Section 8-6 has remained more or less same as in 10th edition. Section 8-7 has been changed moderately. The IP Box has been updated with newer data and graphs. Figure 8-8 has been eliminated. Section 8-8 case study in 10th edition has been eliminated completely, and the rest of the sections have been renumbered. The new Section 8-8 explains the supply shocks, and this section has gone through some major changes as the textual explanation has been expanded and new topic box has been added.

Section 8-9 has not changed much apart from some tweaking of words.

In Section 8-10, the old case study “The Goldilock Economy: Why Inflation Was so Low in the Late 1990s” has been replaced with a new case study “Why Did Inflation Creep Up After 2003?” Sections 8-11 and 8-12 have not changed that much apart from the figures. Figure 8-12, a graph of the unemployment rate against the output ratio, has been updated for the period 1965–2004 with a new explanation for the perpendicular dashed line. Figure 8-13, showing the history of the unemployment rate and the inflation rate, has been updated with a new diagram. In the Summary section, a new number 7 is added and the rest are renumbered. Appendix to Chapter 8, titled “The Elementary Algebra of the SP-DG Model” contains minor changes.

**Answers to Questions in Textbook**


2. Both the SAS curve and the SP curve are supply curves; that is, they relate a price variable to the amount of output that producers are willing to produce. The SAS curve shows the relationship of the price level to output. The SP curve shows the relationship between the change in the price level (the inflation rate) and the level of output.

3. a. An increase in money supply growth increases the rate of nominal GDP growth. This causes the economy to experience some combination of higher real GDP and higher inflation, moving it up along a given SP curve.
   b. An increase in the expected inflation rate causes the SP curve to shift upward.
   c. A decrease in production costs associated with technological improvement causes a downward shift of the SP curve.
   d. A decrease in nominal GDP growth has the opposite effect of (a). The economy experiences some combination of lower real GDP and lower inflation, moving it down along a given SP curve.

4. When the equilibrium real wage is constant and output is at the natural rate, the nominal wage will be increasing at the same rate as the inflation rate. If output is greater than the natural rate and actual inflation exceeds expected inflation, then the actual real wage would be falling. In this case, we would expect workers to try to increase the rate of growth of nominal wages.

5. The three conditions are: (1) the economy is on the SP curve; (2) $x = p$ (so that $y = 0$); and (3) expectations are accurate ($p^e = p$). The economy cannot be off SP because SP gives the amount of output firms will produce at various inflation rates. If $x$ is greater than (less than) $p$, then real GDP increases (decreases) and thus cannot be at the natural level of output. If expectations are not accurate, the economy can be in short-run equilibrium, but workers will adjust their expectations (and wage demands) in the coming period.
6. Point $D$ in Figure 8-4 is not on the $SP$ curve, which shows how much output firms are willing to produce at different rates of inflation. Given the 6 percent increase in nominal GDP growth, the 6 percent increase in real GDP (from 100 to 106) with zero inflation, represented by a move from Point $E_0$ to Point $D$, is a mathematically possible outcome, but it is not consistent with firms’ profit-maximization. Firms would be willing to increase output to 106 only if the inflation rate were 3 percent, but that is not possible given nominal GDP growth of just 6 percent. The 6 percent nominal GDP growth must be divided between real GDP growth and inflation along the $SP$ curve as it is at Point $D$.

7. Forward-looking expectations attempt to predict the implications of economic disturbances (and policy changes) in advance. The backward-looking approach adjusts to what has already happened. It is likely that workers and firms will use the backward-looking approach. The existence of long-term wage and price agreements would prevent actual inflation from responding immediately to policy changes. Thus, they know that changes in wages and prices will adjust gradually to policy changes.

8. This represents forward-looking expectations, because workers and firms use the predictions of the long-run $LP$ model to form their expectations of the behavior of inflation. With $p^e = x$, the $SP$ line immediately shifts upward or downward by the full amount of the change in nominal GDP growth. Thus, there is no effect on real GDP ($y = 0$). The economy moves along its $LP$ line, and the adjustment loops pictured in Figures 8-4 and 8-6 are no longer relevant. If workers and firms adjust their expectations in this way, the output cost of disinflation is zero.

9. a. If workers and business firms believe that the Fed will take actions to prevent a demand shock from causing any permanent change in the rate of inflation, then their expectations are that any changes in inflation rates are only temporary. Therefore, any change in the output ratio that raises or lowers the inflation rate does not result in a change in the expected rate of inflation. Given that the expected rate of inflation does not change, there is no shift in the short-run Phillips curve.

b. For workers and business firms to continue to hold these expectations, the Fed must take actions to reduce the growth of nominal GDP to its original level when there is a positive demand shock, and to increase the growth of nominal GDP to its original level when there is a negative demand shock. If the Fed fails to do so, then the demand shock could result in a permanent change in the inflation rate, which would cause workers and business firms to abandon their original expectations.

