

## Money, Output, and Prices in the Long Run



### What you will learn in this Module:

- The effects of an inappropriate monetary policy
- The concept of monetary neutrality and its relationship to the long-term economic effects of monetary policy

In the previous module we discussed how expansionary and contractionary monetary policy can be used to stabilize the economy. The Federal Reserve can use its monetary policy tools to change the money supply and cause the equilibrium interest rate in the money market to increase or decrease. But what if a central bank pursues a monetary policy that is not appropriate? That is, what if a central bank pursues expansionary policy during an expansion or contractionary policy during a recession? In this module we consider how a counter-productive action by a central bank can actually destabilize the economy in the short run. We also introduce the long-run effects of monetary policy. As we learned in the last section, the money market (where monetary policy has its effect on the money supply) determines the interest rate only in the short run. In the long run, the interest rate is determined in the market for loanable funds. Here we look at long-run adjustments and consider the long-run effects of monetary policy.

Because of its expansionary and contractionary effects, monetary policy is generally the policy tool of choice to help stabilize the economy. However, not all actions by central banks are productive. In particular, as we'll see later, central banks sometimes print money not to fight a recessionary gap but to help the government pay its bills, an action that typically destabilizes the economy.

What happens when a change in the money supply pushes the economy away from, rather than toward, long-run equilibrium? The economy is self-correcting in the long run: a demand shock has only a temporary effect on aggregate output. If the demand shock is the result of a change in the money supply, we can make a stronger statement: in the long run, changes in the quantity of money affect the aggregate price level, but they do not change real aggregate output or the interest rate. To see why, let's look at what happens if the central bank permanently increases the money supply.

◀ Money, Output, and Prices ▶

# Short-Run and Long-Run Effects of an Increase in the Money Supply

To analyze the long-run effects of monetary policy, it's helpful to think of the central bank as choosing a target for the money supply rather than for the interest rate. In assessing the effects of an increase in the money supply, we return to the analysis of the long-run effects of an increase in aggregate demand.

**Figure 32.1** shows the short-run and long-run effects of an increase in the money supply when the economy begins at potential output,  $Y_1$ . The initial short-run aggregate supply curve is  $SRAS_1$ , the long-run aggregate supply curve is  $LRAS$ , and the initial aggregate demand curve is  $AD_1$ . The economy's initial equilibrium is at  $E_1$ , a point of both short-run and long-run macroeconomic equilibrium because it is on both the short-run and the long-run aggregate supply curves. Real GDP is at potential output,  $Y_1$ .

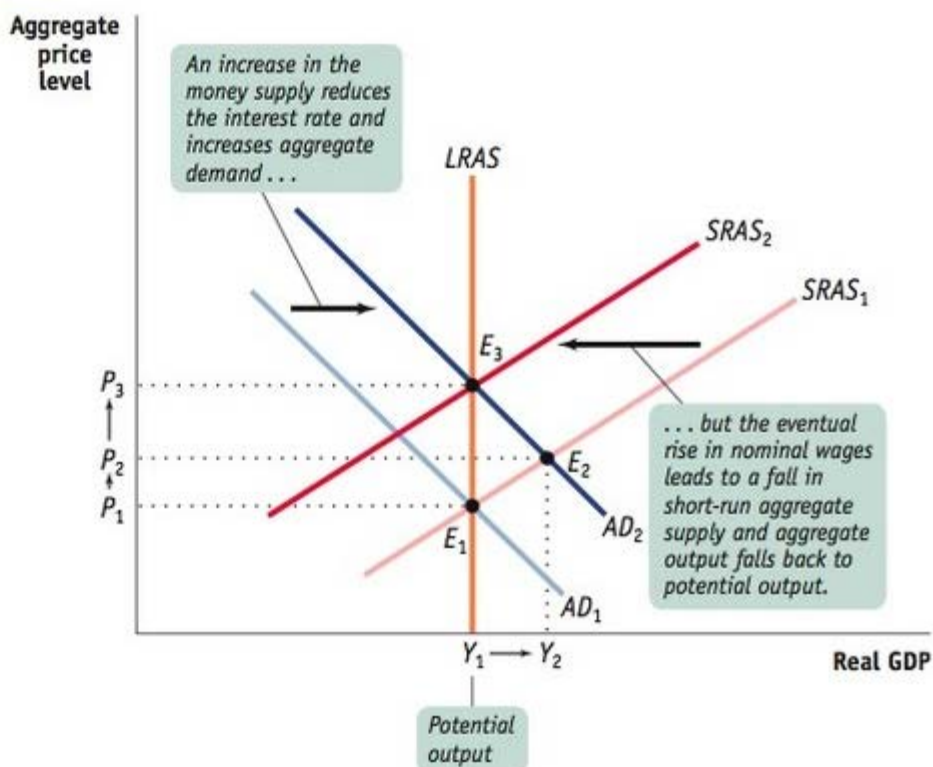
Now suppose there is an increase in the money supply. Other things equal, an increase in the money supply reduces the interest rate, which increases investment spending, which leads to a further rise in consumer spending, and so on. So an increase in the money supply increases the quantity of goods and services demanded, shifting the  $AD$  curve rightward to  $AD_2$ . In the short run, the economy moves to a new short-run macroeconomic equilibrium at  $E_2$ . The price level rises from  $P_1$  to  $P_2$ , and real GDP rises from  $Y_1$  to  $Y_2$ . That is, both the aggregate price level and aggregate output increase in the short run.

