Modeling the Demand Curve in Detail — The IS–LM Framework

This additional chapter has been written by David Miles and Andrew Scott to accompany their book *Macroeconomics: Understanding the Wealth of Nations.*

It contains the following sections:

1. IS–LM — WHAT IT IS AND WHAT IT IS ABOUT  
2. THE KEYNESIAN CROSS  
3. THE IS CURVE  
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5. IS–LM AND COMPARATIVE STATICS  
6. MONETARY POLICY IN PRACTICE  
7. MUNDELL–FLEMING AND THE OPEN ECONOMY  
8. FROM IS–LM TO AGGREGATE DEMAND  
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Overview

This chapter offers a comprehensive development of the IS–LM approach and how it links eventually to the aggregate demand and aggregate supply model. Throughout this chapter we refer to material in the main text and reproduce some key passages.
In 1936 John Maynard Keynes (1883–1946) published *The General Theory of Employment, Interest and Money*. This was a defining moment for macroeconomics. Keynes wrote his masterpiece with the Great Depression of 1929–1932 in mind. His basic message was that in certain circumstances the market mechanism may not work. For various reasons he argued that prices, wages, and interest rates might be unable to change, or to change by enough, to prevent the economy getting caught in a period of low output and high unemployment. If the market works well, then prices and wages should fall until demand and employment increase. Keynes argued that prices may not be able to fall, and even if they did, it may exacerbate matters. Keynes was essentially arguing that microeconomics — the study of the marketplace and how prices and individuals interact — may not be relevant for studying the aggregate economy. In other words, that macroeconomics needed different models and tools.

*The General Theory* was innovative not just in its analysis of the Great Depression but in its suggested remedy. If markets could not on their own restore prosperity, then governments had to. If prices could not be relied on to change to create demand, then government had to pump demand into the economy by raising government expenditure, cutting taxes, or lowering interest rates. The differences between this approach to business cycles and that of Real Business Cycle theory are many. This Keynesian perspective says that recessions are caused not by adverse supply shocks but by too low a level of demand. Further, recessions are occasions not when individuals optimally choose to produce low output but periods when the market does not work properly, leading to suboptimally low output. In other words, recessions are bad, and the government should and can improve things.

*The General Theory* is a fascinating book. However, Keynes tended to prefer words to diagrams and math. As a result, what he means, or how the effects he details operate, is not always entirely clear. The book has so many ideas that it is not always obvious which idea Keynes put most emphasis on. As a result, a huge literature is dedicated to sorting out what Keynes really meant to say. However, given that Keynes died in 1946, it is hard to reach a definitive view on this issue, so the literature has recently focused less on what he meant to say and more on developing his insights into how market failures may lead to business cycles.  

One of the most influential strands of this literature was the development, by John Hicks and Alvin Hansen, of the IS–LM model. As our brief summary of Keynesian economics above suggests, this is effectively a detailed way of modeling the aggregate economy in detail. The IS–LM framework is one of the most influential tools in macroeconomics.
demand side of the economy that helps analyze how changes in fiscal or monetary policy can influence the economy. It is hard to overstate the importance of this IS–LM model to the development of macroeconomics during the 1950s and 1960s. The IS–LM framework formed the backbone of the large macroeconometric models that governments across the world used, and still use, to form forecasts and to evaluate the relative merits of different policies.

In focusing just on the demand side of the economy, the IS–LM approach is in essence assuming that prices are fixed, at least in the short run. The basic IS–LM model is built around the assumption that firms respond to changes in demand, at least initially, by supplying more or less rather than by raising or lowering prices. In the extreme case this suggests that the supply curve is horizontal, so that Gross Domestic Product (GDP) is determined by the level of demand — if demand increases, as in Figure 1, then GDP increases one for one. Hence the importance of demand side factors in Keynesian economics.

![Diagram of IS–LM model](image)

**Figure 1** Fixed prices mean shifts in demand generate movements in real output.

**Are Prices Fixed?**

Are firms prepared to meet increases in demand by expanding output rather than just raising prices? And why would firms not just raise prices when demand increases?

Figure 2 shows the results of a Bank of England survey that asked firms how they respond to increases in demand. The huge percentage of respondents who would increase output even if this means working more overtime, hiring more workers, or increasing capacity is striking. Only 12% of firms gave increasing prices as one of their main responses. Figure 2 gives very strong practical justification for the flat supply curve in Figure 1.

Firms seem willing to increase output rather than raise prices when demand increases for two reasons. The first is that firms only periodically review prices, so that for significant
Increasing demand can be met by increasing output, hiring workers, increasing prices, increasing capacity, subcontracting, or increasing delivery lags. Figure 2 illustrates how firms respond to increased demand. Survey evidence suggests most firms respond to higher demand more by raising output than increasing prices. Source: Hall, Walsh, and Yates, “How Do UK Companies Set Prices?” Bank of England Working Paper 67 (1997). Reprinted with the permission of the Bank of England.

Periods prices are fixed. For instance, mail order firms and restaurants print catalogues and menus in advance and cannot alter prices between printings. This makes prices sticky and costly to change, an example of what economists call “nominal rigidities.” Figure 3 shows that firms from the same Bank of England survey only occasionally review their prices — the rest of the time prices are fixed, and either output or delivery lags vary when demand changes. While 22% of firms review their prices daily, over a quarter review them once a month and another 19% only once a quarter. Therefore firms may not be able to change prices in response to every change in demand — prices are sticky.

Prices are also sticky because firms may be unable, or may choose not to change them. Figure 4 shows from the Bank of England survey the number of price changes firms made over a year. Even though 22% of firms review their prices daily only 6% change their prices more than twelve times a year. In total 80% of firms change their prices every six months or more — firms do not adjust prices frequently in the short run.

But if we assume that firms are maximizing profits, why don’t they increase prices by more when they have the opportunity to increase them? Firms don’t raise prices for many reasons. The first is that when firms raise prices they lose customers and thus revenue. If the firm has many competitors, none of which has raised prices, then the firm will be wary to do so itself for fear of losing revenue and profit. The second reason
is costs. A standard result in microeconomics is that firms maximize their profits when they set price equal to a markup over their marginal cost, where the markup depends on how much monopoly power the firm has. According to this formula, firms should only change prices when either the markup they demand, or their costs, change. Therefore, the behavior of marginal costs is crucial in determining the slope of the supply curve. If marginal costs do not alter much when the firm increases output, then it should increase output, not change its prices. Therefore it can be profit maximizing for firms
not to increase prices even if they have the opportunity—this is what economists call “real rigidities.” Similarly even if marginal costs increase with output, firms may not change prices if they are prepared to take a lower markup. Therefore, a combination of nominal rigidities (that is, firms cannot change prices because of fixed contracts), existing advertising, or price stickers, and real rigidities (that is, firms not wanting to raise prices even when they make a price review) means that in the short run the supply curve is not vertical and in the extreme case where firms do not change prices at all it will be horizontal, as in Figure 1.

The exact status of IS–LM in the economics profession today is somewhat confused. Critics of the approach argue that it misses too much that is important (see the final section of this chapter for a list of these criticisms), while proponents argue that all of these criticisms can be overcome by extensions and skilled use of the IS–LM framework. What is for sure though is that to participate as an economist in a debate about business cycles and stabilization policy a detailed knowledge of IS–LM is useful. The concepts and terminology remain firmly fixed in the business cycle literature.

### The Keynesian Cross

At the heart of the Keynesian perspective is the importance of demand and all its components—consumption, investment, government expenditure, and net exports. Our starting point for the analysis of how shifts in these components affect demand is the Keynesian cross. Why it gets that bizarre name will become clear later.

Assume for the moment we have a closed economy (so that exports = imports = 0), in which case the national income identity we introduced in Chapter 2 becomes

\[ Y = C + I + G \]  

(1)

The most naïve model of consumption expenditure, somewhat unfairly labeled the Keynesian model, stresses the link between spending and current disposable income to the exclusion of all else. For our purposes we need not take this literally. But let us suppose for the moment that all the things that influence aggregate consumption expenditure over and above current income (e.g., demographics, expectations of future income, levels of wealth, and so on) can be held constant as current income varies. Suppose also the link between changes in current income and spending is proportional so that a given rise in available dollars of income always raises consumption by a given fraction of that rise—say c.

### THE BASIC KEYNESIAN MODEL OF CONSUMPTION

The economist John Maynard Keynes stated that “The fundamental psychological law, upon which we are entitled to depend with great confidence both a priori from our knowledge of human nature and from the detailed facts of experience, is that men are

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5Passage reproduced from Chapter 15 (pages 396–398).
disposed, as a rule and on the average, to increase their consumption as their income increases, but not by as much as the increase in their income.’’6 In other words, we should expect to see a very close relationship between current consumption and current income — both for an individual and for an economy. Evidence in support of this can be seen in Figure 5 which shows that in the UK, consumption rises strongly with disposable income.7


In Keynes’s work an important concept is the marginal propensity to consume, or m.p.c. The marginal propensity to consume is the extra amount an individual will spend if you give them an extra $1. If the m.p.c. is 80%, or 0.8, then from every extra dollar of income the individual spends 80 cents.

However, the m.p.c. only tells us how much additional income an individual spends. What about someone who receives no income? This individual will still need to consume goods and services, whether financed by begging, borrowing, or stealing. Therefore, even at zero income an individual will have positive levels of consumption. In Figure 6

7Disposable income is the sum of all income earned by an individual — including wages and salaries, benefits and interest payments, and dividends — less their tax payments.
we show how individual consumption is linked to income according to this simple Keynesian model.

At zero income the individual spends $a. For every extra dollar, they spend $c dollars, where $c$ is the m.p.c. Therefore, consumption is given by

\[
\text{Consumption} = a + c \times \text{Disposable income}
\]

or

\[
C = a + c \times Y
\]

The m.p.c. is given by $c$, but we can also define the average propensity to consume — how much of an individual’s total income he or she spends (the m.p.c. is about how much of your additional income you spend). The average propensity to consume (a.p.c.) is just consumption divided by income, or $C/Y$. Given our expression for consumption this is

\[
\frac{C}{Y} = \frac{a}{Y} + c
\]

As income gets larger, the term $a/Y$ goes toward zero so that eventually the a.p.c. is the same as the m.p.c. Because consumption plus savings equals income ($C + S = Y$), the a.p.c. equals 1 minus the savings rate ($S/Y$).