10. What happens to the rate of inflation depends on how fast actual real GDP rises. If actual real GDP rises by more than 3 percent, the growth rate of natural real GDP, then the output ratio rises. The increase in the output ratio results in a rise in the inflation rate, given the expected rate of inflation. On the other hand, if actual real GDP increases by less than 3 percent, then the output ratio falls, resulting in a decline in the rate of inflation, given the expected rate of inflation.

11. The four types of supply shocks are oil shocks, farm price shocks, import price shocks, and productivity growth shocks.

An oil price shock is when a change in the price of oil results in a rise or fall in the inflation rate, given the growth rate of nominal GDP. Oil price shocks were adverse during the 1970s and from 2003 to 2007, and beneficial from 1981 to 1986 and again from 1995 to 1999.

Farm price shocks are when changes in the prices of agricultural commodities lead to a rise or fall in the inflation rate, given the growth rate of nominal GDP. Farm price shocks were adverse from 1972 to 1974 and just recently as the use of ethanol as a gasoline additive drove up the price of corn.
Import price shocks are when changes in the prices of imported goods lead to a rise or fall in the inflation rate, given the growth rate of nominal GDP. Import price shocks were adverse during the 1970s, from 1985 to 1987, and have been since 2002. Import price shocks were beneficial from 1980 through 1985 and again from 1995 to 2002.

Productivity growth shocks occur when changes in the growth rate of productivity cause a rise or fall in the inflation rate, given the growth rate of nominal GDP. Productivity growth shocks were adverse from 1965 to 1980 and have been slightly adverse since 2004. Productivity growth shocks were moderately beneficial in the early 1980s and were strongly beneficial from 1995 thorough 2004.

12. The three policies have different rates of nominal GDP growth. A neutral policy would keep the growth of nominal GDP constant. An accommodating policy requires an acceleration of nominal GDP growth, but an extinguishing policy requires cutting nominal GDP growth.

<table>
<thead>
<tr>
<th>Policy</th>
<th>Inflation</th>
<th>( \frac{Y}{Y^N} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accommodating</td>
<td>Increases</td>
<td>Remains the same</td>
</tr>
<tr>
<td>Extinguishing</td>
<td>Remains the Same</td>
<td>Decreases</td>
</tr>
<tr>
<td>Neutral</td>
<td>Increases</td>
<td>Decreases</td>
</tr>
</tbody>
</table>

13. A permanent shock will cause a permanent increase in the price level. If the shock occurs for only one period, however, inflation will increase only during that period if policymakers choose either a neutral or an accommodating response. It will then return to its previous level if expectations do not change and if COLAs do not exist. Even if inflation returns to its previous level, though, there will be a decrease in natural real GDP.

14. Inflation was so low in the late 1990s due to the beneficial supply shocks provided by falling oil and import prices and a rapid rise in productivity growth. The decline in import prices was due to an appreciation of the dollar during the late 1990s.

Inflation started to rise after 2003 as the same beneficial supply shocks of the late 1990s turned into adverse supply shocks. The price of oil more than tripled between 2003 and 2007. Import prices rose as the dollar depreciated from 2002 through 2007. The growth rate of productivity, which had been strong from 1995 up through the first half of 2004, declined by more that 50 percent from 2005 to 2007.

15. a. Inflation and the output ratio both increase if nominal GDP growth increases, moving the economy up along a given \( SP \) curve.

b. Inflation increases and the output ratio decreases if an adverse supply shock, which shifts the \( SP \) curve upward, combines with a neutral policy response, which holds the rate of nominal GDP growth constant.

c. Inflation is constant and the output ratio decreases if an adverse supply shock combines with an extinguishing policy response, which reduces the rate of nominal GDP growth so as to prevent any increase in the inflation rate.

d. Inflation decreases and the output ratio is constant if a beneficial supply shock, which shifts the \( SP \) curve downward, combines with an accommodating policy, which reduces the rate of nominal GDP growth.
16. Okun’s Law shows that the unemployment rate is inversely related to the output ratio. The reason is that if real GDP rises relative to natural real GDP, employers need to hire more workers in order to produce the additional output, which drives down the unemployment rate.

