CHAPTER

16

The IS-LM Model

We have now explored three of the major issues with which macroeconomics is concerned: gross national product (GNP), money and distribution. We questioned the appropriateness of GNP as the desirable end for economic policy, and emphasized the importance of a just distribution as a desirable end, but said little about policies for attaining these ends. In this chapter, we examine the policy tools at the macroeconomist's disposable that can help us attain an economy with sustainable scale, just distribution, and efficient allocation.

Of course, to know how policies work, we have to know how the macro-economy works. One way of doing this might be to build on microeconomic principles to construct a model in which supply and demand of all goods and services balances simultaneously. This approach would extend the basic market equation presented in Chapter 8—MU*xn**MPP*ax* = MU*yn**MPP*ay*—into a general equilibrium model encompassing all goods (*x, y, z* . . .), all commodities (*a, b, c* . . .), and all consumers (*n, m, o* . . .). Such a model can easily become overwhelming. A thousand simultaneous equations with a thousand unknowns is hard to come into mental contact with. It does show that everything depends on everything else, which is interesting and usefully humbling, but it is also crippling from a policy perspective to have to face the implication that in order to predict anything, you have first to know everything. But a smaller system of two or three or five especially important aggregate sectors interacting through two or three or five simultaneous equations that reflect key behavior can aid the understanding and give basic policy insights. This is the kind of model that most macroeconomists have sought. They still look at the whole economy, but they divide it into fewer but larger aggregate

sectors than does the general equilibrium model of microeconomics.[1] A model of this type, first offered in 1937 by Sir John Hicks[2] and now called the IS-LM model, has proven to be a good "two-digit" compromise between completeness and simplicity. It has become the "workhorse" model in macroeconomics. Below we will explain this model, and then discuss its applications to ecological economics.

The model divides the economy into two sectors: the real sector (dealing with national income, savings, investment, rates of productivity of capital, government spending, taxation, etc.) and the monetary sector (money supply, interest rates, demand for liquid cash balances). The real sector reflects the theories and insights of classical economics, and the monetary sector reflects the insights of John Maynard Keynes, which in 1937 were still quite new. The model seeks to explain how the interdependent behavior of consumers and savers, lenders and borrowers, and monetary authorities interact to determine the level of national income and the rate of interest.

Box 16-1 The Quantity of Money Theory of Income

Another way of relating the real and monetary sectors in an aggregate way is through the "identity of exchange," MV = PQ, where Q is quantity of final commodities sold to households, P is average price of exchange, M is stock of money, and V is velocity of circulation of money (number of times an average dollar is spent per year on final goods and services). Since by definition V = PQ/M, the equation of exchange is an identity or truism. To the extent that V is a constant or slow to change, reflecting stable payment habits and settlement periods, the identity becomes the "quantity of money theory of income," stating that changes in PQ are proportional to changes in M. If the economy is at full employment, it will be very hard to increase Q in the short run, and the change in PQ will be mainly a change in P—i.e., inflation. Historically M and P have often moved in direct proportion, yielding a quantity of money theory of the price level.

[1] Our measures of the two most basic magnitudes of macroeconomics, GNP and money, are too dialectical and uncertain to be able to support exact calculations implicit in complicated models. As Oskar Morganstern remarked in his classic *On the Accuracy of Economic Observations*, "economics is a two-digit science."

[2] J. Hicks, Mr. Keynes and the "Classics," *Econometrica* 5(2) (April 1937).

IS: The Real Sector

Let's begin with the real or classical sector. The real sector is in equilibrium when the supply of goods by firms is just equal to the demand for goods by households (the lower half of the circular economy in Figure 2.4). Of course, the demand for goods by households is determined by their income—the money firms pay households for their factors of production (e.g., labor), and the supply of goods is determined by the firms' employment of those factors of production (the upper half of the circular economy in Figure 2.4). In equilibrium, income (Y) equals output (GNP). Remember from the circular flow diagram in Figure 2.5 that the equilibrium condition for the continued flow of national income at a given level is that leakages equal injections. In the simplest case, the leakage is savings (S) by households, the new injection is investment (I) by firms. Therefore, the equilibrium condition for the real sector is S = I.

But how do S and I get determined? Let r be the interest rate and Y be national income (GNP). In equilibrium, income paid to the factors of production will just equal the output of goods provided by those factors of production, and the income will be used to purchase the output. Savers (i.e., households) will save more if their income Y is higher than if it is lower. Also savers will save more with a higher interest rate r than with a lower one. Investors (i.e., firms) will borrow and invest more if the interest rate is lower, and if income is higher. In other words, savings is some function of the interest rate and national income, says S = S(r, Y). Likewise, investment is some different function (representing the behavior of firms instead of households) of the same two variables, say I = I(r, Y).

In equilibrium,

$$S = I$$

or

$$S(r, Y) = I(r, Y)$$

The above equation is satisfied for all combinations of r and Y such that S = I, that is, such that savers and investors are both satisfied.

There are many such combinations of r and Y—we have only one equation with two unknowns. Plotting all the combinations of r and Y that result in S = I gives us Hicks' so-called IS curve, short for I = S (Figure 16.1). To reiterate, this is the combination of r and Y that leads to equilibrium in the real sector: leakages (savings) equal injections (investment), and the demand for goods is just equal to the supply.

Why is the IS curve drawn with a negative slope? Businesses will only borrow money to invest if they can make sufficient returns from the investment to pay off the loan plus interest and still have money left over for profit. A businessperson would not borrow money at 6% interest to invest

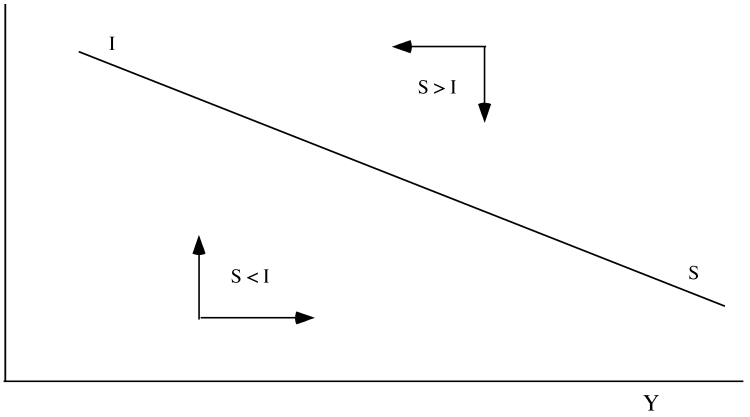

Figure 16.1 • The IS curve: At low (high) levels of income Y, there is a correspondingly low level of savings. At high (low) rates of interest r, there is a low (high) demand for investment. Therefore, at low (high) levels of Y, savings and investment will only be in equilibrium when r is high (low). If interest rates are too high for a given level of income, savings (leakages) will be greater than investment (injections). Firms producing more goods than people consume reduce production and the economy shrinks. Firms with excess capacity borrow less, so the price of borrowing (the interest rate) falls to clear the market. The converse is true when investment is greater than savings.

in a project expected to return 5% annually on the investment, but would borrow at a rate of 4%. As interest rates go down further, more and more investments become profitable, and therefore more investments are made. More investment leads to higher Y. Therefore, high interest rates lead to low rates of investment and low income, while low interest rates lead to high rates of investment and high income. Savings, in contrast, are probably determined more by income than by interest rates.[3] When income is low, all money has to be spent simply to meet basic consumption needs, and none is available to save. As income increases, basic consumption needs require a smaller percentage of income, and more is left over to save, so in general higher incomes lead to greater savings.