While current consumption undoubtedly depends on current income, the model we have outlined is rather simplistic. According to this model an individual looks at his or her monthly salary check and spends a constant proportion of it. But consider whether this insight holds true for the following characters:
If we are thinking about how consumption is linked to current income, e.g., what is the marginal propensity to consume, then in each of these three cases we would arrive at different answers. Although the student’s current income is low, she will probably wish to spend substantially more than she is currently earning because of her high future income (assuming the bank will loan her the money). The Goldman Sachs trader has a very high current income, but uncertainty about the future will lead him to accumulate savings in order to prevent consumption from crashing if he loses his job. The third case involves a one-time windfall receipt of income that will not be repeated. The consumer therefore has to choose between spending it all today or spreading it out over several years.

However, if we return to the basic model (assuming these concerns about future income do not vary with current income), then we have

\[ C = a + c(Y - T) \]  

(2)

Where a is a constant that reflects the factors we hold fixed—and is likely to be significant and positive because even if current disposable income falls to very low levels, people will still spend in the anticipation of higher future incomes and the necessity of eating! Disposable income is income net of tax or \( Y - T \). For simplicity we assume here that tax (T) is independent of income. A more realistic assumption would be that taxes are proportional to income; this does not change the essentials of the story but is not unimportant.

At this early stage of developing the IS–LM model, we are assuming that only consumption varies with income and that all the other factors of demand (planned investment, government expenditure, and net exports) are given exogenously. Note that we refer to planned investment rather than just investment. From our analysis of GDP in Chapter 2 it will be remembered that investment equals investment in physical capital plus any increase in inventories or unsold output. The latter will be important whenever overall spending in the economy differs from planned levels.

Assuming a closed economy, total planned expenditure \( PE = C + G + I \) in the economy equals

\[ PE = a + c(Y - T) + G + I \]  

(3)

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8Passage reproduced from Chapter 13 (pages 319–322).

9If tax revenue is \( tY \) (where \( t \) is the average tax rate, assumed also to be the marginal tax rate), then equation 5 would become \( Y = \frac{(a + I + G)}{1 - c(1 - t)} \). This means that the multiplier is \( \frac{1}{1 - c(1 - t)} \), which is lower than \( \frac{1}{1 - c} \).
So planned aggregate spending depends upon actual income. Actual income has to be the sum of consumption, investment, and government spending. If actual income equals planned expenditure, then $PE = Y$, which implies

$$PE = Y = a + c(Y - T) + G + I$$

which implies

$$Y = \{a + I + G - cT\}/1 - c$$

So when planned aggregate expenditure equals actual income, the level of income is a multiple (of $1/(1 - c)$) of the components of demand that are independent of income, the expression in curly brackets in equation 5. Shifts in those components have a multiplied impact upon demand and income. The multiplier is $1/(1 - c)$, which depends positively on the marginal propensity to consume. We will return to consider the multiplier in more detail later.

What happens when planned expenditure and actual spending do not coincide? Consider Figure 7. On the horizontal axis we measure actual income, which given GDP accounting is equivalent to output. On the vertical axis we measure planned aggregate spending. A $45^\circ$ line is drawn on the figure and when actual and planned spending are equal—which is something we will require for an equilibrium—we need to be on this line. The line $PE – PE$ shows how planned spending varies with actual income. Because the propensity to consume is $c$, a number we plausibly take to be less than one but positive, the slope of the $PE – PE$ line is less than $45^\circ$. Its slope reflects how much planned spending rises as actual income goes up $1$. Since we assume that the
only component of demand that depends on current income is consumption and that the marginal propensity to spend is \( c \), this slope is \( c \) — demand increases directly through increases in consumption by \( \$c \) for every \( \$1 \) increase in output.

Suppose that firms assess that the level of output they should produce to satisfy planned spending is at level \( Y_1 \). This is in excess of the level of output consistent with output being equal to planned spending — which is level \( Y^* \). If firms produce \( Y_1 \), they will find that so long as the government spends \( G \) and taxes at \( T \) the overall level of demand, given the firms’ own planned investment, will fall short of \( Y_1 \). The vertical distance \( ab \) shows the difference between actual output and planned spending at a production level of \( Y_1 \). That distance is equal to unplanned inventory accumulation. Since we count inventory accumulation as a part of investment (see Chapter 2 and GDP accounting), we can interpret the vertical distance \( ab \) as the difference between actual investment and planned investment.

Unplanned inventory accumulation is likely to encourage firms to reduce their output. Wise and farsighted firms who could work out where they went wrong in the first period, when they expected planned spending to be at \( Y_1 \), might decide to produce \( Y^* \) in the second period. If so, we would then go straight to the equilibrium at which plans and outcomes for spending are consistent. But maybe firms only scale back their plans partly and aim to produce \( Y_2 \) in the next round of production. In this case they would still accumulate unwanted inventories, but at the lower rate of \( \delta e \); eventually firms would converge on \( Y^* \).

A similar story would unfold if firms had been too pessimistic about equilibrium output. Had firms anticipated that only at output level \( Y_3 \) would production match planned spending, they would have found that demand exceeded their expectations and that inventories would be decumulated by the amount \( fg \). Only when they increase output up to level \( Y^* \) would unanticipated reductions in inventories cease.

In Figure 7 the point at which the 45° line and the planned expenditure line intersect is the point at which actual and planned spending coincide; this crossover point of the two lines is what gives the Keynesian cross its name. At this point the economy can be considered to be in equilibrium — planned output equals actual output.

**BOX 1**

**INVENTORIES**

Understanding inventories poses problems for economists. They are too small to be worth much attention in their own right, but their extreme volatility makes them one of the key drivers of business cycles. The other problem that they present is that their behavior does not fit most economic models.

As Figure 8 shows, inventories make up a small and shrinking share of US GDP. Their steady decline is a testament to the success of “just in time” stock control methods. At present, the value of stocks held by producers and retailers only amounts to some 12% of GDP. Given that we are comparing a stock of inventories (the value of all inventories in the economy), with the flow of GDP (how much the economy produces in a year) these numbers are tiny in economic terms.
However, anyone studying the business cycle in detail will be acutely interested in their behavior. Changes in stocks (stock building) are one of the key drivers in the business cycle and the extreme volatility in inventory behavior means that this tiny part of the economy has a significant impact on overall GDP. As Figure 9 shows, taking changes in inventories out of GDP reduces its volatility substantially (in fact, about half of the recent volatility of GDP growth is due to inventories).\textsuperscript{10}

Equation 5 says that a rise in an exogenous component of demand has a multiplied impact on overall demand, with the multiplier being $\frac{1}{1-c}$. If the marginal propensity

\textsuperscript{10}Passage reproduced from instructors manual covering Chapter 14 (page 75).
to consume is 0.8—a figure consistent with studies of aggregate data—then the multiplier would be 5. In other words, a sustained rise in investment or government expenditure of $1 billion will raise equilibrium output by $5 billion.

How does this happen? Think of it like this. An extra $1 billion of government spending has a first round impact of spending of—not surprisingly—$1 billion. But that $1 billion ends up in the hands of consumers (for instance, the government may increase the salaries it pays civil servants by $1 billion or it may purchase $1 billion worth of pharmaceutical drugs, which will end up being paid out by drug producers as wages, dividends, or interest income). Assuming an m.p.c. of 0.8, these consumers will want to spend $800 million of it. This generates a second round rise in spending. That second round rise in spending of $800 million comes back into household pockets once again (having gone via companies and once more been paid out as wages, dividends, or interest income). When the $800 million finds its way back to households, a further 80% of that gets spent, that is, $640 million, and so the process continues.

The story that unfolds looks like this:

<table>
<thead>
<tr>
<th>Cumulative increase in spending</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st round spending</td>
</tr>
<tr>
<td>$1 billion</td>
</tr>
<tr>
<td>2nd round spending</td>
</tr>
<tr>
<td>$800 million</td>
</tr>
<tr>
<td>3rd round spending</td>
</tr>
<tr>
<td>$640 million</td>
</tr>
<tr>
<td>4th round spending</td>
</tr>
<tr>
<td>$512 million</td>
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<tr>
<td>5th round spending</td>
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<tr>
<td>$410 million</td>
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<tr>
<td>6th round spending</td>
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<tr>
<td>$328 million</td>
</tr>
<tr>
<td>...</td>
</tr>
<tr>
<td>50th round spending</td>
</tr>
<tr>
<td>$0.0178 million</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>$4.999 billion</td>
</tr>
</tbody>
</table>

Each round of spending is a fraction c of what was spent the previous round. The cumulative sum of extra spending—which is the overall impact upon aggregate spending and output—is $1/(1−c). Therefore the Keynesian multiplier measures the ratio between the eventual increase in output generated by a given initial boost to spending and the size of that initial boost. Notice how critical the assumption of a constant marginal propensity to consume is. As discussed at length in Chapter 13 and in the excerpt earlier, we are following a very simplistic model of consumption here—consumers focus only on current income. Imagine that the government increased expenditure by distributing $1 billion to citizens as a one-off payment. As this is only a one-off payment, consumers are unlikely to treat it as an increase in permanent income and so the marginal propensity to consume out of this $1 billion transfer payment might be very low. In other words, we cannot really expect the marginal propensity to spend, c, to be invariant to how extra income is generated.

To demonstrate graphically how the multiplier works, we can return to our simple Keynesian cross model and show how important are shifts in investment, government spending, and the exogenous (to income) element of consumer spending (a) to the determination of income. Figure 10 shows that a given rise in G or in I or in a has a

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Deriving the multiplier is straightforward. We wish to know the sum of $1 billion ($1 + 0.8 + 0.8^2 + 0.8^3 + \cdots$). Call this sum X. What does X equal? Note that $X − cX = 1$, therefore, $X = 1/(1−c)$. 

long-run effect upon output that is much greater than the original stimulus — greater in fact precisely by the magnitude \( \frac{1}{1-c} \).

Figure 11 shows that if we look at two economies with different propensities to consume, the impact of extra investment or government spending will be greater in the economy with the larger propensity to consume. The economy with the larger marginal propensity to consume has a larger multiplier.

### The IS Curve

In the Keynesian cross diagram we focused either on autonomous shifts in investment or government expenditure or on changes in consumption induced by changes in disposable income. But as our analysis of Chapters 13, 14, 17, 18, and 19 suggested, the level of interest rates also has a potent influence on GDP. It is the influence of interest rates on the components of aggregate demand that leads us to the IS curve. (Remember that we are holding prices constant during this analysis so that any change in nominal interest rates is the same as a change in real interest rates).

Why does aggregate demand depend on the interest rate? Consider first the case of investment and why higher interest rates lead to a lower desired stock of capital and so a fall in investment.
FIGURE 11 The larger is c, the greater is the multiplier.

