9, this is the exact situation. The nominal policy rate of interest is zero and the real policy rate of interest is the negative of the expected inflation rate. Thus, if an action by the Fed increases expected inflation, this would decrease the real policy interest rate and shift the LM curve down. You would move ALONG the IS curve and output would rise.

Explore Further

10. a. The main requirement for a bond to be risk-free is that it should be issued by an entity with no default risk, and that there should be zero or negligible probability of reinvestment risk. As British policymakers indicated that government spending will be cut and taxes will be raised, rating firms downgraded the UK's rating, based on risks to

- public finances, macroeconomic slowdown, and the decline in both London's role as a global financial center and the British pound's role as an international reserve currency. The sectors that are most likely to be affected by the downgrade are banking and finance.
- b. Answers will vary.
 - c. Immediately after the vote, bond traders have more confidence in British corporate bonds rather than in British government bonds.
11. a. While there may be some cultural influences, the high rate of inflation over the past few years has induced double-digit inflation expectations, which has driven an increase in demand for gold, whose value increases with purchasing power.
- b. WPI inflation decreased to around 5%, 30 months after the issuance of the IIB and CPI inflation. The bonds generated significantly lower returns than the traditional debt instruments of banks and post offices.
 - c. The IIB bonds turned highly illiquid, as WPI inflation remained negative for 15 consecutive months (as on Feb 2015) since November 2014. The government decided to buy back the IIB bonds. The Government of India announced the repurchase of the “1.44% Inflation Index Government Stock-2023” in February 2016.

CHAPTER 7

Quick Check

1. a. False. The participation rate has increased over time.
 b. False. On average there are 8.5 million separations each month.
 c. False. Approximately 44% of the unemployed quit looking for work.
 d. True.
 e. False. Worker pay typically exceeds their reservation wage.
 f. Uncertain/False. The degree of bargaining power depends on the nature of the job and the employee's skills.
 g. True.
 h. False. Many policy factors can impact this rate.
2. a. $(\text{Monthly hires} + \text{monthly separations})/\text{monthly employment} = (5.4 + 5.5)/132.0 = 8.3\%$
 b. $2.0/8.6 = 23.3\%$
 c. $(2.0 + 1.8)/8.6 = 44.2\%$. Duration is $1/0.442$ or 2.26 months.
 d. $(3.7 + 3.4 + 1.8 + 2.0)/(132.0 + 8.6) = 8.9\%$.
 e. new workers: $0.45/(3.7 + 2.0) = 7.9\%$.
3. a. $W/P = 1/(1 + \mu) = 1/1.05 = 0.952$
 b. Wage setting: $u = 1 - W/P = 1 - 0.952 = .048$, or 4.8%

- c. $W/P = 1/1.1 = .91$; $u = 1 - .91 = .09$, or 9%. The increase in the markup lowers the real wage. Algebraically, from the wage-setting equation, the unemployment rate must rise for the real wage to fall. So, the natural rate increases. Intuitively, an increase in the markup implies more market power for firms, and therefore less production, since firms will use their market power to increase the price of goods by reducing supply. Less production implies less demand for labor, so the natural rate rises.

Dig Deeper

4. a. Answers will vary.
- b-c. Most likely, the difference between your actual wage and your reservation wage will be higher for the job you will have ten years later.
- d. The later job is more likely to require training, which means you will be costly to replace, and will probably be a much harder job to monitor, which means you may need an incentive to work hard. Efficiency wage theory suggests that your employer will be willing to pay a lot more than your reservation wage for the later job, to make the job valuable to you, so you will stay at it and work hard.
- e. This would increase reservation wages.
5. a. The computer network administrator has more bargaining power. She is much harder to replace.
- b. The rate of unemployment is the most important indicator of labor market conditions. When the rate of unemployment increases, it becomes easier for firms to find replacements, and worker bargaining power falls.
- c. In our model, the real wage is always given by the price-setting relation: $W/P = 1/(1 + \mu)$.
- Since the price-setting relation depends on the actual price level and not the expected one, this relation holds in the short run and the medium run of our model.
6. a. The upward slope follows from the bargaining power of workers increasing as the unemployment rate falls. As total employment N approaches the total labor force L , the unemployment rate gets smaller.
- b. An increase in the markup would lower the price-setting relation. This increases the natural rate of unemployment.
7. a. The ILO defines the informal economy as “all economic activities by workers or economic units that are, in law or practice, not covered or sufficiently covered by formal arrangements.”
- b. The informal sector contributes to GDP and job creation but is not officially included in GDP. As a result, tax evasion could be a serious problem that deprives countries of useful resources needed for government expenditure. This is why many nations with high levels of informality endeavor to include the informal sector or informal employment in their official statistics.

- c. First, the size of the total non-agricultural workforce is estimated. Then, the number of formal employees in the non-agricultural registered firms is estimated based on an economic census or survey. Next, total informal employment (outside of agriculture) is estimated by subtracting the number of formal employees from the total non-agricultural workforce. This difference represents a residual estimate of the total number of individuals in informal employment. In the fourth step, the total non-agricultural workforce is divided into paid employees and self-employed individuals. Lastly, an estimate of non-agricultural informal paid employment is derived by subtracting the number of self-employed individuals (from step 4) from the total number of individuals in informal employment (from step 3).
- d. Answers will vary.

Explore Further

8. a. $56\% ; (0.56)^2 = .31$, or 31%; $(0.56)^6 = .03$, or 3.0%
- b. 56%
- c. second month: $(0.56)^2 = .31$, or 31%; sixth month: $(0.56)^6 = .03$, or 3.0%
- d.
- | | | | | | | | |
|-------|-----|------|-----|------|-----|------|-----|
| 2000: | 11% | 2004 | 22% | 2008 | 20% | 2012 | 41% |
| 2001: | 12% | 2005 | 20% | 2009 | 32% | 2013 | 38% |
| 2002: | 18% | 2006 | 18% | 2010 | 43% | 2014 | 33% |
| 2003: | 22% | 2007 | 18% | 2011 | 44% | | |
- The long-term unemployed exit unemployment less frequently than the average unemployed worker.
- e. There is a very large increase in the proportion of long term unemployed in the crisis years right to 2012 or even 2013.
- f. In 2014, there is a slight reduction in the percentage of unemployed who have been unemployed for 6 months or longer. We need to be careful here, some of those persons may have left the labor force.
- g. It would seem that the extension of unemployment insurance benefits did coincide with the larger proportion of long-term unemployed during the crisis. But other factors may be at work.
9. According to the ILO World Employment and Social Outlook Report for 2019, there are people who would like to work but are unable to do so. These people constitute the unemployed workforce. Therefore, unemployed persons include individuals over a specified age that, during a particular reference period, (1) are not employed, (2) are actively searching for a job, and (3) are currently available for a job. It should be noted that not all countries in a particular region apply these three criteria to estimate the number of unemployed persons.
- a. The definition of what constitutes unemployment may differ by country or organization

selected by the student. For example, the OECD defines unemployment as those who report that they are without work, that they are available for work, and that they have taken active steps to find work in the last four weeks. When unemployment is high, some people become discouraged and stop looking for work, so they are excluded from the labor force.

- b. The lowest unemployment rates are mostly in Eastern Asia: Thailand 0.9%, Vietnam 2.3%, Malaysia 3.2%, Japan: 3.4%, Korea 3.6%, China 4.1%. The highest unemployment rates are mostly in European countries (in the Eurozone, it is 10.9%).
 - c. It is usual to analyze unemployment according to gender, age (youth unemployment), length (long-term unemployment over one year), and educational attainment. These categorizations are done because the policies that should be implemented are different as they depend on the nature of the unemployment that needs to be addressed.
10. a. The unemployment rate is generally higher in the year after the recession because of the adjustment delay of the enterprises that began to terminate their employees when they realized that recession would last for a while.

GDP Growth Rate (GGR) / Unemployment Level (UL)												
Country	France		Germany		Spain		UK		Japan		US	
Year	GGR	UL	GGR	UL	GGR	UL	GGR	UL	GGR	UL	GGR	UL
1981	1.1	7.3	0.1	5.6	-0.4	—	-0.8	8.0	4.5	—	2.6	7.6
1982	2.5	6.9	-0.8	7.7	1.2	—	2.0	9.4	3.6	—	-1.9	9.7
1983	1.3	7.2	1.6	9.2	1.7	—	4.2	10.8	3.0	—	4.6	9.6
1991	1.0	8.1	5.0	6.3	2.5	15.5	-1.1	8.6	3.4	2.1	-0.1	6.8
1992	1.6	9.1	1.5	6.7	0.9	17.0	0.4	9.9	0.9	2.2	3.6	7.5
1993	-0.6	10.1	-1.0	9.8	-1.3	20.8	2.5	10.4	0.2	2.5	2.7	6.9
2008	0.2	7.4	0.8	7.5	1.1	11.3	-0.6	5.7	-1.1	4.0	-0.3	5.8
2009	-2.9	9.1	-5.6	8.1	-3.6	17.9	-4.3	7.6	-5.4	5.0	-2.8	9.3
2012	0.2	9.8	0.7	6.8	-2.9	24.8	1.3	8.0	1.5	4.3	2.2	8.1
2013	0.6	10.3	0.6	6.9	-1.7	26.1	1.9	7.6	2.0	4.1	1.7	7.4
2014	0.9	10.3	1.9	6.7	1.4	24.5	3.1	6.2	0.3	3.6	2.6	6.2

- b. Spain has had always a higher unemployment rate. Germany and the UK have managed to decrease unemployment since 2010. France did not succeed in doing so.
 - c. Japan has a constant ratio of low unemployment. The reactivity of the labor market appears to be higher in the United States where the unemployment rate varies quickly with the recession and the expansion.
11. A closer look at changes in state labor markets - There is a lot of discussion of the decline of the “rust belt” and the differences between labor markets at the state level. The table below is a snapshot of the labor market in California, Ohio and Texas in 2003 before the Great Financial Crisis, in 2009 at the height of the crisis and in 2018 after the crisis. Ohio is considered a rust belt state.

State	California	Ohio	Texas
Variable	Participation Rate		

2003	65.9	67.4	68.0
2009	65.1	66.0	60.8
2018	62.4	62.4	61.7
Employment Rate			
2003	61.5	63.3	63.4
2009	57.8	59.2	60.8
2018	59.8	59.5	61.7
Unemployment Rate			
2003	6.7	6.1	6.8
2009	11.3	11.8	7.5
2018	4.2	4.5	3.8

- a. Participation rates fell by 3.5 percentage points in CA; 5 percentage points in OH and 6.3 percentage points in TX. Thus, Texas is the state with the largest long-term decline in participation, not immediately consistent with the rust belt decline story.
- b. The increase in the unemployment rate from 2003 to 2009 was highest in OH (5.7 percentage points); then California (4.6 percentage points); then Texas (a mere 0.7 percentage points). Ohio was the hardest hit state.
- c. Using the decline in the participation rate from 2003 to 2009 to measure economic stress, Texas was the hardest hit state. Its participation rate dropped by 6.3 percentage points from 2003 to 2009. This could explain the small rise in the unemployment rate.
- d. There is no state where all three indicators suggest the weakest labor market. As of 2018, Ohio has the highest unemployment rate and the lowest employment rate but has a slightly higher participation rate than Texas and the same participation rate as California.

CHAPTER 8

Quick Check

1.
 - a. True.
 - b. False. After 1970 the relationship between inflation and unemployment broke down.
 - c. True.
 - d. True.
 - e. False. Expectations are forecasts and rarely exactly meet actual inflation rates.
 - f. False. They argued the appearance of a tradeoff between unemployment and inflation was an illusion.
 - g. True.
 - h. False. The natural rate of unemployment varies over time.
 - i. False. The natural rate of unemployment can vary substantially across countries.
 - j. True.
 - k. False. This statement describes the de-anchored relation.
 - l. False. Real wages can change for many reasons including that actual inflation may be different than the expected rate of inflation embodied in the wage contract.

2.
 - a. Most economists would agree that in the short term, there can be a trade-off between unemployment and inflation. However, there is disagreement over whether this policy is valid for the long term.
 - b. Increasing short-term interest rates works to check price inflation because higher interest rates reduce the pace of economic activity. This reduces the pace of unemployment, increases the workers' ability to bargain for higher wages, and puts upward pressure on price inflation from labor costs.
 - c. During the global financial crisis, employers experienced downward nominal wage rigidity. They were relatively unwilling to reduce salaries and wages (in nominal terms). To continue employing their best workers, most employers chose to fire some of their workforce rather than reduce pay.
3.
 - a. Solve the equation where actual and expected inflation take the same value to find the natural rate of unemployment $u_n = (m + z)/\alpha$.

Rewrite the Phillips curve as

$$\pi_t - \pi_t^e = -\alpha[u_t - (m + z)/\alpha]$$

Now substitute for u_n . Then $\pi_t - \pi_t^e = -\alpha[u_t - u_n]$

- b. We imposed the condition that $P = P^e$. This is the same condition that actual inflation equals expected inflation.
 - c. The natural rate of unemployment is higher when the markup (m) is higher.
 - d. The natural rate of unemployment is higher when the catchall variable (z) is higher,
 - e. The list mentioned in the text includes the generosity of unemployment insurance benefits; changes in the job-search mechanism; the proportion of persons in jail; the proportion of persons in young age groups; the proportion of employment in temporary jobs; the unionization rate; the minimum wage; employment protection.
4.
 - a. If the parameter θ is zero, then the expected rate of inflation is the constant $\bar{\pi}$. The expected rate of inflation does not vary over time.
 - b. If the parameter θ is one, then the expected rate of inflation is the previous period's rate of inflation. The expected rate of inflation likely varies greatly over time
 - c. Choices will vary.
5.
 - a. $u_n = 0.1/2 = .05$

In this case $\pi_t^e = (1) \bar{\pi} + 0 \pi_{t-1} = \bar{\pi}$ in all periods since $\theta = 0$.

Initial unemployment is 0.05 or 5%. In period t, unemployment is reduced to 3%. If we then use Phillips curve, inflation in period t is: $\bar{\pi} + 0.1 - (2 \times 0.03) = \bar{\pi} + 0.04 = 0.06$. Given the model we have, this will also be the value of inflation in period t+1, t+2, t+3, t+5. This value of inflation is a higher value than the anchored rate of inflation $\bar{\pi}$.

- b. This does not make much sense. Every period actual inflation exceeds expected anchored inflation by 4%. Remember that $\bar{\pi} = \pi^e$ in this model.
- c. This will put more weight on previous year's inflation in forming the expectation of inflation. In the periods from t+1 to t+5, a reasonable person might think last period's inflation (4 percentage points higher than $\bar{\pi}$) is a better predictor of actual inflation than the fixed value $\bar{\pi}$.
- d. The values will be: t+6: solving $\pi_t = \pi_t^e + 0.1 - 2u_t$ and using $\pi_t^e = \pi_{t-1}$

$$t+6 \quad u_{t+6} = .03 \quad \pi_{t+6} = \bar{\pi} + .04 + 0.1 - (2 \times .03) = \bar{\pi} + .04 + .04 = \bar{\pi} + 0.08$$

$$t+7 \quad u_{t+7} = .03 \quad \pi_{t+7} = \bar{\pi} + .08 + 0.1 - (2 \times .03) = \bar{\pi} + .08 + .04 = \bar{\pi} + 0.12$$

$$t+8 \quad u_{t+8} = .03 \quad \pi_{t+8} = \bar{\pi} + .12 + 0.1 - (2 \times .03) = \bar{\pi} + .12 + .04 = \bar{\pi} + 0.16$$
- e. You can see that keeping unemployment below the natural rate leads to an ever accelerating rate of inflation when $\theta = 1$. Hence the other name for the natural rate is the NAIRU, the non-accelerating inflation rate of unemployment. In this case inflation rises by 4 percentage points each year. This does not seem to be a feasible long run policy choice.
- f. If the unemployment rate is at the natural rate of unemployment (5%) and we assume that $\theta = 1$ then we solve $\pi_t - \pi_{t-1} = 0.1 - (2 \times 0.05) = 0$. In this situation, in every period actual inflation equals the previous period's rate of inflation. Inflation does not change.