However, the fact that the unemployment rate moves in the opposite direction from the output ratio does not allow us to say anything about the relationship between the inflation rate and the unemployment rate. For example, demand shocks that initially move the output ratio and the inflation rate in the same direction eventually cause the output ratio and the inflation rate to move in opposite directions as the short-run Phillips curve shifts due to changes in expected inflation. During the initial phase of the economy’s adjustment to the demand shock, the inflation and unemployment rates are negatively correlated as they move in opposite directions. Thereafter, the correlation between the unemployment and inflation rates becomes positive as the short-run Phillips curve shifts up or down.

Furthermore, supply shocks initially cause the output ratio and the inflation rate to move in opposite directions, giving rise to a positive correlation between the inflation and unemployment rates. But subsequent movements in the output ratio and the unemployment and inflation rates depend on whether the government chooses a neutral, accommodating, or extinguishing policy response to the supply shock. If the government chooses either an accommodating or extinguishing policy response, then the correlation between the unemployment and inflation rates equals zero.

17. a. If the unemployment rate did not change, then there was also no change in the output ratio. A fall in the inflation rate and no change in the output ratio result from an accommodating policy.
b. A decline in the unemployment rate results from a rise in the output ratio. A rise in the output ratio and a fall in the inflation rate result from a neutral policy.
c. A decline in the unemployment rate results from a rise in the output ratio. An increase in the output ratio and no change in the inflation result from an extinguishing policy.

### Answers to Problems in Textbook

1. a. Since real GDP grows by 3.2 percent, the output ratio equals 103.2 and the inflation rate increases by $0.25\times(3.2) = 0.8$ of a percentage point. Therefore, the inflation rate equals 4.0 percent, given that the expected inflation rate equals 3.2 percent.
b. Since real GDP grows by 5.6 percent, the output ratio equals 105.6 and the inflation rate increases by $0.25\times(5.6) = 1.4$ percentage points. Therefore, the inflation rate equals 4.6 percent, given that the expected inflation rate equals 3.2 percent.
c. Since real GDP declines by 2.4 percent, the output ratio equals 97.6 and the inflation rate decreases by $0.25\times(2.4) = 0.6$ of a percentage point. Therefore, the inflation rate equals 2.6 percent, given that the expected inflation rate equals 3.2 percent.
d. Since real GDP declines by 4.4 percent, the output ratio equals 95.6 and the inflation rate decreases by $0.25\times(4.4) = 1.1$ percentage points. Therefore, the inflation rate equals 2.1 percent, given that the expected inflation rate equals 3.2 percent.
e. Given the expected rate of inflation equals 3.2 percent, the points on your short-run Phillips curve are: (95.6, 2.1); (97.6, 2.6); (103.2, 4.0); (105.6, 4.6).
f. Since real GDP grows by 2.8 percent, the output ratio equals 102.8 and the inflation rate increases by $0.25\times(2.8) = 0.7$ of a percentage point. Therefore, the inflation rate equals 2.1 percent, given that the expected inflation rate equals 1.4 percent.
g. Since real GDP grows by 5.2 percent, the output ratio equals 105.2 and the inflation rate increases by $0.25\times(5.2) = 1.3$ percentage points. Therefore, the inflation rate equals 2.7 percent, given that the expected inflation rate equals 1.4 percent.
h. Since real GDP declines by 1.6 percent, the output ratio equals 98.4 and the inflation rate decreases by 0.25(1.6) = 0.4 of a percentage point. Therefore, the inflation rate equals 1.0 percent, given that the expected inflation rate equals 1.4 percent.

i. Since real GDP declines by 6.4 percent, the output ratio equals 93.6 and the inflation rate decreases by 0.25(6.4) = 1.6 percentage points. Therefore, the inflation rate equals −0.2 percent, given that the expected inflation rate equals 1.4 percent.

j. Given the expected rate of inflation equals 1.4 percent, the points on your short-run Phillips curve are: (93.6, −0.2); (98.4, 1.0); (102.8, 2.1); (105.2, 2.7).

k. The beneficial supply shock shifts the short-run Phillips curve down by 1.2 percentage points at every output ratio. Therefore, the new points on the short-run Phillips curve are: (93.6, −1.4); (98.4, −0.2); (102.8, 0.9); (105.2, 1.5).