Combining these two tendencies, we would expect that at high levels of income when lots of money is being saved, investors will only borrow all that money to invest if interest rates are low. At low levels of income, savings are low, and unless interest rates are high, businesses will demand more money than is being saved. For some readers, a diagrammatic explanation for the negative slope of the IS curve will be easier to follow (Figure 16.2).

[3]Savings rates should also increase as interest rates increase, as under these circumstances savings yield higher returns, and consumption has a higher opportunity cost. But empirical evidence does not support this. One reason may be that if savers are motivated by attainment of a target future amount, a higher interest rate would mean less saving is needed to reach the future target.

Box 16-2 A Graphic Derivation of the IS curve

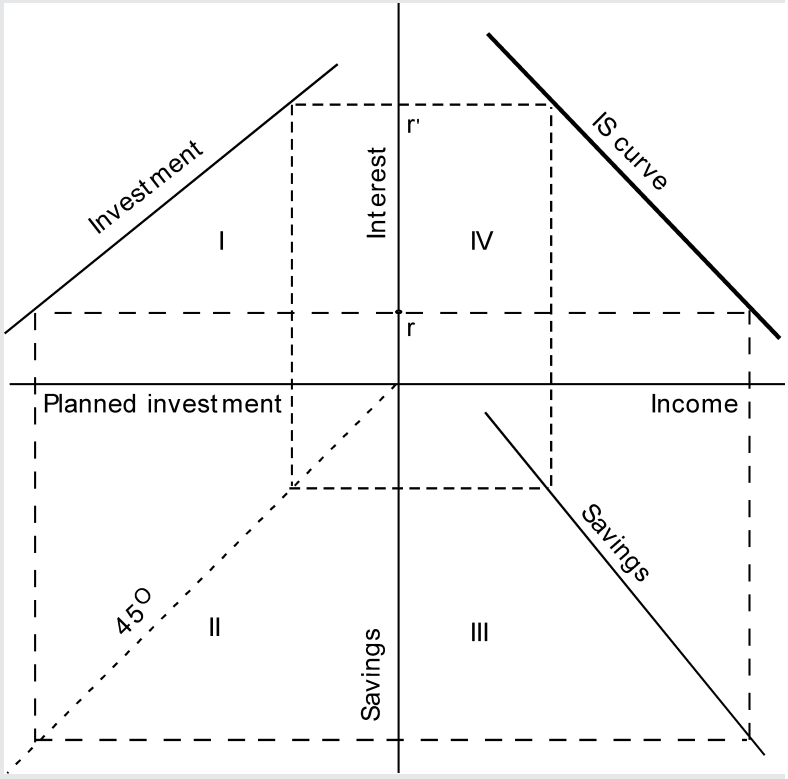

Figure 16.2 • A graphic depiction of the derivation of the IS curve.

Figure 16.2 illustrates one way to derive the IS curve. Quadrant I shows the basic relationship between interest rates and investment—high interest rates lead to low levels of investment, and low interest rates lead to high levels of investment. There is a negative correlation between interest rates and investment, as depicted on the graph. Quadrant III shows the relationship between savings and income. Poor people must spend all their income to meet their basic needs and cannot afford to save anything. As income increases, people begin to save, so there is a positive correlation between income and savings, as depicted on the graph. We know that in equilibrium (which is what the IS curve depicts), investment equals savings. Quadrant II contains a 45-degree line that allows us to translate a given rate of investment from quadrant I to an identical rate of savings in quadrant III. Quadrant IV shows the relationship between income and interest in a real sector equilibrium.
If we start with interest rate r, we can see from quadrant I that this will

correspond to level of investment I. Dropping a line down from I in quadrant I to the 45-degree line then across to quadrant III lets us determine the equilibrium level of savings S in quadrant III. We can see from quadrant III that this level of savings corresponds to income Y. The point in quadrant IV where income Y meets interest rate r gives us one point on the IS curve. If we do the same for interest rate r′, we have two points on the IS curve. We see that a low level of interest leads to equilibrium only when income is high, and a high level of interest leads to equilibrium when income is low. Perhaps the simplest way to remember this relationship is that at low interest rates, investment will be high, and high investment leads to high income.

Macroeconomics does not assume that the economy is always in equilibrium, but it does assume that it is at least moving in that direction. For example, we know that if r rises, then savers will try to save more, and investors will be less willing to borrow and invest, leading to a condition in which planned S > I. In other words, savers want to save more than investors want to invest at the new higher r. This will have two impacts. First, leakages will be greater than new injections, causing income to fall. Second, savers earn interest on their savings because investors are willing to pay that interest to borrow the money. Interest is the price of money. When the supply of savings is greater than the demand for savings, the interest rate must fall. The mechanism is the same as for any other good, as explained in Figure 9.2. At a lower Y savers save less, and at a lower r investors borrow more, and both r and Y continue to fall until I again equals S at a lower income (Y) and higher interest rate (r) than before. If the interest rate falls, then investment will become greater than savings, and adjustment will occur in the opposite manner. These dynamics are indicated by the arrows in Figure 16.1.

LM: The Monetary Sector

We turn now to the monetary sector and the LM curve, which shows the levels of income (Y) and interest (r) at which the demand for money balances (money held by people) equals the supply of money. We must first ask why individuals want to hold money balances when they could easily exchange them for real assets. From our earlier discussion the answer is clear—people hold cash balances to avoid the inconvenience of barter. Keynes referred to this as the **transactions demand for money**. He also spoke of a related **liquidity preference**, meaning that, other things being equal, people prefer liquid assets to "frozen" assets because they are so easily convertible into anything else, therefore fungible. Money is the most liquid of all assets. But of course other things are seldom equal, and the cost

of holding wealth in the form of fungible money is to forego the interest that could be had by lending the money, or the utility from spending it on a real asset or commodity. Yet if too much of your wealth is tied up in nonliquid forms, you will have difficulty making necessary transactions in a timely manner and meeting unexpected contingencies. The higher the national income, the more need for transactions and consequently the more money everyone will need (a higher transactions demand for money), and the higher the interest rate will have to be to induce owners of those transactions balances to sacrifice liquidity by lending them.

The demand for money balances (DM) thus depends on r and Y, by means of a relation of liquidity preference (L). Thus:

$$DM = L(r, Y)$$

The equilibrium condition is that the demand for money equals the supply of money (SM):

$$DM = SM$$

What determines the supply of money? In earlier times it was the geology and technology of gold or silver mining (a part of the real sector!), but today we have not real commodity money, but fiat or token money, controlled by the government through the private banking sector, as discussed in Chapter 14. For simplicity, the model usually takes SM as given by the government, equal to M. Thus:

$$L(r, Y) = M$$

is the equilibrium condition for the monetary sector, and the LM curve consists of all those combinations of r and Y such that the aggregate demand for cash balances is equal to the given money supply (Figure 16.3).

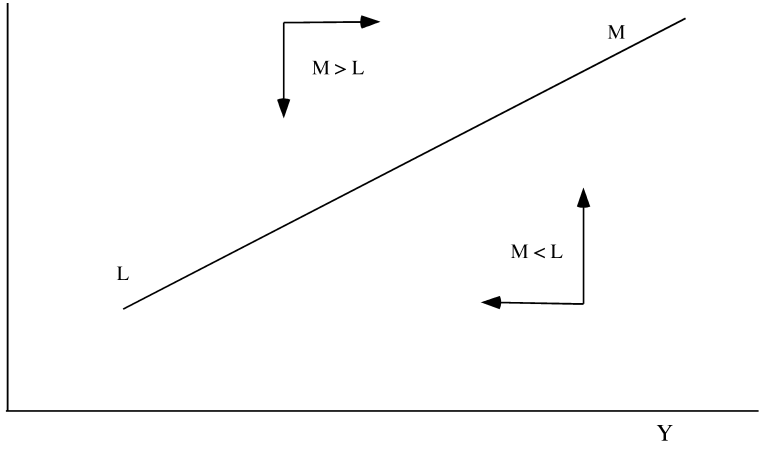

Figure 16.3 • The LM curve.