Dig Deeper

- 6. a. This will move the model of expected inflation so that
$$\pi_t = \pi_{t-1} - 2(u_t - .05) = \pi_{t-1} + 2\% = 2\%$$

$$\pi_t = 2\%; \pi_{t+1} = 4\%; \pi_{t+2} = 6\%; \pi_{t+3} = 8\%.$$
 - b. $\pi_t = 0.5 \pi_{t-1} + 0.5 \pi_{t-1} - 2(u_t - .05)$
or, $\pi_t = \pi_{t-1} - 4(u_t - .05)$
 - c. $\pi_t = 4\%; \pi_{t+1} = 8\%; \pi_{t+2} = 12\%; \pi_{t+3} = 16\%$
 - d. As indexation increases, inflation becomes more sensitive to the difference between the unemployment rate and the natural rate.
- 7. a. The natural rate of unemployment is where inflation does not change (or, when $\pi_{t-1} = \pi_t^e$) and actual inflation equals expected inflation. The left-hand side of the Phillips relation is zero and solving, $u_n = 6.16\%$
 - b. The relation $\pi_t = 2.8\% - 0.16 u_t$ does not include a specific value for expected inflation. Thus, we cannot solve for the value of (m+z) when we do not know expected inflation. The formula for the Phillip is curve is $\pi = \pi^e + (m + z) - \alpha u$. The expression gives us only the value of $\alpha=0.16$ and the sum of π_t^e and (m + z),
 - c. The intercept on the vertical axis is the rate of inflation where unemployment is zero. Its value is 2.8%. Among the reasons to think this is a poor economic outcome would be that an unemployment rate of zero would not allow for normal churn and search in labor

markets. The intercept on the horizontal axis would be interpreted as the rate of unemployment need to reduce inflation to zero using the Phillips relation. The value is 17.5%. This is a very high rate of unemployment and would not be desirable.

- d. If we assume that $\bar{\pi} = 2.0\%$ and that $\pi_t^e = \bar{\pi} = 2.0\%$ then the relation is $\pi_t - 2.0 = 2.8\% - 2 = -0.16 u_t$ and we can solve for $u_n = 0.8/0.16 = 5.0\%$. If the unemployment rate is 5% and expected inflation is anchored at 2%, then actual inflation is 2% and we are at the natural rate of unemployment. There is no reason for expected inflation to change.
 - e. This would be a slightly lower natural rate of unemployment - from 6.16% to 5.0%. But remember both are statistical estimates and these are unlikely to be very different in the statistical sense. Later in the text the issue of not knowing the exact value for the natural rate of unemployment will re-emerge.
 - f. The Focus Box “Changes in the U.S. Natural Rate of Unemployment since 1990” speculates on possible reasons for a lower natural rate of unemployment. Workers could have weaker bargaining power. There could be more efficient search mechanisms in the labor force. The population has aged. A larger percentage of the population is incarcerated or disabled.
8. Consider each table below. Is the data presented is consistent with the Phillips curve model of wage determination? Each table has a point A and a point B. Start your answer with true/false/uncertain.
- a. The natural rate of unemployment is 5%

Point	Unemployment rate	Expected inflation (percent)	Percent increase in wages
A	6%	3%	3%
B	6%	2%	2%

True. The rate of wage increase is higher when expected inflation is higher at the same rate of unemployment. This is consistent with the Phillips curve model of wage determination

- b. The natural rate of unemployment is 5%

Point	Unemployment rate	Expected inflation (percent)	Percent increase in wages
A	4%	2%	3%
B	3%	2%	2%

False. The rate of wage increase is lower when the unemployment rate is lower at the same rate of expected inflation. This is not consistent with the Phillips curve model of wage determination

- c. The natural rate of unemployment is 4%

Point	Unemployment rate	Expected inflation (percent)	Percent increase in wages
A	4%	6%	7%

B	4%	2%	3%
---	----	----	----

True. The rate of wage increase at the natural rate of unemployment differs by the difference in the expected rate of inflation. The Phillips curve has shifted up to factor in expected inflation. This is consistent with the Phillips curve model of wage determination

- d. The natural rate of unemployment is 5%

Point	Unemployment rate	Expected inflation (percent)	Percent increase in wages
A	12%	2%	0%
B	12%	-2%	0%

Uncertain. Money wage decreases do not take place as expected inflation is negative even at the same rate of unemployment, a rate far above the natural rate of unemployment. This set of data could capture the phenomenon of rigid money wages in a Phillips curve framework.

Explore Further

9. The filled in table for the period will look like this (truncated to one decimal place)

Year	Inflation	Unemployment	Predicted inflation	Inflation minus predicted inflation
2006	3.3	4.7	2.0	1.2
2007	2.5	4.6	2.1	.4
2008	4.3	5.4	1.9	2.3
2009	-0.6	8.8	1.4	-2.0
2010	1.8	9.7	1.3	.5
2011	2.7	9.1	1.3	1.4
2012	2.3	8.2	1.5	.8
2013	1.5	7.5	1.6	-.1
2014	1.7	6.3	1.8	-.1
2015	0.2	5.4	1.9	-1.8
2016	1.0	4.9	2.0	-1.0
2017	2.0	4.4	2.1	.0

2018	2.4	4.0	2.2	.2
Future years				

- a. There is no simple answer here. In the years 2007, 2010, 2012, 2013, 2017 and 2018 – the predicted rate of inflation is within 0.5 percentage points of the actual rate of inflation. In the other years, the predictions of the rate of inflation are further away from the actual rate of inflation. Clearly many other factors affect inflation. The average error in prediction over the period is 0.1 percentage points. So, the Phillips curve as written does a decent job of predicting inflation but is far from perfect. If the expected rate of inflation is anchored on 2 percent, then some of the expectational errors are quite large relative to 2 percent.
- b. If we focus on the crisis years, 2009 and 2010, the model fits better in 2010. In 2009, the actual rate of inflation is negative 0.6% and the model predicts a positive value of 1.4%. The high level of unemployment in 2010 predicts a reduction in the inflation rate from 2009 to 2010 and one occurs. The model does not fare well in 2011. The high level of unemployment in 2011 predicts rate of inflation that is 1.3 percentage points below the actual rate of inflation.
- c. Answers will vary. Remember that the Phillips curve holds the natural rate of unemployment constant at its estimated value for the period 1996 to 2018.

10. From the 1960's

Year	Actual inflation	Lagged actual inflation	π_t^e Expected inflation under different assumptions		$\pi_t^e - \pi_t$ Difference: expected minus actual inflation under different assumptions	
Year	π_t	π_{t-1}	assume $\theta = 0$ and $\bar{\pi} = 0$	assume $\theta = 1.0$	assume $\theta = 0$ and $\bar{\pi} = 0$	assume $\theta = 1.0$
1963	1.2	1.1	0.0	1.1	1.2	0.1
1964	1.3	1.2	0.0	1.2	1.3	0.1
1965	1.5	1.3	0.0	1.3	1.5	0.1
1966	2.6	1.5	0.0	1.5	2.6	1.2
1967	2.7	2.6	0.0	2.6	2.7	0.1
1968	3.9	2.7	0.0	2.7	3.9	1.1
1969	5.0	3.9	0.0	3.9	5.0	1.1

- a. Zero is a poor choice for the both the value of θ and $\bar{\pi}$ in the 1960s because it generates a poor prediction of inflation. In every year inflation is under predicted. It seems very unlikely that $\bar{\pi} = 0$. Inflation should move around both sides of the actual value of $\bar{\pi}$.
- b. One is a better choice for the value of θ in the 1960s because the differences between expected inflation and actual inflation are actually quite small. However, because the level of inflation is accelerating all values of actual inflation minus expected inflation are positive. If we had allowed $\bar{\pi}$ to be positive as of 1963, the errors in expectations would have been smaller.

Fill in the values in the table below for inflation and expected inflation using the 1970s and 80s. You will have the most success using a spreadsheet.

From the 1970's and 1980's:

Year	Actual inflation	Lagged actual inflation	π_t^e Expected inflation under different assumptions		$\pi_t^e - \pi_t$ Difference: expected minus actual inflation under different assumptions	
Year	π_t	π_{t-1}	<i>Assume</i> $\theta = 0$ and $\bar{\pi} = 0$	<i>Assume</i> $\theta = 1.0$	<i>Assume</i> $\theta = 0$ and $\bar{\pi} = 0$	<i>Assume</i> $\theta = 1.0$
1973	5.1	3.2	0.0		3.2	5.1
1974	9.4	5.1	0.0		5.1	9.4
1975	9.1	9.4	0.0		9.4	9.1
1976	5.8	9.1	0.0		9.1	5.8
1977	5.8	5.8	0.0		5.8	5.8
1978	6.8	5.8	0.0		5.8	6.8
1979	9.6	6.8	0.0		6.8	9.6
1980	12.0	9.6	0.0		9.6	12.0
1981	9.8	12.0	0.0		12.0	9.8

- c. Zero is now clearly a terrible choice for the value of θ and $\bar{\pi}$ in the 1970s and early 1980s. It is clear that inflation is, on average positive and very large. Ignoring this information in forming expectations of inflation is clearly wrong.

- d. One is a better choice for the value of θ in the 1970s and early 1980s. Once the value of θ is one, the value of $\bar{\pi}$ is not relevant - it takes on a weight of zero in the formation of expected inflation. There are some years where lagged inflation predict actual inflation well and some years where it does not. But there are now both positive and negative errors in expectations. The average error is 0.7 percentage points.

From the 2010's (which you have partly done in Q. 8):

Year	π_t Actual inflation	π_{t-1} Lagged actual inflation	π_t^e Expected inflation under different assumptions	$\pi_t^e - \pi_t$ Difference: expected minus actual inflation under different assumptions	
Year			<i>Assume $\theta = 0$ and $\bar{\pi} = 2.0$</i>	<i>Assume $\theta = 1.0$</i>	<i>Assume $\theta = 1.0$</i>
2013	1.5	2.3	2.0	2.3	-0.5
2014	1.7	1.5	2.0	1.5	-0.3
2015	0.2	1.7	2.0	1.7	-1.8
2016	1.0	0.2	2.0	0.2	-1.0
2017	2.0	1.0	2.0	1.0	0.0
2018	2.4	2.0	2.0	2.0	0.4
Future years					

- e. The fit of the model where the anchored rate of inflation is 2% between 2013 and 2018 is all right – but not spectacular. There are 4 negative values where inflation is actually less than the 2% anchored rate. In 2017 inflation is exactly the anchored rate and in 2018 inflation is higher than the anchored rate.
- f. If we continue with the model that lagged inflation is expected inflation, the $\theta = 1$ model, this model still has good predictive power. There are two negative values where actual inflation is less than lagged inflation and 4 positive values. The average of the 6 prediction errors in this model is zero. So $\theta = 1$ will be a workable model of inflation expectations even when they are anchored. This makes sense – anchored expectations only stay anchored if the path of inflation is quite stable.
- g. The 1960s capture the acceleration of inflation very well and show that depending on either zero expected inflation or lagged inflation is a poor model. In the 1970s lagged inflation works fairly well. In the 2010s, as makes sense, if inflation is stable, then either

an anchored model of expected inflation or a model where expected inflation is the lagged value of inflation works fairly well.

CHAPTER 9

Quick Check

1.
 - a. False. An increase in taxes (T) will shift the IS curve down as will an increase in risk premium (x).
 - b. False. When unemployment exceeds the natural rate then the output gap is negative.
 - c. True.
 - d. False. The output gap would be positive if the natural rate of unemployment is greater than the actual rate of unemployment.
 - e. True.
 - f. False. The change in the unemployment rate is typically less than the increase in output growth.
 - g. True.
 - h. False. The target rate of inflation may be positive, not zero.
 - i. False. The central bank may be constrained, for example by zero lower bound.
 - j. True.
 - k. True.
 - l. True.
2.
 - a. Situations B, C, D, and E are all situations where output is not at potential output and unemployment is not at the natural rate of unemployment. As a result, given that the expected rate of inflation is fixed at the target rate of inflation, actual inflation is not at the target rate of inflation.
 - b. If you compare Situation B to Situation A, output is above potential output. Looking carefully you can see investment spending is higher because the real interest paid by firms is $2 - 2 + 1$ or 1%. If the central bank increased the target nominal policy rate (i) from 2% to 4%, this would move Situation B to Situation A.
 - c. If you compare Situation C to Situation A, output is below potential output. Looking carefully you can see real investment spending is lower because the real interest paid by firms is $4 - 2 + 3$ or 5%. The value of the risk premium (x) rose from 1% to 3%. Following what was learned in part b, if the central bank lowered the target nominal rate of interest by 2%, then the real rate of interest paid by firms would fall to 3% and investment would return to 150 units.
 - d. If you compare Situation D to Situation A, output is below potential output. Looking carefully you can see real government spending is 20 units lower in Situation D than in Situation A. If we were to lower the nominal and real policy rate of interest from 4% to 2%, we have learned that investment would rise to 170 units and this would restore the economy to medium run equilibrium.
 - e. If you compare Situation E to Situation A, output is above potential output. Looking carefully you can see real government spending is 20 units higher in Situation D than in Situation A. If we were to raise the nominal policy rate of interest from 4% to 6%, we have learned that investment would fall to 130 units and this would restore the economy to medium run equilibrium.

- 3.
- a. Expected inflation will not change since in the medium run equilibrium actual inflation equals expected inflation. In this characterization of equilibrium, the expected rate of inflation is the anchored rate of inflation and since the anchored rate of inflation is actual inflation, there is no reasons for households or firms to revise their expectations of inflation.
 - b. The central bank must lower the natural policy rate by 2 percentage points. The level of aggregate demand associated with the IS curve is determined by $r_n + x$. The value of aggregate demand and income must remain at Y^* for the actual rate of inflation to be the anchored rate of inflation. Thus, if x increases by 2 percentage points, r_n must decrease by two percentage points.
 - c. The central bank must increase r_n . The level of aggregate demand associated with the IS curve is determined by G and $r_n + x$. The value of aggregate demand and income must remain at Y^* for the actual rate of inflation to be the anchored rate of inflation. Thus, if G increases, r_n must increase so that $r_n + x$ increases to reduce aggregate demand and leave it equal to Y^* .
 - d. The central bank must increase r_n . The level of aggregate demand associated with the IS curve is determined by T and $r_n + x$. The value of aggregate demand and income must remain at Y^* for the actual rate of inflation to be the anchored rate of inflation. Thus, if T decreases, r_n must increase so that $r_n + x$ increases to reduce aggregate demand and leave it equal to Y^* .
 - e. The increase in G or the decrease in T in parts d and e constitute a fiscal expansion and an increase in aggregate demand. To leave demand equal to output unchanged at potential output Y^* , the central bank must act to raise the borrowing rate by raising the policy rate because the fiscal changes imply an increase in the natural policy rate.
- 4.
- a. Output increases in the short run as the IS shifts up when c_0 increases. Inflation rises beyond expected inflation as the economy moves up the PC curve. Output and inflation is higher than 2%, its value in period t.
 - b. Total aggregate demand and output is determined by the intersection of the IS curve and the LM curve. Since the question states that the central bank will leave the real policy rate constant, that intersection occurs at the same values of output and the real interest rate in period (t+1) and (t+2). Inflation will be the same value in period (t+1) and (t+2) since the PC line does not move. Note: To leave the real policy rate unchanged, the central bank must raise the nominal policy rate by an amount equal to the increase in expected inflation.
 - c. If the central bank leaves the real policy rate unchanged, then the upward shift in the IS curve will increase output beyond the natural rate. The inflation rate, read off the unchanged PC line, will exceed 2% and will remain above 2% forever. The issue for the central bank will be that inflation and expected inflation exceeds the target rate of inflation in every period. So, the policy to target inflation will eventually fall apart.

