Chapter 11

Strategies *and* Rules *for* Monetary Policy

After reading this chapter, you will understand the following:

1. Why lags, forecasting errors, and time-inconsistency make it difficult to fine-tune the economy.
2. The distinctions among policy instruments, operating targets, intermediate targets, and goals
3. How policy rules attempt to overcome the limits of fine-tuning
4. The advantages and disadvantages of various policy rules and targets

Before reading this chapter, make sure you know the meaning of the following concepts:

1. The aggregate supply and demand model
2. Monetary policy instruments
3. Fiscal policy
4. Money
5. Planned expenditure
6. The multiplier effect
7. Equation of exchange
8. Velocity
9. Transmission mechanism

Stability and prosperity are the twin goals of macroeconomic policy. Achieving stability means taming the business cycle by moderating short-term swings in real output, inflation, and unemployment. Achieving prosperity means promoting productivity and growth of real output over a longer time horizon. There is a close relationship between the two goals: if short-term stabilization policy fails, long-run prosperity will prove elusive.

To achieve stability and prosperity, monetary and fiscal policy must work together. This chapter focuses primarily on strategies and rules for monetary policy although some of the ideas it presents apply to both areas of policy. Chapters 12 and 13 will undertake a more detailed look at fiscal policy. Chapter 14 will show how policy rules can be used to tame inflation and deflation.

11.1 The Limits of Fine-tuning

The discussion of domestic and international monetary policy instruments in Chapters 8 and 9, together with the aggregate supply and demand model developed in Chapter 10, provide a framework for our discussion of stabilization policy. As this chapter will make clear, however, the models are only a starting point. Models make stabilization policy look far too easy—as if policymakers were like engineers in a recording studio, who can just twist a few knobs with labels like "monetary base" and "federal funds rate," and presto! Aggregate demand, interest rates, real output, and the price level will slip into harmony with one another.

Fine-tuning

An economic policy strategy that attempts to avoid even small, short-run departures from full employment and price stability

Applying Economic Ideas 11.1 explains that there was a time when economists thought a strategy of **fine-tuning** was possible. Over the years, however, it has become apparent that between the clean, orderly, world of the models and the real world where policymakers operate there exist some messy problems that make it frustratingly difficult to fine-tune the economy to a state of harmonious stability.

Applying Economic Ideas 11.1

"It Is Now Within Our Capabilities …"

The 1960s were an exciting decade for the economics profession. Some people had feared that the United States would sink into renewed depression after World War II, but instead, the economy returned to prosperity. Although the 1950s were, on the whole, a good decade for the economy, many people thought the country could do even better.

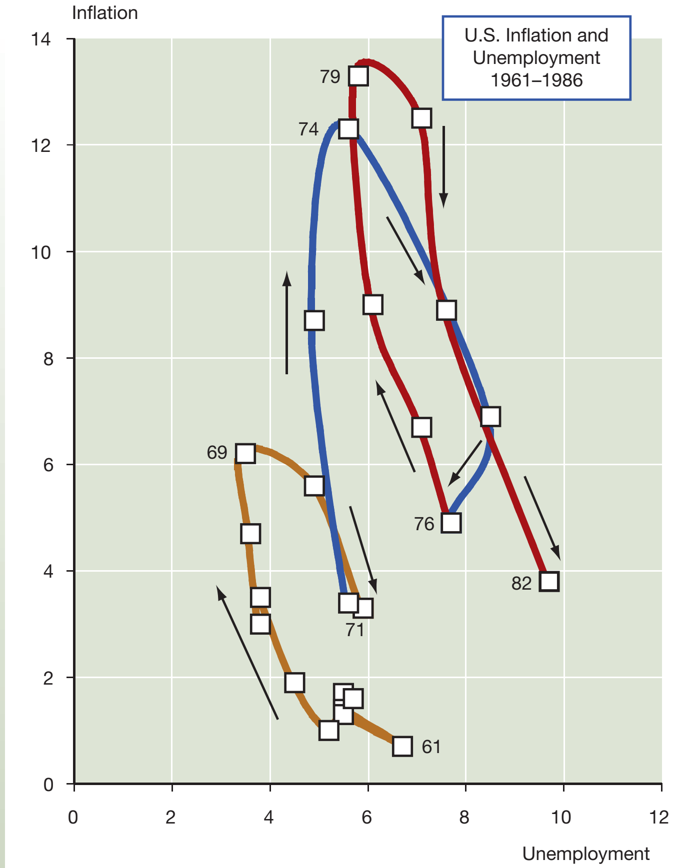
In the 1960s, Harvard-educated President John F. Kennedy brought some of the country's best and brightest economists to Washington, including some of his former professors. His successor, Lyndon Johnson, kept them there. By 1966, the President's Council of Economic Advisers consisted of three of the most distinguished professionals ever to sit on that body: Gardner Ackley, Otto Eckstein, and Arthur Okun.

Armed with refined versions of theories that John Maynard Keynes had developed in the 1930s by and with newly available electronic computers, these policymakers were convinced that it was time to attempt more than just safeguarding the economy from deep depression and runaway inflation. In their 1966 Economic Report to the President, they wrote,

> It is now within our capabilities to set more ambitious goals.... We strive to avoid recurrent recessions, to keep unemployment far below rates of the past decade, to maintain price stability at full employment … and indeed to make full prosperity the normal state of the American economy. It is a tribute to our success … that we now have not only the economic understanding but also the will and determination to use economic policy as an effective tool for progress.

It was a high-water mark of professional self-confidence. Regrettably, the hope that policymakers would be able to fine-tune the economy to recession-free and inflation-free prosperity proved unfounded. As the figure shows, 1965, with its enviable achievements of 4.5 percent unemployment with just 1.9 percent inflation was the last good year before a long period of serious instability. Between 1965 and 1982, the U.S. economy went through three severe cycles of inflation and unemployment. In each cycle, the highest rates of inflation and unemployment exceeded the cycle before. 1960s-style fine-tuning failed dismally to live up to expectations.

SOURCE OF QUOTATION: Annual Report of the Council of Economic Advisers, 1966. Washington, D.C.: Government Printing Office, p. 186.



The Problem of Lags

The first problem standing in the way of fine-tuning is that of *lags*, a term economists use to refer to unavoidable delays in the execution of monetary or fiscal policy. There are two kinds of these lags. **Inside lags** are delays between the time a problem develops and the time policymakers decide what to do about it. **Outside lags** are delays between the time policymakers reach a decision and the time when the resulting policy action affects the economy. Both kinds of lags are a problem for both monetary and fiscal policy.

Inside lags
Delays between the time a problem develops and the time policymakers decide what to do about it

Outside lags
Delays between the time policymakers reach a decision and the time the resulting policy action affects the economy

Inside Lags Some inside lags arise because of the time required to collect and report economic data. A few kinds of data, like interest rates and exchange rates, are available almost instantly; other important data take longer to gather. Data on inflation, unemployment, consumer confidence, and several other variables come out monthly. The longest lags are for data on GDP and foreign transactions. As explained in Chapter 6, those data are available only quarterly. Furthermore, the first estimates for each quarter, published about four weeks after the close of the quarter, are subject to significant revisions. Final data are not available until nearly three months after the close of the quarter.

Another problem compounds the effect of lags. Random events like weather and measurement errors influence all macroeconomic variables in a way that causes unpredictable ups and downs in monthly or quarterly indicators. That means it is usually not enough to base policy decisions on the single most recent observation. It may take several monthly or quarterly observations to establish a clear trend on the basis of which policymakers can reach sound decisions.

The long lags in collection of macroeconomic data, especially data on real GDP and its components, mean that policymakers may not be aware of a turning point in the business cycle until long after it has occurred. Consider the example of the mild recession from January to November 2001, which marked the end of the dot com boom. In May 2001, when the recession was already half over, the latest government data still showed the economy to be expanding, although at a slowing rate. Only after the recession was over did revised data clearly show that the economy had begun to shrink at the end of 2000. The next recession officially started at the end of 2007. However, an increase in GDP in the second quarter of 2008 followed a drop in the first quarter. Then, just as some people began to think there might be a quick recovery, GDP turned down again and shrank for four successive quarters.