2. a. An inflation rate equal to 0 is two percentage points below its expected level, so firms cut real GDP by 2 percent, so that real GDP is 98 percent of natural real GDP. Therefore, the output ratio equals 98 when the inflation rate equals zero, given expected inflation equals 2. Use the same logic to show that given the expected rate of inflation equals 2, the following points are also on the short-run Phillips curve: (99, 1); (100, 2); (101, 3); (102, 4); and (103, 5).

b. If the output ratio initially equals 100 and the expected and actual rates of inflation are equal, the economy is in long-run equilibrium and the inflation rate equals the growth rate of nominal GDP. Therefore, the growth rate of nominal GDP initially equals 2 percent since the inflation rate initially equals 2 percent.

c. The inflation rate plus the growth rate of real GDP must equal the growth rate of nominal GDP, which now equals 4 as a result of the increase in government spending. The only point on the short-run Phillips curve that is consistent with this combination of the growth rate in real GDP and inflation rate is an output ratio equal to 101 and an inflation rate equal to 3, given that natural real GDP is constant.

d. The economy is in long-run equilibrium when the economy is operating on its short-run Phillips curve, the inflation rate equals the growth rate of nominal GDP, and the expected and actual inflation rates are equal. That occurs when the inflation rate equals 4 percent, the growth rate of nominal GDP.

The economy adjusts to the long-run equilibrium through shifts of the short-run Phillips curve as the expected rate of inflation changes. The adjustment of the output ratio and inflation rate follows a loop similar to the one shown in Figure 8-5 on page 247.

3. a. The expected inflation rate in the second period equals 3 percent since that is the actual inflation rate in the first period. Therefore, the inflation rate is three percentage points below its expected level when it equals 0, resulting in firms producing only 97 percent of natural real GDP. Therefore, (97, 0) is a point on the new short-run Phillips curve, given that expected inflation equals 3 percent. The remaining points on the new short-run Phillips curve are: (98, 1); (99, 2); (100, 3); (101, 4); and (102, 5).

b. If monetary policymakers wish to reduce inflation to 2 percent in the second period, then they must cut the growth rate of nominal GDP enough so that the output ratio equals 99, because that is the output ratio on the new short-run Phillips curve when the inflation rate equals 2 percent. Since the output ratio is 101 in the first period, real GDP must fall by 2 percent in the second period for the output ratio to equal 99 in the second period. Therefore, the growth rate of real GDP must equal −2 percent in the second period. Since the nominal GDP growth rate is the sum of the inflation rate and the real GDP growth rate, monetary policymakers must reduce the nominal GDP growth rate to 0 percent in the second period in order to reduce the inflation rate to 2 percent in the second period.
c. The expected inflation rate in the third period equals 2 percent since that is the actual inflation rate in the second period, given the monetary contraction. Therefore, the inflation rate is two percentage points below its expected level when it equals 0, resulting in firms producing only 98 percent of natural real GDP. Therefore, (98, 0) is a point on the new short-run Phillips curve, given that expected inflation equals 2 percent. The remaining points on the new short-run Phillips curve are: (99, 1); (100, 2); (101, 3); (102, 4); and (103, 5).

To maintain an inflation rate of 2 percent, monetary policymakers would have to provide a growth rate for nominal GDP so that the output ratio equals 100, because that is the output ratio on the new short-run Phillips curve when the inflation rate equals 2 percent. Since the output ratio is 99 in the second period, real GDP must rise by 1 percent in the third period for the output ratio to equal 100 in the third period. Therefore, the growth rate of real GDP must equal 1 percent in the third period. Since the nominal GDP growth rate is the sum of the inflation rate and the real GDP growth rate, monetary policymakers must increase the nominal GDP growth rate to 3 percent in the third period in order to maintain the inflation rate at 2 percent in the third period.

The economy is in long-run equilibrium when the economy is operating on its short-run Phillips curve, the inflation rate equals the growth rate of nominal GDP, and the expected and actual inflation rates are equal. Therefore, to maintain the inflation rate at 2 percent in the long run, monetary policymakers need to maintain the growth rate of nominal GDP at 2 percent in the long run.

d. The short-run Phillips curve does not shift when the actual inflation rate deviates for the expected inflation rate if workers and employers expect monetary policymakers to take actions to quickly restore inflation to its long-run equilibrium of 2 percent.

e. If workers and employers expect monetary policymakers to take actions to quickly restore inflation to its long-run equilibrium of 2 percent, then the second period’s short-run Phillips curve is the same as that of the first period. To reduce inflation to 2 percent in the second period from 3 percent in the first period, monetary policymakers must reduce nominal GDP enough so that the output ratio equals 100, because that is the output ratio on the short-run Phillips curve when the inflation rate equals 2 percent. Since the output ratio is 101 in the first period, real GDP must fall by 1 percent in the second period for the output ratio to equal 100 in the second period. Therefore, the growth rate of real GDP must equal –1 percent in the second period. Since the nominal GDP growth rate is the sum of the inflation rate and the real GDP growth rate, monetary policymakers must reduce the nominal GDP growth rate to 1 percent in the second period in order to reduce the inflation rate to 2 percent in the second period.