- d. Output increases in the short run as the IS shifts up. Inflation rises beyond the target rate of inflation as the economy moves up the PC curve. Output and inflation are higher in period (t+1) than in period t.
 - e. In period (t+2) the central bank leaves the real policy rate unchanged since expected inflation remains anchored at $\bar{\pi}$. So, in period (t+2) output remains above potential, its initial value, and actual inflation is higher than $\bar{\pi}$.
 - f. This policy is not sustainable because in every period actual inflation exceeds both the target rate of inflation and the rate of expected inflation. It is unrealistic to expect expected inflation to remain at the anchored rate forever when the anchored rate is never achieved.
 - g. The difference between the two assumptions about expected inflation is subtle. In both parts b and c, output remains above potential. Because the PC curve in this model is not responsive to changes in expected inflation, the increase in output leads to actual inflation higher than the 2% target. In parts (a), (b) and (c), expected inflation rises to be equal to actual inflation. In parts (d), (e) and (f) actual inflation exceeds expected inflation in every period. In both scenarios, the central bank is left announcing a target inflation they never achieve.
 - h. Neither scenario seems completely realistic. In part b, the central bank accepts a level of inflation that is always greater than its target. In part c, expected inflation remains anchored at a target rate of inflation that is never achieved.
5. a. The PC curve will shift up. In period (t+1) output remains at the period t level since the components of demand are not changed when there is no change in the real interest rate and inflation increases. The level of potential output decreases. In period (t+1) inflation would increase beyond the target rate of inflation and output remains at the initial level that it was in period t.
- b. The period (t+2) equilibrium when $\pi_{t+2}^e = \pi_{t+1}$ and when the central bank leaves the real policy rate of interest unchanged will have the same level of output as in period (t+1) and period t. Since the PC curve has shifted up, inflation will exceed 2% by the same amount as in period (t+1).
- c. The maintenance of the real policy rate at its initial value is not sustainable. Inflation will exceed the target rate of inflation forever. So, the target rate of inflation policy will eventually fall apart.
- d. Output will remain the same as in period t. The real interest rate has not changed and no factors that shift the IS curve are in play. Since the PC curve shifted up, the same level of output is associated with a higher inflation rate.
- e. In period (t+2) if the central bank does not change the real policy interest, the output remains higher than the natural rate, at the level of output in period t and (t+1). Inflation remains at its higher than 2% value since the PC curve has shifted up.

- f. This policy is not sustainable because in every period actual inflation exceeds target inflation. It is unrealistic to expect expected inflation to remain at the anchored rate forever when the anchored rate is never achieved.
- g. In both cases output remains higher than the new lower level of potential output. In the cases discussed in (a) and (b) inflation and expected inflation stay at the value higher than 2% forever. In the (d) and (e) case, actual inflation simply remains higher than the target rate of inflation forever.
- h. Neither situation is realistic in term of a supply shock. The large permanent increase in the price of oil would almost certainly be noticed and be expected by participants in the economy to affect both the inflation rate (at least temporarily) and the natural level of output (permanently).

Dig Deeper

- 6. a. Unemployment rises in a recession so $u - u(-1)$ will be positive. In a recovery period the unemployment rate is falling so $u - u(-1)$ will be negative.
- b. 3% is the growth rate of potential output.
- c. This coefficient is not unity due to labor hoarding.
- d. The growth rate of potential output would increase, the number 3 would be larger.
- 7. a. Your sketch would show the IS in period t curve crossing potential output where the real policy rate of interest is $-\bar{\pi}$. This would mean that the nominal policy interest rate is zero. Note the real borrowing rate for firms would be $0 - \bar{\pi} + x$ and could be positive. Inflation is equal to $\bar{\pi}$ and $\pi - \bar{\pi} = 0$. In period t+1 the IS curve would shift to the left (or down) with the cut in G and the increase in T and equilibrium output falls. Actual inflation will be less than the anchored expected rate of inflation.
- b. Actual inflation could become negative if the level of income is a great deal lower than potential. If inflation is persistently less than the target rate of inflation, the expected rate of inflation will eventually fall.
- c. If the nominal policy interest rate is already at zero, the fall in expected inflation would increase the real policy rate of interest. This would then cause a movement up the IS curve and a further decline in income and inflation. The rate of inflation could become negative if income falls far enough. The negative expected rate of inflation is a higher real rate of interest. The cycle would continue. The fiscal consolidation could lead to a deflationary spiral as outlined above.

Explore Further

- 8. a. Output is not at potential in 1933. The unemployment rate is still very high. Although output growth is positive in 1933, it is clearly still far below its value in 1929. The years of negative output growth have not been offset.

- b. The constantly increasing rate of deflation (inflation getting more negative) from 1929 to 1932 suggest a spiral of an increasing rate of deflation.
 - c. The actual value of inflation in 1929 was zero. If the expected rate of inflation had remained anchored at zero, the real rates would have been much lower and investment would have been higher.
 - d. Had a substantial fiscal stimulus taken place in 1930 or even earlier, perhaps the level of output would have been higher. If the level of output had been higher, the output gap would have been less negative, deflation less and the rise in real interest rates less. The depression might have been shorter and less severe.
9. a. Real interest rates would be: 1929: 7%; 1930: 4.4; 1931: 5.6; 1932: 13.2; 1933: 13.4. It would be quite hard to say whether this pattern of real interest rates explains changes in output better. It is not very different.
- b. 1930: -.72; 1931: -.49; 1932: 4.3; 1933: +.14. You notice that unemployment and output growth looks like Okun's Law in 2 of the 4 years. These are not exact relations. Even though output grew in 1933, it seems likely firms would be wondering if the increase in output was permanent enough to take on extra staff.
10. a. Every European country was severely hurt by the U.S. depression (Germany more than the other two countries), with a collapse in growth and an explosion of unemployment.
- b. The movement of production, price, and unemployment were similar for Germany and the UK. France had increased inflation with decreased growth.
- The recovery was unequal. The UK seemed more flexible and Germany's economic growth was the result of the war economy.
11. a. President Trump's comment does roughly match up to our model. With a permanent fiscal expansion, the Fed must raise the neutral real policy rate. However, Mr. Trump would prefer that the economy continue to have a high level of output and a low level of unemployment.
- b. The second comment also roughly fits our model. As we are doing so well – the economy is either above potential or predicted to be above potential and the Fed is raising interest rates to reduce demand.

CHAPTER 10

Quick Check

1.
 - a. True.
 - b. False. Prices of goods, including food, are typically lower in poor countries.
 - c. True
 - d. False. Output per person is converging across countries but most still lag far behind the U.S.
 - e. True.
 - f. False. Capital formation cannot sustain growth alone, but it does contribute to long-term growth.
 - g. True.
2.
 - a. The Japanese consumption per student = $\text{¥}600 \times 60 + \text{¥}170 \times 80 = \text{¥}49,600$.
 - b. The Chinese consumption per student = RMB $15 \times 50 + \text{RMB } 3 \times 100 = \text{RMB } 1,050$.
 - c. With the exchange rate of 17 yuan being equal to one yen, the Chinese consumption per student is: $\text{RMB } 1,050 \times 17 = \text{¥}17,850$. It is lower than consumption in Japan.
 - d. Using the purchasing power parity method, the Chinese consumption per student is: $\text{¥}600 \times 50 + \text{¥}170 \times 100 = \text{¥}47,000$.
 - e. Therefore, the standard of living of students in China is lower than those in Japan. The Chinese student's standard of living relative to that of the Japanese student is 0.36 using the exchange rate method, while it is 0.95 using the purchasing power parity method.
3.
 - a. $Y = 10 + 2 \times 20 = 50$
 - b. $Y = 30 + 2 \times 60 = 150$
 - c. This function has constant returns to scale since Y triples.
 - d. $Y/N = (K/N) + 2$
 - e. $Y/N = 2 + 2 = 4$;
No. When $K/N = 4$, $Y/N = 4 + 2 = 6$.
 - f. No. The relation between output per worker and capital per worker has decreasing returns.
 - g. The latter function represents decreasing returns to capital, whereas the former represents decreasing returns to scale.

Dig Deeper

4.
 - a. $\Delta Y/Y = .5 (\Delta K/K)$
growth rate of output = 1/2 growth rate of capital
 - b. 4% per year
 - c. K/Y increases.
 - d. No. Since capital is growing faster than output, the saving rate will have to increase to maintain the same pace. Eventually, the required saving will exceed output. Capital must

grow faster than output because there are decreasing returns to capital in the production function.

5. Even though the United States was making the most important technical advances, the other countries were growing faster because they were importing technologies previously developed in the United States. In other words, they were reducing their technological gap with the United States.

Explore Further

6. a. The data for each of the junctures is shown below:
Average annual growth in real per capita GDP

	1960	1980	2000	2014
China	121	221	1128	3863
Euro area	9,389	20,281	30,366	32,883

The following table shows China's GDP per capita relative to that of the euro area in each of these years:

1960	1980	2000	2014
1%	1%	4%	12%
1%	1%	4%	12%

Therefore, the data shows convergence.

- b. The average annual growth rates of the GDP per capita for both economies is given in the table below:

	1960–1980	1980–2000	2000–2014
China	4.1%	20.6%	12.1%
Euro area	5.8%	2.5%	0.4%

Faster growth in China's GDP per capita confirms the view that convergence is taking place.

- c. In 2014, the GDP per capita in China and in the euro area were \$3,863 and \$32,883 respectively. As shown in Part b of this answer, China's GDP per capita was 12% of the euro area's GDP per capita. At steady growth rates of 6% and 1% respectively, China and the euro area's GDP per capita would rise to \$12,389 and \$40,124 respectively. Therefore, China's GDP per capita would represent almost 31% of the euro area's GDP per capita – a significant increase from 12%.

Questions 7 and 8 require you find the data in the Penn World Tables that measures real GDP per capita using purchasing power parity exchange rates as described in the text. As of the time of writing, version 9 is the latest version of this data. The variable rgdpo is

total real output in millions of PPP 2011 US dollars. The variable pop is population in millions. You will have to isolate these variables in the spreadsheet and construct real GDP per person for each country in each year. In manipulating the data in a very large spreadsheet, you will be able to answer Questions 7 and 8.

7. a. There was substantial convergence for the France, Belgium, and Italy. The ratio of per capita income in these countries to that of the United States in 2014 is much larger in 2014 than in 1950.
- b. Three of these four African countries have not converged. The ratio of per person real GDP in these countries in 1950 to that of the United States in 1950 is smaller in 2014 than in 1970 for all but Ethiopia. There is some evidence of convergence in Ethiopia but the level of real GDP per capita in Ethiopia remains low.

Real GDP Per Capita 2PPP adjusted expressed in 2011 US dollars

Country	1970	2014	ratio
United States	23373.5	51958.6	2.2
France	15742.7	38584.4	2.5
Belgium	13693.4	39950.5	2.9
Italy	11820.3	35323.5	3.0
Ethiopia	509.3	1504.3	3.0
Nigeria	4649.9	5574.2	1.2
Kenya	1650.9	2970.8	1.8
Uganda	994.7	1869.2	1.9

8. Real GDP per Capita (\$2011), PPP adjusted

- a. Richest 10 countries 1970

Country	Real GDP per capita
Bermuda	80424
Brunei	57500
Switzerland	23863
Luxembourg	22362

Kuwait	21488
United States	20547
Bermuda	18490
Denmark	17050
Austria	16857
Sweden	16573

b. 10 Richest Countries (in the data sample) in 2014

Per capita
real GDP

Qatar	151763
China, Macao SAR	131850
Norway	78293
United Arab Emirates	70096
Brunei Darussalam	69667
Kuwait	69305
Luxembourg	67324
Singapore	66482
Switzerland	62637
United States	51959

c. The ten fastest growing countries are

Taiwan	5.067942
Mongolia	5.078347
El Salvador	5.135735
China	5.20462

Egypt	5.220532
Turks and Caicos Islands	5.670956
Republic of Korea	6.404573
Botswana	7.10022
China, Macao SAR	7.207959
Equatorial Guinea	9.431726

- d. Slowest growing countries with data from 1970 and 2014

Bermuda	-9.33751
Cayman Islands	-4.57779
United Arab Emirates	-2.87603
Djibouti	-2.19843
Central African Republic	-1.93212
D.R. of the Congo	-1.60263
Kuwait	-1.46549
Niger	-1.21873
Comoros	-0.90264
Nicaragua	-0.76299

- e. Answers will vary. Wars and revolutions can play a significant role in slowing growth. Large resource discoveries or large swings in resource prices in countries where a single commodity dominates the economy can also play a large role in moving growth rates.
9. a. The graph clearly has a broad pattern where the level of happiness is higher the higher is real GDP per capital.
- b. The most interesting observation in the graph is that for the two most populous countries in the world, India and China, the pattern is very different. In China real GDP per capita increased and so did happiness. In India real GDP per capita increased but happiness fell.

CHAPTER 11

Quick Check

1.
 - a. True, in a closed economy, and if saving includes public and private saving.
 - b. False. The economy will eventually reach a steady state where output per worker does not increase.
 - c. True. In the model without depreciation, there is no steady state. A constant saving rate produces a positive but declining rate of growth. In the infinite-time limit, the growth rate equals zero. Output per worker rises forever without bound. In the model with depreciation, if the economy begins with a level of capital per worker below the steady-state level, a constant saving rate also produces a positive but declining rate of growth, with a limit of zero. In this case, however, output per worker approaches a fixed number, defined by the steady-state condition of the Solow model. Note that depreciation is not needed to define a steady state if the model includes labor force growth or technological progress.
 - d. Uncertain. See the discussion of the golden-rule saving rate.
 - e. False. The golden-rule level of capital relates the savings rate to consumption levels and is unaffected by the depreciation rate.
 - f. True.
 - g. Partially true. According to endogenous growth models, investments in education, which translate into higher levels of human capital, may lead to sustained higher growth only if combined with an increase in physical assets. Increases in human capital alone lead to decreasing returns.
2. A lower consumption rate implies a higher saving rate. However, a higher saving rate does not translate automatically into higher consumption levels in the future: this depends on where the country stands with respect to the golden-rule level of capital. If the stock of capital in the country already exceeds that level, then an increase in savings will actually lead to a decline in steady-state consumption.
3. Assume that the economy begins in steady state. One decade after an increase in the saving rate, the growth rate of output per worker will be higher than it was in its initial steady state. Five decades after an increase in the saving rate, the growth rate of output per worker will be close to its value in the initial steady state (this value is zero in the absence of technological progress). The level of output per worker will be higher, however, than it was in the initial steady state.

Dig Deeper

4.
 - a. This would likely lead to a higher saving rate, so output per worker and output per person would be higher in the long run.
 - b. Treat an increase in female participation as a one-time increase in employed labor. In this case, an increase in female participation would have no effect on the level of output per worker, but would lead to a higher level of output per person, since a greater fraction of the population would be employed.

5. As equation (11.3) indicated in the text of this chapter, the net effect on capital per worker (and thus, the output per worker) of a simultaneous increase in the saving rate and the depreciation rate is uncertain. If the increase in the saving rate is higher (lower) than the increase in the depreciation rate, then the future stock of capital per worker will increase (decrease). This, in turn, will positively (negatively) affect the steady state value of output per worker – but not the growth of output per worker in the long run, which is unaffected by changes in the saving and depreciation rates.
6. a. $\frac{K}{N} = 4 \frac{s^2}{\delta^2}; \frac{Y}{N} = 4 \frac{s}{\delta}$
 b. $\frac{C}{N} = (1 - s) \frac{Y}{N} = 4 \frac{s-s^2}{\delta}$
 c-d. Y/N increases as s increases. C/N increases as s increases until s reaches 0.5, and then it decreases. Thus, C/N is maximized at $s = 0.5$.
7. a. Yes. The Cobb-Douglas production function satisfies the two properties of constant returns to scale and decreasing returns to capital and labor.
 b. Yes. The Cobb-Douglas production function satisfies the two properties of constant returns to scale and decreasing returns to capital and labor.
 c. Yes. The Cobb-Douglas production function satisfies the two properties of constant returns to scale and decreasing returns to capital and labor.
 d. $Y/N = (K/N)^{1/3}$
 e. In steady state, $sY/N = \delta K/N$, which, given the production function in part (d), implies

$$K/N = (s/\delta)^{3/2}$$

 f. $Y/N = (s/\delta)^{1/2}$
 g. $Y/N = 2$
 h. $Y/N = 2^{1/2}$
8. a. Substituting from problem 7 part (e) implies $K/N = 1$.
 b. Substituting from problem 7 part (f), $Y/N = 1$.
 c. $K/N = 0.35; Y/N = 0.71$
 d.