In addition to delays in data collection, the time needed to make decisions adds to the inside lag. The Fed makes decisions on interest rates and other instruments at regular meetings of the Federal Open Market Committee, which occur just eight times a year. Before those meetings can take place, the Fed's professional staff spend weeks of work preparing background materials. The Fed has the power to make emergency changes in policy between regular meetings, but it does so only rarely. Decision-making lags for fiscal policy can be even longer since many key fiscal policy decisions require action by Congress. The next two chapters will return to the problem of lags in fiscal policy.

Outside Lags Even after policymakers reach a decision, their actions do not affect the economy immediately. Consider the use of expansionary monetary policy to cut interest rates. Lower interest rates affect aggregate demand by reducing the cost of business investment and home mortgages. Firms and households do not react instantly to interest rate changes. It takes time for them to make investment decisions. Even after they make decisions, they must draw up designs, place orders, and obtain permits before projects actually get under way.

The aggregate supply and demand model allows for some of the most important outside lags. Suppose a policy change shifts the aggregate demand curve to the right, as shown in Figure 10.6 of the previous chapter. At first the economy begins to move up and to the right along the short-run aggregate supply curve, with both prices and output rising. After a lag, the short-run aggregate supply curve begins to shift upward. Prices rise even more, but real output begins to move back toward its natural level. The economy does not reach a new long-run equilibrium until it returns to a point where the aggregate demand curve and the short- and long-run aggregate supply curves all intersect at a common point equal to the natural level of real output.

The model makes the sequence of events clear enough, but policymakers need to know more than that. Just how long, according to the calendar, are the abstract intervals of "short run" and "long run" that mark stages in the adjustment process? Econometric studies shed some light on the issue. Studies based on data from both the United States and Europe suggest that the "short run," during which real output increases following a reduction in interest rates (or falls following an increase in rates), lasts for at least one year and sometimes as much as two years. The full effect of an interest rate change on the price level, allowing time for real output to return to its natural level, appears to take three years or longer. By the time the full effects of one policy change work their way through the economy, it is likely that new events will disturb aggregate demand and supply. In reality, the economy is constantly in motion and never reaches a full long-run equilibrium of the kind we show so easily in textbook graphs.

Forecasting Errors

Lags in data collection and policy effectiveness are serious problems, but they would cause less trouble if we had accurate forecasts. Consider the situation of an economic policy maker in comparison to that of the captain of a giant oil tanker. The tanker captain also faces a problem of lags. If she turns the wheel of her ship or signals for a change in engine speed, it may take up to several miles for the ship to steady on its new course. The difference between the captain and the policymaker is that the captain has accurate charts of the waters she is navigating and radar to show obstacles ahead. Based on the charts and radar, she can give orders well in advance, so that the ship changes course long before it goes on the rocks. In contrast, the economic policymaker has no good way to see into the future. The economic ship may end up on the rocks before anyone knows what has happened.

Instead of charts and radar, policymakers must rely on economic forecasts. In every country, competing teams of economists—some private and some in government agencies like the Fed and the Office of Management and Budget—publish estimates of key variables for the year ahead. Unfortunately, those forecasts are not as reliable as we would like. According to a study by the International Monetary Fund, one-year forecasts of the rate of real GDP growth for industrialized countries are, on average, wrong by more than a full percentage point (disregarding the sign of the error).[1] For two years ahead, the error is nearly two percentage points. For developing countries, accuracy is worse than this by still another full percentage point.

What is more, forecasts are least accurate at turning points in the business cycle, just when we need them most. Looking at an international sample of seventy-two recessions in the 1990s, the IMF paper found only two cases in which forecasters accurately predicted the recession two years in advance. Even more than halfway through the year in which a recession began, only about half of forecasters were predicting that a recession would occur.

Economic forecasts tend to be least accurate at turning points in the business cycle, when we need them most.

Several factors combine to reduce the accuracy of forecasts. First, forecasters themselves face the problem of lags in data collection. They must try to see into the future when they are not yet sure what has happened in the recent past. Second, the real world economy is much more complex than any model—not just more complex than the simplified models of textbooks like this one, but more complex than even the most sophisticated multivariate models of the best professional forecasters. Third, because the structure of the economy is always changing, models that rely on data from past periods may not be reliable for forecasting the future.

Finally, forecasts are subject to bias. Government forecasts may have a bias toward optimism because politicians do not like to hear or deliver bad news. Private sector forecasters may see a marketing advantage in developing a reputation as being persistently optimistic or persistently gloomy. The private clients of forecasters may reinforce those tendencies when, knowing that forecasts are not accurate, they play it safe by buying forecasts from several sources with differing methodologies and reputations.

Time Inconsistency

Lags and forecasting errors together make the conduct of economic policy very difficult, but they are not the whole story. We must add one more factor to see the full difficulty of fine-tuning the economy. Economists call that factor **time-inconsistency**, by which they mean a tendency of policymakers to take actions that have desirable results in the short run, but undesirable long-run results.

Time-inconsistency
Tendency of policymakers to take actions that have desirable results in the short run, but undesirable long-run results

Time-inconsistency is not unique to economic policymaking. It occurs in many situations of everyday life. Perhaps some readers may have had the experience of accepting a glass of tequila or vodka at a party. The short-run effects of drinking it are pleasant, so down goes another glass, and then another. The next day the undesirable results come on in full force. As another example of time-inconsistency, patients with drug-resistant forms of tuberculosis or malaria must take heavy doses of strong medications over a long period in order to achieve a full cure. Often, such patients feel better after just a few weeks; they then stop taking their medicine because of unpleasant side effects. When they stop the medications before the cure is complete, they become carriers of drug-resistant forms of the disease. In the long run, they endanger their whole community.

Time-inconsistency is especially troublesome when policymaking interacts with the cycle of democratic elections. For example, the aggregate supply and demand model shows that expansionary policies like tax cuts initially have desirable results. They shift the aggregate demand curve, and the economy moves up and to the right along its short-run aggregate supply curve. Real output increases, incomes increase, unemployment falls, and there is only mild inflation. This process takes place over a short-run time frame of one to two years.

Later, as expectations adjust and the short-run aggregate supply curve begins to shift upward, less desirable consequences occur. Real output falls back toward its natural level, and unemployment rises back toward its natural rate. The rate of inflation increases. That process occurs over a time frame of one or two additional years, perhaps longer.

Taking all of the lags into account, we can see that if expansionary policy comes into effect a year or so before an election, the beneficial effects will be at their strongest just as the election approaches. The harmful effects will come along in due time, but not until the election has passed.

For contractionary policy, the sequence of events works in reverse. Suppose policymakers use an increase in interest rates or taxes to combat overheating of the economy. The immediate effect will be a leftward shift of the aggregate demand curve and a move down and to the left along the short-run aggregate supply curve. During this painful phase, which lasts a year or two years, unemployment rises, real output and incomes fall, and the rate of inflation slows only a little. Later, after expectations adjust, the short-run aggregate supply curve will begin to shift downward. Real output will again rise toward its natural level, and unemployment will fall back toward its natural rate. There will be additional progress toward slowing, or even reversing, previous inflation.

In short, from a political point of view, the period just before an election is not a good time to make a move toward stopping inflation. There will be a temptation to let the economy overheat for a few months longer and begin to apply contractionary medicine only after the election has passed.

Unintended Consequences

When lags, forecasting errors, and time-inconsistency are combined, well-intentioned efforts to fine-tune the economy are in danger of producing two types of unintended consequences.