To maintain an inflation rate of 2 percent, monetary policymakers would have to provide a growth rate for nominal GDP so that the output ratio continues to equal 100 in the third period, because that is again the output ratio on the short-run Phillips curve when the inflation rate equals 2 percent. Therefore, there can be no growth in real GDP in the third period. Since the nominal GDP growth rate is the sum of the inflation rate and the real GDP growth rate, monetary policymakers must increase the nominal GDP growth rate to 2 percent in the third period in order to maintain the inflation rate at 2 percent in the third period.

f. The reason that monetary policymakers have to reduce the growth rate of nominal GDP less in the second period once they have established a record of maintaining an inflation rate of 2 percent is that they do not have to overcome the effect of how a change in the actual inflation rate affects the expectations of workers and employers concerning the inflation rate. It also means that the third period’s increase in the growth rate of nominal GDP is less because it took a smaller decrease in real GDP in the second period to reduce inflation to the level desired by monetary policymakers.
4. a. Since natural real GDP grows by 3 percent every year, it equals $1.03(11,000) = 11,330$ in the first year. It equals $1.03(11,330) = 11,669.9$ in the second year. It equals $1.03(11,669.9) = 12,020$ in the third year. It equals $1.03(12,020) = 12,380.6$ in the fourth year, and it equals $1.03(12,380.6) = 12,752$ in the fifth year.

b. Since actual real GDP falls by 2 percent in the first year, and then grows by 4 percent in the second year, 5.5 percent in the third year, 4.2 percent in the fourth year, and 3.5 percent in the fifth year, actual real GDP equals $0.98(11,000) = 10,780$ in the first year. It equals $1.04(10,780) = 11,211.2$ in the second year. It equals $1.055(11,211.2) = 11,827.8$ in the third year. It equals $1.043(11,827.8) = 12,324.6$ in the fourth year, and it equals $1.035(12,324.6) = 12,756$ in the fifth year.

c. The output ratio equals $(10,780/11,330)(100) = 95.1$ in the first year. It equals $(11,211.2/11,669.9)(100) = 96.1$ in the second year. It equals $(11,827.8/12,020.0)(100) = 98.4$ in the third year. It equals $(12,324.6/12,380.6)(100) = 99.5$ in the fourth year, and it equals $(12,756/12,752)(100) = 100.0$ in the fifth year.

d. The cumulative loss of output equals $4.9 + 3.9 + 1.6 + 0.5 + 0 = 10.9$ percent.

e. The reduction in the inflation rate equals $3.5 - 1.1 = 2.4$ percentage points. Therefore, the sacrifice ratio equals $10.9/2.4 = 4.5$.

5. a. Since the output ratio equals 100 and the inflation rate equals 2 percent, that combination of the output ratio and the inflation rate is on the long-run Phillips curve. Therefore, the expected inflation rate equals 2 percent. Since natural real GDP is constant and actual real GDP grows by 2 percent for every 1 percent increase in the inflation rate above its expected level, the following points are on the short-run Phillips curve: (95, −0.5); (97, 0.5); (99, 1.5); (100, 2); (101, 2.5); (103, 3.5); and (105, 4.5).

b. Since the inflation rate equals the growth rate of nominal GDP at points on the long-run Phillips curve when natural real GDP is constant, the growth rate of nominal GDP equals 2 percent.

c. The $SP$ curve shifts up by 3 percentage points, the amount of the adverse supply shock. Therefore, the following points are on the new $SP$ curve: (95, 2.5); (97, 3.5); (99, 4.5); (100, 5); (101, 5.5); (103, 6.5); and (105, 7.5).

d. If government follows a neutral policy, then the rise in the inflation rate and the fall in the actual real GDP are equal at 2 percentage points, and the output ratio equals 98 and the rate of inflation equals 4 percent. Also note that the sum of the growth rate of actual real GDP plus the rate of inflation equals $−2 + 4 = 2$ percent, the growth rate of nominal GDP.

e. If the government follows an accommodating policy, then the output ratio remains at 100, but the inflation rate rises to 5 percent. The combination of a 0 percent growth rate in actual real GDP plus a 5 percent inflation rate requires that the growth rate of nominal GDP increase from 2 percent to 5 percent.

f. If the government follows an extinguishing policy, then the inflation rate remains at 2 percent, but the output ratio declines to 94. The combination of a negative 6 percent growth rate in actual real GDP plus a 2 percent inflation rate requires that the nominal GDP decrease by 4 percent.