	<u>K/N</u>	<u>Y/N</u>
t	1.00	1.00
$t+1$	0.90	0.97
$t+2$	0.82	0.93
$t+3$	0.75	0.91

9. a. Both K/N and Y/N decline over time.

	K/N	Y/N
t	1,440	1,200
t+1	1,428	1,195
t+2	1,405	1,185

- b. An increase in the depreciation rate at the outset of the period in question changes the steady-state values of K/N and Y/N but does not change the trend (decline).

	K/N	Y/N
t	1,000	1,000
t+1	0,990	0,995
t+2	0,971	0,985

Explore Further

10. The GE solution uses 2016 data. Students should be encouraged to use a similar format with the most recent numbers available on the website.

- a. This table shows the steady-state output per worker and the steady-state capital per worker for each country:

	Indonesia	India	Korea	Malaysia	China
KIN	10.2	9.0	13.0	7.8	21.2
YIN	3.2	3.0	3.6	2.8	4.6

- b. The data is given in the following table:

	Indonesia	India	Korea	Malaysia	China
Deficit/GDP	-2.5	-4.1	0.3	-3.2	-3.7
Difference from Korean Balance	2.8	4.4		3.5	4.0

The difference with the Korean balance is given in the preceding table and the saving rate will consequently increase to the same size. Thus, the long-run levels of capital per worker and output per worker should increase in these countries.

- c. The performance of these countries is closer than that of Korea. The position of China is specific as it has a very high level of saving rate (46.5%).

	Indonesia	India	Korea	Malaysia	China
KIN	12.1	11.8	13.0	9.9	25.0
YIN	3.5	3.4	3.6	3.2	5.0

CHAPTER 12

Quick Check

1. a. True.
b. True.
c. False. In steady state, there is no growth of output per effective worker.
d. True.
e. False. The steady-state rate of growth of output per effective worker is zero. A higher saving rate leads to higher steady-state level of capital per effective worker, but has no effect on the steady-state rate of growth of output per effective worker.
f. True.
g. False. Many marketable innovations come from basic research so the quest for profits will ensure private firms continue to conduct all types of research.
h. False/Uncertain. Even pessimists about technological progress typically argue that the rate of progress will decline, not that it will be zero. Strictly, however, the truth of this statement is uncertain, because we cannot predict the future.
i. False. Although China's growth has been dominated by an increase in the capital stock per worker, there is no reason to believe that China has not benefitted from the increase in technology around the world and contributed to the development of that technology.

2.
 - a. Most technological progress seems to come from R&D activities. See discussion on fertility and appropriability in Chapter 12.
 - b. The TRIPS agreement introduced intellectual property law into the international trading system for the first time and remains the most comprehensive international agreement on intellectual property to date. The developing countries accepted that compulsory frame as they expect more foreign exchange and investments.
 - c. This proposal would lead to an increase in the R&D spending of private firms and attracted the implementation of private research teams from abroad. If fertility does not fall, there will be an increase in the rates of technological progress and output growth.
 - d. Presumably, this proposal gives a mixed signal to private firms: either it is considered that the universities are so good that they do not need public support to collaborate with industry or it would cause industries to cooperate with other universities in other countries.
 - e. Actually, SMEs contribute more and more to technological progress, but in many technological domains they are prevented from using the patent system because of its complexity and its high cost. Patents are not the only means for protecting and managing inventions. SMEs use other means like business secrets, copyrights (in the software industry) and shorter lead times (where the time between inventions in many domains gets shorter).
3.
 - a. The economic leaders achieve technological progress by setting up a comprehensive system of innovation. R&D is one of the main elements of this system and the leading countries in terms of innovation aim to spend 3% of their GDP in R&D.
 - b. Developing countries can import technology from leading countries through foreign direct investment or technology transfer (licensing but also copying), or in the frame of international aid (specifically, through the World Bank). However, as the example of Asian countries has shown, they may also develop strong educational programs and innovation incentives which lead to a solid knowledge infrastructure and growth in the number of inventors.
 - c. The implementation of solid intellectual property laws and a working judicial system attracts foreign investments and exchanges, facilitates cooperation and technological transfers, and incentivizes local inventors.

Dig Deeper

4.
 - a. The growth rate of output per worker falls in the short run and continues to fall over time. In the long run, the growth rate of output per worker approaches a new steady state with a permanently lower (but still positive) growth rate. Output per worker continues to rise over time, just at a slower rate. Since output per worker continues to grow, the level of output continues to grow.
 - b. A permanent reduction in the saving rate has no effect on the steady-state growth rate of output per worker. The growth rate of output per worker falls (but remains positive) in the short run but in the long run it approaches its original steady-state rate. The level of total output grows with the number of workers.

5. a. Nominal GDP

$$\text{Year 1: } 10(100) + 10(200) = 3000$$

$$\text{Year 2: } 12(100) + 12(230) = 3960$$

- b. Year 2 Real GDP (Year 1 Prices) = $10(100) + 10(230) = 3300$
growth rate of real GDP = $3300/3000 - 1 = 10\%$

- c. GDP deflator

$$\text{Year 1=1; Year 2} = 3960/3300 = 1.2$$

Inflation = 20%

- d. Real GDP/Worker

$$\text{Year 1} = 3000/100 = 30; \text{Year 2} = 3300/110 = 30$$

Labor productivity growth is zero.

- e. Year 2 Real GDP (Year 1 Prices) = $10(100) + 13(230) = 3990$
output growth = $3990/3000 - 1 = 33\%.$

- f. GDP deflator

$$\text{Year 1 = 1; Year 2} = 3960/3990 = 0.992$$

Inflation = $0.992/1 - 1 = -0.8\%$

- g. Real GDP/worker = 36.3 in year 2. Labor productivity growth is $36.3/30 = 1.21$, or 21%.
h. This statement is true, assuming there is progress in the banking services sector.

6. a. i. $K/(AN) = (s/(\delta + g_A + g_N))^2 = 1$

ii. $Y/(AN) = (K/AN)^{1/2} = 1$

iii. $g_{Y/(AN)} = 0$

iv. $g_{Y/N} = g_A = 4\%$

v. $g_Y = g_A + g_N = 6\%$

- b. i. $K/(AN) = (s/(\delta + g_A + g_N))^2 = 0.64$

ii. $Y/(AN) = (K/AN)^{1/2} = 0.8$

iii. $g_{Y/(AN)} = 0$

iv. $g_{Y/N} = g_A = 8\%$

v. $g_Y = g_A + g_N = 10\%$

An increase in the rate of technological progress reduces the steady-state levels of capital and output per *effective* worker, but increases the rate of growth of output per worker.

- c.
 - i. $K/(AN) = (s/(\delta + g_A + g_N))^2 = 0.64$
 - ii. $Y/(AN) = (K/AN)^{1/2} = 0.8$
 - iii. $g_{Y/(AN)} = 0$
 - iv. $g_{Y/N} = g_A = 4\%$
 - v. $g_Y = g_A + g_N = 10\%$

People are better off in case (a). Given any set of initial values, the level of technology is the same in cases (a) and (c), but the level of capital per effective worker is higher at every point in time in case (a). Thus, since $Y/N = AY/(AN) = A(K/(AN))^{1/2} = A^{1/2}(K/N)^{1/2}$, output per worker is always higher in case (a).

7.
 - a. Probably affects A . Think of climate.
 - b. Affects H and possibly A , if better education improves the fertility or research.
 - c. Affects A . Strong protection tends to encourage more R&D but also to limit diffusion of technology.
 - d. May affect A through diffusion.
 - e. May affect K , H , and A . Lower tax rates increase the after-tax return on investment, and thus tend to lead to more accumulation of K and H and to more R&D spending.
 - f. If we interpret K as private capital, then infrastructure affects A (e.g., better transportation networks may make the economy more productive by reducing congestion time).
 - g. Assuming no technological progress, a reduction in population growth implies an increase in the steady-state level of output per worker. A reduction in population growth leads to an increase in capital per worker. If there is technological progress, there is no steady-state level of output per worker. In this case, however, a reduction in population growth implies that output per worker will be higher at every point in time, for any given path of technology. See the answer to problem 6(c).

Explore Further

8. Growth accounting

The appendix to this chapter shows how data on output, capital, and labor can be used to construct estimates of the rate of growth of technological progress. We modify that approach in this problem to examine the growth of capital per worker.

$$Y = K^{1/3} (AN)^{2/3}$$

The function gives a good description of production in rich countries. Following the same steps as in the appendix, you can show that

$$\begin{aligned}(2/3)g_A &= g_Y - (2/3)g_N - (1/3)g_K \\ &= (g_Y - g_N) - (1/3)(g_K - g_N)\end{aligned}$$

where g_Y denotes the growth rate of Y .

- a. The quantity $g_Y - g_N$ is the growth rate of output per worker. The quantity $g_K - g_N$ is the growth rate of capital per worker.
- b. The filled in chart will look (using version 9 of the PWT)

Use rgdpo for output (2011 US dollars); emp number of employees labor input; ck for the capital stock (2011 US dollars)

The share of labor is labsh. These values are copied directly from the PWT Version 9

	Year 2000				Year 2014			
	Y	N	K	Share of Labor	Y	N	K	Share of labor
China	5108341	717.395	11468023	0.599299	17135952	798.3678	69379696	0.567239
United States	13031820	139.2961	35997032	0.6426	16598099	148.4634	52849892	0.603597

The annualized growth rates are (rounded to one decimal place)

China: Output 8.6% Employees 0.8% Capital Stock 12.9%

United States: Output 1.7% Employees 0.5% Capital Stock 2.7%

Since the growth rate of capital in China is much higher than the growth rate of labor, K/N is rising. This is also true in the United States.

Labor's share of output is slightly higher in the United States.

The calculation of the residual is 2.8% in China and 0.4% in The United States.

China has a larger residual. The residual represents growth that is not accounted for by increases in inputs, labor and capital. We usually label this technological growth. It seems surprising that China would have so much higher a rate of "technological growth" than the United States. The appendix gives a hint as to what might be happening. Chinese labor inputs are switching from low productivity jobs to high productivity jobs.

CHAPTER 13

QUICK CHECK

1. a. True.
 b. False. Review Figure 13.1
 c. False. Some workers will always be displaced and must retrain to find work.
 d. True.
 e. False. Mismeasurement can explain only a small part of the decrease in measured productivity growth.
 f. True.
 g. False. General purpose technologies are major innovations that have applications in many fields and many products. They occur very infrequently. Electricity and the internal combustion engine are two examples.
 h. True.

- i. True.
2. a. Reduce the gap, if this leads to an increase in the relative supply of high-skill workers.
 b. Reduce the gap, since it leads to a decrease in the relative supply of low-skill workers.
 c. Reduce the gap, if it leads to an increase in the relative supply of high-skill workers.
 d. Increase the gap, if it leads U.S. firms to hire low-skill workers in Central America, since this reduces the relative demand for U.S. low-skill workers.
 e. This is likely to increase the gap since robots are more likely to displace lower skill workers. It is possible in theory that robots could reduce the price of intermediate goods enough to create more jobs for skilled and unskilled workers.
3. a. When all inputs double (triple) output doubles (triples). This is constant returns to scale

Units of N	Units of K	Units of E	Output
27	125	64	60
54	250	128	120
81	375	192	180

- b. The values of energy inputs are

Units of N	Units of K	Units of E	Output
54	250	128	120
54	375	85.33	120
81	250	85.33	120

- c. The statement is false. Even when the consumption of energy increases from 85.33 (row 2) to 128 (row 1) output stays the same, since the 50 percent increase in energy in this case is accompanied by a 50 percent reduction in capital usage when labor usage remains unchanged.
- d. The words would be that you can substitute capital or labor for energy inputs and either produce the same amount of output with less energy or increase the non-energy factors of production and produce more output. If the price of energy were raised through a tax on carbon emissions, economists would predict that firms would use less energy to produce and more capital and labor.

DIG DEEPER

4. In Chapter 12 the calculations for 2000-2014 showed that

	Year 2000				Year 2014			
	Y	N	K	Share of	Y	N	K	Share of

				Labor				labor
United States	13031820	139.2961	35997032	0.6426	16598099	148.4634	52849892	0.603597

The annualized growth rates are (rounded to one decimal place)

United States: Output 1.7% Employees 0.5% Capital Stock 2.7%

The formula for the rate of growth of technology is the residual $\equiv g_Y - [\alpha g_N + (1 - \alpha)g_K]$ and the rate of technological change from 2000-2014 was 0.4%

From 1985 to 1999:

	Year 1985				Year 1999			
	Y	N	K	Share of Labor	Y	N	K	Share of labor
United States	7860199	111.4718	23116866	0.608186	12510232	137.3371	34374992	0.631764

The annualized growth rates are (rounded to one decimal place)

United States: Output 3.3% Employees 1.5% Capital Stock 2.8%

The formula for the rate of growth of technology is the residual $\equiv g_Y - [\alpha g_N + (1 - \alpha)g_K]$ and the rate of technological change from 2000-2014 was 1.3%

- a. The growth rate of technology between 1985-1999 was dramatically higher than the growth rate of technology from 2000-2014
- b. The description is that the unemployment rate for this group is quite high overall – almost always greater than 10 percent. The rate is very high in the World Economic Crisis from 2009 to 2013 - the average unemployment rate for this group 2009-2013 is 20.9%
- c. Average unemployment rate of this group are

1985-1999: 11.6% 2000-2018: 16.9% 2017-18: 10.7%

For much of the period after 2000, a period of low rates of technological change, the unemployment rate of the low-skilled workforce was higher. It was necessary to look at 2017-2018 because it is apparent that the World Economic Crisis caused both an immediate surge in the unemployment rate of the low skill workers which continued long after the crisis.

5. Technological change has led to a reduction in agricultural employment, but evidently has had no effect on the natural rate of unemployment.

6.
 - a. $W/P = F((1 - N/L), z)$
 - b. Labor supply slopes up. As N increases, u falls for given L , so W/P increases.

- c. $MC = W/MPL$ so $W/P = MPL/(1 + \mu)$
- d. Labor demand slopes down. As N increases, the MPL falls, so W/P falls.
- e. An improvement in technology increases the MPL , so the labor demand curve shifts right. The real wage increases when technology improves.

EXPLORE FURTHER

- 7. a. The data shows that “computer professionals” and “personal care and related workers” are among the top three occupations (in terms of employment growth). While the former can be identified with industries with a strong rate of technological innovation, this is not the case in the latter.
- b. Some declining occupations can be more clearly related to technological change than trade. Messengers, porters, and doorkeepers, for instance, are unlikely to be outsourced elsewhere. For other occupations (such as machine operators), the prevailing causal factor is less clear.
- 8. a. i. Real wages have grown at a much faster rate in Asia than in developed economies: with a base of 100 in 1999, average real wages reached 106.3 in developed economies against 243.3 in Asia.
ii. Growth of real wages in Asia has had very different trends: real wages rose by more than 200% in East Asia (including China) against +52% in South East Asia and the Pacific. Therefore, large intra-regional wage inequality has occurred.
- b. While technological progress may explain the rise in real wages in the region as a whole, it may be especially relevant in understanding the growing wage inequality within the region.
- c. The case of the garment industry suggests that technological progress in an industry employing many unskilled workers may actually benefit these workers in terms of higher real wages, given that, according to the ILO report, “global garment buyers increasingly prioritize productivity and reliability of supply – and they are adverse to the reputational risks of poor working conditions.”
- 9. a. Figure 1 in the text box “The Long View: Technology, Education, and Inequality” shows the 90/10 ratio increasing with data ending around 2000. Figure 13-2 shows a divergence between the relative wages of more educated and less educated persons. Figure 13-3 shows an increasing share of income earned by the top 1% relative to the bottom 50%.
- b. The supply and demand argument is based on the observation that the demand for skilled workers has increased faster than the supply in the period after 1980s.
- c. Here the argument is that the demand for low-skilled workers has fallen due to international competition. More and more goods are being made abroad by low-skilled workers.
- d. In general Democrats favour policies that reduce income inequality and Republicans do

- not perceive income inequality as a major problem,
- e. If incomes of the better educated are rising more rapidly than of the less educated and it is more likely that like-educated persons marry each other, then household income inequality will rise even more than wage inequality. Richer earners will marry richer earners.
10. a. The carbon intensity of output in the United States per dollar of GDP has dropped from 0.8 to 0.3 units.
- b. The five largest emitters per dollar of GDP in 1990 are China, Trinidad and Tobago, Bulgaria, Poland and Romania.
- The five largest emitters per dollar of GDP in 2014 are Trinidad and Tobago, Palau, Turkmenistan, South Africa and the Ukraine.
- There is only one country on both lists.
- c. Here is the reduction in carbon intensity in these countries 1990 to 2014:

Country	1990	2014
China	2.2	0.6
Trinidad and Tobago	1.8	1.0
Bulgaria	1.6	0.3
Poland	1.6	0.3
Romania	1.4	0.2

- You would conclude a reduction in the intensiveness of carbon emissions is possible. To see if total emissions have fallen you would multiply emissions per dollar of GDP in the PWT times the rate of emissions.
- d. For the United States Part (a) showed the carbon intensity of GDP per dollar dropped from 0.8 to 0.3 units. In China emissions per dollar of GDP dropped from 2.2 to 0.6.