First, there is a danger that lags and forecasting errors alone will lead policymakers to apply expansionary or contractionary policy too late in the business cycle. Expansionary policies, intended to combat a recession, may not have their full effect until the next upturn of the business cycle has already begun. When they do, they will push the economy past the point of equilibrium and promote inflationary overheating. Similarly, contractionary policies, intended to prevent overexpansion during a boom, may come into effect only after the economy has already begun to slow. They will make the next recession worse than it would have been if policymakers had done nothing. Together, then, lags and forecasting errors create a danger that poorly timed policy will cause overshooting at both ends of the business cycle.

Second, when we add the problem of time-inconsistency to those of lags and forecasting errors, policy may develop a systematic bias toward expansion and inflation. Policymakers will continue expansionary policy too long at the top of the business cycle, causing the economy to overheat. They will cut contractions short before they have fully squeezed out inflation. The motives for doing so are largely political. Policymakers want to prolong expansionary policies like tax cuts, spending increases, or interest rate reductions, even at the risk of inflation, in order to keep unemployment low ahead of the next election. For the same reason, they want to delay the application of contractionary policies like tax increases, spending cuts, or interest rate increases.

Is this purely a theoretical danger, or could it actually happen? Look back for a moment to the diagram in *Applying Economic Ideas 11.1* near the beginning of this chapter. A close examination of the figure will show that the inflation rates at the cyclical peaks of 1969, 1974, and 1979 are each time higher than the peak rate of the preceding cycle. Similarly, the unemployment rates at the cyclical troughs of 1971, 1976, and 1982 are also each higher than at the preceding trough. Clearly, the experience of the 1960s and 1970s failed to justify hopes that economists had finally acquired both the tools and the political will to implement successful fine-tuning.

11.2 Policy Rules

Since the 1970s, there has been a widespread shift in the way economists think about stabilization policy.[2] They no longer view fine-tuning with favor. That does not mean economists think monetary and fiscal policy are ineffective. It does not mean that the government should always take a hands-off approach to the business cycle. It does not deny that emergency measures may be helpful in extreme situations. What it does mean is that in a world of lags and forecasting errors, frequent, discretionary tinkering with monetary and fiscal policy is more likely to be destabilizing than stabilizing. Destabilization is even more likely when we take into account the risk of politically motivated time-inconsistency.

Policy rules
A set of rules for monetary and fiscal policy that specifies in advance the actions that policymakers will take in response to economic developments

In place of fine-tuning, a majority of economists now favor stabilization strategies based on preset **policy rules**. Policymakers should announce in advance the way they will respond to unfolding developments in the economy. There is a growing consensus that such rules minimize the risk that lags and forecasting errors will lead to overshooting at peaks and troughs of the business cycle and minimize the unintended consequences of politically motivated time-inconsistency. If successful, policy rules will provide a stable framework for planning by private firms and households and promote long-run prosperity. This section focuses primarily on rules for monetary policy. We will look at rules for fiscal policy in Chapter 13.

Instruments and Targets

As background for our discussion of policy rules, it is useful to distinguish among instruments, targets, and goals of economic policy.

- A **policy instrument** is a variable that is directly under the control of policymakers. For example, open market purchases and the discount rate are policy instruments of the Federal Reserve.
- An **operating target** is a variable that responds immediately, or almost immediately, to the use of a policy instrument. For example, the federal funds rate for interbank lending (an operating target) responds almost immediately to an open market purchase (a policy instrument).
- An **intermediate target** is a variable that responds to the use of a policy instrument or a change in operating target with a significant lag. For example, inflation and real GDP (intermediate targets) respond to changes in interest rates (an operating target), but not immediately.
- A **policy goal** is a long-run objective of economic policy that is important for economic welfare. Stated in their broadest forms, the goals of macroeconomic policy are prosperity and stability.

Policy instrument
A variable directly under the control of policymakers

Operating target
A variable that responds immediately to the use of a policy instrument

Intermediate target
A variable that responds to the use of a policy instrument or a change in operating target with a significant lag

Policy goal
A long-run objective of economic policy that is important for economic welfare

We can illustrate the hierarchy of instruments, targets, and goals by returning to our example of the oil tanker. The ship's wheel and engine speed control are the captain's main policy instruments. The ship's speed and course are operating targets that respond immediately, or almost immediately, to use of those instruments. The captain's intermediate target, on a given voyage, is to get the ship to a certain harbor by a certain date. Long-run goals, over a series of voyages, are to establish a reputation for reliability and earn a profit for the company that owns the ship.

Debates over strategies for stabilization policy do not usually focus on the choice of policy instruments or the long-term policy goals of prosperity and stability. More often, they focus on which operating targets to emphasize and the choice of intermediate targets that link changes in operating targets to long-term goals. The remainder of the chapter will look at several alternative policy rules, each having its supporters and critics.

Monetarism: The Grandparent of Policy Rules

Monetarism

A school of economic thought that emphasized the importance of the quantity of money and advocated the use of stable rules for monetary policy

Even while enthusiasm for macroeconomic fine-tuning was at its peak in the 1960s, there were dissenters. One of the best known was University of Chicago professor Milton Friedman. (*See Who Said It? Who Did it? 11.1*.) Friedman was the intellectual leader, although by no means the only prominent member, of a school of thought that economists came to call **monetarism**.

Who Said It? Who Did It? 11.1

Milton Friedman and Monetarism

In October 1976, Milton Friedman received the Nobel Memorial Prize in Economics, becoming the sixth American to win or share that honor. Few people were surprised. Most people wondered why he had to wait so long. Perhaps it was because Friedman had built his career outside the economics establishment, challenging almost every major doctrine of the profession.

Friedman was born in New York in 1912, the son of immigrant garment workers. He attended Rutgers University where he came under the influence of Arthur Burns, then a young assistant professor and later chairman of the Federal Reserve Board. From Burns Friedman learned the importance of empirical work in economics. Statistical testing of all theory and policy prescriptions became a key feature of Friedman's later work. From Rutgers, Friedman went to the University of Chicago for an MA and then east again to Columbia University, where he received his PhD in 1946. He returned to Chicago to teach. There, he and his colleagues of the "Chicago school" of economics posed a major challenge to economists of the "Eastern establishment."

If one could single out a recurrent theme in Friedman's work it would be his belief that the market economy works—and that it works best when left alone. "The Great Depression," Friedman once wrote, "far from being a sign of the inherent instability of the private enterprise system, is a testament to how much harm can be done by mistakes on the part of a few men when they wield vast power over the monetary system of the country."

Friedman strongly favored a hands-off policy by government in almost every area. In his view, the problem was not that government is evil by nature, but that so many policies end up having the opposite of their intended effects. He thought that social reformers who claimed to do nothing but serve the public interest would invariably be led to serve some private interest, even if doing so was not part of their intention. Not just monetary policy but also transportation regulation, public education, agricultural subsidies, and housing programs were among the many policy areas in which Friedman believed that the government has done more harm than good and for which a free competitive market would do better.

Source for quotation: Milton Friedman, *Capitalism and Freedom*, 1962.

In his most famous work, *A Monetary History of the United States*, co-authored with Anna Schwartz, Friedman argued for a reinterpretation of the causes of the Great Depression. In the book, Friedman and Schwartz took issue with the approach that John Maynard Keynes had taken in the 1930s (See *Who Said It? Who Did It? 4.1*). Keynes' approach emphasized fiscal policy, planned expenditure, and the multiplier as the key variables in macroeconomics. Friedman saw mistakes, instead, in monetary policy as the principal factor that turned an ordinary cyclical recession into a national disaster lasting ten years. He argued that the correct conduct of monetary policy continued to be crucial for stabilization policy in the 1960s. This emphasis on monetary policy gave the monetarist school its name.

A second element of Friedman's thinking was his argument that neither monetary nor fiscal policy is capable of fine-tuning the economy. Instead, the Federal Reserve should conduct its policy according to a simple rule that would avoid the problems of lags, forecasting errors, and time-inconsistency. Specifically, Friedman recommended that the Fed use a steady rate of growth of the money stock, equal to the economy's long-run rate of growth of real GDP, as its principal operating target. It would use open market operations as its main instrument for keeping money growth on target.