Since we have one equation with two unknowns, we cannot get unique values of the unknowns, but we can determine all those combinations of r and Y that satisfy our one equation.

Box 16-3 The Federal Reserve Bank

In the U.S., money is *not* controlled by the democratically elected government but rather by the Federal Reserve Bank (the Fed), a nonelected "branch" of government. Decisions concerning monetary policy are decided upon by a seven-member board of governors with lesser influence by the directors of the 12 regional Federal Reserve Banks. Members are appointed by the President (with Senate approval) for 14-year staggered terms, and the chair and vice chair are appointed for 4-year terms. Despite the importance of monetary policy in the functioning of our economy, the system is specifically designed to insulate the Fed from pressure by democratically elected politicians! The Fed is not expected to respond to voters. This does not mean that the Fed does not have a constituency to which it feels responsible, as we shall discuss later.

Why is the LM (short for L = M) curve drawn with a positive slope? Let's ask ourselves what are the consequences on the interest rate (r) of an increase in income (Y). A larger Y means a larger volume of transactions and will cause a greater demand for transactions balances. This will lead to a higher r to compensate for the loss in liquidity from lending those balances. Thus, a higher Y will require a higher r for money holders to again be satisfied (for L to equal M). Hence the positive slope of the LM curve. This relationship seems to be sufficiently clear that a more detailed graphic explanation is unnecessary.

When the monetary sector is out of equilibrium, what specific mechanisms drive it toward equilibrium? Say the monetary authority increases the money supply, so there is more money available than people actually desire to hold at the existing interest rate—that is, M > L. Excess money is used to buy bonds and other nonliquid interest-bearing assets (which we will refer to jointly as "bonds" for convenience). More money chasing the same number of bonds will drive up their price.

There are many types of bonds, but in the simplest case, when someone buys a bond, they are paying something now to receive a fixed amount when the bond matures. For example, if I pay $50 today for a $100 bond that matures in 10 years, my rate of return is about 7.2%. An increase in the money supply might drive the price of the bond up to $60, which provides a rate of return of only 5.24%. The higher the price for a bond, the

lower the interest rate on that bond. Hence, an increase in the supply of money increases the demand for bonds and drives down the interest rate.

At lower interest rates, there is less opportunity cost to holding money, and hence a higher demand for money. Lower interest rates also stimulate investment, leading to economic growth, which further stimulates the demand for money. The result is a new equilibrium at lower interest rates and higher income. A decrease in the money supply of course leads to the opposite result. These forces are illustrated by the arrows in Figure 16.3.

Combining IS and LM

Putting the IS and LM curves together lets us determine a unique combination of r and Y (namely r*, Y*) that satisfies both the S = I condition of the real sector and the L = M condition of the monetary sector (Figure 16.4). The point of intersection is the only point common to both curves, the only point that gives equilibrium in both real and monetary sectors. Basically we now have two simultaneous equations determining two unknowns, r and Y.

The **IS-LM model** is used in a comparative statics[4] way to analyze the effect on r and Y of changes in the underlying determinants—namely,

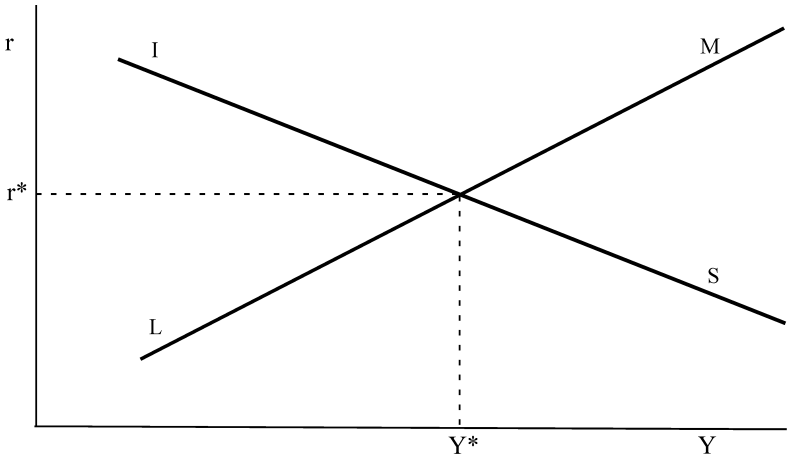

Figure 16.4 • The IS-LM model.

[4]Comparative statics is the analysis of what happens to endogenous variables in a model (in this case, r and Y) as a result of change in exogenous parameters (in this case, propensity to save, efficiency of capital investment, and liquidity preference). It compares the new equilibrium variables with the old ones, without explaining the precise dynamic path leading from the old to the new equilibrium.

propensity to save, the efficiency (productivity) of capital investment, and liquidity preference. Of particular interest to policy makers is the impact of policy variables on r and Y—namely, government expenditure, taxation, and the money supply. Each of these changes results in a shift in one of the curves, and consequently in a move along the other curve to a new intersection point. What we are really interested in, then, is how the economy moves toward equilibrium after policies or outside (exogenous) changes push it away.

Exogenous Changes in IS and LM

First let's look at some exogenous changes, those that are basically independent of fiscal and monetary policy, and therefore outside the IS-LM model. Consider an increase in the marginal propensity to save. Such a change in savings rate might result from fears of an economic downturn that would lead to lower wages and greater unemployment. (We might hope that people might one day simply decide to consume less in order to protect the environment!) In either case, people decide to save more and spend less of their extra income. This means that now $S > I$ for all the combinations of r and Y on the IS curve. We need a new IS curve for which $S = I$ again. If people save more at every r, this means $S > I$, or leakage greater than injection, so the flow of income will fall to the level at which $S = I$ again.

Even though people are saving a larger fraction of their income, they will end up having a smaller income out of which to save, with the result that S will be the same, only now the product of a higher rate of savings per dollar times a lower number of dollars in income. The very act of saving more and spending less will have caused a fall in aggregate income to the extent that the lower income times the higher fraction saved gives the same total savings, equal to the unchanged level of investment. So every r will be paired with a smaller Y in the new IS than with the old one. The IS curve will have shifted to the left. The new intersection with LM will occur at a lower r^* and lower Y^* than before. An increase in the marginal propensity to save will therefore result in a fall in national income and a fall in the interest rate.

Of course if the marginal propensity to save increases, then the marginal propensity to consume must decrease. As people consume less, businesses will be unable to sell their goods, leading to unplanned accumulations of inventory. This in turn will lead businesses to reduce planned investment and production—perhaps laying people off. Unemployment resulting from layoffs further decreases consumption, requiring another round of adjustment, lowering Y still more. The final result, when $S = I$ again, may well be that S will be lower than the level at which

we started. Thus, the effort of everyone to save more in the aggregate could result in everyone actually saving less—the so-called **paradox of thrift**. In such a case, a higher savings rate induced by fear of recession could itself cause a recession—a self-fulfilling prophecy.

Now suppose there's an increase in the efficiency of investment (an increase in the marginal productivity of capital), thanks to a new invention. For example, many people claim that this is exactly what has happened in today's "new economy," in which information technology is said to have increased productivity. This would increase I, so that I > S now along the old IS curve. With I > S, injections are greater than leakages out of the circular flow, so the flow of income will grow until S = I again. The new IS curve will have a higher Y for each r. The curve shifts rightward. The new equilibrium occurs with a higher Y* and a higher r*. An improvement in the marginal efficiency of capital raises both income and the interest rate.