But the aggregate output level  $Y_2$  is above potential output. As a result, nominal wages will rise over time, causing the short-run aggregate supply curve to shift leftward. This process stops only when the  $SRAS$  curve ends up at  $SRAS_2$  and the economy ends up at point  $E_3$ , a point of both short-run and long-run macroeconomic equilibrium. The long-run effect of an increase in the money supply, then, is that the aggregate price level has increased from  $P_1$  to  $P_3$ , but aggregate output is back at potential output,  $Y_1$ . In the long run, a monetary expansion raises the aggregate price level but has no effect on real GDP.

figure 32.1

### The Short-Run and Long-Run Effects of an Increase in the Money Supply

An increase in the money supply generates a positive short-run effect, but no long-run effect, on real GDP. Here, the economy begins at  $E_1$ , a point of short-run and long-run macroeconomic equilibrium. An increase in the money supply shifts the  $AD$  curve rightward, and the economy moves to a new short-run equilibrium at  $E_2$  and a new real GDP of  $Y_2$ . But  $E_2$  is not a long-run equilibrium:  $Y_2$  exceeds potential output,  $Y_1$ , leading over time to an increase in nominal wages. In the long run, the increase in nominal wages shifts the short-run aggregate supply curve leftward, to a new position at  $SRAS_2$ . The economy reaches a new short-run and long-run macroeconomic equilibrium at  $E_3$  on the  $LRAS$  curve, and output falls back to potential output,  $Y_1$ . The only long-run effect of an increase in the money supply is an increase in the aggregate price level from  $P_1$  to  $P_3$ .



If the money supply decreases, the story we have just told plays out in reverse. Other things equal, a decrease in the money supply raises the interest rate, which decreases investment spending, which leads to a further decrease in consumer spending, and so on. So a decrease in the money supply decreases the quantity of goods and services demanded at any given aggregate price level, shifting the aggregate demand curve to the left. In the short run, the economy moves to a new short-run macroeconomic equilibrium at a level of real GDP below potential output and a lower aggregate price level. That is, both the aggregate price level and aggregate output decrease in the short run. But what happens over time? When the aggregate output level is below potential output, nominal wages fall. When this happens, the short-run aggregate supply curve shifts rightward. This process stops only when the  $SRAS$  curve ends up at a point of both short-run and long-run macroeconomic equilibrium. The long-run effect of a decrease in the money supply, then, is that the aggregate price level decreases, but aggregate output is back at potential output. In the long run, a monetary contraction decreases the aggregate price level but has no effect on real GDP.

# Monetary Neutrality

How much does a change in the money supply change the aggregate price level in the long run? The answer is that a change in the money supply leads to a proportional change in the aggregate price level in the long run. For example, if the money supply falls 25%, the aggregate price level falls 25% in the long run; if the money supply rises 50%, the aggregate price level rises 50% in the long run.