The link between the operating target of steady money growth and the policy goals of stability and full employment can be expressed by means of the equation of exchange, MV = PQ. As explained in Chapter 8, M stands for the quantity of money, V for the velocity of circulation of money, P for the price level, and Q for real GDP. The concept behind Friedman's money growth rule was that if M grew steadily at the same rate as Q, and V was subject only to minor or predictable variations, the price level P would remain approximately constant in the long run—that is, there would be little or no inflation. Although random events might cause short-term variations in prices, real output, and employment, there could be no risk of run-away inflation or deep, lasting depression.

The Fed never made a commitment to Friedman's rule. Structural reforms in the banking industry during the 1980s increased the variability of velocity and weakened the link between the growth rate of the money stock and the rate of inflation. However, the idea that policy rules were a better basis for stabilization strategy than fine-tuning prevailed. It was just a matter of finding the right rule.

Inflation Targeting

Today, the most popular policy rule among the world's central banks is **inflation targeting**, a term used to describe any stabilization strategy that focuses on a target range for the rate of inflation.

Inflation targeting

A strategy for stabilization policy that focuses on holding the rate of inflation within a target range

The basic idea behind inflation targeting, like Friedman's money-growth target, can be explained in terms of the equation of exchange, MV = PQ. The money growth target promotes long-term price stability only if both velocity (V) and the growth rate of real output (Q) are fairly stable. If either or both are subject to significant, unpredictable changes, even a steady rate of money growth could lead to undesired inflation or deflation. The idea of inflation targeting is that policymakers can guard against these sources of instability by using the rate of change of the price level, P, itself as their target rather than the rate of growth of money, M.

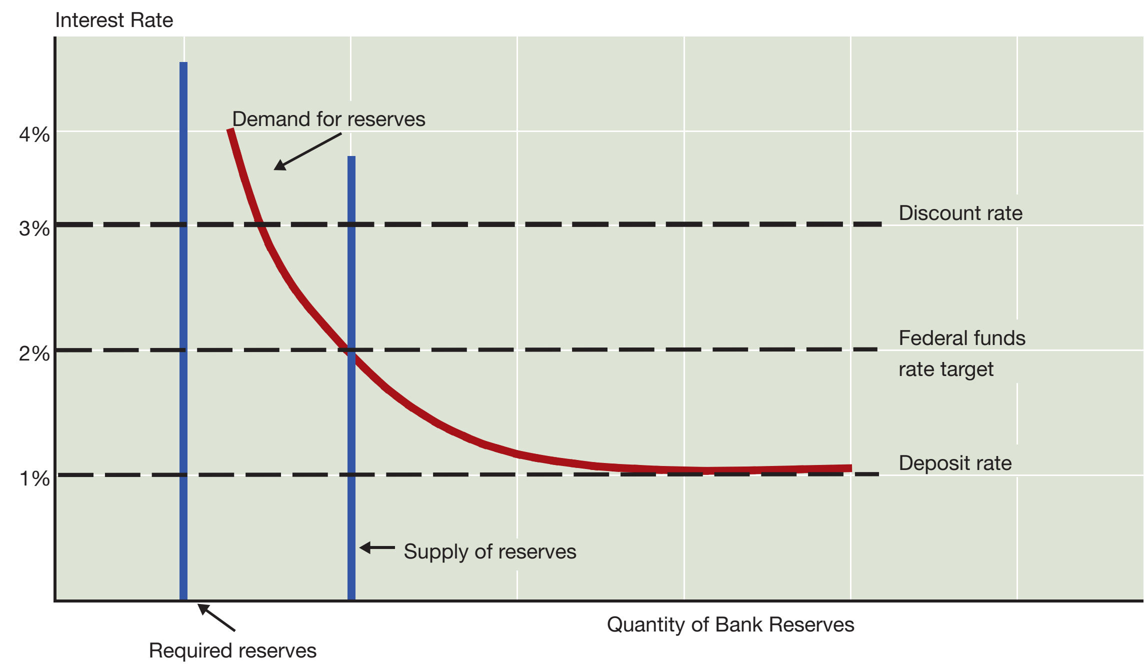
Interest Rates as an Operating Target Although the concept of inflation targeting is simple, implementing it is not so easy. One major problem is that policymakers cannot use the rate of inflation itself as a short-run operating target. The reason is that inflation does not respond fast enough to the use of policy instruments. Instead, as our discussion of the aggregate supply and demand model has shown, inflation responds to policy actions only after a lag of up to several years. Policymakers can use the rate of inflation, averaged over a one- or two-year time horizon, as an intermediate target; but in order to implement an inflation targeting strategy, they must also have a suitable operating target over which they can exercise closer control.

Many central banks have chosen to use short-term interest rates as their principal operating target. That includes not only central banks like those of the U.K. and Australia that have officially adopted an inflation targeting strategy, but also many, like the Federal Reserve in the United States and the European Central Bank in the euro area, that pursue a mixed strategy that includes some elements of inflation targeting. This section shows how the Fed would implement a strict inflation targeting strategy if it chose to do so.

Figure 11.1 shows how an interest rate operating target works.[3] There are three interest rates involved. The first two are administrative rates set directly by the central bank. One is the interest rate that the central bank charges for reserves that it loans to commercial banks (the discount rate in U.S. terminology). The second is the interest rate paid on reserves that commercial banks keep on deposit with the central bank. In the United States, the Fed began paying interest on reserve deposits only recently (October 2008); the practice has been common for some time in other countries, however. The third interest rate is the rate on interbank loans of reserves that commercial banks make to one another (the federal funds rate, in U.S. terminology). Unlike the first two, the federal funds rate is not under the direct administrative control of the central bank. Instead, it depends on supply and demand in the interbank loan market.

Figure 11.1 also shows commercial banks' demand curve for reserves. As explained in Chapter 8, commercial banks hold reserves of liquid assets to meet their customers' needs and minimize liquidity risk, but the amount of reserves they hold depends on the interest rate. Other things being equal, the lower the interest rate, the lower the opportunity cost of holding reserves—so the greater the quantity of reserves demanded. In the United States and many (but not all) other countries, the central bank also sets a minimum required level of reserves, shown by a vertical line in the diagram. The demand curve becomes vertical as it approaches the minimum required level of reserves. It becomes horizontal as it approaches the central bank's deposit rate because if the interbank rate were to fall below the deposit rate, banks could make an effortless, risk-free profit by borrowing reserves from other banks and depositing them with the central bank.[4]

Figure 11.1 How an Interest Rate Operating Target Works



The Fed's discount rate and deposit rate instruments are under its direct administrative control. The Federal funds rate for interbank lending is a market rate set by supply and demand. Commercial bank demand for reserves has a negative slope because lower interest rates mean a lower opportunity cost of holding reserves. To implement an interest rate operating target, the Fed would set a target value for the federal funds rate (2 percent in this example), and set its administrative rates to form a corridor above and below the target. It would then use open market purchases or sales to adjust the supply of reserves to a quantity such that the supply and demand curves intersect at the target rate of interest.

For the first several years after the Fed began paying interest on deposits of reserves, interest rates were near zero. Rather than reflecting that unusual situation, the figure shows how the Fed and other central banks would conduct policy in a setting of moderate but positive market interest rates. In such a setting, the Fed would implement its policy as follows.

First, it would set the discount rate and the deposit rate, both of which are under its direct administrative control. Those two rates form a corridor within which supply and demand conditions determine the federal funds rate. Next, the Fed would set an operating target for the federal funds rate. In our example, the target is 2 percent, in the center of the corridor. Although the Fed cannot directly control the federal funds rate, it can control it indirectly by using open market purchases or sales to adjust the quantity of reserves it supplies to the banking system. As Figure 11.1 shows, adjusting the supply of reserves to the right quantity would ensure that the equilibrium federal funds rate is equal to the target.