THE OPTIMAL STOCK OF CAPITAL

It makes sense for a company to expand its stock of capital if the cost of the additional investment turns out to be lower than the value of the extra profit the new machines
generate. And it also makes no sense to continue investing if the extra revenues from the new machine do not at least cover its cost. So we can think of the optimal capital stock as being that level beyond which extra returns are lower than cost, and below which extra returns exceed cost. Figure 12 shows a simple illustration of the determination of the desired capital stock. On the horizontal axis, we measure the total value of machines in place (that is, “the capital stock”), and on the vertical axis, we measure costs and marginal rates of return. It is important to be clear about the units in which we are measuring costs and returns here. When we think about costs, we are measuring the extra resources that are used over a particular period as a result of installing one extra unit of capital. Let us think of that period as one year. We can then measure the cost of capital as the resources that a company has to come up with to enjoy the use of a particular lump of capital for 12 months. And we measure the marginal product of capital as the extra profit that the company derives from having that capital in place over that period.

Of course, it is arbitrary to think of the period over which we measure extra profits, and the cost, as precisely 12 months. We should really think about how long the capital is in place and the stream of extra profit that it can generate over that period. If we can buy a machine today and sell it again in a few months, then the relevant period to calculate profits against cost is a few months. But, most machines aren’t like this. Once a machine is in place, trying to sell it in a couple of months would generate little revenue. So the relevant time horizon that a firm needs to look at in measuring costs and benefits might be the whole useful economic life of the machine, and that might be 10 or 20 years. When we think about the extra profit that a machine can earn and about its cost, then we may need to form expectations of those benefits and costs over many years. But this will vary from machine to machine. You can hire some pieces of capital for a day. If I hire a van to help me move furniture into my new house, then the relevant cost of capital is the one-day rental cost, and the gain is whatever money value I can put on the benefits of using a van for 24 hours.

So in practice it matters a lot what type of capital we are talking about when we think about measuring costs and benefits. Let us, for the moment, return to the somewhat abstract world depicted in Figure 12 and focus on how we actually measure the cost of
capital. We need to think about the extra resources that using a piece of capital for “a period” consumes. This cost reflects several things. First, there is the opportunity cost of the funds tied up in the machine. Suppose that you bought a piece of capital machinery on January 1 and borrowed the money to finance the purchase. A major element of the cost of capital would then be the interest rate on the borrowed funds. If you sold the machine again at the end of the year, a second element of cost would be the change in its value, which itself reflects both the depreciation (or wear and tear) and the change in the market price of that sort of capital.

So two of the major elements in the cost of capital are changes in the value of the machine and the cost of using funds. That second element — the cost of funds — is more subtle than simply the rate of interest. Most corporations, in fact, do not finance their investment expenditure by borrowing from banks. So we need to think about more than just a bank interest rate. Companies finance investment from many sources: they issue shares, retain profit, issue bonds, and sometimes rely on credit from suppliers of capital goods. So funds come from many sources, and the cost of capital should reflect the cost of each type of finance and its relative importance. In the recent past, companies in Germany, Japan, the US, and the UK have, in aggregate, relied on internal funds for a far higher proportion of their investment than borrowing from banks or issuing new debt or equity.12 Of course, internal finance is not free!

When a company uses some of its profits to finance investment, it is using money that it could otherwise pay out to shareholders as dividends. And once the dividends are distributed to shareholders, they could earn a rate of return that reflects the investment opportunities open to investors. So we should think of the cost of internal finance as reflecting the rates of return that investors might earn on funds if they were available to them. Those funds could be invested in the stock or bond markets or put in banks, so the overall cost to a firm of using internal finance reflects rates of return that could be earned on a whole range of financial assets.13

Therefore an increase in interest rates leads to lower investment.14 The effect of interest rates on consumption is less clear-cut.

THE INFLUENCE OF INTEREST RATES ON CONSUMPTION

Because of the importance of consumption as a component of GDP, the influence of interest rates on consumption is an important aspect of monetary policy. In the basic Keynesian model all that matters for consumption is current income, so that interest rates have only an indirect effect. For savers a higher interest rate means greater income because of higher interest payments. However, for debtors the higher interest rates reduce their income available for discretionary consumer spending. The extra income gained by creditors should equal the income loss to debtors, so overall aggregate income has not changed. However, there may still be an influence on consumption. Creditors tend to have low m.p.c. — they do a lot of saving — whereas debtors have a high

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12 Internal funds mean profit not paid out to shareholders that is available to finance expenditure.
13 Passage reproduced from Chapter 14 (pages 348–350).
14 Chapter 14 also outlines the q theory of investment, which suggests that higher interest rates, which the analysis of Chapter 21 suggests will lead to lower equity prices, will also lead to lower investment.
m.p.c. — this helps explain why they are debtors. The interest rate increase therefore leads to a redistribution of income from those with a propensity to spend toward those with a tendency to save. The result will be a fall in consumption. This fall in consumption, via the multiplier effect outlined at the beginning of the chapter, will lead to a further fall in GDP, rising unemployment, potentially generating a further fall in consumption.

In the forward-looking model the effect of interest rates is more direct but also more ambiguous, as shown in Figure 13. An increase in interest rates leads the budget constraint to tilt from AB to CD. Higher interest rates mean that for the same second period repayment the consumer can afford a smaller loan — more money has to be spent on interest payments. Therefore on the horizontal axis the budget line shifts inward. However, if the consumer saves his or her first period income, then the higher interest rates lead to greater second period interest income and lead the budget line to shift up on the vertical axis. Because the budget line tilts, interest rates have two conflicting effects on consumption. One impact is called the substitution effect and causes a fall in first period consumption and is best reflected in the inward shift on the horizontal axis. The interest rate is an intertemporal price for the consumer — every $1 of current consumption means $(1 + r) less future consumption. If the interest rate increases, this makes first period consumption more expensive and so the consumer substitutes away toward second period consumption by saving more. The other influence is the income effect. When interest rates increase, savers receive higher interest payments and can afford to spend more — this is the reason why the intercept on the vertical axis shifts up. This higher income means the consumer can spend more over his or her lifetime and because of consumption smoothing this will lead to an increase in first and second period income.

\[
\begin{align*}
C(2) & \quad \text{OLD} \\
Y(2) + Y(1) (1 + r_{\text{NEW}}) & \quad \text{after rise in interest} \\
C(2) & \quad \text{NEW} \\
Y(2) + Y(1) (1 + r_{\text{OLD}}) & \\
C(1) & \quad \text{OLD} \\
Y(1) + Y(2)/(1 + r_{\text{NEW}}) & \quad \text{after rise in interest} \\
C(1) & \quad \text{NEW} \\
Y(1) + Y(2)/(1 + r_{\text{OLD}}) & \\
\end{align*}
\]

**Figure 13** Impact of interest rates on consumption. Increases in interest rates lead to lower consumption as a result of income and substitution effects.

For savers the income effect leads to higher current consumption. However, for debtors, the higher interest rates mean higher debt interest payments and so lower lifetime income and lower current consumption. Therefore, for debtors, the income
effect of higher interest rates leads to lower current consumption. For borrowers, the effect of higher interest rates is unambiguous—current consumption falls. For savers, however, consumption can either rise or fall depending on the relative strength of income and substitution effects. In Figure 13 we have shown the substitution effect dominating so that consumption falls; this outcome is also supported in the aggregate consumption data. However, the impact of interest rates on consumption is relatively small, partly due to offsetting income and substitution effects.\footnote{15}

We have so far been focusing on a closed economy, but when considering how interest rates affect demand, it is useful to extend our analysis to include net exports. Chapter 18 focuses on the behavior of the real exchange rate, a measure of the competitiveness of a country. Net exports of a country will depend positively on the income level of the rest of the world, negatively on a country’s own income, and negatively on the real exchange rate. With a high real exchange rate, a country’s goods are expensive and net exports are low.

Our key assumption is that the real exchange rate does not influence the level of net savings but does affect net exports. The real exchange rate reflects a country’s competitiveness—the higher its real exchange rate, the more expensive its commodities are to overseas residents. With a high real exchange rate, a country’s exports will be low and imports high because foreign goods are cheap. Therefore, the higher the real exchange rate the lower the level of net exports and the higher the current account deficit. Figure 14 shows this negative relationship between the real exchange rate and net exports.

\begin{figure}[h!]
\centering
\includegraphics[width=\textwidth]{figure14.png}
\caption{Real exchange rate and net exports. Net exports rise when the real exchange rate falls.}
\end{figure}

Figure 14 suggests that when countries experience a real depreciation, their current account should ultimately improve. We stress two features of this statement. First, it is the real exchange rate that matters. If the nominal exchange rate falls but is offset by higher domestic inflation, so that the real exchange rate is unaltered, then there is no effect on net exports. Second, the beneficial effect of the depreciation may not be

\footnote{15Passage reproduced from Chapter 13 (pages 332–333).}
immediately felt. In fact in the short term, the current account may worsen. When the real exchange rate depreciates, the cost of imports rises in domestic currency terms. Eventually this higher cost of imports will lead to a lower demand for them, and net exports will improve. However, in the short run, firms and individuals may be contracted to purchase, at specified foreign currency prices, goods from overseas. While these contracts are in force, the costs of imports will rise without offsetting benefits from reduced demand. Of course, as contracts come up for renewal, the extra cost means that many will be cancelled, and net exports will improve. Therefore the depreciation of the real exchange rate may lead the current account to deteriorate at first before an improvement occurs. It may take six months or more before the improvement manifests itself. Economists call this delayed beneficial effect on the current account the J-curve effect for reasons that should be obvious from Figure 15.\footnote{Passage reproduced from Chapter 18 (pages 481–482).}

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{jcurve.png}
\caption{J-curve. The current account initially worsens before improving after real depreciation.}
\end{figure}

Therefore, if interest rates lead to changes in the real exchange rate, then they will have an effect on net exports. However, the main thrust of Chapter 18 is to argue that in the long run the real exchange rate is driven by Purchasing Power Parity (PPP) rather than interest rates. Again though we can use our assumption of fixed prices (both domestically and overseas) to argue that changes in the nominal exchange rate will feed through initially into changes in the real exchange rate (the real exchange rate being equal to the nominal exchange rate multiplied by the ratio of domestic to overseas prices). Chapter 19 outlined Uncovered Interest Parity (UIP) as a theory to explain changes in nominal exchange rates. UIP suggests that an increase in domestic interest rates leads to an immediate appreciation of the domestic currency, while an increase in overseas interest rates leads to a depreciation of the domestic currency (see Chapter 19, Section 19.4). Therefore if domestic interest rates increase, the nominal exchange rate will appreciate, which will in turn lower the level of net exports by reducing exports and increasing imports. Once again higher interest rates will have a depressing effect on demand.