Finally, turning to the LM curve, suppose there was an increase in liquidity preference, so that L > M. Such a change could result from increasing uncertainty over future economic conditions, and a desire by people to be prepared for the unforeseen with cash on hand. Alternatively, the deregulation of banking in the United States during the mid-1970s allowed certain checking accounts to pay interest. This reduced the opportunity cost of holding money, and therefore probably increased the liquidity preference as well. In either case, for any income and associated level of needed transactions balances, there is a greater willingness to hold those balances, to hold more than strictly needed. It takes a higher r to induce holders of money to lend. Consequently each level of Y will be associated with a higher r on the new LM than on the old one. The new LM will shift upward. The new equilibrium will occur at a higher r* and lower

Box 16-4 Junk Bonds and Timber Companies

Seemingly abstract things like interest rates on bonds and Wall Street transactions can affect real economic production and the provision our environmental services. For example, during the 1980s, hostile takeovers and the introduction of junk bonds on Wall Street led to deforestation on the West Coast. How did this happen? Mergers, when two companies join together, and acquisitions, when one company purchases another, are a normal part of corporate activity in the U.S. Sometimes, however, one company does not wish to be taken over by another. For example, mergers and acquisitions (M&A) focused primarily on short-

term profits can weaken or destroy the company being acquired, leading to massive layoffs.

Reasonably enough, managers not eager to be laid off will be opposed to a merger, and under such circumstances, takeover attempts are "hostile." One company acquires another through the purchase of a controlling share of stocks. As soon as someone starts buying enough stock to control a company, the stock price rises. A company threatened by a hostile takeover can attempt to defend itself by repurchasing its own stock, driving up the price of stock even further. To get enough money for a hostile takeover, the company attempting the takeover can offer high-yield, high-risk bonds known as "junk bonds" in Wall Street jargon.[a]

The best target for takeover is a company that has lots of assets in a nonliquid form that can be liquidated after takeover to pay off the junk bonds, but that cannot be sold quickly to defend against the takeover. Timber companies have valuable assets in the form of forests that can be liquidated after takeover, but cannot be sold quickly to buy back stock and prevent a hostile takeover. This made them popular takeover targets during the 1980s.

A classic example is Charles Hurwitz's acquisition of Pacific Lumber in the mid-1980s. Pacific Lumber fought the takeover, but using a combination of junk bonds and short-term loans, Hurwitz won out, acquiring with the company 196,000 acres of forest, including the largest unprotected stands of virgin Redwood in the world. Hurwitz was saddled with an enormous debt and crushing interest payments. To repay the debt, Hurwitz liquidated much of the forest stock, including many old-growth redwood groves. Some illegal cuts were conducted on weekends and holidays to avoid state regulators. Wall Street innovations during the 1980s accelerated the decimation of the nation's last remaining virgin forests, and of the environmental services those forests once provided.[b]

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[a] *Different companies (and cities and countries) have different credit ratings based on their financial soundness. Bonds from financially sound companies are themselves very sound, bonds from less sound companies are not, and the risk of default is higher.*

[b] *N. Daly, "Ravaging the Redwood: Charles Hurwitz, Michael Milken and the Costs of Greed,"* Multinational Monitor, *16 (9) (1994). On-line: http://multinationalmonitor.org/hyper/issues/1994/09/mm0994_07.html.*

Y*. An increase in liquidity preference raises the interest rate and lowers national income.

The above analysis of changes in propensity to save, efficiency of investment, liquidity preference, and money supply is summarized in Figure 16.5.

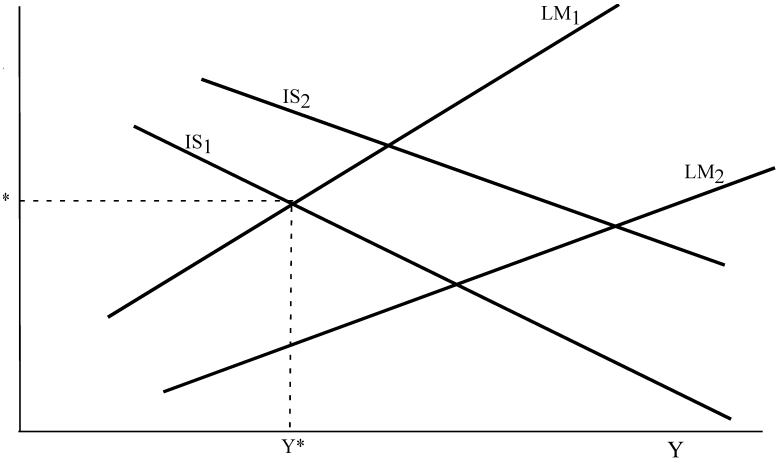

Figure 16.5 • Shifting of the IS and LM curves. The shift from IS_1 to IS_2 could be the result of either a decrease in the marginal propensity to save or an increase in the marginal efficiency of investment. The shift from LM_1 to LM_2 is caused by either a reduction in liquidity preference or an increase in the money supply. Can you work out the changes in r and Y resulting from an increase or decrease in each of the four parameters, others remaining constant? What about changes in two or more parameters at the same time?

IS-LM and Monetary and Fiscal Policy

Changes in the propensity to save, the efficiency of investment, and liquidity preferences are not brought about directly by policy interventions; they are affected by psychology and technology and as a result are difficult, if not impossible, to predict. However, policy makers do have two sets of economic levers by which they can influence these variables: monetary policy and fiscal policy.

What does the IS-LM model tell us about different monetary and fiscal policy levers? The analysis of monetary and fiscal policy in macroeconomics can be worked out by tracing the effects on IS or LM of changes to the money supply and of government taxing and spending.

Monetary policy basically affects the money supply. When the monetary authority (the Federal Reserve, in the U.S.) increases money supply, the LM curve shifts downward and M > L, which drives interest rates down, as explained above. Lower interest rates stimulate the economy, and income grows. If the money supply is increased by too much, there can be too much money chasing too few goods, and inflation threatens. Reducing the money supply drives interest rates up, shrinks the economy, and can help control inflation.

Fiscal policy is basically government expenditure and taxation. When the government spends money, industry has to produce more goods and

services to meet the increased demand. This drives up income and also increases the demand for investments, driving up interest rates. The IS curve shifts to the right. Decreasing government spending has the opposite effect.

There are three ways the government can finance expenditures. First, it can impose taxes. When the government increases taxes, people have less to spend, decreasing demand, and leading to less investment. The economy shrinks, and interest rates go down. However, if the government spends the entire tax increase, the stimulus of increased expenditure outweighs the contraction caused by taxes, since some of the tax money now being spent would have been saved. Second, the government can use debt financing and borrow money. The government borrows money by selling bonds. An increase in the supply of bonds drives down the price and drives up the interest rate. Third, the government can use its right to seigniorage to simply print and spend money, which increases the money supply. As we noted above, the increased money supply will further stimulate the economy but will have a countervailing impact on interest rates.

Seigniorage-financed fiscal policy seems the logical choice for stimulating the economy, but it carries the threat of inflation. Governments could dramatically increase their ability to use seigniorage if they increased reserve ratios to 100%, as suggested by Frederick Soddy so long ago. The government would then be able to print and spend money when the price index started to fall, and tax and destroy money if inflation threatened to become a problem. The government would also be able to target monetary policy much more effectively, using it to address issues of scale, distribution, and allocation. X and X.