Of course, changes in market conditions might cause the demand curve to shift, in which case the federal funds rate would temporarily rise above or below the target. Central banks that practice inflation targeting are willing to tolerate brief, small moves away from the target; but if the rate moved more than a little, the Fed would use open market operations to adjust the supply of reserves to bring the federal funds rate back to the target. For example, if an increase in demand for reserves pushed the federal funds rate up, the Fed would use an open market purchase of securities to shift the supply of reserves to the right. The federal funds rate would then fall back to its target. Similarly, the Fed would counteract an undesired decrease in the federal funds rate by using an open market sale.

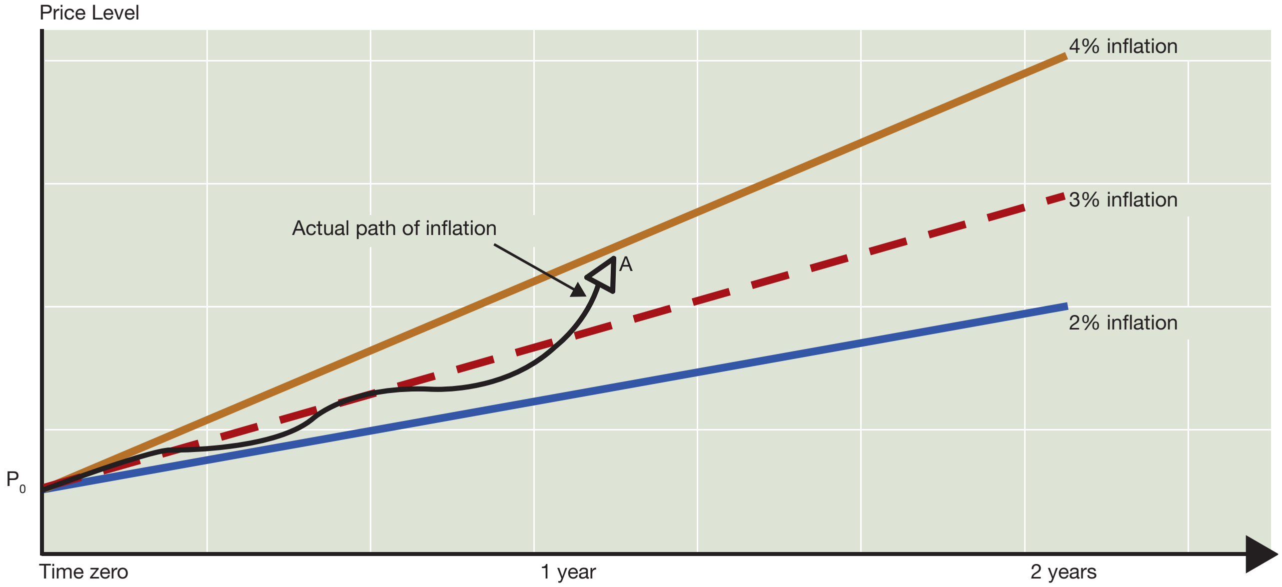
For the most part, this procedure would allow the Fed, or any other central bank, to control the interbank lending rate with a fair degree of precision. (When interest rates approach zero, the procedure for interest rate targeting can break down, but that part of the story will have to wait until Chapter 13.)

Setting the Right Operating Target How would the Fed or another inflation-targeting central bank know where to set the operating target for the interbank lending rate? Why should the federal funds rate target be 2 percent rather than, say, 1 percent or 5 percent?

To set the right operating target, the Fed would have to use a forecasting model to predict how a given interest rate target will affect the rest of the economy. Recall the discussion of the transmission mechanism for monetary policy in Chapter 10. A reduction in interest rates stimulates planned investment and purchases of durable consumer goods. The increased planned expenditure shifts the aggregate demand curve to the right. In the short-run, real output and the price level both increase. In the long run, the price level increases more and real output returns to its natural level. A forecasting model that includes a model of the transmission mechanism would be able to estimate the rate of inflation over the next year or two that would result from any given interest rate operating target.

Figure 11.2 shows how the Fed would use forecasting as a bridge between the its interest rate operating target and its intermediate inflation target. First, it would set its intermediate target for the inflation rate. Fed officials would know they cannot control inflation precisely, so they would name a target range of inflation, for example, between two percent and four percent on average over the next two years. Starting from the current price level P_0, the target range for inflation defines a cone-shaped area of acceptable values for the future price level.

FIGURE 11.2 IMPLEMENTATION OF INFLATION TARGETING



The Fed would implement a policy of inflation targeting as follows. First, it would set upper and lower limits on the acceptable rate of inflation over a one or two-year time horizon. Here the limits are 2 to 4 percent, which define a cone-shaped area of acceptable values for the price level. Next, it would use a forecasting model to determine an interest rate that would put the expected rate of inflation on a path in the middle of the target cone. As time goes by, unexpected developments might push the actual inflation rate higher or lower than the forecast. If the rate of inflation threatened to move the price level above the acceptable range, as at point A, the Fed would raise its interest rate target until the forecast rate of inflation fell back within the target cone.

Next, the Fed would use its forecasting model to find an operating target for the federal funds rate that appeared likely to result in a rate of inflation near the center of the cone. It would then use open market operations, as shown in Figure 11.1, to maintain the interbank rate at that level.

Now comes the tricky part. As we know from our earlier discussion, forecasting models are far from perfect. Even if policymakers maintain their operating target for the interest rate, unforeseen events are likely to cause the actual path of inflation to swing above or below the center of the target cone, as shown in the figure. If the price level threatened to cross the limits of the target cone, as it does at point A in Figure 11.2, the central bank would have to act. It would raise its operating target for the interbank interest rate and use open market operations to tighten the supply of reserves to commercial banks. Doing so would restrain the growth of aggregate demand. When the forecasting model indicated that predicted inflation was back in the acceptable range, the Fed would stop tightening policy and would hold interest rates steady until new developments occurred. In the opposite case, if the economy slowed and the rate of inflation started to drop near the bottom of the target cone, the Fed would lower its interest rate operating target in order to stimulate aggregate demand.

Other Proposed Policy Rules

The monetary policy of the Federal Reserve has, in recent years, resembled inflation targeting in some ways, but not in all ways. The Fed does place a higher priority on price stability than on any other single intermediate policy target. In 2011, for the first time, it openly announced that it considered "price stability" to mean a rate of inflation close to 2 percent. With this goal in mind, it uses open market instruments to control bank reserves and sets an operating target for the federal funds rate very much as described above.

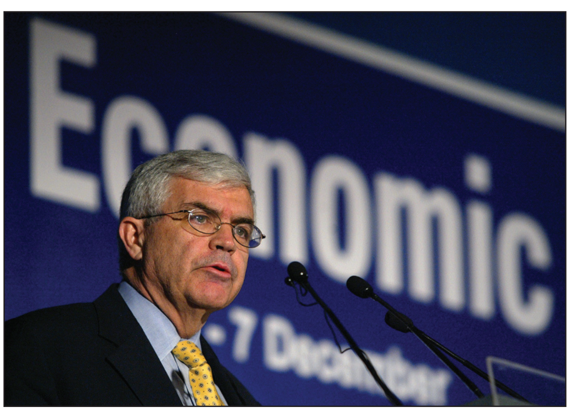
Even so, the Fed's policy is not true inflation targeting because it pursues other targets as well. The most important of those is the unemployment rate—by law, a goal that the Fed is required to balance with its mandate to maintain price stability. In addition, the Fed pays close attention to the growth rate of real output, and in some cases developments in other financial markets.

Taylor rule

A rule that adjusts monetary policy according to changes in the rate of inflation and the output gap (or unemployment)

A Taylor Rule A number of economists have proposed explicit policy rules based on the Fed's practice of watching more than one intermediate target. The best known of these is the **Taylor rule**, proposed by Stanford University economist John Taylor. Under the Taylor rule, the Fed would tighten policy by adjusting its interest-rate operating target upward by a specified amount whenever the rate of inflation increased, and also raise interest rates whenever real output exceed its natural level, that is, when a positive output gap developed.