So in summary, we expect higher interest rates to have a negative impact on investment; to have some, perhaps small, negative impact on consumption and in an open economy to probably have a negative impact on net trade. Therefore on balance, we would expect overall planned spending to decline with higher interest rates. Figure 16
shows that in the Keynesian cross diagram the implication of this is that the higher are the interest rates the lower will be the equilibrium level of output. When interest rates increase from $r_0$ to $r_1$, the aggregate spending schedule shifts down from $PE_{r_0}$ to $PE_{r_1}$ and the equilibrium level of output falls from $Y_0$ to $Y_1$.

If we vary the interest rate and calculate the equilibrium level of output for each rate, we would trace out a negative relation, shown in Figure 17. This negative relation between the level of interest rates and the level of equilibrium output in the short run is the IS curve.

We have used the Keynesian cross diagram and our knowledge of how consumption, investment, and net exports respond to interest rates to derive the IS curve but we could also have used the analysis in Chapter 5, Section 5.3 (Determining Interest Rates).
That section argued that in the loanable funds market it should be the case that investment equals savings. However, if GDP increases then, because the marginal propensity to consume is less than 1, consumption increases by slightly less and so savings increases. However in order to achieve equilibrium in financial markets, it is necessary for this increased savings to be matched by increased investment. But this can only be achieved by a fall in interest rates in order to stimulate the additional investment. Therefore higher income produces lower interest rates in order for savings and investment to remain equal. This derivation also helps explain how the IS curve gets its name — Investment and Savings. From the definition of GDP in a closed economy, remember too that savings equals GDP — consumption — government expenditure, or \( S = Y - C - G \).

Although the IS curve is a useful means of summarizing the relationship between interest rates and GDP, we will ultimately be interested in how movements in the IS curve affect the equilibrium of the economy. In our final IS–LM analysis it will be seen that shifts in the IS curve and the slope of the IS curve are critical.

Consider first the case of shifts in the IS curve caused by any changes in the autonomous components of \( C, G \), that is, changes in demand unrelated to changes in income or interest rates. In terms of Figure 16, any such rise in planned spending at given rate of interest shifts the PE schedule up, so the level of equilibrium output is higher. Working through the implications for the IS curve, it should be clear that any upward shift in the PE line equates to a rightward shift of the IS curve and any downward fall in PE is a leftward shift of the IS curve. Therefore autonomous fluctuations in consumption, investment, government expenditure, or net exports will shift the IS curve, as shown in Figure 18. Because of the logic of the multiplier, the IS curve shifts across by the original increase in planned expenditure scaled up by the multiplier.

**Figure 18** Shifts in components of demand move the IS curve.
What might cause these autonomous shifts in planned expenditure? In the main text we discuss several alternatives: financial liberalization leading to an increase in funds being provided at a given interest rate, “animal spirits,” whereby entrepreneurs increase their investment plans on a wave of optimism, a shift in taste toward a country’s goods—all could qualify as possibilities for shifting the IS curve.

The other important factor is the slope of the IS curve. This reflects how sensitive demand is to interest rates—if investment, consumption, and net exports are all very elastic with respect to changes in interest rates, then the IS curve will be very flat so that small changes in interest rates generate big changes in demand.

Note again the simplifying assumptions underlying the analysis. For instance, we know from Chapter 14 that investment is more sensitive to changes in long-term real interest rates, while the nominal exchange rate responds to short-term nominal interest rates. By assuming prices are fixed and collapsing the yield curve by talking of the interest rate, we have simplified the analysis down to just the IS curve.

To see this, consider the case of an individual choosing between holding their wealth in the form of a noninterest-bearing cheque account or bonds (see Chapter 22, Section 22.2 for an analysis of bond prices, yields, and interest rates). Imagine that GDP rises as does the income of the investor, which will boost their consumption and so increase their demand for liquid assets. This will cause them to move some of their wealth from bonds into cash. But by selling bonds they will affect bond prices and this influences interest rates. Therefore we cannot just focus on combinations of interest rates and income levels in isolation from conditions in the financial markets (which is what we are looking at when we consider points on the IS curve). To complete our analysis of aggregate demand, we need to introduce the LM curve, which focuses on equilibrium in the money market. In particular it focuses on the demand and supply of money provided by the central bank.

To fully understand the LM curve, and in particular how to analyze the impact of monetary policy within the IS–LM framework, it is important to understand the process whereby the central bank controls interest rates or sets the money supply, a process known as open market operations.
As well as the ultimate and intermediate targets, the other key component of monetary policy is the instruments the central bank has at its disposal. Currently the key tool of monetary policy is the short-term interest rate.

How can central banks, with limited resources, control almost exactly the level of short-term interest rates? The answer is that, at least in the current state of monetary arrangements and transactions technologies, money remains essential, and the central bank is the monopoly supplier of so-called base money, that is, the cash plus reserves that the commercial banking system holds.

The monetary system in most developed economies is, ultimately, similar. At its center stand commercial banks, which take deposits from the private sector, make loans, and, crucially, help facilitate transactions by honoring checks and other payment instructions from their customers. If the customers of a bank write more checks in a working day than they receive in payment, that bank may have to make a net transfer of funds to another bank. For example, suppose that the customers of Deutschebank write checks that customers of Dresdnerbank pay in and that compensating flows in the other direction do not match them. Suppose that at the end of the day Deutschebank needs to transfer 50 million euros to Dresdnerbank. Both banks will typically have accounts with the central bank; the central bank will hold accounts for the major commercial banks that allow them to settle transactions with each other. Central banks severely limit the ability of private banks to overdraw these accounts or take their reserves below a critical threshold (the reserve requirement). This means that if toward the end of a working day Deutschebank has insufficient funds to transfer the necessary amount to the Dresdnerbank account, Deutschebank will need to do something.

The interbank market allows Deutschebank to borrow money overnight, so that it does not go into deficit at the central bank. But suppose that most major banks are going to be overdrawn at the end of the day and that the system does not have enough funds to allow individual banks to borrow from others that had a surplus at the central bank. Suppose, for example, that a large corporation pays its tax bill on a particular day. When it pays its tax bill, it transfers a large quantity of funds from its account at a commercial bank to a government account. Government accounts are normally held with the central bank, so that clearing the check will result in a net drain of funds from the pool of money available to private banks. If the central bank did nothing to alleviate this shortage, private banks would be bidding for funds on the interbank market and would begin to drive interest rates up. If the central bank did not allow individual banks to go into significant deficit without incurring enormous penalties, interest rates on the interbank market would be bid up to high levels as individual banks sought desperately to borrow money to prevent being overdrawn at the central bank.

In this system, central banks operate by providing reserves, mainly through so-called open market operations or through lending at the discount window. During a working day, a central bank may realize that the money market will run short of funds unless it acts. The central bank will then signal that the system is likely to run short of funds that day and that it will buy short-term securities in exchange for cash at a specified interest rate. Every time the central bank buys a security from a private bank, that bank’s reserves

17Short-term securities are certificates that represent ownership of loans to government (treasury bills) or companies (commercial paper) where the loans are less than six months.
with the central bank are credited with the sale proceeds. So by buying securities (that is, engaging in open market operations), the central bank can help regulate the quantity of reserves in the system. Central banks can also control reserves by directly lending funds to the private banks that require funds. In the US system, such loans are called *discount window lending*. In some countries, for instance, the UK, lending through the discount window is the means of controlling interest rates and reserves rather than through open market operations in the interbank market.

The key thing to remember about all this is that the central bank has rules about how much funds the private sector banks have to hold with it. The private sector banks will, in certain circumstances, find that there is a shortage (or sometimes a glut) of reserves. If the central bank were to do nothing, the level of money market interest rates would move. The central bank can prevent significant movement in these money market rates by buying or selling securities or by lending money at the discount window. The central bank has enormous influence over the level of money market interest rates because it can supply almost unlimited quantities of funds to the market, or by selling securities, it can drain enormous quantities of reserves from the market. *Central banks decide the terms at which they will purchase or sell securities and lend them at the discount window.*

Note that if commercial banks were not required to hold reserves at the central banks, the central banks would not have the power to alter interest rates. The precise nature of the reserve requirements the central bank requires differs from system to system. In the United States, commercial banks that hold accounts at the Fed for settlement of flows are required not to be in deficit, on average, over a two-week period. Other systems require that individual banks not be overdrawn on a daily basis. Regardless of the specific detail, the key point is that failure to meet these reserve requirements are penalized by the central bank and only the central bank can supply reserves to the banking system. This is the reason behind the central bank’s influence over short-term interest rates.\(^{18}\)

Therefore the central bank can intervene in the money markets by buying and selling short-term securities from the commercial banks and so influence the commercial banks’ deposits at the central bank as well as influencing the interest rate in the money markets. As was shown in Chapter 12, Section 12.6, the amount of money commercial banks hold on deposit at the central bank is a key determinant of broad measures of money supply. We shall see later that this suggests central banks have two options when performing open market operations — they can either target a level for the money supply or they can target a level for interest rates.

Having explained how central banks intervene through open market operations, we can now return to our development of the LM curve. The LM curve shows equilibrium in the money market where money supply equals money demand. Chapters 12 and 17 review the demand for money. A useful place to begin is the quantity equation (see Chapter 12, Section 12.9), which says that

\[
MV = PY
\]

Consider the case where \(M\) denotes noninterest bearing forms of money. We know that in equilibrium, money supply (\(M^s\)) equals money demand (\(M^d\)) so that \(M = M^s = M^d\).

\(^{18}\)Passage reproduced from Chapter 17 (pages 443–445).
With a little rearrangement we therefore have

\[ \frac{M^d}{P} = \left( \frac{1}{V} \right) Y \]

so that the demand for real money balances depends inversely on the velocity of circulation and positively on the level of GDP (income). As explained in Chapter 12, Section 12.9, the velocity of circulation is a measure of how frequently money is used for transactions. We saw in Chapter 17 that one reason this changed over time was because of financial innovation, in particular the introduction of ATMs. It also depends on the level of interest rates; when interest rates are high, holding cash is expensive (owing to the foregone interest) and so individuals will economize on their cash balances and the velocity of circulation will rise so that at a given level of income \( \frac{M^d}{P} \) will fall. Therefore we can expect increases in interest rates to lower the demand for money and increases in income to increase the demand for money.