The impact of fiscal and monetary policy depends on how much excess capacity exists in the economy. Consider a bowling alley in a small isolated town where the government is undertaking a large project to stimulate economic growth. When unemployment is high, wages may be fairly low, and few people have disposable income to spend on bowling. As a result, the bowling alley is virtually empty. If the government funds a large project in town, some people are directly employed by the project, and they spend much of their money in town, inducing other local businesses to hire to meet the increased demand. People use their extra income to go bowling, and the bowling alley's income grows.

Now imagine that the government implements the same project in a town with very low unemployment. Bowling is popular, and the alley is full every night. The government needs employees for the project, but increasing demand when supply is low drives up wages, the price of employees. Disposable income increases, but every new bowler at the alley simply "crowds out" another bowler, who would have to leave the alley. The alley might like to expand, but the government is borrowing money to finance its project, driving up interest rates, making it too expensive for

the alley owner to expand. The alley can raise its prices with the increased demand, but it must also pay higher prices for its labor force, and therefore can only break even. When an economy is at full employment, the bowling alley owners might be much better off with an expansionary monetary policy that lowered interest rates so they could expand. In contrast, if the government lowered interest rates when the alley had considerable excess capacity, expansion would do the owners no good at all.

The failure of lowering interest rates to stimulate economies with low demand is known as a **liquidity trap**. In general, the economy is somewhere between the extremes of depression and operation at full capacity (i.e., most bowling alleys are full sometimes, but very few are always full). While increased government expenditure leads to some degree of crowding out and increased interest rates, it also increases income.

Table 16.1 summarizes the impacts of fiscal and monetary policy on interest and income. In each case, the impact is obviously the opposite for the opposite policy.

Inflation and Disinflation

If we looked only at the IS-LM model, and if our goal was continued economic growth, the superior policy option would be clear: keep increasing the money supply to lower interest rates and stimulate investment, and use fiscal policy when necessary to stimulate demand. However, when we first presented the LM model, we saw that the real money supply is equal to the nominal money supply divided by prices—that is, the real money supply equals M/P. There is, therefore, another path toward equilibrium between supply and demand for money in response to an increase in money supply—price inflation. A larger nominal money supply divided by higher prices can lead to no change in real money supply. The closer the system is to full output, the less output is likely to increase in response to lower interest rates, and the more likely that monetary expansion will result in inflation. **Inflation** is an increasing general level of prices (not a state of high prices).

Why are governments and monetary authorities so worried about inflation? Are their concerns justified? How does inflation affect the real economy? The first point to make is that people appear not to like inflation, which alone is some justification for trying to avoid it. Many economists argue that inflation is regressive, but empirical support for this argument is difficult to find.[5] Empirical evidence does show, however, that real wages can fall substantially during prolonged episodes of high

[5]A. Bulir and Anne-Marie Gulde, Inflation and Income Distribution: Further Evidence on Empirical Links, IMF Working Papers, no. 95/86. Washington, D.C.: International Monetary Fund, 1995.

Table 16.1

EXPECTED IMPACTS OF BASIC MONETARY AND FISCAL POLICIES ON INTEREST RATE AND INCOME

Policy	Interest Rate	Income
Monetary expansion can be accomplished by: • Reduced reserve requirements • Selling bonds on the open market • Lowering the discount (interest) rate	(–) When economy is weak (high unemployment, low investment), monetary policy may have little to no impact on interest rates.	(+) When economy is weak, no impact on income. Known as the liquidity trap.
Tax increase	(–) Taxes (especially progressive income taxes) help stabilize the economy.	(–) Taxes collect more money when income grows and less when it shrinks.
Increased government expenditure	(+) Can be spent on market or nonmarket goods.	(+)
• Financed by deficit spending	(+) Impact on interest rate may be small when economy is weak, large when economy is operating at full capacity.	(Probably +) Income will increase when economy is weak, but may not increase when it is already operating at full capacity; latter condition is known as crowding out.
• Financed by taxes	(+) Increase in interest rate is less than occurs with deficit spending.	(+) Growth rate is less than occurs with deficit spending.
• Financed by seignorage	o	+ Likely to cause inflation under crowding out conditions, with no real growth in income.

inflation.[6] In addition, during episodes of high inflation, it is likely that the wealthy and educated are better able to take advantage of investments and contracts that protect their money than the poor. Thus, with continuous high inflation, the poor may well lose ground to the rich.

Hyperinflation, often defined as inflation greater than 50% per month, can also destabilize the economy. In hyperinflation, money fails not only as a store of value, but also as a medium of exchange. Impacts of moderate inflation depend to a large extent on whether it is expected or unexpected.

[6]B. Braumann, High Inflation and Real Wages, Western Hemisphere Department Series: Working Paper WP/01/50, May 1, 2001.

If everyone expects a certain rate of inflation, and their expectation comes to pass, then inflation is incorporated into contracts and causes very few problems. The only groups one would expect to lose from an expected inflation are holders of money (which pays no interest) and people on fixed incomes. However, with expected inflation, most people will hold less money, and incomes are likely to be inflation adjusted. **Disinflation** is a decrease in the rate of inflation. Deflation is a decline in the overall price level. Unexpected inflation, disinflation, and deflation have entirely different outcomes than expected inflation. The most useful way to assess the impacts of these unexpected changes is to look at debtors versus creditors.

Unexpected inflation has entirely different outcomes. The most useful way to assess the impacts of unexpected inflation and disinflation is to look at debtors versus creditors. When there is unexpected inflation, any loans with nominal interest rates (i.e., interest rates that are not pegged to inflation) will be worth less and less every year. Debtors benefit and creditors suffer. For example, people in the 1960s got 30-year house mortgages at around 6%. When inflation in the 1970s climbed over 12%, some home owners ended up paying back less than they originally borrowed. In general, unexpected inflation systematically redistributes wealth from creditors (generally the rich) to debtors (generally the poor). The government is a net debtor, and therefore benefits, as do the future generations that are expected to pay off the government's debts. However, a country cannot have unexpected inflation forever—eventually it becomes expected, or else becomes hyperinflation, with its accompanying problems.

What happens when the government tries to cause disinflation or deflation? Obviously, just as unexpected inflation benefits debtors, unexpected disinflation must benefit creditors. In 1980, a 30-year mortgage at 14% didn't look so bad when inflation was 13% annually, and people expected their incomes to rise by at least that rate. By 1986, however, inflation (and wage increases) had fallen to less than 2%, and creditors were collecting a 12% annual real return on their loans. Thus, existing debtors suffer and existing creditors benefit from disinflation.

Other impacts of disinflation depend on whether it is brought about by fiscal or monetary policy. Theoretically inflation can be reduced by decreasing aggregate demand or increasing aggregate supply, but policy usually acts on demand. Fiscal policy can only decrease aggregate demand through greater taxation or reduced expenditure, both of which should lower the real interest rate to the benefit of new debtors. Other distributional impacts depend on the specific policy used. For example, demand could be reduced by reducing subsidies for big business or by reducing transfer payments to the poor.

THINK ABOUT IT!

Under President Reagan there was a big emphasis on supply-side economics, increasing income by providing incentives for production (i.e., supply). Policy measures for achieving this include investment subsidies, reduced capital gains taxes, and reduced taxes for the rich. Can you explain why these policies would theoretically increase supply and reduce inflation?

The monetary authority, on the other hand, can only act to reduce demand by reducing the money supply, which increases real interest rates, to the detriment of debtors. Interest-sensitive sectors of the economy, such as farming and construction, also lose out. If losers are forced into liquidation or bankruptcy, they may be forced to sell their assets at bargain prices, and it is the well-to-do who maintain the liquidity necessary to purchase those assets. Thus, recessions may generate corporate mergers and increased concentration of the means of production.