Despite its resemblance to what the Fed actually does, explicit implementation of a Taylor rule would encounter practical difficulties. One is the question of how much to adjust interest rates for a given change in inflation or the output gap. If the adjustment were too small, the policy would not be effective in damping the business cycle. If it were too large, policy might overshoot its goals at cyclical peaks and troughs, making things worse rather than better. Taylor's original formulation also encounters the difficulty that data on the output gap are available to policymakers only with a long lag. A variation of the Taylor rule would instead watch the unemployment rate. Unemployment varies inversely with changes in the output gap, but data are available with a much shorter lag.



The Taylor rule was developed by Stanford University economist John Taylor.

NGDP Targeting Another rule to which economists have paid increasing attention recently is NGDP targeting, which focuses on the rate of growth of nominal GDP—that is, on the right-hand side of the equation of exchange, MV = PQ.

Because the level of nominal GDP is equal to the price level, P, times real output, Q, the rate of growth of nominal GDP is the sum of the rate of growth of real GDP and the rate of inflation. The average rate of growth of U.S. real GDP in recent decades has been about 2.5 percent. If we combine this with the Fed's 2 percent target rate of inflation, we get 4.5 percent as an appropriate target rate of growth for NGDP, or perhaps 5 percent just to make it a round number.

If velocity were constant, then maintaining NGDP growth at a steady 4.5 percent would simply require an equal steady rate of growth of the money stock. In that sense, many economists consider **NGDP targeting** to be the natural heir of Milton Friedman's monetarism. NGDP targeting is more flexible than simple monetary targeting, however. It takes into account the fact that velocity has proved much more variable in recent years than was foreseen in the 1960s. Under NGDP targeting, an unexpected increase in velocity could be offset by a slowdown in the rate of growth of the money stock, or vice versa.

NGDP targeting

A policy under which the central bank adopts the rate of growth of nominal GDP as its principal intermediate target

Among the considerations that favor NGDP targeting is the possibility that inflation targeting, under some conditions, can have harmful unintended consequences. One problem occurs when an event arising outside the control of policymakers causes a burst of inflation. For example, suppose an increase in world oil prices causes upward pressure on the rate of inflation for some oil-importing country. Holding to a strict inflation target would require the central bank to raise interest rates and pursue a strongly contractionary policy that could cause a decrease in real output and send the unemployment rate up sharply. If the central bank were, instead, targeting NGDP growth, the oil-price shock could be absorbed partly by a higher price level and only partly by a reduction in real output. NGDP targeting, in this case, is less rigid and more inclusive of multiple policy objectives than is inflation targeting.

NGDP targeting would also give the central bank more flexibility when the economy enters a deep recession. In that case, the rate of inflation may fall to zero, or even below. Under those circumstances, if the central bank did no more than aim for an inflation target of two percent, it could be years before real GDP recovered to its potential level. Instead, a central bank that set a 4.5 percent target for NGDP growth would be willing to tolerate more aggressively expansionary policy. Doing so might, in the short run, allow inflation to rise well above two percent; but once real GDP returned to its long-run potential growth of 2.5 percent, inflation would slow again.

We will return to these and other NGDP targeting scenarios in Chapter 14, where we will discuss inflation and deflation in more detail.

Overall, there is no simple answer to which monetary policy strategy is best for any given country. The choice of an inflation target, an exchange rate target, an NGDP target, or some mixed target involves both economic and political considerations. Nonetheless, over the past couple of decades, economists have more and more come around to the view that some kind transparent policy rule, based on preset targets of some kind, does a better job of promoting stability and prosperity than the kind of ad-hoc fine-tuning that many countries attempted in the past.

Summary

1. **Why do lags, forecasting errors, and time-inconsistency make it difficult to fine-tune the economy?** Simple textbook models make it look as if it would be easy to *fine-tune* the economy. In practice, three problems make fine-tuning difficult. *Lags* create delays between the time problems develop and the time policies take effect. Forecasting errors make it difficult for policymakers to overcome the problem of lags by acting before a turning point in the business cycle approaches. *Time-inconsistency* is a tendency for policymakers to take actions that are beneficial in the short run, but make problems worse in the long run.

2. **What are the distinctions among policy instruments, operating targets, intermediate targets, and policy goals?** *Policy instruments* are variables that are under direct control of policymakers. *Operating targets* are variables that respond immediately, or almost immediately, to changes in policy instruments. *Intermediate targets* are variables that respond to changes in operating targets with a significant lag. *Policy goals* like prosperity and stability contribute directly to people's long-run economic welfare.

3. **How do policymakers attempt to overcome the limits of fine-tuning?** If policy makers follow transparent, preset policy rules, there is less chance that lags and forecasting errors will lead to over-shooting at the top and bottom of the business cycle. Also, preset rules reduce the risk that time-inconsistency will lead to politically motivated destabilizing actions.

4. **What are the advantages and disadvantages of various policy targets?** The school of monetarism, which emerged in the 1960s, advocated using the money stock as the Fed's chief policy target. Under inflation targeting, the central bank uses its policy instrument to hold the forecast rate of inflation within a target range over a one to two year time horizon. Under a Taylor rule, the central bank would watch developments both of inflation and of real output or unemployment. NGDP targeting makes nominal GDP (real output times the price level) the target for monetary policy. All such policy rules face a tradeoff between simplicity and flexibility.

Key Terms	Page#
Fine-tuning	314
Inflation targeting	323
Inside lags	315
Intermediate target	321
Monetarism	322
NGDP targeting	329
Operating target	321
Outside lags	315
Policy goal	321
Policy instrument	321
Policy rules	320
Taylor rule	328
Time-inconsistency	318

Problems and Topics for Discussion

1. **Terms of Federal Reserve governors** The Federal Reserve System operates under a seven-member Board of Governors. The term of a governor is fourteen years, and governors usually cannot serve more than one term (except for an additional partial term to fill a vacancy). Terms are staggered, so that one governor's term expires every other year. Governors can only be removed from office "for cause," that is, for abuse of their office—not just for policy disagreements. In what way do the long terms and secure tenure of Federal Reserve governors help to overcome the problem of time-inconsistency in monetary policy? Discuss.

2. **Monetary policy targets in Eudemonia** Suppose that natural real output in the country of Eudemonia grows at a steady rate of 3 percent per year. In the past, velocity has been approximately constant, and the Eudemonian Central Bank has maintained a target rate of growth of 4 percent per year for the money stock. What would be the resulting rate of inflation? Now suppose that the introduction of Internet banking allows people to make transactions online without holding large amounts of currency or bank balances. As Internet banking spreads, velocity begins to increase at a rate of 3 percent per year. What will happen to the rate of inflation? How would the central bank react to the change in velocity if it pursued an NGDP target instead of a money stock target?

3. **Core versus headline inflation** Among central banks that practice inflation targeting, there is a debate over whether to target "headline" inflation or "core" inflation. Headline inflation means the consumer price index for all items. Some central banks favor headline inflation as a target because promising to stabilize a widely-publicized inflation measure has maximum psychological impact on public expectations. Core inflation means consumer price inflation with adjustments to remove the most variable prices, like those of food and energy. Some central banks favor core inflation because food and energy prices are set in world markets and are beyond the control of domestic monetary policy. Compare the rates of core and headline inflation for the most recent month and the past year. For the United States, these data can be found on the web at bls.gov/cpi/.

4. **Inflation Targeting in Norway** The Fed does not pursue a true inflation targeting strategy, but many central banks around the world do. The central bank of Norway is a good example. Visit the bank's website, www.norges-bank.no/en/ and click on the "price stability" tag to find a full explanation of the bank's strategy. Among other things, look for the charts that give the bank's forecasts for CPI inflation. In what ways do they resemble Figure 11.2 in this chapter? In what ways do they differ? Is the Norwegian central bank currently succeeding in its policy for maintaining price stability in the country?