In considering the supply of money we shall first consider the case in which the central bank uses open market operations to achieve a fixed level for the money supply. Combining this with our demand for money, we have the situation shown in Figure 19 and equilibrium is shown at A. We can use this to derive the LM curve, which is a curve showing the relationship between interest rates and income. When income increases, for a given level of interest rates, this will increase the demand for money. But if the central bank does not alter the supply of money, then the market is not in equilibrium. The only way equilibrium can be restored is if interest rates rise so that a new equilibrium is restored at B. Therefore money market equilibrium involves a positive relationship between interest rates and GDP; this is the LM curve shown in Figure 20.

**Figure 19** A rise in the demand for money requires interest rates to increase if the money supply is fixed.
One of the benefits of introducing the LM curve is it helps show how monetary policy affects the economy. In terms of the model we have developed so far that involves changing the money supply. As shown in Figure 21, when the central bank increases the money supply from $M_0$ to $M_1$, it leads to a fall in interest rates—assuming income remains unchanged, the only way for money demand to equal the new higher level of money supply is if interest rates fall to encourage higher demand. In other words, an increase in the money supply is equivalent to a rightward shift in the LM curve, as shown in Figure 22. In contrast, a reduction in the money supply involves the LM curve shifting leftward.

Suppose that the central bank does not have a target for the supply of money but instead allows the supply of money to move so as to preserve a given level of the interest rate (for instance, in the United States, the Federal Reserve uses open market operations to achieve its Federal Funds target rate). How does that affect the shape of the LM curve?
FIGURE 22 Shifts in the LM curve.

The upward slope of the LM curve when supply is fixed reflected the fact that interest rates needed to go up (down) as income increased (fell) so as to keep money demand constant as $Y$ fluctuated. But if $M$ fluctuates so as to preserve a given level of $r$, then there will be no relation between $Y$ and $r$ — the LM curve will be flat at the targeted level of interest rates.

So we can think of the LM curve as showing consistent combinations of $r$ and $Y$ for equilibrium in the money market. It does not imply that monetary policy is designed to fix the money supply; interest rate setting, which is now much more common among central banks, is quite consistent with the LM analysis and implies a certain shape of the LM schedule. However, as we shall see, if the central bank follows a Taylor rule (see Chapter 17), then the importance of the LM curve to our analysis is much reduced.

BOX 2

CONTROLLING THE MONEY SUPPLY OR INTEREST RATES?

Central banks have tended to move away from trying to control the money supply to a framework of inflation targeting. In order to better understand how a central bank implements monetary policy we shall consider each of these cases. Figures 23 and 24 illustrate the difference between these two systems.

Figure 23 illustrates a situation where the central bank has a target for some measure of the money supply. We assume a negative relation between the level of the short-term nominal interest rate and the stock of money. The higher the interest rate
**FIGURE 23** Monetary policy when targeting the money supply. Money supply targets imply volatile interest rates if money demand is unstable.

**FIGURE 24** Monetary policy when central bank sets interest rates. When the central bank sets interest rates, volatility occurs in the money supply.
the more expensive it is to hold cash, so narrow money demand falls, and the more expensive it is to borrow, so credit and broad money declines. \( M^* \) is the target level and \( MD_0 \) illustrates the expected position of the money demand curve. If demand for money turns out to be what the central bank anticipated, then interest rates will be \( R_0 \). But if the demand for money is either higher or lower than the central bank anticipates, interest rates will deviate from \( R_0 \). If demand is at level \( MD' \) and the target does not change, monetary conditions will be tighter, and interest rates will rise to \( R' \) to reflect the scarcity of funds. But if demand for money is lower than the central bank anticipates, at \( MD'' \), interest rates will fall to \( R'' \). With higher demand for money, the central bank will be offsetting expansion in banks balance sheets by selling securities (that is, entering into contractionary open market operations). This will drain reserves from the banking system and cause interbank interest rates to be bid up as the commercial banks vie to attract funds. In this case, where the central bank is targeting the money supply, fluctuations in money demand produce considerable volatility in interest rates.

Under inflation targeting, the central bank sets interest rates to achieve a particular inflation target. This case is shown in Figure 24. Again, \( MD_0 \) denotes the level of demand for money that the central bank anticipates. If the central bank aims to keep interest rates at \( R^* \) and if demand turns out to be \( MD_0 \), the money supply will be at \( M_0 \). But if demand deviates from \( MD_0 \) and interest rates are kept at level \( R^* \), the supply of money will deviate from \( M_0 \). So, for example, if the money demand schedule is to the right of \( MD_0 \), the quantity of money will exceed \( M_0 \). And if the demand for money balances is substantially lower than \( MD_0 \), then so will be the stock of money.

If the demand for money schedule is predictable, there is no substantive difference between interest rate targeting and money supply targeting. The central bank could choose to specify a money supply target or a particular level of interest rate, and the two would be equivalent because each interest rate corresponds to a particular (known) level of money demand. It was unpredictable shifts in money demand, due to technological developments and financial innovation, that contributed to central banks looking for alternatives to targeting the money supply.\(^{19}\)

\[ 5 \]

IS–LM and Comparative Statics

Having developed both the IS and LM curves, we can finally complete our analysis by bringing them together, as shown in Figure 25. In this figure the only combinations of interest rate and output consistent with simultaneous equilibrium in the goods market (the IS curve) and the money market (the LM curve) are \( r^* \) and \( Y^* \).

We can now show how shifts in fiscal and monetary policy and movements in the demand for money or in the levels of planned household or company spending affect the economy in the short run. Once again we must stress that all this is under the assumption

\(^{19}\)Passage reproduced from Chapter 17 (pages 445–446).
that prices are fixed so that shifts in nominal variables are shifts in real variables. In other words, movements in nominal income are movements in real output.

Consider first the impact of an expansionary fiscal policy. A rise in government spending or a cut in taxes will typically move the IS curve to the right. (We say “typically” because it is possible that expansionary fiscal policy is offset by a cut in private sector spending; see the discussion of Ricardian equivalence in Chapters 11 and 16.) Figure 26 shows the impact on output and on interest rates under two different assumptions about monetary policy: with a nonaccommodating stance (e.g., a fixed money supply target) in Figure 26a and with an accommodating monetary policy (e.g., an interest rate target, which generates a flat LM curve) in Figure 26b. In both cases output increases. But with an accommodating monetary policy that leaves interest rates unchanged, the rise in income is greater; with a fixed money supply, interest rates rise and part of the impact of the rise in government spending is offset by a fall in investment induced by the rise in interest rates. There is partial crowding out (see Chapter 16, Section 16.2) of private investment expenditure by higher government spending when monetary policy is not relaxed alongside fiscal policy expansion. But Figure 26b shows that crowding out is not inevitable—if the money supply is expanded so as to leave interest rates unchanged, investment will not fall and the rise in income generated by fiscal expansion is greater.

Empirical evidence suggests that crowding out is important. Blanchard and Perotti find that in the United States increases in government spending do raise output, but that the multiplier is fairly small—in fact it is little more than unity. Investment spending seems to respond negatively to rises in government spending.20

A rise in consumer confidence leading to an increase in consumption or an increase in planned investment reflecting greater confidence in the corporate sector also shifts the IS curve to the right. Figure 26 is again relevant and shows that the impact of such forces on the economy will be to increase incomes (at least if prices are fixed so that the

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supply of output is accommodating). Once again how great the increase is will depend to some extent on whether there is a target for the money supply—in which case interest rates will rise and some demand will be choked off—or whether interest rates are kept constant—in which case the money supply will rise and the increase in demand and incomes will be larger.

Figure 27 illustrates the impact of a relaxation in monetary policy. In Figure 27a we show a situation where there is a money supply target and the target is raised and the central bank allows a larger money supply. This shifts the upward sloping LM curve to the right. Output is higher, interest rates are lower, and demand and output expand as interest-sensitive components of demand—investment, exports, and consumption—react to a lower cost of funds. Looser monetary policy operates here by inducing a move down an IS curve; in contrast easier fiscal policy operates by shifting the IS curve. Figure 27b shows a situation where the central bank operates a target for the interest rate and reduces the target level (from $r_0$ to $r_1$). In effect the impact on the

**Figure 26** Expansionary fiscal policy with and without monetary accommodation.
Monetary Policy in Practice

For reasons discussed in Chapter 17, Section 17.4, few countries now target the money supply. Instead most central banks set interest rates with the aim either of hitting an exchange rate target or of controlling the level of domestic demand so as to keep inflation low, through the use of Taylor rules for instance. We consider in the next section how targeting the exchange rate changes our analysis. Now we focus on the use of expansionary monetary policy.

FIGURE 27 The impact of expansionary monetary policy.

economy is the same — interest rates fall, output rises, and we move down an IS curve. The distinction between Figure 27a and 27b is, in some sense, not very significant — as noted above, in a world where there is no uncertainty about the demand for money schedule (and therefore no uncertainty about the position of the LM curve), the same effect can be achieved by moving the target for the supply of money by a given amount or shifting the price of money in a way that leads people to want to hold that amount of more money.
of a Taylor rule, in which in response to an increase in GDP the central bank raises interest rates.

**BOX 3**

**TAYLOR RULES**

Setting interest rates to control inflation is a complex activity. A useful way of summarizing the way interest rates are set is through what are known as “Taylor rules.” Taylor rules specify a link between the level of the short-term interest rate and output and inflation. Some proponents of Taylor rules advocate them for use in setting interest rates in practice. However, our discussion of inflation targeting outlined some problems with using fixed rules. Here we simply purpose Taylor rules as a way of approximating what central bankers try to do when setting rates. A number of studies have found such rules provide a reasonably good explanation of actual central bank behavior.

The following equation gives the typical structure for a Taylor rule:

\[
\text{nominal interest rate} = \text{equilibrium nominal interest rate} + \lambda \times \text{output gap} + \alpha \times (\text{inflation} - \text{inflation target})
\]

where the equilibrium nominal interest rate is the real interest rate plus the inflation target and \(\lambda\) and \(\alpha\) are positive numbers. The Taylor rule says that if the output gap is positive (GDP is above its trend value), then the central bank should raise interest rates. Similarly, if inflation is above its target, then interest rates also should be increased. A variety of versions of the Taylor rule exist. Some use the gap between expected future inflation and the inflation target, rather than current inflation. Also, interest rates from last period are often included in order to smooth the changes in interest rates, something that central banks appear to do.

The positive coefficients \(\lambda\) and \(\alpha\) reflect an assessment of sensitivity of inflation and output to shifts in monetary policy and to the chosen trade-off between inflation volatility and output volatility. If inflation is very sensitive to changes in interest rates, then, other things being equal, \(\alpha\) will be small, similarly for \(\lambda\). If the central bank will not tolerate much volatility in inflation, then \(\alpha\) will be large, similarly for \(\lambda\) and output volatility. For the United States, the values of \(\lambda\) and \(\alpha\) that best account for the behavior of interest rates are 0.5 and 1.5, respectively. This says that in response to a 1% increase in the output gap, the Fed tends to raise interest rates by 0.5%. In response to inflation being 1% above its target, the Fed raises interest rates by 1.5%. It cuts them by 1.5% when inflation is 1% below target. Broadly similar values are obtained for other countries, although differences in attitudes toward inflation mean there are some variations.