Our other uses of the Penn World Tables help us fill in this table

	China	United States
1990 GDP Millions of 2012 PPP dollars	2755448	9203227
2014 GDP Millions of 2012 PPP dollars	17080304	16704698
1990 Kilos of carbon per dollar of real GDP	2.180863	0.806645
2014 Kilos of carbon per dollar of real GDP	0.561283	0.301492

1990 Total Carbon Millions of kilos	6	7.3
2014 Total Carbon Millions of kilos	9.6	5.0

Source: Penn World Tables

CHAPTER 14

Quick Check

1. a. True.
b. True.
c. False. Interest rates change frequently as market conditions change.
d. Uncertain. Bonds typically have a repayment of principal at maturity as well as a constant income stream of interest payments.
e. True.
f. True including an owner renting to herself.
g. True.
h. False. The assets vary in risk
i. False. Bubbles occur when prices are pushed above the expected present value of future returns.
j. False. The stock market is very volatile and can change in price dramatically over one year.
k. Uncertain or true. There may be a lag in the protection.

2. a. Real. Nominal profits are likely to move with inflation; real profits are easier to forecast.
b. Nominal. The payments are nominal.
c. Nominal. Car lease and car loan payments are usually stated in nominal terms.

3. a. exact 2.498% approximate 2.5%
b. exact 5.924% approximate 6.0%
c. exact 2.99% approximate 3.0%

4. a. The equation discounts the first dividend received so it must be received one period in the future.
b. The first component is the discounted value of the expected dividend. The second component imagines the stock is sold in one period. It discounts the expected price of that

- sale. Both payments are received one year from now, so both are discounted.
- c. The price of stock falls today.
 - d. The price of the stock falls today.
 - e. The price of the stock rises today.
 - f. The coefficient on $\$D_{t+3}^e$ is 0.85 and on $\$D_{t+10}^e$ is 0.46. Thus, an expected \$1 increase in a dividend two years hence adds 85 cents to the share price today. An expected one-dollar increase in a dividend 10 years hence adds only 46 cents to the share price today.
- g. The new values are 0.78 and 0.29. Higher discount rates make future events less important.
5. a. $\$V = \$100/0.1 = \$1000$
- b. Since the first payment occurs at the end of the year,
- $$\$V = \$z[(1/i) - (1/i(1 + i)^n)]$$
- 10 years: \$614.46; 20 years: \$851.36; 30 years: \$942.69; 60 years: \$996.72
- c. $i = 2\%$: PV of consol = \$5,000; 10 years: \$898.25; 20 years: \$1,635.14; 30 years: \$2,239.65; 60 years: \$3,476.09
- $i = 5\%$: PV of consol = \$2,000; 10 years: \$772.17; 20 years: \$1,246.22; 30 years: \$1,537.25; 60 years: \$1,892.93
6. a. Very little will happen to stock prices. The present value discount factor for year one will decrease and the stock price will fall slightly.
- b. Now all the discount factors get slightly smaller and the present value of all expected dividends falls resulting in a lower stock price.
- c. The change in stock price will depend on the expected changes in magnitude of future output and future dividends relative to the change in interest rates.

Dig Deeper

7. a. The bond's present value of \$47.23 is higher than the stock's value of \$45.66. Therefore, the investor should choose to invest in bonds.
- b. The lowering of the risk premium on stocks makes the stock more remunerative than bonds, since the present value of the stock goes up to \$49.73.
- c. The present values of both the stock and the bond decline. However, the bond price drops less than the stock price, and the investor will prefer to invest in stocks. Even though both securities undergo a similar decline in interest rates, the decline favors stocks since stock prices incorporate earlier payments (dividends earned in year $t + 1$ and $t + 2$).
8. a. Houses last a long time. Rents are likely to rise with inflation. Real interest rates would

- be better.
- b. Let R_{t+n}^e be the expected real rent on the house. Let Q_{Ht} be the price of a house. We can let x_H be the risk premium on a house. The equation would be
- $$Q_{Ht} = \frac{R_{t+1}^e}{(1+r_{1t}+x_h)} + \frac{R_{t+2}^e}{(1+r_{1t}+x_H)(1+r_{1,t+2}^e+x_H)} + \dots$$
- c. The future rents would be discounted less and the price today would rise.
- d. x_H would decline in value. The discount factors would be less and the price would rise.
- e. Answers will vary.

Explore Further

9. a. This measure did predict the US crash – see the Box “The Increase in US Housing Prices: Fundamentals or Bubble?” which country is currently most overvalued will vary depending on date of access.
- b. The ratio of the house price to income is a sort of measure of the ability to pay the rents on houses - say those rents are a constant proportion of income. If this ratio were way out of its historical norm, this would also predict a crash. This measure also suggested the US housing price crash would occur.
10. a. As of March 2016, the yield curve was clearly upward-sloping, with lower yields for short-term bonds (or bills) than for long-term bonds. This reflects a “normal” relationship between bond maturities and yield, that is, the lower the maturity, the lower the yield (because of lower risk).
- b. As of March 2015, the yield curve for Japan was also upward-sloping and sharper than it was a year later. In other words, the yield curve slightly flattened in Japan over that period. This might have reflected worsening expectations on the part of economic agents.

CHAPTER 15

Quick Check

1. a. False. Human wealth for a college student will be much higher since they have their entire working life ahead of them.
- b. False. Consumption does appear to depend somewhat on expected future income.
- c. True.
- d. False. Buildings only depreciate about 2.5% per year while equipment depreciates at a rate of 15% or more.
- e. False. A higher Tobin’s q corresponds to higher investment.
- f. False. Figure 15-3 shows that investment and current profit are strongly related.
- g. True.

- h. True. The percentage change in investment is larger, but the absolute size of consumption is much bigger, so total changes in consumption and investment are of similar magnitude.
2. a. Lucy's human wealth and total wealth amount to €149,960. Adam's human wealth and total wealth are €96,403 and €146,403, respectively.
 b. Lucy's permanent consumption level is €49,987. Adam's is €48,801.
 c. An increase in taxation would decrease Lucy and Adam's human wealth and therefore their consumption levels. Lucy's total wealth and permanent consumption would decline to €139,248 and €46,416 respectively. Adam's total wealth and permanent consumption would decline to €139,517 and €46,506 respectively.
 d. This would increase Lucy's human wealth by 8% each year or 26% in three years.
 As the permanent income theory shows, Lucy's consumption level would grow.
3. a. The hospital must make a trade-off between its investment projects and take into account the necessary balance of its budget. So, as the present value of the expected revenues from this equipment is €833,333 below its actual cost, it must choose another investment.
 b. The expected present value of future revenues would rise to €1,000,000. The investment would carry neither a net loss nor a net profit. The hospital may decide to invest in the hope that future revenues may be slightly higher-than-expected profits.
4. a. If you do attend the course, you will work for a total of 36 years and if you do not attend it you will work for 38 years. With 40% taxes, the maximum you should be willing to pay to attend the course is
- $$\begin{aligned}
 & 1,650,000 \text{ KRW} (1 - 0.4)36 - 1,500,000 \text{ KRW} (1 - 0.4)38 \\
 & = 35,640,000 \text{ KRW} - 34,200,000 \text{ KRW} \\
 & = 1,440,000 \text{ KRW}
 \end{aligned}$$
- b. If you pay 30% in taxes, the maximum you should be willing to pay to attend the course is
- $$\begin{aligned}
 & 1,650,000 \text{ KRW} (1 - 0.3)36 - 1,500,000 \text{ KRW} (1 - 0.3)38 \\
 & = 41,580,000 \text{ KRW} - 39,900,000 \text{ KRW} \\
 & = 1,680,000 \text{ KRW}
 \end{aligned}$$

Dig Deeper

5. a. The EPDV of future labor income = €30.
 Consumption = €10 in all three periods.
 b. Youth: -5
 Middle age: 15
 Senior: -10
 c. Total savings = $n(-5 + 15 - 10) = 0$
 d. $0 - 5n + 10n = 5n$
6. a. Youth: 5
 Middle age: 12.5

Old age: 12.5

The consumer cannot borrow against future income when young.

- b. $0 + 12.5n - 12.5n = 0$
- c. $0 + 0 + 12.5n = 12.5n$
- d. By allowing people to borrow in youth, financial liberalization may lead to a decrease in overall capital accumulation.

7. a. The expected value of earnings during middle age is $0.5(\text{€}40,000 + \text{€}100,000) = \text{€}70,000$.
The EPDV of lifetime earnings = $\text{€}20,000 + \text{€}70,000 = \text{€}90,000$.
The consumption plan is $\text{€}30,000$ per year.
The consumer will save $-\text{€}10,000$ (i.e., the consumer will borrow $\text{€}10,000$) in the young period.
- b. In the worst case, the EPDV of lifetime earnings = $\text{€}60,000$.
Consumption = $\text{€}20,000$ and savings = 0 in the first period of life.
Consumption is lower than part (a), and saving is higher.
- c. Consumption in the first period is $\text{€}20,000$. In the second period it is $\text{€}50,000$. In the third period it is $\text{€}50,000$.
Consumption will not be constant during the consumer's lifetime.
- d. The uncertainty leads to higher saving by consumers in the first period of life.

Explore Further

8. a. Capital formation is by far the most volatile rate. When they face some constraints, the economic actors first delete future projects. When the economic situation improves, they attempt to compensate. The second explanation is that most investment cannot be split.
- b. If we compare the variation between consumption and capital formation the ratio has been more stable in Argentina than in Brazil (except in the year 2012)
9. a. The consumer confidence index is more volatile.
- b. These two regions have the same depressed reactions before the financial crisis and a similar pattern of recovery during the years after, but with more fluctuation in consumer confidence in China.
- c. The correlation between consumer confidence and consumption does not seem to be very strong, as consumers did not decrease their purchases during the crisis. In China, the fluctuation of consumer confidence did not affect the steady growth of consumption. On the other hand, the correlation between business confidence and the production growth is strong. This difference can be explained as the permanent revenue theory assumes that consumption is rigid and changes only after many years of different conditions.

CHAPTER 16

Quick Check

1.
 - a. False. Changes in the current real policy rate have limited impact on spending.
 - b. False. The *IS* curve gets steeper.
 - c. True.
 - d. True/Uncertain. If consumers include information about future fiscal policy, for example future tax rates, then expectations about future fiscal policy could affect consumption.
 - e. False. Expected changes in tax rates or deficit reduction do appear to impact current economic activity.
 - f. True.
 - g. False. The evidence is mixed on whether deficit reduction leads to output expansion.
 - h. False. The net effect of the fiscal consolidations was contractionary.
2.
 - a. Communication has been essential for central banks for some years now. As Mario Draghi said in a 2014 speech, “Communication and transparency have become more important for central banks like the ECB in recent decades and will become even more important in the decades to come. A transparent central bank is not only more accountable, but also more effective in implementing its monetary policy. If the general public and financial markets can understand how the ECB is likely to respond in a given situation – it’s so-called “reaction function” – they can form reasonable expectations about future monetary policy. This in turn gives the ECB the capacity to influence interest rates at longer maturities and steer broader financial and economic conditions.”
<https://www.bis.org/review/r140424b.pdf>
 - b. The ECB is entitled to only manage the inflation rate and not the general state of the economy, especially not growth and unemployment rates. When Draghi speaks outside the frame of the Central Bank, he can deal with the general state of the economy but when he speaks for the ECB, he can only mention monetary policy measures and goals.
 - c. The monetary measures presented are intended to ease the financing of the economic recovery and to boost growth and lower unemployment.
3.
 - a. The *IS* curve shifts right.
 - b. The *LM* curve shifts up.
 - c. There are three effects. First, an increase in expected future taxes tends to reduce expected future after-tax income (for any given level of income), and therefore to reduce consumption. This effect tends to shift the *IS* curve to the left.
Second, the increase in future taxes (a deficit reduction program) would require that the central bank reduce the real policy rate so that output returns to potential. At the lower real policy rate, there is more investment. More investment might, in the very long run, increase the level of potential and actual output. This could increase wealth (the expected present discounted value of future output) and thus shift the *IS* back, even in the short run.

The net effect on the *IS* curve is ambiguous. Note that the model in the text has lump sum taxes. If taxes are not lump sum, the tax increase may increase distortions in the economy. These effects tend to reduce output (or the growth rate of output). So, the size of any increase in potential output could be affected by the mix of taxes chosen.

- d. The *IS* curve shifts to the left.
4. Rational expectations may be unrealistic, but it does not imply that every consumer has perfect knowledge of the economy. It implies that consumers use the best available information—models, data, and techniques—to assess the future and make decisions. Moreover, consumers do not have to work out the implications of economic models for the future by themselves. They can rely on the predictions of experts on television or in the newspapers. Essentially, rational expectations rule out systematic mistakes on the part of consumers. Thus, although rational expectations may not literally be true, it seems a reasonable benchmark for policy analysis.
5. The answers below ignore any effect on capital accumulation and output in the long run. Assume the tax cut policy in the future is temporary, so we need only worry about future short-run effects.
 - a. The effect on current output is fairly clear. The tax cut in the future leads to higher expected future income at the same interest rate. Wealth and consumption rises today. The *IS* curve shifts right and the *LM* curve remains unchanged. Current output rises. Here it is unclear whether the Fed is expected to increase future interest rates to return output to its original level. If this is the case, then the rightward shift in *IS* will be smaller and the increase in current output will be smaller.
 - b. This means that the Fed will increase the interest rate in the future (shift the *LM* curve up) so that actual output remains at the same level. The *IS* curve would still shift right but the *LM* curve shifts up so the intersection is at the same level of income. The higher interest rate reduces investment by the same amount that the decrease in expected future taxes increases consumption.
 - c. The contrast here is to part (a). If the Fed explicitly commits to no change in current and future real interest rates, then the *IS* shifts right with the decrease in expected future taxes. There is no leftward shift associated with a potential increase in real interest rates to return output to its original level.
6.
 - a. The main reason was to restore the confidence of foreign investors, as well as to stay in control of the economy.
 - b. The international community expects the economies to be well managed.
 - c. The fiscal deficit is the main signal a government can give.
 - d. If they want to keep their “freedom to operate”, developing countries should avoid an excessively large debt and be as balanced as possible.

Dig Deeper

7. a. Future interest rates will tend to rise. Future output will tend to fall. Both effects shift the *IS* curve to the left in the present. Current output and the current interest rate fall. The yield curve has a larger positive slope after the announcement.
- b. No.
- c. Compared to original expectations, the nominee is expected to follow a more expansionary monetary policy. The slope of the yield curve will have a lower positive slope after the announcement.
- d. If you download the daily stock price data - there is little change in the Dow Jones. There is a slight decline in bond yields after the nomination. You might interpret that to say expected inflation was stable or falling on the nomination. Since neither stock nor bond prices in financial markets did not change much, this is a hint that the nomination was not a surprise or at least did not shake up financial markets.