Case for Discussion

The FOMC Reveals Its Strategy

The main policymaking body of the Federal Reserve is the Federal Open Market Committee (FOMC), which meets eight times per year. After each meeting, the FOMC issues a brief statement explaining its views on the state of the economy and the monetary policy actions it sees as appropriate. Here is the statement for March 13, 2012:

> Information received since the Federal Open Market Committee met in January suggests that the economy has been expanding moderately. Labor market conditions have improved further; the unemployment rate has declined notably in recent months, but remains elevated. Household spending and business fixed investment have continued to advance. The housing sector remains depressed. Inflation has been subdued in recent months although prices of crude oil and gasoline have increased lately. Longer-term inflation expectations have remained stable.
>
> Consistent with its statutory mandate, the Committee seeks to foster maximum employment and price stability. The Committee expects moderate economic growth over coming quarters and consequently anticipates that the unemployment rate will decline gradually toward levels that the Committee judges to be consistent with its dual mandate. Strains in global financial markets have eased, though they continue to pose significant downside risks to the economic outlook. The recent increase in oil and gasoline prices will push up inflation temporarily, but the Committee anticipates that subsequently inflation will run at or below the rate that it judges most consistent with its dual mandate.
>
> To support a stronger economic recovery and to help ensure that inflation, over time, is at the rate most consistent with its dual mandate, the Committee expects to maintain a highly accommodative stance for monetary policy. In particular, the Committee decided today to keep the target range for the federal funds rate at 0 to 1/4 percent and currently anticipates that economic conditions—including low rates of resource utilization and a subdued outlook for inflation over the medium run—are likely to warrant exceptionally low levels for the federal funds rate at least through late 2014.

Questions

1. What does the FOMC mean by its "dual mandate?" What are the target variables with which the Fed expresses the greatest concern in this memo? On the basis of this statement, would you classify the Fed as pursuing an inflation targeting strategy? Why or why not?

2. What is the federal funds rate? Would you classify the federal funds rate as a policy instrument, an operating target, an intermediate target, or a policy goal? Explain.

3. Based on the information in this statement, does it appear that the Fed is attempting to fine-tune the economy, that is, to adjust its policy on a month-to-month basis in response to the latest economic data? What parts of the statement give you a clue as to the Fed's attitude toward fine tuning?

4. Visit the Fed's website, www.federalreserve.gov. Click on the tab "Monetary Policy" and look for the most recent FOMC statement. After some meetings, the FOMC also holds a press conference and posts the video to its website. Based on the latest FOMC statement, how has the state of the U.S. economy changed since March 2012? Is the Fed still pursuing its policy of a very low (0 to 0.25 percent) target for the federal funds rate?

Endnotes

1. Grace Juhn and Prakesh Lougani, "Further Cross-Country Evidence on the Accuracy of the Private Sector's Output Forecasts," *IMF Staff Papers* Vol. 49, No. 1 (2002).
2. For an excellent account of the evolution of economists' views on policy rules, see Marvin Goodfriend, "How the World Achieved Consensus on Monetary Policy," *Journal of Economic Perspectives,* (Fall 2007): 47-68.
3. The appendix to this chapter gives an alternative presentation of interest-rate targeting.
4. For technical reasons, the effective federal funds rate in the United States does occasionally fall below not only the Fed's target rate but also the deposit rate, at least for short periods. However, such episodes do not prevent use of the federal funds rate as a policy target

Appendix to Chapter 11: *Supply and Demand for Money*

As we have seen, central banks control interest rates in two ways. First, the discount rate charged on borrowed reserves and the deposit rate for reserves that commercial banks hold on deposit at the central bank are set administratively. Second, central banks control interest rates indirectly by adjusting the monetary base and the quantity of money using open market operations or other instruments. Some central banks use interest rates as their principal operating target while some use other targets. This chapter has explained the operation of an interest rate target in terms of the supply and demand for bank reserves (see Figure 11.1). This appendix takes an alternate approach that explains interest rates in terms of the supply and demand for money itself.

The Money Demand Curve

What do we mean when we speak of the "demand" for money? If we use the term "money" in the careless way in daily conversation, as a synonym for "income" or "wealth," the answer would be that people seem to have an unlimited demand for money.

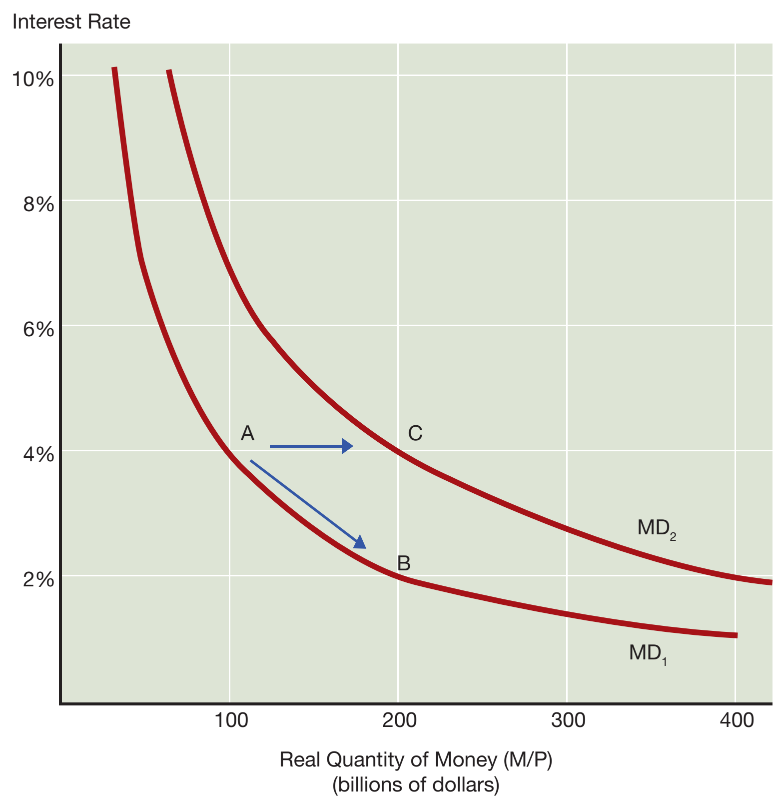
> "I'm studying economics because I want to work on Wall Street and make a lot of money when I graduate," a friend might tell you.
>
> "How much money do you want?" you might ask.
>
> "The more the better!" your friend would say.

When economists discuss the demand for money, they have something different in mind. As we saw in Chapter 8, economists use the term "money" to mean a specific set of liquid assets—the currency, transaction deposits, and other elements that make up M2 or some other specific measure of the money stock. To an economist, the demand for money means how much of those particular assets a person wants to hold at any one time, other things being equal. The "other things" include one's total wealth (that is, the sum of all of one's assets, including less liquid assets like houses, cars, and shares of stock) and also one's income.

The quantity of money demanded, given one's level of income, depends on the opportunity cost of holding money. For an ordinary good like chicken or movie tickets, the measure of opportunity cost is the market price—the amount of money per unit needed to buy it. People, however, do not "buy" money in the same sense that they buy other goods. Instead, they obtain money by exchanging other assets for it, for example, by selling securities in exchange for bank deposits. In that case, the "price," or more accurately, the opportunity cost, of obtaining money is the rate of interest that they could have earned by holding securities instead of currency or transaction deposits that pay no interest.

In this brief appendix, we will make two simplifications with regard to the opportunity cost of money. First, we will assume that money earns no interest at all. It is true that some forms of money, like saving deposits, do pay a small rate of interest, but we will leave these out of consideration. Second, there are many different kinds of securities that we could exchange for money, each of which would pay a different interest rate and, therefore, imply a different opportunity cost. To keep things simple, we will consider only one non-monetary asset, namely, a short-term, interest-bearing asset that has zero default risk, for example, T-bills.

FIGURE 11A.1 DEMAND FOR MONEY



The money demand curve shows the real quantity of money balances that people want to hold at any given interest rate. A change in the interest rate causes a movement along a given money demand curve (for example, from A to B). An increase in real income causes a shift in the money demand curve (for example, from MD_1 to MD_2.)