How do we know this? Consider the following thought experiment: suppose all prices in the economy—prices of final goods and services and also factor prices, such as nominal wage rates—double. And suppose the money supply doubles at the same time. What difference does this make to the economy in real terms? None. All real variables in the economy—such as real GDP and the real value of the money supply (the amount of goods and services it can buy)—are unchanged. So there is no reason for anyone to behave any differently.

We can state this argument in reverse: if the economy starts out in long-run macroeconomic equilibrium and the money supply changes, restoring long-run macroeconomic equilibrium requires restoring all real values to their original values. This includes restoring the real value of the money supply to its original level. So if the money supply falls 25%, the aggregate price level must fall 25%; if the money supply rises 50%, the price level must rise 50%; and so on.

This analysis demonstrates the concept known as **monetary neutrality**, in which changes in the money supply have no real effects on the economy. In the long run, the only effect of an increase in the money supply is to raise the aggregate price level by an equal percentage. Economists argue that *money is neutral in the long run*.

This is, however, a good time to recall the dictum of John Maynard Keynes: “In the long run we are all dead.” In the long run, changes in the money supply don’t have any effect on real GDP, interest rates, or anything else except the price level. But it would be foolish to conclude from this that the Fed is irrelevant. Monetary policy does have powerful real effects on the economy in the short run, often making the difference between recession and expansion. And that matters a lot for society’s welfare.

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According to the concept of **monetary neutrality**, changes in the money supply have no real effects on the economy.

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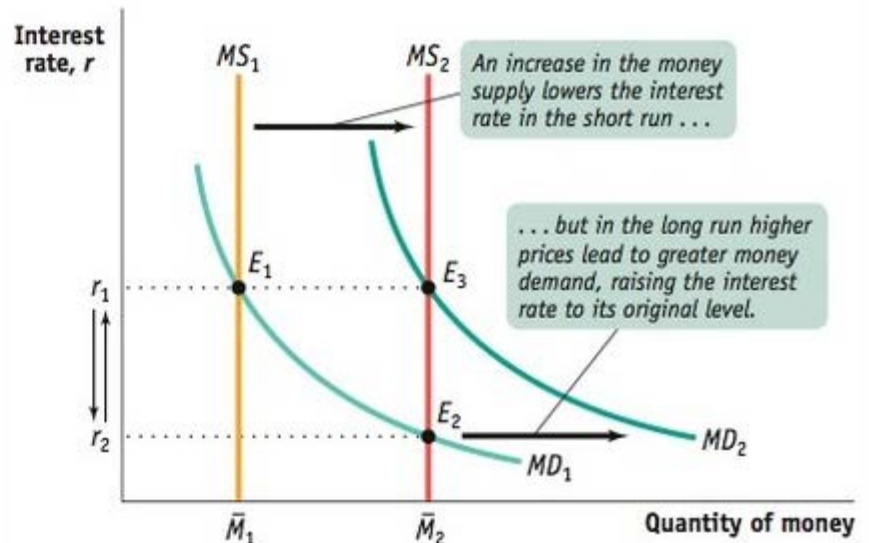
# Changes in the Money Supply and the Interest Rate in the Long Run

In the short run, an increase in the money supply leads to a fall in the interest rate, and a decrease in the money supply leads to a rise in the interest rate. **Module 29** explained that in the long run it's a different story: changes in the money supply don't affect the interest rate at all. Here we'll review that story and discuss the reasons behind it in greater detail.

**figure 32.2**

## The Long-Run Determination of the Interest Rate

In the short run, an increase in the money supply from  $\bar{M}_1$  to  $\bar{M}_2$  pushes the interest rate down from  $r_1$  to  $r_2$  and the economy moves to  $E_2$ , a short-run equilibrium. In the long run, however, the aggregate price level rises in proportion to the increase in the money supply, leading to an increase in money demand at any given interest rate in proportion to the increase in the aggregate price level, as shown by the shift from  $MD_1$  to  $MD_2$ . The result is that the quantity of money demanded at any given interest rate rises by the same amount as the quantity of money supplied. The economy moves to long-run equilibrium at  $E_3$  and the interest rate returns to  $r_1$ .



**Figure 32.2** shows the money supply curve and the money demand curve before and after the Fed increases the money supply. We assume that the economy is initially at  $E_1$ , in long-run macroeconomic equilibrium at potential output, and with money supply  $\bar{M}_1$ . The initial equilibrium interest rate, determined by the intersection of the money demand curve  $MD_1$  and the money supply curve  $MS_1$ , is  $r_1$ .