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If \( \alpha \) equals 1, then nominal interest rates would only rise in line with inflation and the real interest rate would not alter. When \( \alpha \) exceeds 1, then the central bank responds to higher inflation by increasing the real interest rate— it is the increase in real interest rates that makes the policy contractionary. The Taylor rule, and its ability to track actual changes in interest rates, suggests that central bankers translate the various messages that a wide range of macroeconomic variables convey into movements in the output gap and inflation relative to target. Then, having formed these views, they adjust interest rates accordingly.

**FIGURE 28 Taylor rule applied to interest rates in a number of countries.**
Figure 28 gives an illustration of the Taylor Rule applied to the US, Germany, UK, and Japan. It is based on a 1.5% coefficient on inflation and a 0.5% coefficient on output deviations. The equilibrium nominal interest rate is chosen to match the sample average.\footnote{Passage reproduced from Chapter 17 (pages 449–451) and the Instructor’s Manual.}

Monetary policy can be used to offset the impact of fluctuations in components of spending so as to keep demand steady. Figure 29 illustrates this. Here the target for income is $Y^*$. Initially planned spending generates an IS curve at $IS_0$. A surge in optimism in the private sector boosts household and corporate spending plans, so the IS curve moves to $IS_1$. A tightening of monetary policy is required to offset the expansionary
impact of this wave of optimism. The LM curve moves up from $\text{LM}_0$ to $\text{LM}_1$ as the central bank responds to the strength of demand by raising interest rates from $r_0$ to $r_1$ — exactly what is required to keep income constant.

Figure 30 illustrates another example of countercyclical monetary policy. Here monetary policy is loosened to offset a decline in planned private sector spending, which has pushed the IS curve to the left (from $\text{IS}_0$ to $\text{IS}_1$). The LM curve shifts from $\text{LM}_0$ to $\text{LM}_1$, as interest rates fall from $r_0$ to $r_1$ — exactly enough to boost interest-sensitive spending so as to offset the fall in other components of demand.
the interest sensitivity in spending — that is, the slope of the IS curve. Figure 31 compares the necessary cut in interest rates to offset a fall in private sector spending plans in an economy in which spending is responsive to rate movements (a flat IS curve illustrated in Figure 31a) and in an economy in which spending is not responsive to interest rates. One can clearly imagine cases in which spending is sufficiently unresponsive to interest rate changes such that a substantial leftward shift in the IS curve means that even cutting interest rates to zero is insufficient to prevent income from falling, a situation illustrated graphically in Figure 32 and empirically by Japan in recent years (see Figure 33).

The routes through which changes in interest rates influence spending and activity in the economy are the elements of the transmission mechanism. Just how sensitive spending is to shifts in interest rates varies across countries and over time—the transmission mechanism evolves.
The zero floor on the interest rate prevents a sufficient easing in monetary policy to stop income falling from $Y^*$ to $Y_1$.

**THE TRANSMISSION MECHANISM**

The transmission mechanism of monetary policy describes the link among changes in interest rates, changes in components of demand within the economy, and how such changes in demand can affect inflation pressures.

Figure 34 outlines the main links through which the transmission mechanism works. When the central bank increases official interest rates, this will begin to have an effect on interest rates of all maturities and will influence asset prices. Assuming inflation in the short term is relatively unchanged, short-term real interest rates will be higher. If the markets believe the higher interest rates are not purely transitory, this will also increase longer-term bond yields. These increases in interest rates will have a direct effect in lowering demand. As we saw in Chapter 13, increases in interest rates lead to reductions in consumption. In addition, higher interest rates will affect the cost of borrowing and the real rate of return that needs to be earned on investment projects leading to a fall in investment.
in investment spending. The higher interest rates will also lead to a fall in asset prices (see Chapters 21 and 22) and further reductions in consumption and investment through wealth effects and the q theory of investment (see Chapter 14). If higher interest rates are expected to lead to a future slowdown in the economy, consumer and producer confidence will also fall, which in turn will lead to retrenchment of consumption and investment plans.

The increase in interest rates will also affect external demand in the economy. As we noted earlier, higher interest rates lead to an increase in the exchange rate. The higher exchange rate makes imports cheaper, which may place downward pressure on domestic inflation. Further, the higher exchange rate makes exports more expensive and so reduces demand in the economy. The overall impact of the increase in interest rates is therefore to reduce demand in the economy.

Figure 34 focuses on how increases in the price of money, the interest rate, affects the economy. However, in some cases monetary policy operates less as a result of changes in the price of money and more through the quantity of lending banks undertake. This is known as the credit channel of monetary policy. Increases in interest rates can produce declines in real estate and equity prices, which reduce the collateral firms can offer banks. As a consequence, banks reduce their loans to the corporate sector, which has a direct effect on consumption and investment. It has been argued that the credit channel rather than inappropriate levels of interest rates were responsible for the severity of the Great Depression. The credit channel occurred through the failure of the Federal Reserve to offset the dramatic decline in the stock of money by providing banks with cash that they could lend. The Fed could have done this by buying securities from the banking sector and providing it with loanable funds.

Figure 34 only outlines the channels through which interest rates affect output and inflation, not the magnitude of the effects nor how long the impact takes. Figure 35

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shows empirical estimates of how the US economy is affected by a 1% increase in the main Federal Funds interest rate. As our analysis predicts, the higher interest rates lead to a fall in the money supply, increases in unemployment, and lower prices and output. At its peak, output falls by around 0.7% after around two years. Prices are lower by around 0.2%, with the effect peaking after a year. These long lags in the transmission mechanism show the importance of using a forward-looking intermediate target when setting interest rates.

The magnitude of interest rate effects and how quickly they impact the economy depends on the economy’s financial structure. Monetary policy will be particularly effective if many domestic firms and households rely strongly on banks for credit, as the interest rate on bank loans varies closely with changes in the short rates under the control of the central bank. In contrast, the cost to companies of issuing equity is likely to be less affected than the cost of borrowing on a loan from a bank. If some firms and households find it difficult to substitute other forms of finance (for example, issues of equities or long-dated bonds) for bank loans, shifts in monetary policy are likely to hit them hard. The degree of substitutability between bank finance and other forms of finance will also be an important influence on the scale of the credit channel. Because financial structure varies across countries, so does the monetary policy transmission mechanism. Figure 36 shows how the impact of higher interest rates varies across countries. The overall shape of all the responses is the same, but when the peak impact occurs and how substantial the impact is varies.

24Figures 35 and 36 are taken from different studies covering different time periods. As a result, the results for the United States are not identical.

25Passage reproduced from Chapter 17 (pages 446–448).
Mundell–Fleming and the Open Economy

Although our earlier analysis showed how net exports depended on interest rates via UIP, we have not yet modeled how exchange rates are affected by monetary and fiscal policy. To do this we modify the IS–LM model (using what is known as the Mundell–Fleming model). Not surprisingly, we find that the impact of monetary and fiscal policy is highly sensitive to the nature of the exchange rate regime the government operates.

In our open economy model we have that national income is given by

$$Y = C + I + G + NX(e)$$

where, following our earlier discussion, we assume net exports (NX, which is exports minus imports) vary negatively with the exchange rate. This implies that the IS curve will be further to the right the lower the exchange rate is (for a given level of interest rates) since net exports will be greater, and just as higher government spending or investment pushes the IS outwards, so do larger net exports.

We assume that the country under analysis is small relative to the global economy. This means that any changes in domestic policy do not influence interest rates in the global capital markets. From Chapter 19 and our analysis of UIP, it also means that for a stable exchange rate, domestic and overseas interest rates must be the same. This is the key difference between the open and the closed model. In the closed economy model we
have seen that both monetary and fiscal policy can lead to changes in the interest rate and to shifts in output. In the open economy model, although monetary and fiscal policy can influence output, they will not affect interest rates.

**BOX 4**

**IS THERE A GLOBAL INTEREST RATE?**

A simple way to assess whether a single global market is in place is to determine whether a common interest rate at which countries can lend and borrow exists. In the absence of a global capital market, firms have to borrow at the rate prevailing in their national market. But if borrowing from abroad is not restricted and if borrowing rates are lower in another country, then the firm will borrow from there. Competition among banks in different countries to attract lenders and borrowers will result in a single, common interest rate.

We can establish this result of a single real interest rate more formally by combining purchasing power parity (PPP) and UIP. UIP implies

\[
\text{US nominal interest rate} = \text{Japanese nominal interest rate} + \text{expected depreciation of dollar against yen}
\]

As the nominal interest rate equals the real interest rate plus the expected inflation rate (the so-called Fisher equation), we can write this as

\[
\text{US real interest rate} + \text{expected US inflation} = \text{Japanese real interest rate} + \text{expected Japanese inflation} + \text{expected depreciation of dollar against yen}
\]

However, PPP states that

\[
\text{expected depreciation of dollar} = \text{expected US inflation} - \text{expected Japanese inflation}
\]

Substituting this into our expanded UIP equation, we arrive at

\[
\text{US real interest rate} = \text{Japanese real interest rate}
\]

In other words, in the absence of capital controls that restrict the flow of funds between economies, the real interest rate should be identical between countries. If no global capital market exists, the real interest rate will differ across economies.

Figure 37 shows estimates of the real interest rate for five economies. Even though there are some signs of convergence (especially among the United States, Canada, and Australia), at the end of the 1990s, no common global interest rate existed.
Why no single global real interest rate exists remains controversial. Our derivation required the use of PPP, which we argued in Chapter 18 was only useful as a long-run theory—therefore, perhaps a common real interest exists only as a long-run phenomenon. Further, our discussion of UIP in Chapter 19 suggested that we should add a risk premium because of exchange rate volatility and inflation and interest rate uncertainty, which implies that Figure 37 measures real interest rates plus a risk premium.  

Because interest rates are assumed to be independent of domestic economic conditions and determined in global capital markets, monetary and fiscal policy now affect the exchange rate rather than interest rates. Therefore we need to move our graphical representation of the IS–LM analysis away from interest rate-GDP space and into exchange rate-GDP space. We have already commented that net exports depends negatively on the exchange rate, although it is unlikely that investment or consumption are strongly influenced directly by the exchange rate. Therefore, because of net exports, the IS curve will be a downward sloping line, as in Figure 38.  