Figure 11A.1 shows the demand for money in graphical form. The vertical axis shows the interest rate chosen to measure the opportunity cost of money. The horizontal axis shows the quantity of money. We will represent the quantity of money in real terms, so the horizontal axis is labeled M/P, meaning the quantity of money divided by the price level. It would be possible, instead, to place the nominal money stock, M, on the horizontal axis, but the real-money version of the diagram is the one economists most often use.

Along the money demand curve MD_1, the real quantity of money demanded increases as the interest rate decreases. For example, at an interest rate of 4 percent, the quantity of money demanded is $100 billion (point A). If the interest rate falls to 2 percent, the quantity demanded increases to $200 billion (point B).

If real domestic income increases, people will want to buy more goods and services. Other things being equal, people will demand more money to carry out the greater volume of transactions. An increase in real domestic income thus shifts the money demand curve to the right. For example, suppose that MD_1 corresponds to a domestic income of $1 trillion. If domestic income increases to $2 trillion, the money demand curve will shift rightward to MD_2. If the interest rate were to remain at 4 percent as domestic income increased, the quantity of money demand would increase to $200 billion (point C).

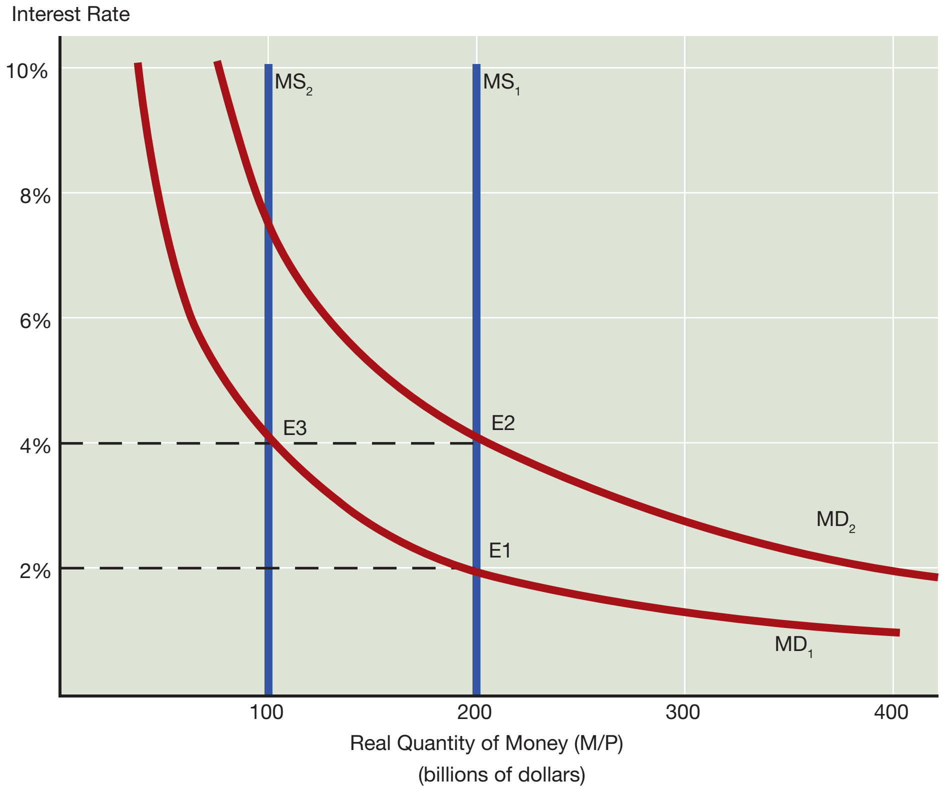
To summarize, we see that the demand for real money balances is inversely proportional to the interest rate and directly proportional to real domestic income, other things being equal. A change in the interest rate causes a movement along the money demand curve, and a change in real income causes a shift in the curve.

The Money Supply Curve

The central bank controls the supply of money and is able to adjust it to any desired value by using open market operations or other instruments. Figure 11A.2 shows how money supply interacts with money demand.

Starting from point E_1, any change in money demand, while money supply remains constant, would change the equilibrium interest rate. For example, suppose that real domestic income increases, shifting the money demand curve to MD_2. If the interest rate remained unchanged, people would want more money to carry out the greater volume of transactions associated with their higher income. Firms and households would try to get the money they want by borrowing it from their banks. However, if the central bank held the quantity of money constant, the banking system would not have the reserves needed to supply the desired amount of money. As the demand for loans increased, but with limited reserves available, banks would raise their interest rates. Increasing interest rates, in turn, would cause firms and households to tighten up their cash management practices and find ways to make do with less money per dollar of income. As interest rates rose, the economy would move to a new equilibrium at E_2.

FIGURE 11A.2 HOW MONEY SUPPLY INTERACTS WITH MONEY DEMAND



Suppose, for example, that the central bank uses open market operations to adjust the real money supply to $200 billion. The result is the money supply curve MS_1. If the money demand curve is in the position MD_1, the equilibrium interest rate will be 2 percent, shown by the intersection of MS_1 and MD_1.

Interest rates would also increase if the central bank used open market sales of securities to reduce the real money supply while real income and the price level remain unchanged. For example, suppose the central bank reduces the real money supply from $200 billion to $100 billion. We would show that by a leftward shift in the money supply curve from MS_1 to MS_2. Banks would suddenly find themselves short on reserves. They would have to reduce their volume of lending by refusing to extend new loans when customers paid off existing loans. Competition among borrowers for the limited volume of loans available would drive up interest rates, and the economy would move from equilibrium at E_1 to a new equilibrium at E_3.

A third factor that can affect the equilibrium interest rate is a change in the price level. Again we start from equilibrium at E_1. Now assume that real income remains constant, but that the price level increases. The increase in the price level will not shift the demand curve, because its position depends on real, not nominal, income. However, if the central bank does not use open market operations or other instruments to increase the nominal quantity of money, the real quantity of money, M/P, will decrease, because P is increasing while M is constant. If the price level doubled, the real money supply curve would shift from MS_1 to MS_2, and the equilibrium interest rate would rise to 4 percent, as shown by E_3.

We can summarize our findings by saying that any of the following three events will cause the interest rate to increase, other things being equal:

1. An increase in real domestic income while the price level and the real money supply are constant
2. A decrease in the real money supply while the price level and real domestic income are constant
3. An increase in the price level while real domestic income and the nominal money supply are constant

Money Supply Target versus Interest Rate Target

The diagrams in this appendix provide additional perspective on the use of different targets and policy rules by the central bank.

A monetarist policy rule of the kind favored by Milton Friedman would use open market operations to hold the nominal money stock constant. Under such a policy rule, any increase in nominal domestic income, whether in the form of inflation, an increase in real income, or a combination of the two, would cause interest rates to rise. As interest rates rose, credit market conditions would tighten, planned investment would decrease, and the growth of nominal income would go down. Similarly, any decrease in nominal income would cause interest rates to fall. Planned investment would be encouraged, counteracting the slowdown of nominal income. In short, under the monetarist rule, countercyclical changes in interest rates would tend to moderate excessive variations in the growth of nominal income.

A central bank that used an interest rate operating target would operate differently. After setting its interest rate target, it would use open market operations to adjust the position of the money supply curve as needed to hit the target. However, the central bank would have to be careful that the interest rate target was set at the right level. If it maintained too low an interest rate target for too long, it would risk an inflationary spiral. When inflation accelerated, it would have to increase the nominal money stock in order to prevent a rising price level from shifting the real money supply curve to the left and, thereby, increasing interest rates. The increase in the nominal money stock, in turn, would feed further inflation. To avoid this trap and prevent unwanted inflation, a central bank must supplement an interest rate operating target with inflation targeting, a Taylor rule, an NGDP rule, or some other intermediate target that tells it when and by how much to adjust the short-run interest rate operating target.