The claim made for disinflationary policies is that in the short term the economy suffers, but in the long term stable money allows for steady growth and higher real wages. The problem is that short-term suffering can be severe, especially when monetary policy is used to decrease demand. While the jury is still out on the distributional impacts of moderate inflation, the distributional impacts of unemployment caused by disinflationary policies, as we will see below, are clear.

Unemployment

In the world of microeconomics, involuntary unemployment should not exist. Prices are set by supply and demand, and when the demand for labor is low, the price falls. At a lower wage, fewer people are willing to work, and supply falls accordingly, returning the system to equilibrium. Clearly, however, unemployment is a persistent problem in modern economies. We particularly want to examine two issues: the link between unemployment and inflation, and the implications of unemployment for distribution.

Some unemployment is inevitable. People are constantly entering and leaving the labor market, changing jobs and moving from place to place. Businesses go bankrupt, or suffer downturns and lay people off. It always takes time to find a new job. This is known as "frictional" or "natural" unemployment. According to theory, if policy makers tried to reduce unem-

[7]This theory was originally introduced by Milton Friedman in his 1967 American Economics Association presidential address.

[8]In the 1960s, economists found an inverse empirical relationship between unemployment and inflation, which was dubbed the Phillips curve. But during the 1970s, a number of economies experienced increasing unemployment and increasing inflation simultaneously.

ployment below this level, the result would be greater demand for a fixed number of workers. Workers would have more bargaining power and would demand higher wages, thereby causing inflation.[7] Thus, a widespread euphemism for "natural" unemployment is NAIRU, the nonaccelerating inflation rate of unemployment.[8] There is considerable disagreement over what NAIRU actually is. James K. Galbraith argues that economists are really quite practical—their estimates of NAIRU simply reflect actual unemployment.[9]

But the link between low unemployment and inflation is not clear empirically. Why not? We offer two explanations. First, in the era of globalization, large corporations are free to move their capital and production to other countries. Even when unemployment is low, corporations can counter demands for higher wages by a local workforce with the threat of moving to a lower-wage country. This explains how the low unemployment of the 1990s in the U.S. was accompanied by stagnant wages and a diminished share of national income going to wage earners.[10] Second, we must point out that income from production is divided between wages, profit, and rent. Increased bargaining power by wage earners need not lead to "wage-push" inflation—it could instead simply increase the share of income going to wage earners and decrease the share going to rent or profit. Does increased bargaining power by owners lead to "profit-push" inflation?

In summary, then, low unemployment increases the bargaining power of wage earners, which translates into higher wages (though this effect is diminished by globalization). Higher wages can cause inflation, which then erodes the higher wages, or it can change distribution patterns between wages and profit. High unemployment, in contrast, increases the bargaining power of corporations and leads to redistribution toward the owners of capital. Whatever the validity of the theory behind NAIRU, it is quite clear that monetary authorities pay close attention to unemployment as an indicator of inflationary pressures. For example, when unemployment falls too low, the Fed tends to raise interest rates to reduce investment, employment, and demand. Distributional impacts of inflation are uncertain, but unemployment caused by disinflationary policies has clearly negative impacts on some of the poorest sectors in society.

Finally, it is worth noting that increasing unemployment can set up a vicious cycle. As people lose jobs, they lose money to purchase goods and service. With less demand, businesses respond by reducing supply,

[9]J. K. Galbraith, Well, Excuuuuse Me! *The International Economy*, December 1995.

[10]R. J. Gordon, The Time-Varying NAIRU and Its Implications for Economic Policy, NBER Working Paper No. W5735, May 1997.

perhaps laying off more workers to do so, and further reducing demand. Many fiscal policies such as welfare payments, unemployment insurance, and other transfer payments are designed to diminish this impact, adding stability to the economy. Economic stability is a public good, and an important policy objective.

The Impact of Policies on Scale, Distribution, and Allocation

Now that we understand the basic elements of fiscal and monetary policy, we can turn to their particular applications. How we apply these policies, of course, depends on what we wish to achieve. Mainstream macroeconomists primarily pursue continuous economic growth, with a lesser emphasis on distribution. Allocation is left to microeconomic forces. Ecological economists are primarily concerned with the impact of macroeconomic policies on scale (i.e., growth) but with a different goal than mainstream economists—to make sure that the costs of additional growth in material throughput are not greater than the benefits. Ecological economists assume that eventually the costs will exceed the benefits if they haven't already. They also place much more importance on distribution than mainstream economists. In short, ecological economics strives to create an economy in which there is no growth in physical throughput, while avoiding the suffering caused by recession or depression. The allocation of resources between market and nonmarket goods and services can play an extremely important role in this regard.

Macro-allocation

As we have discussed earlier, free markets work very well at allocating resources among market goods but very poorly at allocating nonmarket goods, typically failing to provide them in satisfactory quantities. Many policy makers already recognize this point, as can be clearly seen in government budgets, the bulk of which are spent on public goods such as defense, health care, education, road systems, bridges, streetlights, national parks, and so on.[11] In fact, few institutions besides government allocate resources toward nonmarket goods, and only the government is able to use policy to reduce demand and hence expenditure for market goods and shift it toward nonmarket goods.

For simplicity, we refer to the allocation between market and nonmar-

[11]National defense is generally considered a public good, though arms races, nuclear weapons, and excessive defense expenditures may do more to undermine national security than to ensure it. To the extent that disease is communicable and individuals are made uncomfortable by the suffering of others, health care is also a public good.

ket goods as **macro-allocation**, and allocation among market goods as **micro-allocation**.

Macro-allocation is the allocation of resources among market and nonmarket goods and services.

In the private sector, monetary policy directly affects only the *market* economy, by stimulating or discouraging investment in the production and consumption of *market goods* for profit. Why is this so? Monetary policy acts primarily through its impact on interest rates and hence on borrowing and lending. The private sector invests little in nonmarket goods, since such goods generate no profit that can be used to pay back loans. Therefore, lower interest rates will not affect the production of nonmarket goods by the private sector. Not only will monetary expansion do nothing to provide public goods and open access resources, it can actually increase the degradation of these resources if the production of the market goods is accompanied by negative externalities affecting the environment. Return to our example of the bowling alley. If lower interest rates induce it to expand, it will not expand into a void and may expand into some ecosystem—a wetland, for example—that currently provides valuable nonmarket services to the local community. As we discussed earlier, such negative externalities are an inevitable outcome of market production.

Therefore, if our policy objective is sustainable scale, monetary expansion is very problematic. Even if the economic scale is well within the constraints imposed by the ecosystem, monetary expansion acts on only one type of good, market goods. Market goods do not always offer the highest marginal contribution to human well-being, however. The microeconomic law of the equimarginal principle of maximization thus applies not only to the scale of the economic system relative to the ecosystem that sustains it, but also to the division of market and nonmarket goods produced by an economy. In ecological economics, macro-allocation is every bit as important as micro-allocation.

Theoretically, federal money in a democratic society will be directed toward the goods and services that provide the greatest marginal utility for society as a whole. As we have discussed, an important role of government expenditure is to provide nonmarket goods.

It is important to distinguish between two classes of nonmarket goods, which have different effects on scale. Manmade nonmarket goods affect scale to the same degree as market goods. If the government project in the bowling alley town is a big government building, it may also encroach upon some valuable ecosystem and destroy the services it provides. In contrast, what if the government project in the bowling alley town created a park that provides recreation and restores wetlands that serve as filters for the town's water supply and as a buffer against catastrophic floods? Protecting and restoring the ecosystems that provide nonmarket environmental services can effectively decrease scale, or at least help ensure that we do not surpass optimal scale. As the world becomes more full, the

marginal benefits from protecting and restoring ecosystem funds, and hence the nonmarket services they provide, will increase relative to those from market goods and human made public goods. As this happens, and if politicians better come to understand the benefits and public good nature of ecosystem services, more and more federal money should be allocated toward providing such services.