Once again the modeling of the LM curve is sensitive to whether the central bank aims to control the supply of money or set a target interest rate. Consider the case where the central bank sets a fixed supply of money — $M^*/P$. In equilibrium this money supply must equal money demand that depends on interest rates and income. But interest rates

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26 Passage reproduced from Chapter 20 (pages 535–536).

27 We leave as an exercise derivation of this downward sloping IS curve using the Keynesian cross approach.
are now set by global capital markets, so the only variable influencing money demand is income. Because money demand depends positively on income, there is only one level of income consistent with the fixed money supply and money market equilibrium. Therefore in our open economy model the LM curve is a vertical line, as in Figure 38.

We can use this framework to consider how a central bank would need to behave to achieve a fixed exchange rate. Consider Figure 39 where the government is committed to a fixed exchange rate at level $A$. Assume that the government increases its expenditure, leading to larger fiscal deficits — shifting the IS curve across to the right. If the central bank does not alter the money supply, then equilibrium moves from $b$ to $c$ and the exchange rate appreciates. The reasoning is simple — with a fixed money supply and

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28 An alternative way of deriving this result is simply to return to Figure 20, our original LM curve, and see that for a given level of interest rates money market equilibrium implies a fixed level of income.
an interest rate set in global financial markets, money market equilibrium is consistent with only one level of income. Therefore as government expenditure increases some other component of demand has to fall in order for income to remain the same. If the exchange rate *appreciates*, then net exports will decline to make way for the higher fiscal deficit. However, if the central bank is trying to achieve a fixed exchange rate $A$, then it will respond to the rightward shift in the IS curve by *increasing* the money supply and so the economy moves to $d$. By increasing the money supply, the central bank enables the higher GDP caused by higher government spending to be consistent with money market equilibrium. Note though that in achieving a fixed exchange rate of $A$ the central bank can no longer choose the money supply — instead it has to set the money supply so that the LM curve is consistent with a fixed exchange rate. As we saw with the impossible trilogy in Chapter 20 (repeated below), when a country fixes its exchange rate, it can no longer set an independent monetary policy.

**THE IMPOSSIBLE TRILOGY**

With a floating exchange rate the value of a country’s currency can vary freely and will be influenced by the forces we analyzed in Chapters 18 and 19. By contrast, with a fixed exchange rate, the government will either change interest rates or sell/buy foreign currency to maintain a fixed value for the currency. Fixed exchange rates come in many varieties: from a pure peg, where the exchange rate is fixed at a single numerical value, to a crawling peg, where the government keeps the exchange rate within a certain band but the band itself moves over time in a scheduled way.

Throughout the nineteenth century (and up until 1914), and again for some time in the 1920s and 1930s, a fixed exchange rate system (the gold standard) operated. Under this system a country fixed its currency to be worth a certain amount of gold, which defined a system of fixed exchange rates between different currencies. Between 1945 and 1971, under the Bretton Woods system, only the dollar was pegged against gold, and all other currencies were pegged to the dollar. Since 1971 the world has experimented with flexible exchange rates, although many countries still prefer fixed exchange rate systems.

Whether fixed or flexible exchange rates are better depends on the country and its circumstances — there are no universal laws. Figure 40 shows how exchange rate regimes vary considerably across 71 small economies (with nominal GDP of less than $5 billion in 1998).

To understand the advantages and disadvantages of a fixed exchange rate, we begin with the *impossible trilogy*, which says that a government can choose at most two of the following three options:

- independent monetary policy
- fixed exchange rate
- absence of capital controls.

In other words, if a country chooses a fixed exchange rate, it must either abandon an independent monetary policy or impose capital controls, that is, impose constraints on the free flow of money into and out of a country.

To understand the impossible trilogy, consider again the case of UIP (see Chapter 19), which is based on an arbitrage relation in which investors reallocate
funds to the country that offers the highest expected return. This reallocation can only happen in the absence of capital controls. According to the impossible trilogy, UIP implies that the government cannot operate both a fixed exchange rate and an independent monetary policy. The key result for UIP was that interest rate differentials equal expected exchange rate depreciations. However, under a fixed exchange rate the expected devaluation is zero. Therefore UIP implies that interest rates should be the same between countries with fixed exchange rates—the countries cannot run independent monetary policies. If the fixed exchange rate regime allows for small fluctuations around a central rate, then interest rates can differ between countries in the expectation of small depreciations. Adding a risk premium to UIP allows for more interest rate differentials. However, assuming a narrow exchange rate band and a stable risk premium, then even if interest rates do not have to be identical there will be strong linkages. In particular, countries that participate in a fixed exchange rate system will tend to raise interest rates together even if not by exactly the same amount.

However, with capital controls it is possible to have a fixed exchange rate and choose an independent monetary policy. Consider the case of a country with a fixed exchange rate that unilaterally lowers its interest rate. Without capital controls, investors would move funds out of the country to overseas where a higher return can be earned. This would put downward pressure on the currency and threaten the exchange rate target. However, if capital controls are in place, this outflow can be restricted and so pressures on the exchange rate can be avoided; with capital controls, the government can have an independent monetary policy and an exchange rate target. Without capital controls the impossible trilogy tells us that the cost of a fixed exchange rate is the inability to choose a monetary policy to suit the country’s specific circumstances.

This inability to set your own monetary policy is, paradoxically, often one of the main attractions of a fixed exchange rate, particularly for countries with a history of poor monetary policy and high inflation. By fixing the exchange rate against the currency of a country with a good inflation record, such a country can benefit from losing monetary

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**FIGURE 40 Exchange rate regimes amongst small economies.** Wide variety of exchange rate regimes across countries. *Source: IMF, Exchange Rate Regimes in an Increasingly Integrated World Economy (April 2000).* Courtesy of IMF.
independence. This is what led Italy and the UK to join the European Exchange Rate Mechanism and fix their exchange rates against the German Deutsche mark. However, a country can lose from giving up an independent monetary policy if the other countries in the fixed exchange rate system have different economies and experience different shocks. Under these circumstances a country will often wish to choose different interest rates.

As Figure 39 makes clear, the nature of the exchange rate regime is critical for understanding the impact of policy on the economy. Under floating exchange rates and a fixed money supply, the increase in fiscal spending had no effect on the economy owing to the contractionary effect of a rise in the currency. However, with a fixed exchange rate, fiscal policy is far more effective in boosting the economy as the money supply expands to prevent the currency appreciation.

While fiscal policy is less effective in a floating exchange rate regime, monetary policy is much more effective than it would be in a fixed exchange rate regime. With free flow of capital and a fixed exchange rate regime, there is in fact no role at all for an independent monetary policy (the impossible trilogy again). But with a floating exchange rate, monetary policy can change a key price in the economy — not the interest rate but rather the exchange rate. A loosening of monetary policy, which in a closed economy would generate downward pressure on interest rates, will cause people to want to sell domestic financial assets and acquire overseas assets as soon as domestic rates of return move down even slightly. This will generate a fall in the currency. Because net exports depend upon the exchange rate, monetary policy with floating exchange rates has the scope to boost or contract the economy through its influence on the exchange rate.

Of course implicit behind this analysis is that any resulting shifts in the current account are consistent with the capital account so that there are no balance of payments problems (see Chapter 18, Section 18.4 for a full discussion). If we started from a position of trade balance an expansion in demand is likely to generate higher imports and perhaps lower exports — the current account is likely to move into deficit requiring a capital account surplus to offset this. In time, current account deficits may significantly affect the level of net national wealth — this would be the case if the capital account counterpart to more government spending were to be sales of government debt abroad. This reduction in national wealth may have a feedback impact on spending; households may recognize that debt will ultimately need to be paid off and future taxes rise. These feedback effects are an important long-run mechanism whereby current account deficits can be self-correcting as spending is reduced by falls in net asset positions — the position of the IS curve is likely to depend on stocks of wealth.

If overseas demand for domestic financial assets is highly price-elastic — as is plausible with a credible fixed exchange rate regime run in a relatively small economy — this shift in flows across the capital account can be achieved with no tension. If, however, overseas investors are not prepared to supply funds, there can be problems. Therefore, fixed exchange rates can enhance the effectiveness of fiscal policy when the exchange rate target is credible but a less than fully credible exchange rate policy can be undermined by an expansionary fiscal policy. Box 5, from Chapter 19, elaborates on this point.

29Passage reproduced from Chapter 20 (pages 521–523).
BOX 5

EXCHANGE RATE CRISIS

Because currency crises tend to have enormous political, economic, and social implications, economists devote a lot of attention trying to determine who is responsible for them. In so-called first-generation models of currency crises, which were developed in the late 1970s and early 1980s, the answer is straightforward—the government is to blame for pursuing inconsistent domestic and external policies. However, when the crisis occurs, speculators and global capital markets are the main actors, and politicians blame them. But, speculators are merely the messengers—and their message is that governments have to change their policy.

Let’s consider the most straightforward first-generation model in which a government announces a fixed exchange rate target but also wishes to pursue an expansionary fiscal policy. To finance the fiscal deficit, the government has in part to print money; it has to resort to the inflation tax (see Chapters 10–12 of this book). However, such an expansionary monetary policy leads to low interest rates and capital outflows. Investors withdraw funds to place them abroad, and to do so, they sell the domestic currency. This puts downward pressure on the exchange rate; but the government is committed to a fixed exchange rate target. To try and maintain the exchange rate, the government sells foreign currency reserves and buys the domestic currency. In this scenario the country is experiencing a large and continual fiscal deficit, high money supply growth, rapid inflation, and a fixed nominal exchange rate; this implies an appreciating real exchange rate (because inflation is high). Further, government foreign exchange reserves are falling. This situation will continue as long as the government maintains its policy of fixing the exchange rate and simultaneously running a large fiscal deficit. If it dropped its commitment to a fixed exchange rate, it would no longer have to sell foreign exchange reserves to support the currency, and the exchange rate could depreciate. Alternatively, if it reduced its fiscal deficit, interest rates could be higher, and less capital would flow out, and the exchange rate would not be under pressure. However, if the government does not change its policies, foreign exchange reserves will continue to fall—as shown in Figure 41.