Explore Further

8. a. The fiscal deficit of OECD countries decreased from 6.2% to 2.5%, the rate of growth remained steady at around 2%, and unemployment decreased from 8.5% to 6.2%. Consumer confidence increased steadily but business confidence fluctuated. So, we may conclude that the fiscal consolidation for OECD countries has been successful between 2010-2018, as there has been no slowdown in growth and unemployment has gone down. The robustness of consumer confidence seems to have offset the fluctuation of business confidence. However, the situation in Europe is less appreciable as unemployment remains high.
- b. The general decrease in interest rates, long and short (and the “nonconventional” monetary policy), has supported the recovery. However, at the same time, the constant low level of interest rates has placed the responsibility for rebalancing the economy mainly on fiscal policy and structural policies.
- c. Answers will vary.

CHAPTER 17

Quick Check

1. a. True.
- b. False. $GDP = C + I + G + (\text{exports} - \text{imports})$ so imports exceeding GDP is possible, but not likely.
- c. False. Not necessarily. It could simply be due to product preferences.
- d. False. It implies that FX will adjust to make returns equivalent.
- e. False. It is the price of the domestic currency in terms of the foreign currency.
- f. False. Differences in inflation rates can cause movements in opposite directions.
- g. True
- h. False. The domestic rate must equal the foreign rate minus the expected appreciation of

- the domestic currency.
- i. False. The statement should read: “Given the definition of the exchange rate adopted in this chapter, if the dollar is the domestic currency and the euro the foreign currency, a nominal exchange rate of 0.75 means that one dollar is worth 0.75 euros.”
 - j. False. Domestic goods become relatively more expensive.

2. **Domestic Country Balance of Payments (\$)**

Current Account

Exports	25
Imports	100
Trade Balance	-75 (= 25 - 100)
Investment Income Received	0
Investment Income Paid	15
Net Investment Income	-15 (= 0 - 15)
Net Transfers Received	-25
Current Account Balance	-115 (= 75 - 15 - 25)

Financial Account

Increase in Foreign Holdings of Domestic Assets	80 (= 65 + 15)
Increase in Domestic Holdings of Foreign Assets	-50
Net Increase in Foreign Holdings	130 (= 80 - (-50))
Statistical Discrepancy	-15 (= 115 - 130)

Foreign Country Balance of Payments (\$)

Current Account

Exports	100
Imports	25
Trade Balance	75 (= 100 - 25)
Investment Income Received	15
Investment Income Paid	0
Net Investment Income	15 (= 15 - 0)
Net Transfers Received	25
Current Account Balance	115 (= 75 + 15 + 25)

Financial Account

Increase in Foreign Holdings of Domestic Assets	-50
Increase in Domestic Holdings of Foreign Assets	80 (= 65 + 15)
Net Increase in Foreign Holdings	-130 (= 50 - 80)
Statistical Discrepancy	15 (= 130 - 115)

- 3.
- The nominal return on the Brazilian bond is $10,000/(9,630) - 1 = 3.84\%$.
The nominal return on the Turkish bond is 5.82%.
 - Uncovered interest parity implies that the expected exchange rate is given by $E(1 + i^*)/(1 + i) = 0.79(1.0582)/(1.0384) = 0.805 \text{ TRY/BRL}$.
 - If you expect the Brazilian real to depreciate, purchase the Turkish bond since it pays a higher interest rate and you expect a capital gain on the currency.
 - The Brazilian real depreciates by 5.06%, so the total return on the Turkish bond (in BRL) is $5.82\% + 5.06\% = 10.88\%$. Investing in the Brazilian bond would have reaped a 3.84% return.
 - The uncovered interest parity condition is about equality of expected returns, not equality of actual returns.

Dig Deeper

- 4.
- GDP is 15 in each economy. Consumers will spend 5 on each good.
 - Each country has a zero trade balance. Country A exports clothes to Country B, Country B exports cars to Country C, and Country C exports computers to Country A.
 - No country will have a zero trade balance with any other country.
 - There is no reason to expect that the United States will have balanced trade with any particular country, even if the United States eliminates its overall trade deficit. A particularly large trade deficit with one country may reflect the pattern of specialization rather than trade barriers.
- 5.
- The relative price of domestic goods falls. Relative demand for domestic goods rises. The domestic unemployment rate falls in the short run.
 - The price of foreign goods in terms of domestic currency is P^*/E . A nominal depreciation (a fall in E) increases the price of foreign goods in terms of domestic currency. Therefore, a nominal depreciation tends to increase the CPI.
 - The real wage falls.
 - Essentially, a nominal depreciation stimulates output by reducing the domestic real wage, which leads to an increase in domestic employment.

Explore Further

6.
 - a. We are treating the United States as the domestic country when E is expressed as the number of foreign units (yen) per dollar.
 - b. Considering the evidence through 2018, the yen generally appreciated against the dollar from mid-1985 to mid-1995 from 1995 to 2007, dramatic changes were less. From 2007 to 2011 there was a 32% appreciation followed by a similar depreciation to 2012. , From 2012 to 2018 (the date at the time of writing there was an appreciation of the yen from 79 yen per US dollar to 110 yen per US dollar
 - c. Depreciation of the yen.
 - d. The appreciation from 2012 to 2018 would not help the Japanese recover from their continuing slump.
7.
 - a. These answers are based on the World Economic Outlook published in April 2019. Your answers may vary if subsequent years are used. The sum of world current account balances should be zero. In 2018 (and all previous years), the sum was positive, which implies literally that the world as a whole was borrowing. Obviously, this cannot have been true.
 - b. In 2018, the United States was the world's biggest borrower by far. The rest of the advanced economies as a whole were lenders. The Euro area was a lender in 2018. The economies of the Middle East and developing economies in Asia were other large lenders. The emerging economies of central and eastern Europe, India and Latin America were large borrowers.
 - c. In 2018, the total saving of the advanced economies including the United States was \$371.9B. The US was dissaving by \$468.8 B. Thus, the advanced economies in total were saving and lending to the rest of the world, that is, the total saving in the advanced economies was positive, more than enough to cover US dissaving and still lend to the rest of the world.
 - d. The projections in the October 2018 World Economic Outlook from 2018 to 2024 do not suggest much change. The most interesting observation is that the United States will move further and further into current account deficit, at least measured in current dollars.
8.
 - a. World saving essentially equals world investment, so it must be logically true.
 - b. In 2014, the United Kingdom's saving was 11.9% of GDP, but its investment was 17.8% of GDP. The United Kingdom financed the difference by borrowing from abroad.
 - c. For most countries, GNP and GDP differ insignificantly. Whether GNP is higher or lower than GDP depends on the ratio of domestic to foreign manufacturers in a country. China's GDP is slightly higher than its GNP due to the large number of foreign companies manufacturing in the country. Germany's GNP is higher than its GDP because of its massive investments in foreign nations.

CHAPTER 18

Quick Check

1.
 - a. False. It would appear that the current account deficit in Greece fell as output and imports fell. There would be less consumption in Greece and the average citizen would be worse off.
 - b. False. An increase in the budget deficit will lead to an increase in the trade deficit, but we can't conclude that from the national income accounting identity. We have to use our model to make that prediction.
 - c. False. An increase in spending will now be spread between domestic and foreign goods.
 - d. True.
 - e. True.
 - f. True
 - g. False - when Greece chose to share the Euro currency with its trading partners it made a real devaluation more difficult since prices and wages adjust more slowly than nominal exchange rates.
 2.
 - a. There is a real appreciation over time. Over time, the trade balance worsens.
 - b. The domestic currency depreciates at the rate of $\pi - \pi^*$.
 3.
 - a. The share of European spending on U.S. goods relative to U.S. GDP is $(0.19)(0.123) = 2.3\%$.
 - b. U.S. GDP falls by $2(0.05)(0.023) = 0.23\%$.
 - c. U.S. GDP falls by $2(0.05)(0.123) = 1.23\%$.
 - d. This is an overstatement. The numbers above indicated that even if U.S. exports to Europe fall by 50% (a huge amount), the effect is to reduce GDP by $0.5 \times 2.3\% = 1.15\%$. Exports falling by 50% would be a huge amount.
 4. You will need to follow the text. For the upper right corner of Table 18-1, The level of output is lower than desired, and the net exports are positive. Your goal is to increase output and have a zero trade deficit. If you increase government spending, output rises and the trade surplus falls but remains positive. But it may not fall all the way to zero, if it stops short of zero, you will appreciate your currency. This will decrease net exports. You would then have to increase your increase in government spending. You can make choices until you hit a desired level of output and have a zero trade deficit. However, it is possible that your increase in government spending actually moved the trade surplus from positive to negative. Then you would have to depreciate your currency. This is the source of the ? next to ϵ .
- You repeat this type of analysis for every quadrant.

Dig Deeper

5. a. The ZZ and NX lines shift up. Domestic output and domestic net exports increase.
- b. Domestic investment will increase because output increases. Assuming taxes are fixed and do not respond to income, there is no effect on the deficit.
- c. $NX = S - I + T - G$. Since the budget deficit is unchanged, and I and NX increase, S must increase.
- d. Except for G and (for our purposes) T , the variables in equation (18.5) are endogenous. An exogenous shock such as an increase in foreign output can affect all of the endogenous variables simultaneously.
6. a. There must be a real depreciation.
- b. $Y = C + I + G + NX$. If NX rises while Y remains constant, $C + I + G$ must fall. The government can reduce G or increase T , which will reduce C .
7. a.
$$Y = C + I + G + X - IM$$
- $$Y = c_0 + c_1(Y - T) + d_0 + d_1Y + G + x_1Y^* - m_1Y$$
- $$Y = [1/(1 - c_1 - d_1 + m_1)] [c_0 - c_1T + d_0 + G + x_1Y^*]$$
- b. Output increases by the multiplier, which equals $1/(1 - c_1 - d_1 + m_1)$. The condition $0 < m_1 < c_1 + d_1 < 1$ ensures that the multiplier is defined, positive, and greater than one. As compared to the original multiplier, $1/(1 + c_1)$, there are two additional parameters: d_1 , which captures the effect of an additional unit of income on investment, and m_1 , which captures the effect of an additional unit of income on imports. The investment effect tends to increase the multiplier; the import effect tends to reduce the multiplier.
- c. When government purchases increase by one unit, net exports fall by $m_1\Delta Y = m_1/(1 - c_1 - d_1 + m_1)$. Note that the change in output is simply the multiplier.
- d. The larger economy will likely have the smaller value of m_1 . Larger economies tend to produce a wider variety of goods, and therefore to spend more of an additional unit of income on domestic goods than smaller economies do.
- e.
- | | <u>ΔY</u> | <u>ΔNX</u> |
|-------------------------------|------------------------------|-------------------------------|
| small economy ($m_1 = 0.5$) | 1.1 | 0.6 |
| large economy ($m_1 = 0.1$) | 2 | 0.2 |
- f. Fiscal policy has a larger effect on output in the large economy, but a larger effect on net exports in the small economy.
8. a. It is convenient to wait to substitute for G until the last step.

$$Y = C + I + G + X - IM = 10 + 0.8(Y - 10) + 10 + G + 0.3Y^* - 0.3Y$$

$$Y = [1/(1 - .8 + .3)](12 + G + 0.3Y^*) = 2(12 + G + 0.3Y^*) = 44 + 0.6Y^*$$

When foreign output is fixed, the multiplier is 2 ($=1/(1-0.8+0.3)$). The closed economy multiplier is 5 ($=1/(1-0.8)$). In the open economy, some of an increase in autonomous expenditure falls on foreign goods, so the multiplier is smaller.

- b. Since the countries are identical, $Y = Y^* = 110$. Taking into account the endogeneity of foreign income, the multiplier equals $[1/(1 - 0.8 - 0.3 \cdot 0.6 + 0.3)] = 3.125$. The multiplier is higher than the open economy multiplier in part (a) because it takes into account the fact that an increase in domestic income leads to an increase in foreign income (as a result of an increase in domestic imports of foreign goods). The increase in foreign income leads to an increase in domestic exports.
- c. If $Y = 125$, then $Y^* = 44 + 0.6(125) = 119$. Using these two facts and the equation $Y = 2(12 + G + 0.3Y^*)$ yields $125 = 24 + 2G + 0.6(119)$, which implies $G = 14.8$. In the domestic economy, $NX = 0.3(119) - 0.3(125) = 1.8$ and $T - G = 10 - 14.8 = -4.8$. In the foreign economy, $NX^* = 1.8$ and $T^* - G^* = 0$.
- d. If $Y = Y^* = 125$, then $125 = 24 + 2G + 0.6(125)$, which implies $G = G^* = 13$. In both countries, net exports are zero, but the budget deficit is 3.
- e. In part, fiscal coordination is difficult to achieve because of the benefits of doing nothing and waiting for another economy to undertake a fiscal expansion, as indicated from part (c).

Explore Further

9. a. Current Account Balance = $NI + NT + NX = \text{National Saving} - I$.
 b. Answers will depend on the data retrieved by students.
 c. The current account deficit has decreased substantially over the three periods, whereas gross domestic investment has slightly decreased. The decrease in the current account deficit may be due to higher export levels. The decline in investment as a percentage of GDP may indicate that domestic consumption as a percentage of GDP has increased in comparison to investment.
 d. A trade deficit is not a problem in its own right. It is a symptom of a problem, namely, low national saving. If national saving is low, a reduction in the trade deficit would mean that domestic investment would need to fall to the low level of national saving. Therefore, it would be good if the trade deficit was to disappear while accompanied by an increase in national saving.

	2001–2005	2006–2010	2011–2015
Current Account Balance	-\$91,471,245,846	-\$49,225,968,929	-\$31,288,847,935
GDP	\$1,831,781,515,472	\$1,861,801,615,478	\$2,048,517,438,874
Current Account Deficit/GDP (%)	5%	2.64%	1.53%

Gross Domestic Investment (% of GDP)	37%	32%	32%
--------------------------------------	-----	-----	-----

- e. GNP (Gross National Product) takes into account net income receipts from abroad. The difference between GNP and GDP has improved during the period 2006-2010, but deteriorated during the period 2011-2015. This indicates that net income receipts from abroad has decreased, mainly due to the fact that Indian investment abroad has outpaced the rate of growth of GDP.

	2001–2005	2006–2010	2011–2015
Gross Domestic Product	\$1,831,781,515,472	\$1,861,801,615,478	\$2,048,517,438,874
Gross National Product	\$1,892,548,379,524	\$1,952,846,538,427	\$2,027,963,806,700
GNP-GDP	\$60,766,864,052	\$91,044,922,949	\$-20,553,632,174

CHAPTER 19

Quick Check

1.
 - a. False. Interest rate parity means expected and current exchange rates will adjust to equate returns in countries.
 - b. True.
 - c. True.
 - d. True.
 - e. True.
 - f. False. An increase in the domestic interest rate leads to an increase in the exchange rate and makes goods in the domestic country more expensive to trading partners and lowers exports.
 - g. False. Fiscal expansion increases domestic output and creates a larger trade deficit.
 - h. Uncertain. It depends on the policy response of the central bank under flexible exchange rate when the fiscal policy is changed. Under the flexible regime, the central bank may choose to leave the interest rate at its original value. In this case, fiscal policy has the same effects under fixed and flexible rates since the central bank is acting to keep the exchange rate at the original value
 - i. True (up to a possible risk premium)
 - j. True - countries do engage in trade wars where after one country increases its tariffs to try to reduce imports, the trading partner imposes tariffs in retaliation.
2. The appropriate mix is a cut in interest rates (shift the LM curve down) to lessen the value of the currency (and thereby to improve the trade balance) and a fiscal contraction (shift the IS curve to the left). If this is done correctly, the level of output will be unchanged and the trade balance will be less negative as net exports increase due to the depreciation of the currency. There would be

more exports due to the depreciation and fewer imports (at the same level of income) due to the depreciation.