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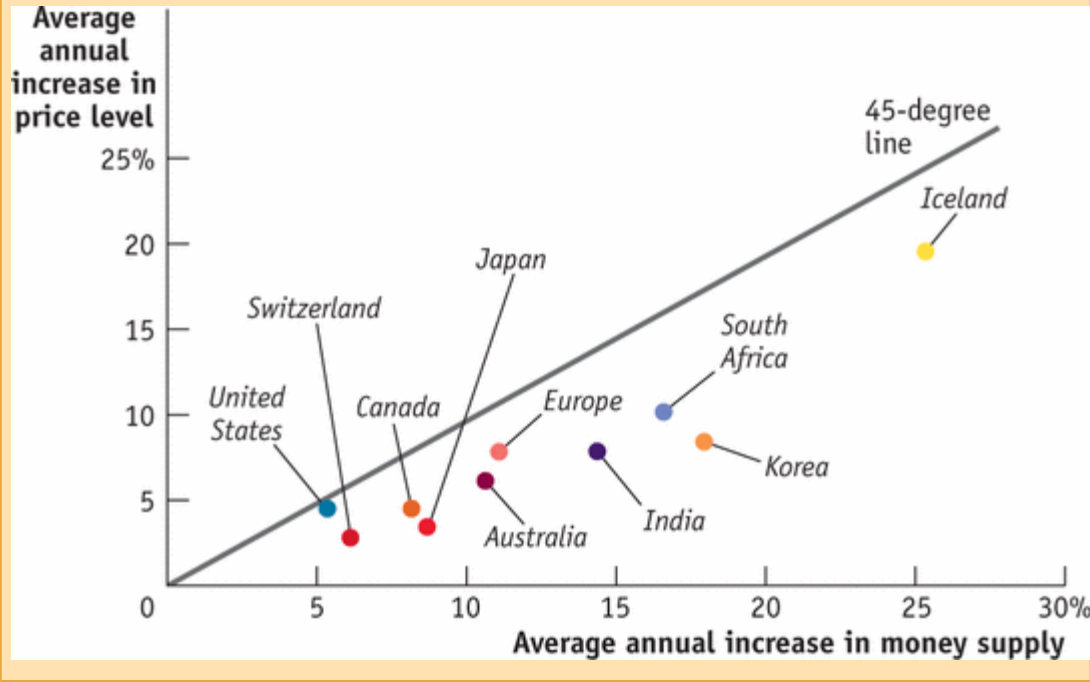
## International Evidence of Monetary Neutrality

These days monetary policy is quite similar among wealthy countries. Each major nation (or, in the case of the euro, the eurozone) has a central bank that is insulated from political pressure. All of these central banks try to keep the aggregate price level roughly stable, which usually means inflation of at most 2% to 3% per year.

But if we look at a longer period and a wider group of countries, we see large differences in the growth of the money supply. Between 1970 and the present, the money supply rose only a few percentage points per year in countries such as Switzerland and the United States, but rose much more rapidly in some poorer countries, such as South Africa. These differences allow us to see whether it is really true that increases in the money supply lead, in the long run, to equal percentage increases in the aggregate price level.

The figure shows the annual percentage increases in the money supply and average annual increases in the aggregate price level—that is, the average rate of inflation—for a sample of countries during the period 1970–2007, with each point representing a country. If the relationship between increases in the

money supply and changes in the aggregate price level were exact, the points would lie precisely on a 45-degree line. In fact, the relationship isn't exact because other factors besides money affect the aggregate price level. But the scatter of points clearly lies close to a 45-degree line, showing a more or less proportional relationship between money and the aggregate price level. That is, the data support the concept of monetary neutrality in the long run.



Now suppose the money supply increases from  $\bar{M}_1$  to  $\bar{M}_2$ . In the short run, the economy moves from  $E_1$  to  $E_2$  and the interest rate falls from  $r_1$  to  $r_2$ . Over time, however, the aggregate price level rises, and this raises money demand, shifting the money demand curve rightward from  $MD_1$  to  $MD_2$ . The economy moves to a new long-run equilibrium at  $E_3$ , and the interest rate rises to its original level of  $r_1$ .