It is important to recognize, however, that government expenditure on ecosystem funds can still increase scale. How is this so? We must remember that once the initial expenditure enters the economy, the multiplier effect takes hold. Money spent to restore ecosystem funds will in turn be spent by its recipients on market goods—workers restoring the wetland may spend their money on bowling, pressuring the bowling alley to expand. The larger the multiplier, the larger the impact on the market sector of the economy, and the less control the government has over composition. As most macroeconomics textbooks explain, tax increases decrease the multiplier and also reduce income. A smaller multiplier increases the ability of the government to affect macro-allocation, and reduced income reduces scale. Taxes can also be used to discourage undesired behaviors, such as pollution, and transfers can be used to encourage desired ones, such as environmental preservation. The full impact of taxation on scale and macro-allocation depends on how the taxes are spent, but taxes can certainly play an extremely important role in achieving an optimal scale—a point we will examine at greater length in Chapter 21.

Another important point must be made here. Under traditional analysis of the IS-LM curve, fiscal policy when the economy is operating at full capacity results in crowding out (remember the full bowling alley) and should be avoided. However, in terms of macro-allocation and scale, full output conditions can increase the effectiveness of fiscal policy. With full employment, if the government spends money to create a park and restore wetlands, interest rates and labor costs go up, and it is more difficult for the bowling alley to expand. (Fortunately, the park offers a recreational alternative to bowling that does not displace ecosystem services.) Government expenditure on restoring ecosystems under such conditions will therefore have an unambiguous impact on reducing scale.

What are the distributional impacts of fiscal and monetary policy? Fiscal policy in the form of taxation and government transfers can be easily and effectively distributed as desired. Government transfers such as welfare, unemployment insurance, Medicare, Medicaid, and Social Security all play an important role in distribution. Corporate welfare programs

[12]C. M. Sennott, "The $150 Billion 'Welfare' Recipients: U.S. Corporations," *Boston Globe*, July 7, 1996.

(which outweigh transfer payments to the poor[12]) affect distribution in the opposite direction. Public goods are available to all, and their provision improves distribution. In terms of income, progressive taxation can help reduce gross inequalities in income distribution, a necessary condition morally and practically if we are to achieve a sustainable scale. Monetary policy can also play an important but narrower role in distribution. High interest rates caused by tight monetary policy can lead to unemployment, and they favor creditors over debtors, as discussed above in the section on inflation and disinflation. Low interest rates have the opposite effect.

In summary, in terms of ecological economic goals, monetary policy is a blunt instrument directed only toward the production and consumption of market goods, with limited flexibility in terms of distribution and macro-allocation. Expansive monetary policy increases scale. Fiscal policy has far greater flexibility in terms of scale, distribution, and macro-allocation.

IS-LM in the Real World

While the IS-LM model is very useful, it has important limitations.[13] The model is deceivingly simple and does an inadequate job of conveying the real-life complexity of monetary and fiscal policies. While the model shows the general impacts of such policies, it fails to incorporate the issues of uncertainty, time lags, and structural changes, as well as the difficulty of choosing the appropriate policy variables to manipulate.

Economists typically have a poor understanding of what is happening in the economy at any given moment. Is unemployment too high? Is the economy growing too fast, threatening inflation? Are we headed for recession? Weathermen may be inaccurate at predicting the future, but at least they can look outside right now and tell you what the weather is. Economics is less advanced. Viewing the same data concerning the economy, economists frequently disagree on how to interpret them. For example, in the United States, the Federal Reserve Bank raised interest rates in May 2000, fearing that the economy was growing too fast, and continued to voice fears of inflation through November 2000. Less than 2 months later, the Fed initiated the first of several interest rate cuts designed to ward off recession. Part of the problem is that the economic system is

[13]See J. R. Hicks, IS-LM: An Explanation, *Journal of Post-Keynesian Economics* III (2): 139–154 (Winter 1980–1981). Hicks, the originator of the model, expresses reservations about how well it fits the real world once expectations and dynamics are recognized. He considers the model useful for understanding the past, but less so for understanding the future. We agree, but feel that many of Hicks' caveats apply to all equilibrium models, and that, rare though it is among scholars, Hicks was too hard on himself!

evolving rapidly in response to technological, environmental, cultural, and structural changes.

Compounding the difficulty of an inadequate understanding of the economy are the time lags involved in policy. There are two types of lags: lags in decision making (the inside lag) and lags between the time the decision is made and the policy takes effect (the outside lag). In fiscal policy, decisions such as tax cuts and expenditure increases are typically debated at length. Both legislative and executive branches must agree, and appropriate legislation must be passed. The decision lag can therefore be substantial. Once the decision to increase or decrease expenditure has been made and carried out, the outside lag may be relatively short, as such policies have an immediate effect on aggregate demand (though the full effect of the multiplier will take some time). Tax cuts or increases, on the other hand, have much slower results and are often not even felt until the next tax year.

The Fed, in contrast, generally has a much shorter decision-making lag. The Federal Open Market Committee (FOMC), responsible for Fed Policy, meets about eight times a year.[14] Policy is generally decided at the meeting, and open market transactions can take place almost immediately. However, the most relevant impact of these policies is on interest rates and their effect on investment and consumption decisions. Investment decisions are rarely spur of the moment; they generally have a long gestation period. Thus, the Fed has a short decision-making lag, and a long lag before the policy takes effect.

These lags are very important to consider when deciding on a policy. It is quite possible that by the time a decision is made and the resulting policy takes effect, the problem the policy was designed to address will have disappeared, and a policy with the opposite effect may even be required.

Another problem is disagreement over what type of policy should be pursued, and what the impact will be, especially for monetary policy. The Fed usually tries to manipulate one of two targets: the money supply or the interest rate. Not only is there considerable debate over which course the Fed should pursue, there are serious obstacles to achieving either goal. For example, as Alan Greenspan, current Chairman of the Fed, admitted in congressional testimony: ". . . we have a problem trying to define exactly what money is . . . the current definition of money is not sufficient to give us a good means for controlling the Money Supply. . . ."[15]

Psychology can also make it difficult to manipulate interest rates. As we

[14]The Federal Reserve Act mandates that the FOMC meet at least four times a year, and since 1981 it has met eight times a year.

[15]Congressional testimony, February 17, 2000.

discussed earlier, interest rates are ultimately determined by the bond markets. Bonds, of course, mature in the future, and the amount someone is willing to pay for a bond depends on their *expectation* of future inflation. The Fed might implement an expansionary monetary policy to bring down interest rates, but if bond marketers believe this expansion will instead induce inflation or force monetary contraction in the near future, it could paradoxically serve to drive interest rates *up*.

A final problem with policy in countries with independent monetary authorities is the difficulty in coordinating between monetary and fiscal policy. This problem can become acute when the monetary authority and the government have different policy objectives. The elected government is mainly concerned with growth and employment, two issues that affect voters, and hence their elected representatives. In contrast, the Fed is mainly concerned with "sound" money (i.e., no inflation) and has frequently pursued this policy in the past, even when it has caused significant hardship in the form of unemployment and worse.

Box 16-5 Why Is the Fed So Anti-Inflation?