These circumstances cannot continue indefinitely—eventually the central bank will run out of foreign exchange reserves and the currency will depreciate sharply. However, the currency crash will occur before the central bank runs out of reserves. In particular, at a critical level of reserves (R_C in Figure 41), a speculative attack will occur, and the currency will drop. Why does this happen? Investors will not want to wait until the foreign exchange reserves of the central bank are zero. At this point the currency will depreciate sharply, and anyone holding it will lose money. Therefore the investor will want to sell the domestic currency before reserves run out and will try and sell the domestic currency before a crisis. When the central bank has high

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30 This model is based on Krugman, “A Model of Balance of Payments Crises,” Journal of Money, Credit and Banking (1978), vol. 11, pp. 311–325. Subsequent work has extended the relevance of the model, but the basic insights remain the same.
levels of foreign currency reserves, it can withstand the pressure of a speculative attack — investors selling the domestic currency. But when reserves reach the critical level, they are too low to offset the sell orders for the domestic currency. Investors know that in a few months reserves will be exhausted, and the currency will crash. At this point they sell the domestic currency in large amounts, and the government either wastes what little reserves it has left or immediately devalues the currency.

When all this occurs, the government will blame investors. They will argue that it was committed to defending the exchange rate and that it still had several months of foreign exchange reserves left. However, according to first-generation models, this is beside the point. Domestic and external policies are inconsistent and a sharp depreciation of the currency is inevitable. By simultaneously pursuing two inconsistent aims, the government has caused the currency crisis.

These first-generation models cannot account for all currency crashes. However, they do explain the volatile exchange rates of Latin America in the 1970s when many governments tried to target the exchange rate to stabilize high inflation rates while still running large fiscal deficits. In empirical attempts to develop “early warning indicators” of currency crises, all the variables that play an important role in first-generation models were found to be important: declining foreign exchange reserves, large fiscal deficits, capital outflows, high rates of seignorage and inflation. First-generation models of exchange rate crises and the role of inconsistent government policy in triggering currency crashes have considerable empirical support. 31

Note that so far we have been assuming that the central bank is setting the money supply. However, as we have repeatedly discussed, in practice most central banks set interest rates. We know that if the demand for money is stable there is an equivalence

31Passage reproduced from Chapter 19 (pages 508–509).
between setting interest rates or controlling the money supply. Therefore instead of thinking of the LM curve shifting outward or inward, we could simply think of the central bank changing interest rates, which through UIP will affect the exchange rate. In other words, we can think of Figure 39 without the LM curve and envisage interest rates adjusting to ensure that the exchange rate target is met; as in our closed economy model we then essentially have a Taylor rule that chooses interest rates at a level at which the IS curve is consistent with the government’s inflation or exchange rate target.

So far we have assumed that prices of goods and services are constant. But in order to show how to derive the aggregate demand curve (a relationship between prices and GDP) from this IS–LM framework, we need to change this assumption. We do this by considering how the IS–LM curves shift as prices are changed.

Let us start with the IS curve. In an open economy then we would expect a move in prices, unless it is completely offset by an equal move in the opposite direction by the exchange rate, to affect competitiveness. A lower level of aggregate prices will increase competitiveness and so lower the real exchange rate. So we expect the IS curve to shift to the right if prices are lower.

There are also other effects on the IS curve from changes in prices — what are called wealth effects. We have so far assumed that consumption depends only on income but, as we discussed in Chapter 13, it also depends on an individual’s wealth — the money they have invested in bank accounts, stock markets and so on. As prices fall, the real value of these assets increases leading to higher expenditure and a further rightward shift of the IS curve.

What about the LM curve? We know from Figure 22 that when there is an increase in the money supply, the LM curve shifts to the right. The money supply is M/P and we have focused so far on the central bank increasing the money supply at unchanged prices, that is, increasing M. But if there is a fall in prices, then the real money supply will increase at unchanged M.

Therefore a fall in prices shifts the IS curve to the right, through real exchange rate and wealth effects, and also shifts the LM curve to the right (at given level of prices, cash can now buy more). The result will be a definite increase in GDP (as both IS and LM curves shift right), although the effect on interest rates will be ambiguous (the IS curve shift will tend to raise interest rates and the LM curve shift will lower them). Figure 42 illustrates this.

The result of all this is that the level of demand for real aggregate output consistent with equilibrium in the money market and in the market for goods is higher the lower is the level of prices. Thus the IS–LM analysis generates a negative relation between the equilibrium demand for real output and the price level. This relation is the aggregate demand curve, illustrated in Figure 42b.

In the longer run it is very unlikely that the aggregate supply curve is horizontal. In the longer run we need to consider the conditions for equilibrium in the markets for factors of production — and most obviously in the labor market — as well as the conditions for equilibrium in the markets for money and for goods and services. It is very
likely that as output rises some factors of production will get more expensive and /or their productivity will decline so that output prices will need to rise to make it profitable to produce more. Indeed we can go further and argue that it is plausible that in the long run the supply of aggregate output is invariant to the aggregate level of prices. In other words the long run aggregate supply curve is likely to be vertical.

As we move from the short run to the long run the implications of shifts in monetary policy and in elements of demand — which drive movements in the LM and IS curves — for real output shift. Figure 43 illustrates this. In the short run a rise in
consumer spending shifts the IS curve to the right (from IS₀ to IS₁) and generates higher nominal and real output. As time passes prices rise and the LM curve moves left so that real demand falls back so that the long-run level of output is unchanged. In an open economy the mechanism whereby demand falls as prices are driven up is by a loss in competitiveness; in an economy where trade in goods and flows in capital are not large, interest rates will rise and the impact of higher prices will show up in higher interest rates and lower investment; it is this latter case that is illustrated in Figure 43. In the first case net exports are squeezed at the expense of the higher level of consumption; in the second case, which we illustrate in Figure 43, interest-sensitive elements of spending fall after the initial boost to consumption increases the aggregate price level. In either case the long-run equilibrium level of real output demanded and supplied is unchanged, though the composition of output has changed.
IS–LM Assessment

We have shown in detail how to derive the IS–LM model and how it in turn can be used to determine the aggregate demand curve. It is clearly a complex model and one that can be used to consider a huge variety of different policy options. Different assumptions about the elasticity of key variables to interest rates affect the slope of these curves and in turn can have big effects on how policy impacts on the economy. That so many different markets and considerations can be reduced to two curves is clearly impressive. Macroeconomics is about the general equilibrium of an economy that involves many prices and quantities — distilling these into one diagram is no mean achievement.

However critics of IS–LM argue that the distillation is misleading as it misses too much that is important. The key criticisms are as follows:

1. Assumption of fixed prices. Even if this assumption is valid in the immediate short run it surely cannot be appropriate for future periods too.
2. Abstracting from supply considerations. The IS–LM curve can be used to derive a demand curve that can then be interacted with a supply curve, but this is far from being the main focus of its analysis.
3. Ignoring asset markets. The LM curve offers some links with a bond market but the stock market and real estate and the exchange rate market are not explicitly integrated.
4. Ignoring expectations and their formation. As every discussion of monetary and fiscal policy, consumption, investment, asset markets, and exchange rates in the textbook suggested, expectations exert a critical influence on the behavior of the economy. As Rational Expectations stressed, these expectations cannot be assumed but have to be modeled.
5. Focusing too much on flows and not on stocks, for example, ignoring intertemporal budget constraints. We touched briefly on consumption depending upon wealth. But wealth is previous saving or previous nonconsumption. How does this period’s consumption influence future wealth? How does the accumulation of fiscal deficits affect government debt and the behavior of the economy? In focusing so much on the short run these dynamic considerations are missing from IS–LM.

We have at various points shown how each of these factors could be incorporated into the IS–LM model — we showed what happens when prices change and the IS–LM curves shift; how the IS–LM model could be linked to a demand and supply curve analysis; how shifts in bond prices, equity, and property would affect wealth and potentially influence both the IS and the LM curve; how increases in permanent income would shift out the IS curve; and finally how allowing for wealth effects would influence the IS curve. However, with each amendment the model becomes more cumbersome and less compact and complete. For some economists this is a major problem. Robert King has gone so far as to say “the IS–LM model has no greater prospect of being a viable analytical vehicle... than the Ford Pinto has of being a sporty reliable car...”32 In recent years growing

numbers of macroeconomists have moved away from the IS–LM model in an effort to focus more explicitly on the dynamic nature of macroeconomics (the Real Business Cycle model of Chapter 15 is a good example here). But the IS–LM model continues to have many adherents and remains widely used in policy circles.

It is not necessary for us to announce a verdict here on the IS–LM model. All models are an abstraction of reality and the IS–LM model focuses on one specific form of abstraction; alternative models use a different perspective. In truth, like all models, if the IS–LM model is used in an expert way and with knowledge of the various assumptions being made, then insightful policy advice can emerge. If instead the model is used blindly and automatically and with little art or sensitivity shown for its assumptions, then it is unlikely to yield anything useful. The same of course holds for any economic model.

THE GOODS MARKET: THE IS CURVE

In the case of a closed economy, equilibrium in the goods market is the familiar

\[ Y = C + I + G \]

These elements are most simply determined by the following linear equations.

\[
\begin{align*}
C &= a + c(Y - T) \\
I &= b - d(r) \\
G &= \bar{G} \\
T &= \bar{T}
\end{align*}
\]

Consumption is determined by disposable income. c is the marginal propensity to consume.

Investment is negatively related to the level of interest rates (r) with d measuring the sensitivity of investment to interest rates.

Government spending is fixed — exogenous — in this model.

Taxation is a fixed lump sum (i.e., not related to income).

Given these elements, we arrive at a simple relationship between interest rates and output. It implies that saving must equal investment and since savings is positively related to income and investment is negatively related to interest rates, higher output implies lower interest rates.

Algebraically

\[ Y = (1/1 - c)[a + b + G - cT - d(r)] \quad \text{(A1)} \]
THE MONEY MARKET: THE LM CURVE

Equilibrium in the money market requires that the demand for money equals the supply of money.

\[ M^d = M^s \]  
Demand for money must equal the exogenous supply.

\[ M^d = (1/v)Y - l(r) \]  
Money demand increases with output, decreases with interest rates.

So

\[ r = (1/vl)Y - (1/l)M^s \]  \hfill (A2)

By combining equations (A1) and (A2) and then simplifying the resulting equation, we can show the relation between the exogenous components of spending (i.e., a, b, G, and T), the stock of money (M^s), and the equilibrium level of income or output (Y).

\[ Y = \left[ \frac{1}{1 - c + (d/vl)} \right] \times (a + b + G - cT) + \left[ \frac{d/l(1 - c) + d/v}{1 - c + (d/vl)} \right] \times M^s \]  \hfill (A3)

Equations (A2) and (A3) can be used to show the effects of the following:

1. Expansionary monetary policy (an increase in M^s). By moving the LM curve out to the right, expansionary monetary policy increases output and lowers interest rates. It increases output by encouraging investment.
2. Expansionary fiscal policy (an increase in G or decrease in T). By moving the IS curve to the right, expansionary fiscal policy increases output and raises interest rates (when the money supply is fixed).