How do we know that the long-run equilibrium interest rate is the original interest rate,  $r_1$ ? Because the eventual increase in money demand is proportional to the increase in money supply, thus counteracting the initial downward effect on interest rates. Let's follow the chain of events to see why. With monetary neutrality, an increase in the money supply is matched by a proportional increase in the price level in the long run. If the money supply rises by, say, 50%, the price level will also rise by 50%. Changes in the price level, in turn, cause proportional changes in the demand for money. So a 50% increase in the money supply raises the aggregate price level by 50%, which increases the quantity of money demanded at any given interest rate by 50%. Thus, at the initial interest rate of  $r_1$ , the quantity of money demanded rises exactly as much as the money supply, and  $r_1$  is again the equilibrium interest rate. In the long run, then, changes in the money supply do not affect the interest rate.

◀ Changes in the Money Supply and the Inte... ▶

## Check Your Understanding

1. Suppose the economy begins in long-run macroeconomic equilibrium. What is the long-run effect on the aggregate price level of a 5% increase in the money supply? Explain.

[Answer Field]

Show Answer

2. Again supposing the economy begins in long-run macroeconomic equilibrium, what is the long-run effect on the interest rate of a 5% increase in the money supply? Explain.

[Answer Field]

Show Answer



## Tackle the Test: Multiple-Choice Questions

1. In the long run, changes in the quantity of money affect which of the following?
- I. real aggregate output
  - II. interest rates
  - III. the aggregate price level
- a. I only
  - b. II only
  - c. III only
  - d. I and II only
  - e. I, II, and III

[Answer Field]

Show Answer

2. An increase in the money supply will lead to which of the following in the short run?
- a. higher interest rates
  - b. decreased investment spending
  - c. decreased consumer spending
  - d. increased aggregate demand
  - e. lower real GDP

[Answer Field]

Show Answer

3. A 10% decrease in the money supply will change the aggregate price level in the long run by
- a. zero.
  - b. less than 10%.
  - c. 10%.
  - d. 20%.
  - e. more than 20%.

[Answer Field]

Show Answer

4. Monetary neutrality means that, in the long run, changes in the money supply
- a. can not happen.
  - b. have no effect on the economy.
  - c. have no real effect on the economy.
  - d. increase real GDP.
  - e. change real interest rates.

[Answer Field]

Show Answer

5. A graph of percentage increases in the money supply and average annual increases in the price level for various countries provides evidence that
- a. changes in the two variables are exactly equal.
  - b. the money supply and aggregate price level are unrelated.
  - c. money neutrality holds only in wealthy countries.
  - d. monetary policy is ineffective.
  - e. money is neutral in the long run.

[Answer Field]

Show Answer

## Tackle the Test: Free-Response Questions

1. Assume the central bank increases the quantity of money by 25%, even though the economy is initially in both short-run and long-run macroeconomic equilibrium. Describe the effects, in the short run and in the long run (giving numbers where possible), on the following:
  - a. aggregate output  
[Answer Field]
  - b. the aggregate price level  
[Answer Field]
  - c. the real value of the money supply (its purchasing power for goods and services)  
[Answer Field]
  - d. the interest rate  
[Answer Field]

### Answer (8 points)

- 1 point: Aggregate output rises in the short run.
- 1 point: Aggregate output falls back to potential output in the long run.
- 1 point: The aggregate price level rises in the short run (by less than 25%).
- 1 point: The aggregate price level rises by 25% in the long run.
- 1 point: The real value of the money supply increases in the short run.
- 1 point: The real value of the money supply does not change (relative to its original value) in the long run.
- 1 point: The interest rate falls in the short run.
- 1 point: The interest rate rises back to its original level in the long run.

2.
  - a. Draw a correctly labeled graph of aggregate demand and supply showing an economy in long-run macroeconomic equilibrium.  
[Answer Field]  
[Show Answer](#)
  - b. On your graph, show what happens in the short run if the central bank increases the money supply to pay off a government deficit. Explain.  
[Answer Field]  
[Show Answer](#)
  - c. On your graph, show what will happen in the long run. Explain.  
[Answer Field]  
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