From our discussion of inflation, it would seem that inflation is less harmful than unemployment induced by anti-inflationary policies. Why then is the Fed so anti-inflation? In answering this question, it is worth bearing in mind who the natural constituency of the Fed is. Most members of the FOMC are bankers or Wall Street professionals, and the Fed seems to listen closely to the concerns of these groups. These two groups form the bulk of the wealthy creditors who benefit from low inflation and disinflationary episodes, and who are unable to increase their share of national income as readily during inflationary periods.[a]

[a] *W. Greider,* Secrets of the Temple: How the Federal Reserve Runs the Country, *New York: Simon & Schuster, 1987.*

Despite its shortcomings, the IS-LM model is a vast improvement over prior models. It is a two-sector general equilibrium model, the sectors being the real sector and the monetary sector. Before Hicks' model, economists often tried to explain the interest rate as a purely monetary phenomenon (liquidity preference and money supply) or a purely real phenomenon (savings and investment). There was an investment rate of interest and a money rate of interest, and confusion about which set of factors "really" determined the interest rate. Hicks showed that the real

and monetary sectors simultaneously interact to determine both the interest rate and national income. But Hicks said nothing about the ecosystem and biological rates of growth. In 1937 the world was still considered "empty." Thus, the IS-LM model treats all economic growth as identical—it does not distinguish between government expenditures on market goods, manmade public goods, or investments in ecological restoration, nor does it address distribution.

Adapting IS-LM to Ecological Economics

How might the IS-LM model be adapted to ecological economics? Remembering our basic vision of the macroeconomy as a subsystem of the finite and nongrowing ecosystem, the most obvious suggestion would be to impose an external constraint on the model representing the biophysical limits of the ecosystem. For example, we could assume a fixed throughput intensity per dollar of Y (i.e., GNP), so that a given Y in money terms implied a given physical throughput. Then we could estimate the maximum ecologically sustainable throughput, convert that into the equivalent Y, and impose that as an exogenous constraint on the model. Based on Figure 16.4, it would be represented by a vertical line at the Y corresponding to maximum sustainable throughput. It would not be a function of the interest rate at all.[16] Let's call the vertical line EC for "ecological capacity." It reflects a *biophysical* equilibrium, not an *economic* equilibrium. It is ignored by the actors whose behavior is captured in the IS and LM curves.[17]

The most obvious approach is not always the best, but it is usually a good place to start. Also, this approach closely parallels the macroeconomist's representation of full employment of labor as a perpendicular at the level of Y corresponding to full employment at an assumed labor intensity of GNP. Our EC line represents "full employment" of the environment at an assumed throughput intensity of GNP. Later we will discuss further the assumption of fixed throughput intensity.

Let's consider the three possible positions of the biophysical equilib-

[16]A. Heyes, A Proposal for the Greening of Textbook Macro: "IS-LM-EE," *Ecological Economics* 32 (1) (2000); P. Lawn, *Toward Sustainable Development*: An Ecological Economics Approach, Boca Raton, FL: Lewis Publishers, 2001. Heyes and Lawn have proposed an EE curve corresponding to the ecological limits discussed here that would be a function of the interest rate. Several technologies produce income, some of which require or degrade more natural capital than others. Less natural capital-intensive technologies require investments and are thus more likely at lower rates of interests. One problem is that the investments themselves would require natural capital.

[17]However, it need not be ignored by government, which affects the IS curve. The government is perfectly capable of investing in environmental services produced by natural capital and other nonmarket goods. But it is completely ignored by monetary policy (the LM curve), which acts on the economy through its effect on interest rates and hence market goods.

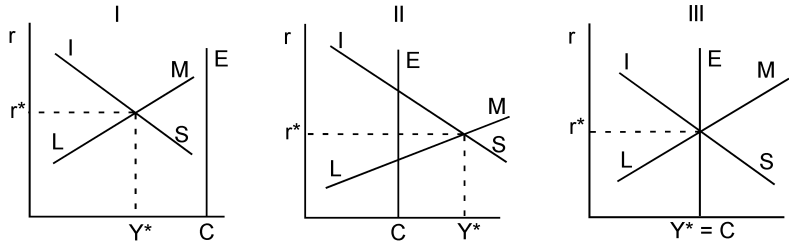

Figure 16.6 • The biophysical equilibrium relative to the economic equilibrium.

rium relative to the economic equilibrium, shown in Figure 16.6. The first case represents the "empty world" scenario. The biophysical limit is not binding. The distance Y*C may be thought of as excess carrying capacity. Most macroeconomists who use the IS-LM model would have this case in mind, if indeed they thought at all about EC. If the distance Y*C is large then there is for practical purposes of short run policy no point in conceiving or drawing the EC line.

The second case is the "full world" (or overfull) scenario. The economic equilibrium has overshot the biophysical equilibrium. The distance CY*, the overshoot, can be given two interpretations. In neither case, however, would it represent real income. In the first case we might think of it as a purely monetary phenomenon, inflation. After hitting EC the real sector is effectively at the end of its tether. Even though the monetary sector keeps on churning, it only generates price increases for the same real income C. The other interpretation assumes that the real sector keeps producing real output, but by unsustainable drawdown of natural capital. Thus, CY* would represent capital consumption counted as income. As natural capital is consumed, the EC line eventually has to shift even farther to the left, increasing the overshoot. Most ecological economists believe the second case to be a rather accurate description of the present state of affairs. We seem to be avoiding short-term inflation by long-term capital drawdown. Most conventional economists do not worry about long-term capital drawdown and shifting the EC curve farther to the left because they believe that knowledge is shifting EC to the right and thereby restoring the empty world situation.

The third case represents a big coincidence under our assumptions. For the economic equilibrium to coincide with the biophysical equilibrium would require either extraordinary good luck, or purposeful coordination and planning. There is nothing in the model to make it happen, just as, currently, there seems to be nothing in our institutions or behavior that would make it happen. In Chapters 20–23, we will discuss policy changes that could theoretically lead to this outcome.

Recall that we previously discussed the concept of full employment, which we might represent by an FE limit for labor similar to the EC limit for natural capital. Ideally, a FE labor line should coincide with the ISLM equilibrium point—make IS = LM at full employment. If FE is beyond the intersection of IS and LM, then policy makers might pursue FE through growth in Y. But what if FE is beyond EC? The problem is no longer to pursue FE by growth in Y, but instead through structural change, such as shifting factor intensity away from fossil fuels and manmade capital (both of which rapidly draw down natural capital) and toward labor. We have already explained that when IS = LM beyond EC, we are likely to draw down natural capital, and it is implicit in the acronym NAIRU (the non-accelerating inflation rate of unemployment) that going beyond FE results in inflation. Why the difference? Why doesn't moving beyond EC also simply cause inflation? The answer is that natural resources are either free or cheap to begin with; they are not appropriately priced by the market mechanism, and excessive use therefore does not affect the price signal.

It remains true, however, that the assumption of constant throughput intensity of Y is troublesome. We know that throughput intensity of Y changes with new technology, and with shifts in the mix of goods that make up Y, even if probably not with factor substitution of capital funds for throughput flows. Differing assumptions about throughput intensity of Y can at least be represented by a shift in the EC perpendicular. (Curve shifting is, as you have no doubt realized by now, not an uncommon device in economic analysis!) However, in terms of practical policy recommendations, perhaps the best approach would be simply to impose the ecological constraint as a limit on throughput. For any given technology, a fixed limit on throughput will also limit Y, but over time, new technologies and a different mix of goods and services can allow Y to increase without increasing throughput, thereby threatening the life-support functions of the ecosystem.

BIG IDEAS to remember

- Macroeconomic model vs. general equilibrium
- Real vs. monetary sectors
- IS = LM
- MV = PQ
- Transactions demand for money
- Liquidity preference
- Relation of bond prices to interest rate
- IS-LM analysis of monetary and fiscal policy
- Comparative statics
- Crowding out
- Inflation and disinflation
- Unemployment
- Macro-allocation
- IS-LM adapted to show economic and biophysical equilibria