3.
 - a. Consumption increases because output increases. Investment increases because output increases and the interest rate falls.
 - b. A monetary expansion has an ambiguous effect on net exports. The nominal depreciation tends to increase exports and reduce imports at the same level of income, but the increase in output tends to increase imports. While we would normally expect net exports to increase, you can construct cases where the marginal propensity to import is so large, net exports could fall.
4.
 - a. The *IS* curve shifts right, because net exports tend to increase as foreign output rises. Domestic output increases if the central bank leaves the interest rate unchanged (the *LM* curve does not shift). The exchange rate will be unchanged
 - b. When the foreign interest rate rises, at the same domestic rate of interest, the domestic interest rate is relatively lower. The *UIP* curve will shift in so that the domestic currency depreciates. Note that the *IS* curve also contains a term in the foreign interest rate. The higher foreign interest rate, at the same domestic interest rate, will depreciate the domestic currency and increase net exports. The *IS* curve will shift out. Domestic output rises when the foreign country tightens its monetary policy. One cautionary note (see below) is that the tighter foreign monetary policy could reduce foreign output and thus decrease foreign imports (our exports).
5.
 - a. The increase in both Y^* and i^* shifts the *IS* curve to the right. At the same domestic interest rate, the domestic currency depreciates and net exports rise. The increase in Y^* directly increases net exports. Output will rise for both reasons. The *UIP* curve will shift left – at the same domestic interest rate and a higher foreign interest rate, the currency will depreciate.
 - b. If the domestic central bank matches the increase in foreign interest rates then although the *UIP* curve shifts left, the central bank increases the domestic interest rate so that the exchange rate remains unchanged. However, the effect of Y^* on exports, net exports remains in play. So the *IS* curve will shift to the right. It is not clear whether domestic output will rise or fall. It will tend to rise as the *IS* shifts right. Domestic output will tend to fall as you move up the new *IS* curve with a higher interest rate.
 - c. The required domestic monetary policy change will depend on the effect on domestic output found in part (b). if the net effect of the increase in Y^* and the increase in i (and i^*) was to increase output, the domestic central bank would have to raise interest rates to leave output unchanged, this would appreciate the exchange rate. This policy might become necessary if domestic output had risen above potential output and there were worries about inflation.

However, it could be the case that the combined effect of the increase in Y^* and the increase in i and i^* reduced domestic output and increased unemployment so output was less than potential. Then the domestic central bank would have to lower interest rates.

Dig Deeper

6. a. The follower country must immediately raise interest rates to match the increase in interest rates in the leader country. Output would fall as you move up the IS curve. Assuming the expected exchange rate does not change, there is no change in the current exchange rate as long as increases in i^* are matched exactly by increases in i .
- b. The movement up the IS curve reduces output by reducing investment.
- c. The follower country could use fiscal policy to shift the IS curve out and increase output back to its original level at the higher rate of interest. It would be desirable if the decline in output due to the leader country's increase in interest rates moved output below potential output.
- d. The fiscal policy that leaves consumption unchanged would have to leave output at the original level and taxes at their original level. Thus a fiscal policy that only increased government spending would work to leave consumption unchanged. When government spending rises, investment spending falls because the interest rate has increased.
7. a. In the short run, a decline in consumer confidence will lower consumption and raise private saving at any level of income, causing the IS curve to shift to the left, moving the aggregate demand to the left, and lowering prices and output. Output falls, the interest rate falls, and the currency depreciates. Currency depreciation tends to increase output by increasing net exports. Therefore, the exchange rate movement dampens the effect of the fall in consumer confidence.
- b. The IS curve shifts rightward as foreign investment increases. The IS curve shifts right, because the increase in i^* tends to create a depreciation of the domestic currency and therefore an increase in net exports. Domestic output increases. The interest parity line also shifts up.
- c. Output falls more under fixed exchange rates than under flexible exchange rates. When the exchange rate is flexible, movements of the exchange rate tend to dampen the output effects of IS shocks. The currency depreciates when the IS curve shifts left and appreciates when the IS curve shifts right. Flexible exchange rates also automatically match domestic inflation with foreign inflation. However, the main disadvantage of flexible exchange rates is their excess volatility. In the post-Bretton Woods era, one of the characteristics of flexible exchange rates is their volatility.

Explore Further

8. a. $E_t = E_t^e + 1(1 + i_t + x)/(1 + i^*t + 1)$
- b. The IS curve slopes down as before, but with the result in part (a) substituted for the nominal exchange rate in the NX function.
- c. The uncovered interest parity condition states that under risk neutrality and perfect substitutability between home- and foreign-currency denominated assets, the interest rate differential should be equivalent to the expected depreciation (or appreciation) of the exchange rate. If the foreign currency has a higher interest rate its exchange rate will appreciate. If the interest rate increases, the output and the net exports will decrease. The

- appreciation causes an upward shift on the UIP curve, an upward shift on the LM curve, and a rightward shift on the IS curve.
- d. The expansionary monetary policy leads to a decrease in the interest rate and thus a decrease in the exchange rate. The lower interest rate increases the demand and the output, while the depreciation of the exchange rate increases the exports. So both effects move in the same direction. However, this policy may cause a level of inflation that will wipe off these positive impacts.
 - e. An increase in x means that domestic assets are more in demand and tends to push up the exchange rate for the same asset price, thus preventing depreciation. This increase in the exchange rate shifts the equilibrium point on the IS curve to the left.
9. a-b. Answers to this question could vary substantially depending upon movements of the dollar. According to data in *The Economist* on April 13, 2019, the dollar was expected to depreciate against the pound, Euro and Canadian dollar over the 10-year period (US 10-year bond yields were higher than rates in those three countries) and appreciate against the Chinese and Mexican currencies (US 10-year bond yields were lower than 10-year bond yields in China and Mexico)
- c. The largest interest rate gap in the 10-year bond yields above was between the Mexican rate (8%) and the US rate (2.5%). This implies an expectation that there will be a significant depreciation of the peso. This is a nominal depreciation – which would be needed if Mexico has higher inflation than the United States. In the data from the same issue of *The Economist*, inflation in the United States was forecast to be 2.2% in 2019 while inflation in Mexico was forecast to be 4.1%. If that large difference were expected to persist over the decade, it would account for the large difference in bond yields between the United States and Mexico
10. You will have many search results. You should find that China did raise tariffs on US exports to China. Stories also seemed to cover how the Trump tariffs raised prices for imported goods paid by American consumers. The tariffs were not a large enough factor to move the level of real GDP very much at the time of writing

CHAPTER 20

Quick Check

1. a. False. Real exchange rates could change as the relative price levels change.
- b. False. Inflation rates are independent of whether a currency floats or is fixed.
- c. False. A devaluation is a decrease in the nominal exchange rate.
- d. True. Britain returned to the gold standard at an exchange rate in terms of gold that overvalued the pound
- e. True.
- f. True (unless the exchange rate is fixed)
- g. True
- h. False. Keeping a fixed exchange rate can be very costly.
- i. False. There has been some labor mobility within Europe but less than expected.
- j. False or Uncertain. Currency boards are specific to a country's economic circumstances

- and have had mixed success.
2.
 - a. The $(i^* - \pi^e)$ is the real interest rate in the domestic country. The foreign nominal interest rate and the domestic nominal interest rate are the same value in a fixed exchange rate regime.
 - b. The term $\frac{EP^*}{P}$ is the real exchange rate. An increase in this value is an appreciation and the appreciation reduces demand for domestic goods. The IS curve shifts left.
 - c. The real exchange rate is appreciating as P is rising more quickly than P^* . Domestic inflation is 3% per year and foreign inflation is 2% per year. Between period 1 and period 5, the IS curve shifts left.
 - d. The real exchange rate is depreciating as P^* is rising more quickly than P . Domestic inflation is 2% per year and foreign inflation is 3% per year. Between period 1 and period 5, the IS curve shifts right.
 - e. The real exchange rate is depreciating as P^* is rising more quickly than P . Domestic inflation is 2% per year and foreign inflation is 3% per year. Between period 1 and period 5, the IS curve shifts right.

 3.
 - a. If the foreign economy is always in medium run equilibrium, then foreign income is at the natural level and foreign inflation is constant.
 - b. When both economies are in medium run equilibrium, they will share the same value of inflation at the anchored level $\bar{\pi} = \bar{\pi}^*$.
 - c. The key feature of the diagram will be that the domestic country will be in short run equilibrium where the actual level of output Y will be less than the natural rate of output Y_n . To return to a medium run equilibrium, inflation in the domestic country will be less than $\bar{\pi}$ for a prolonged period. As this occurs, the real exchange rate will gradually depreciate, and the IS curve will shift right.
 - d. Start with the same diagram as in part c. Immediately devalue so the real exchange rate falls and the IS curve shift right. The economy returns to full employment immediately.
 - e. The devaluation means that the return on the domestic bonds over the devaluation was much lower than the return on the foreign bonds over the devaluation. It is hard to know if the bondholders will believe the devaluation is one-time only. If they believe another devaluation is imminent, domestic interest rates will be higher than foreign interest rates.

 4.
 - a. The domestic interest rate in period 1 will be the foreign interest rate = 3%.
 - b. The domestic interest rate in period 2 will be the foreign interest rate = 3% plus the expected rate of depreciation = 10% for a total of 13%. This continues into period 3.
 - c. The resolution of the crisis in period 4 occurs when beliefs change about the expected future exchange rate. The peg becomes credible.

- d. The domestic interest rate has to rise to 23% to maintain uncovered interest rate parity. It only rises to 15%. Foreign exchange reserves would fall in this case.
 - e. There is devaluation from period 5 to period 6. The expected exchange rate equals the actual exchange rate at the new lower level. It may be difficult for the government and central bank to convince bondholders that they will never devalue again when they just did.
5. a. There must have been a change in the expected exchange rate in the future.
- b. The headline does make sense. From an American perspective, halfway through a 30-day holding period, foreign (European) interest rates are expected to fall. This makes the denominator of expression (20.5) smaller and the value of the exchange rate larger. This is an appreciated dollar and is consistent with the words “dollar rises.”
- c. The headline does make sense. Using Expression (20.5), the markets appeared to learn that American interest rates will be lower longer than they had expected. Thus, the numerator of (20.5) falls and the value of the expression falls and the dollar falls.
- d. In expression (20.5), the current account announcement affects the last term, the expected value of the exchange rate in the future. A larger deficit implies more debts to be repaid and the need for a lower real and nominal exchange rate.

Dig Deeper

6. a. The vertical axis is an index of each country's nominal exchange rate against the German currency. All exchange rates are set to 1 in January 1992. The largest depreciation appears to be Sweden of about 25%. France had the smallest depreciation - essentially of zero.
- b. France.
- c. The group at the bottom – Sweden, Italy, Finland and Spain – had the largest depreciations so the question implies they were the most overvalued.
7. a. We redefine the exchange rate so that they are, from the point of view of Canada and Mexico, the number of foreign currency units bought with a unit of domestic currency. An appreciation of the currency makes this a bigger number and a depreciation a smaller number. FRED presents the exchange rates in the opposite way, that is, treats the United States as the domestic country.
- b. There is a very brief period where the peso is fixed to the dollar from March 1994 to November 1994. When the peg was released the peso depreciated (the US dollar appreciated) Following the sharp appreciation in late 1994, the exchange rate (US cents per peso) gradually moved from 15 US cents to 5 US cents per peso. This is a nominal depreciation. There is a substantial appreciation in real terms that peaks around 2002. Mexican inflation must have been higher than American inflation for that period. After 2002 there is a real depreciation of the peso, from a peak value of the FRED index of 130 in 2002 to about 80 in 2018. Such a real depreciation would increase Mexican exports to the United States and reduce Mexican imports from the United States. The nominal

depreciation of the peso in the same period was from about 10 pesos per US dollar to 5 pesos per US dollar. This would account for most of the real depreciation.

- c. The Canada-US real exchange rate has fluctuated a lot - is a real exchange rate that has fluctuated a lot – about 35% or more over the time period. There is no period where the Canadian dollar is pegged (this occurred from 1962-1970). The real exchange rate index tracks the nominal exchange rate index so closely because Canada and the United States have a similar inflation history.

There may or may not have been benefits to have a fixed nominal exchange rate between these two countries. The argument against is that Canada experiences different shocks than the US economy, that factor markets are not integrated and that exchange rate crises may have been avoided. The argument for a fixed exchange rate would be that, in a way similar to Europe, the two economies trade a lot and large real exchange rate movements might be undesirable.

Explore Further

8. Answers will vary.
9. a. There is a very long period from January 1994 to June 2005 where the value of the yuan *was fixed at or near 12 US cents per yuan. There is a second period from July 2007 to June 2010 where the exchange rate appears to be fixed at or near 14.6 US cents per yuan.*
- b. The value of the real exchange rate is not fixed during the first period. Instead there is a significant real appreciation followed by a significant real depreciation. In the real appreciation, aggregate demand would have been reduced, in a real depreciation, aggregate demand would have increased.
- c. *From July 2007 to June 2010, the value of the yuan was very close to 14.6 US cents. This was a second period of fixed exchange rates. When the exchange rate was allowed to be flexible, there was a rapid appreciation. That suggests markets expected the long run real exchange rate to be a higher below than the real exchange rate in 2010. Thus China may have prevented a rise in the yuan between 2007 and 2010. This would increase aggregate demand in China*

CHAPTER 21

Quick Check

1. a. False. Monetary policy has been shown to be effective in stimulating growth.
b. True.
c. True.
d. True/Uncertain.
e. False. The evidence does not support the existence of political business cycles.
f. False. These rules worked well until they were abandoned after 1998.
g. False. See the Focus box on page 474. These rules have been largely ineffective.

- h. True.
 - i. Uncertain. It may be wise for a government to commit not to negotiate with hostage takers as a means to deter hijackings, even recognizing that after a hijacking has taken place, there is a strong incentive to negotiate. However, the phrase “under no circumstances” is categorical. There may be some circumstances under which a government might wish to violate its commitment. This statement, of course, illustrates the difficulty of pre-commitment. Can a government really commit not to negotiate, no matter what the circumstances, even if these circumstances may not have been imagined at the time the commitment was made?
 - j. True
 - k. False. Tax cuts come first which leads to higher deficits and pressure to reduce spending.
2. a. Inflation will increase in the fourth year.
- b. The President should aim for high unemployment early in the administration, to reduce inflation before the fourth year.
- c. The policies are not likely to achieve the increase in output desired in the fourth year. Since people are forward-looking, expected inflation for the fourth year will account for the intentions of policymakers. If inflation equals expected inflation, unemployment equals the natural rate.
3. Answers will vary, but there is some discussion of this issue in the text.
4. In 1989, New Zealand wanted to eliminate fears that the central bank might try to reduce unemployment below the natural rate with expansionary monetary policy and higher inflation. The single goal for monetary policy was intended to stabilize expected inflation and prevent any possibility that monetary policy could be manipulated for political advantage.
5. In 2018, New Zealand decided that the single goal for monetary policy placed too tight a constraint on its central bank to react to shocks to the economy. It was decided that giving the central bank the power to stabilize employment would be useful.

Dig Deeper

6. a. $\pi_t^e = 0.5(\pi_A + \pi_B)$
- b. The unemployment rate will be less than the natural rate. Inflation will be higher than expected.
- c. The unemployment rate will be greater than the natural rate. Inflation will be lower than expected.
- d. The unemployment rate will equal the natural rate, because $\pi = \pi^e$. There will be high inflation.
- e. The party who won the election would have no control over monetary policy. The elected party would still control fiscal policy. You would have to make an argument that parties would tend to have expansionary fiscal policy in the last two years before the election and that the central bank, in spite of independence and an inflation target, was

willing to allow faster economic growth and lower unemployment lower as a result of the fiscal expansion and the risk of missing the inflation target.

7.
 - a. If the conservatives accept less party control, the liberals get a payoff of -10 if they do not obtain more market mechanisms, and a payoff of 30 if they obtain them.
 - b. The best answer is for the Liberals to enhance more market mechanisms, which corresponds to a payoff of 10.
 - c. If each group tries to fight the other, one can win, but the risk of losing is high. So the best solution is the cooperative one, where both can obtain equal satisfaction, either on the positive side (more/more) or on the *mitigation* side (less/less).

Explore Further

8. Answers will vary.
9.
 - a. The Statute clearly organizes the priorities of the ECB and its monetary policy: maintaining price stability comes first, followed by supporting general economic policies, as long as the second priority does not contradict the first goal. In practice, studies have shown that the ECB is concerned not only with price stability but also with the general situation of European economies — specifically with growth and unemployment.
 - b. The Statute and the EU, where there is no dominant political power, have probably established the most independent position for a central bank worldwide. These provisions illustrate this situation explicitly when it says that ECB governing bodies shall not seek or take instructions from EU institutions or from the governments of member states. The process of nomination of the heads of the bank seems to guarantee their independence: the multiplicity of institutions involved in the process and the professional qualifications required ensure that. Considering these elements, the ECB can be put in the extreme left part of Figure 21.3 after the Deutsche Bank (Germany's central bank), which serves as a model for the ECB.

CHAPTER 22

Quick Check

1.
 - a. False. The official deficit is a nominal number.
 - b. True.
 - c. True.
 - d. True.
 - e. False. Cyclically adjusted deficits are fine and should be offset by future surpluses.
 - f. True.
 - g. False. Many countries have debt-to-GDP ratios over 100% including the U.S.
 - h. True.

- i. False. It can be smaller or larger.
 - j. False. Inflation could be negative
 - k. False. The need for a fiscal consolidation depends on many other factors.
 - l. True.
 - m. False. Borrowing and lending stop which reduces investment and output.
2. First, even a temporary deficit leads to an increase in the national debt, and therefore to higher interest payments. This, in turn, implies continued deficits, higher taxes, or lower government spending in the future. Second, the evidence does not support the Ricardian equivalence proposition. Third, if Ricardian equivalence did hold, then government spending would have the same effect on output regardless of whether it was financed by bonds (i.e., with a deficit) taxes. Thus, a deficit, per se, would not be needed to stimulate output. Fourth, war-time economies are already low-unemployment economies. There is no need for further stimulation by using deficits rather than tax finance. The only correct part of the statement is the first sentence. A deficit can be preferable to higher taxes during a war, but not for the reasons stated here.
3. a. Primary deficit:

$$7.8\% \text{ GDP} - 0.25\% \times 123\% \text{ GDP} = 7.8 - 0.3 = 7.5\%.$$
- b. Inflation-adjusted deficit:
The real interest payment is $(0.25 - 0.4) \times 123\% = -0.18\%$, so the inflation-adjusted deficit is $7.8 - 0.18 = 7.62\%$.
- c. If output is below its natural level by 2%, using the rule of thumb in the text, the deficit is lower by $0.5 \times 2\% = 1\%$. So, the cyclically-adjusted, inflation-adjusted deficit is 6.62%.
- d. Time to reach 60% with a growth of 2%:
The real interest rate is $r = 0.25 - 0.4 = -0.15$.
The net effect on the debt payment is $(r - g) \times \text{debt/GDP} = (-0.15 - 2) \times 123\% = -2.6\%$.
The debt to GDP ratio falls by 2.6% in the first year and continues to fall thereafter. It will take 24 years for the debt ratio to reach 60%.
4. a. If money growth = 25%, 50%, 75%, seigniorage = 162.5, 325, 487.5.
b. In the medium run, if money growth = 25%, 50%, 75%, seigniorage = 162.5, 200, 112.5.
The fall in real money balances associated with higher ongoing inflation reduces the potential for seigniorage. Part (a) did not allow for this effect.

Dig Deeper

5. a. The new domestic interest rate is $10\% + 10\% = 20\%$. So, assuming that expected depreciation was previously zero, the domestic interest rate increases from 10% to 20%.
- b. The real interest rate increases from 3% to 17%. The high real interest rate is likely to decrease growth.
- c. The official deficit increases from 4% to 14% of GDP. The inflation-adjusted deficit increases from -3% (a surplus) to 7% (a deficit).
- d. In the first year, the change in the debt ratio = $(14\% - 0\%) - 6\% = 8\%$. It goes up very quickly.

6. a. The *IS* curve shifts right. Output rises. The government finances the extra spending by borrowing.
- b. The *IS* curve shifts right, but by less than the amount in part (a). In fact, the *IS* curve will shift to the right by exactly the increase in government purchases, because the balanced budget multiplier is one (see Chapter 4, problem 4). Output increases, but by less than the amount in part (a).
- c-d. The results are the same as in part (b). If Ricardian equivalence holds, the financing mechanism is irrelevant. If taxes are not increased, consumers simply increase saving by the same amount as the increase in government spending. So regardless of the financing mechanism, the effect on consumption is the same.
- e. Statement (i) is false. Statement (ii) is true.

Explore Further

7. a. Since the real interest rate equals the growth rate, the annual change in the debt to GDP ratio is simply the primary deficit, or 4% of GDP. In 10 years, the debt to GDP ratio rises from 40% to 80%.
- b. In 10 years, the debt to GDP ratio rises to 93%.
- c. The answer is the same as in part (b), because the difference between the real interest rate and the growth rate is the same as in part (b).
- d. After 10 years, the primary deficit must fall to zero to maintain the debt-to-GDP ratio of 50%.
- e. After 5 years, the debt-to-GDP ratio will be 60%. A primary surplus of 2% of GDP for each of the years 6 through 10 is required to reduce the debt-to-GDP ratio to 50% after 10 years.
- f. If the growth rate declines, the debt-to-GDP ratio will tend to grow more quickly, so a larger reduction in the primary deficit is required to achieve the debt-to-GDP objective.
- g. The policy in part (e) is probably more dangerous. First, this policy relies on the promise of future deficit reduction, which is less credible than current deficit reduction and may make financial market participants nervous about lending to the government. Second, this policy requires a large policy change—from a 4% primary deficit to a 2% surplus—between years 5 and 6. Such a large policy change is likely to have a negative effect on growth, and perhaps a larger negative effect than would be predicted by standard models, which are likely to be more accurate at predicting the effect of smaller policy changes. Answers will depend upon current Fed policy.
8. a. Between 2016 and 2017, the latest year in this data: Over 2017, (the latest years as this is written), the ratio of debt-to-GDP fell by 0.6 percentage points of GDP. The ratio of debt to GDP rose sharply in the crisis years. Before the crisis, the ratio of debt to GDP was around 65%. By 2012 the ratio of debt to GDP was up to 100%.

- b. The primary deficit in 2017 was 2.2%. The ratio of debt-to-GDP can fall and did fall in 2017 even if there is a primary deficit as long as the growth rate of income “g” is sufficiently larger than the real interest rate “r.”
 - c. The missing term is $(r - g)$ times the ratio of debt to GDP. The latter value is 105% (think of it as 100% or 1). Then the $(r - g)$ term needs to equal about -2% to offset the primary deficit of 2%. This would happen if the real interest rate were zero and economic growth were 2%. This seems plausible in this period. Your calculations may vary.
 - d. Japan has by far the largest debt-to-GDP ratio, over 200% in 2017. The lowest debt-to-GDP ratio is in Germany at 64%. In 2017, the United States has the largest overall deficit and Germany was the only G7 country with an overall surplus. These are not primary surpluses, these are overall surpluses.
- 9.
- a. In 2018, there is no year in the next decade without a deficit.
 - b. Yes, the outlays include the interest on the debt and transfers.
 - c. Rise.
 - d. You need to look at three graphs (1) the nominal interest rate is assumed in 2018 to be about 3% over the decade (2) inflation is assumed to be 2% (3) real output growth is assumed to be 2%. Thus $r - g = -1\%$

CHAPTER 23

Quick Check

- 1.
- a. False. Seignorage profits are typically very small and not sufficient to warrant the costs of higher inflation.
 - b. False. The Fed is also charged with growing the economy and job creation.
 - c. False. Figure 23-1 shows several years of divergence between inflation and money growth.
 - d. False. Evidence suggests that people have money illusion, which would seem to imply that inflation would distort decision making.
 - e. False. The target inflation rate of most central banks is 2%.
 - f. True. The capital gains tax is not indexed to inflation.
 - g. True or uncertain. The Taylor rule uses both inflation and unemployment to help determine the interest rate. If you limit the reference to recessions and booms as a reference to the unemployment rate, the answer would be false.
 - h. False. Zero bound did not emerge as an issue until after the financial crisis of the late 2000s.
 - i. True.
 - j. True.
 - k. True.
 - l. True.

2. a. In the medium run equilibrium, the real interest rate is at r_n . This is the real interest rate where aggregate demand is equal to the natural level of output. Actual inflation will equal expected inflation and target inflation. The target nominal interest rate will be $i^* = r_n + \pi^*$.
- b. The right-hand side of the money demand equilibrium will not change. Thus, the left-hand side must remain unchanged. The growth rate of money will equal the growth rate of prices.
- c. The right-hand side of the money market equilibrium will now grow at 3% per year. Thus, the real money stock must grow at 3%. Thus, the growth rate of M must be 3 percentage points higher than the growth rate of P. You would expect money growth to be larger than inflation if there is growth in potential output.
- d. In the part of Figure 23-1 before 1995, money growth appears to exceed inflation (price growth) by about 2-3 percentage points. This gap would be accounted for by growth in output. The results in parts b and c are consistent with Figure 23-1 up to 1995.
- e. i. This would reduce average cash holdings – easier to get cash when needed
 ii. This would reduce average cash holdings
 iii. This would reduce average cash holdings
 iv. This would also reduce average cash holdings
- f. Between 1993 and 2018 the ratio of currency to GDP rose from about 5% to about 8%. It is not clear whether this is surprising. The nominal interest rate which is the opportunity cost of holding currency is lower in 2018 than it was in 1993. However, it also seems like many ways other than cash to make payments were created between 1993 and 2018.
3. a. The arguments for zero inflation mentioned in the text are (1) lower shoe leather costs (2) smaller tax distortions or no tax distortions (3) money illusion issues would be avoided (4) you would avoid a slippery slope where 2% inflation is all right, so is 3%.
- b. The argument in favor of inflation higher than 2%, in the example 4%, is that (1) real wage reductions might occur more easily if needed (2) there would be a tiny amount more seigniorage (3) the zero lower bound on the nominal interest rate would be encountered less frequently.
4. a. The nominal interest rate is $(\$100 - \$P_B)/P_B$
 b. The real interest rate is $[(\$100/P_{t+1}) - (\$P_B/P)] / (\$P_B/P)$
 c. The payment on the bill will rise to \$110. The real interest rate will simply be the nominal interest rate.
 d. It depends on your sensitivity to risk and your perception of the variation of actual inflation around the level of expected inflation. The indexed bond offers a certain real return. If you dislike risk, purchasing the indexed bond will appeal to you.

The non-indexed bond has some risk. If inflation is lower than expected, its real return will be higher. If inflation is larger than expected, its real return will be lower. You might like the possibility of the higher return and are willing to accept the risk.

In addition, you might disagree with the market on the level of expected inflation. If you thought expected inflation was going to be lower than the general consensus, then you would buy the nominal bond.

5.
 - a. The Fed's goal in quantitative easing was to increase the price (lowering the yield) on these securities by purchasing and holding more of them. The goal was to make mortgages less expensive and stimulate the purchase of new houses. The other interpretation would be that the risk premium on these securities has increased and the Fed was trying to offset part of that increase.
 - b. The Fed was trying to raise the price (lower the yield) on these securities. In terms of Chapter 14, the term premium must have been higher. By taking the supply of these long-term bonds off the market, the Fed was hoping to reduce long-term yields on government bonds. Then they wanted to have the private sector see the lower yields and be more willing to borrow for new investments.
 - c. You would expect to see the interest rates on mortgage-backed securities rise
 - d. You would expect to see long-term bond yields rise.
 - e. The changes in the balance sheet between 2015 and 2018 show a reduction in the holding of long-term Treasuries and an increase in the holding of short-term Treasuries. This is evidence of unwinding. But there is a very small increase in total holdings of mortgage-backed securities – evidence against unwinding.
6.
 - a. The minimum down payment is 20% of the home's value or \$60,000.
 - b. If the loan-to-value maximum is reduced, this increases the down payment. We would expect this to reduce the demand for homes as households have to save a bit longer to achieve the required down payment.
 - c. Canadian home prices have continued to rise and the rate of increase was not slowing up to 2015. By increasing the minimum down payment on very expensive homes, the Finance Minister hoped to reduce the demand for homes and control a potential bubble. House prices in Canada have slowed their rate of increase starting in 2017 to date so perhaps the policy had some effect.
7.
 - a. This member bank has excess reserves of \$10 billion. They would prefer to deposit these reserves at the Fed where they would earn 0.5% than to lend on the overnight market where they would earn only 0.4%.
 - b. This bank is short of reserves by \$20 billion. They would borrow from the discount window at 0.75% rather than pay 0.8% on the overnight market.
 - c. If all banks in America were member banks, then the Federal Reserve would always make loans available overnight at the discount rate to all banks. No loan would ever be

- made privately at a higher rate than the discount rate. Similarly, if all banks had access to deposits at the Fed's deposit rate, there would be no overnight loans at a lower rate.
- d. This is a non-member bank without the option to increase its deposits at the Federal Reserve and earn the Federal Reserve deposit rate. They have excess reserves and they would try to lend them. It is possible that another non-member bank without access to the Federal Reserve needs the reserve. They could agree to this transaction at lower than the Federal Reserve deposit rate if a lot of non-member banks had reserves to lend and very few non-member banks wanted reserves. This appears to have been what happened for most of the period after 2015 until 2019 when the two rates converge at the deposit rate.

Dig Deeper

8. a. i. $r = 4\% - 0\% = 4\%$;
ii. $r = 14\% - 10\% = 4\%$
- b. i. $r = 4\%(1 - 0.25) - 0\% = 3\%$;
ii. $r = 14\%(1 - 0.25) - 10\% = 10.5\% - 10\% = 0.5\%$
- c. Given the deductibility of nominal mortgage interest payments, inflation is good for homeowners in the United States.
9. a. The ECB decided to fix a negative interest rate on the deposit facility, which is the deposit of commercial banks on their accounts at the ECB, since June 11, 2014.
b. In January 2016, the Central Bank of Japan decided, “to apply a negative interest rate of minus 0.1 percent to current accounts that financial institutions hold at the Bank. It will cut the interest rate further into negative territory if judged as necessary.” This differs from the ECB in that it adopts a three-tier system in which “the outstanding balance of each financial institution’s current account at the Bank will be divided into three tiers, to each of which a positive interest rate, a zero interest rate, or a negative interest rate will be applied”.
The aim of both central banks is the same: to induce commercial banks to issue more loans instead of increasing their holdings at the central bank and achieve the price stability target of 2% to sustain economic growth.

Explore Further

10. The Bank of Japan and the Federal Reserve all spent considerable time with their policy rate of interest very close to zero.
Both the Bank of Canada and the Bank of England had policy rates that bottomed at 0.5 percentage points, not quite zero. These central banks still have room to lower nominal rates further. In their circumstances, they did not (quite) hit the zero lower bound.
The European Central Bank had a policy interest rate that was negative from 2015 to 2018. Negative interest rates are a story for another day.

11. a. Based on the press release accessed by the students, the answers should be similar to what is given here:
- i. The principal and official concern of ECB, repeated several times, is to “return to the objective of a rate of inflation which is close to but below 2%.” However, the number of analyses about the weakened growth prospects shows that this dimension is also a concern of the bank. Regarding the, “high structural unemployment and low potential output”, the Bank firmly asks for structural policies and a “more growth-friendly composition of fiscal policy”.
 - ii. The ECB decisions are based on an analysis of inflation and growth with precise figures on quarterly and annual growth rates, as well as the monthly HIPC. Thus, it conforms to the parameters of an economic model of the same family as Taylor’s rule. In one of his answers, the vice president of the ECB confirms that the Bank uses certain models. This means that there is more than one model that supports the bank’s decision-making process.
- Note: See the presentation of its monetary policy by the bank itself, which mention four category of models: “money demand models, structural general equilibrium models with an active role for money and credit, money-based inflation risk indicators and flow-of-funds analysis”.
- iii. The term, “macro prudential tools”, refers to structural financial aspects outside the usual scope of monetary policy, also called ‘financial stability,’ with factors including housing prices and capital inflows. In this conference, too, there are no real macro-prudential elements.
- b. The objective of the monetary policy for the People’s Bank of China is “to maintain the stability of the value of the currency and thereby promote economic growth.” Price stability is not mentioned as a goal of the monetary policy, which is something that is unique among central banks.