EC1010 Macroeconomics

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Chapter 1

The Very Basics

"A large income is the best recipe for happiness I ever heard of."

- Jane Austen.

1.1 Measuring Output

Definition 1 (Nominal *GDP***)** *Nominal GDP is the market value of final goods and services produced in a country in a given time period.*

Because its rise could be solely attributable to rising *prices*, nominal GDP doesn't really tell us much about welfare. For instance, a doubling of nominal GDP could be due to a doubling of *prices*. Yet we're primarily concerned with changes in *output*, not *prices*. What determines welfare are changes in output, and such changes are reflected in changes in *real GDP*.

Definition 2 (Real GDP) *Real GDP measures the value of an economy's final production in a given period using the prices of some base year. As a result, changes in real GDP measure changes in quantities of output alone, and filter out the effects of price changes. Crucially, we measure real GDP using the same set of prices each year (i.e., using the prices from the "base year.")*

In other words, changes in real GDP measure changes in *physical* output produced within countries' borders. Certainly real GDP is an important variable. Our real concern, however, is not the level of real GDP, which measures *aggregate* output. Rather, we're concerned with real GDP *per person* or what's known as real GDP *per capita*; this is our measure of a country's *standard of living*. Like most measurements, it is imperfect, but because it is highly correlated with all other measures of well-being—such as nutrition, life expectancy, and poverty rates—real GDP per capita is in fact a pretty reliable measure of living standards for all citizens of a country. Nevertheless, you could argue that this *average* masks economic disparities: most obviously, it says little about the *distribution* of wealth. Take, for example, Bill Gates. If he walks into lecture, GDP per person will assuredly increase a billion-fold. More generally, GDP is a measure of *market* production and doesn't measure such factors as leisure time or environmental degradation, and could rise as a result of military expenditure. Most notably, is fails to capture the black economy, which is large in many poor countries.

Examples

Now picture this in your mind: a simple economy produces two goods in 2001 at \$10, so *nominal GDP* is \$20. The price of both goods increase to \$15 in 2002, so *nominal GDP* in 2002 is \$30. To evaluate *real GDP*, we must use the *same* price level each year. So using 2001 prices (say) as our *base* year, we see that there has been *no change* in real *GDP* in 2002—it's still \$20. See? We have two goods each period, nothing "real" changes. Using prices from 2002 gives different values for real GDP. Yet the proportionate changes in real GDP—what we're really interested in—stay the same. Tables 1.1 and 1.2 give another example; for a one-good economy, Table 1.1 shows nominal GDP, while Table 1.2 presents real GDP *in 1999 prices.* Finally, when we compare GDPs across countries, we try to use the same prices across countries too. When we do this, such measurements are called *PPP-adjusted* GDPs. This way, just because prices are higher in, say, Britain, will not imply it has a higher GDP.

Table 1.1: GDP at Current Prices

Year	*Quantity*	*Price*	*Nominal GDP*
1999	5	2	10
2000	5	4	20
2001	7	5	35

Table 1.2: Real GDP in 1999 Prices

Year	*Quantity*	*Price*	*Real GDP*
1999	5	**2**	10
2000	5	**2**	10
2001	7	**2**	14

1.2 Measurement

Moving on, we have the national accounts identity in 5:

$$\boxed{\text{Income=Expenditure=Output}} \tag{1.1}$$

Imagine a small economy produces 20 cars a year, worth $20,000. So the value of *output* is $20,000. All those cars are sold, so *expenditure* is also $20,000. And all the producers receive that money, so *income* is $20,000.

Considering that all forms of expenditure end up as someone's income (so income=expenditure), that gives us the first part of the equality. Furthermore, output produced is ultimately purchased and thus is equal to expenditure (so output=expenditure); that's the second part. Now, in case you're wondering, what happens if some of the output is not purchased? In this case, the output is *still* counted as expenditure. According to national account conventions, the output is treated as a purchase by the producer himself for his inventories (and this appears in *Investment*, as *inventory investment*). Using this convention, output is indeed equal to expenditure. Don't worry too much about this point: inventory investment comprises only a small part of GDP. Firms are typically quick to reduce production when they foresee lower demand for their products.

As another example of GDP calculation, consider this: a carpenter buys wood from a forester for 20, and uses the wood to make a bookshelf, which he in turn sells for 50. There are three ways we can calculate (nominal) GDP. First, we can use the *expenditure approach*: this measures the amount of expenditure on <u>final</u> goods and services. In this simple example, this is simply the amount paid for the table i.e., 50. Second, we can use the *income approach*: this simply adds up the values of all incomes in the economy. In this example, the forester receives income of 20, and the carpenter receives (net) income of $50 - 20 = 30$. Hence the sum of incomes in the economy is 50. Third and finally, we can add up the *value added* by each worker in the economy: that is, what is the value each worker's contribution to the value of what they sell? In this example, the value added by the carpenter would be 20, while the value added by the carpenter would be 30. Again, the sum is 50.

Because it is the most common way to measure GDP, let's talk more about the *expenditure approach*. This entails adding up the values of <u>final</u> expenditure in the economy. Most importantly, we do not include *intermediate goods.* Adding up the components of final expenditure gives a measure of GDP, Y:

$$\boxed{Y = C + I + G + X - M} \tag{1.2}$$

Considering that imports represent *foreign* production, we must subtract its value from domestic expenditure. This leaves us with the value of domestic expenditure that's *domestically produced*; i.e., GDP. Note finally that GDP is the sum of final sales and inventory investment.

Consumption (C) C includes durable goods (e.g., cars and tvs), nondurable goods (e.g., food, clothing) and services, which are the largest component (items like education, healthcare, and haircuts.) It only includes the purchase of new goods, not the transfer of second-hand goods (the same applies for all spending components.) It's the largest component of GDP, currently constituting around 70% of GDP in the U.S.

Investment (I) This is the sum of nonresidential private investments (expenditures by firms on equipment and structures), residential investment (new homes) and changes in inventories (inventory investment). If firms place goods in inventories, this is regarded as a purchase by the firm from itself.

Government Spending (G) Sum of all purchases of goods and services by the government. It does not include government transfers (we are seeking to measure the value of *production.*) Investment by the government is part of G.[1]

Exports (X) Sale of domestically produced goods and services to the rest of the world.

Imports (M) The purchase of goods and services from the rest of the world.

Some Examples

1. An American firm, Boeing, sells a 747 to the American government - *this is part of G.*
2. Boeing sells a 747 to an American airline, US Airways - *this is part of Investment.*
3. Boeing sells a 747 to an American citizen - *part of Consumption.*
4. Boeing sells a 747 to an Ryanair - *in the U.S. accounts, this is an Export.*
5. Boeing builds a 747 to be sold next year - *this is part of inventory investment, I.*
6. A firm buys a new robot helping to automate production -*regarded as Investment.*
7. The Irish government purchases a foreign painting for an Irish museum - *included in G and M, so ultimately makes no difference to GDP (since it enters positively as G and negatively as M), as we'd predict. If a consumer purchased the painting it'd be recorded in C and M.*
8. The wage of an Irish immigration official - *this is part of G, since it's a service purchased by the Irish government.*

[1] In economic models—such as in the Solow model—it is conventional to assume G refers to government consumption, not investment.

9. The government pays someone the dole - *this is not part of GDP, since the transaction doesn't represent an increase in production. We refer to this as a transfer payment.*

1.3 Other Definitions

Definition 3 (Current Account) *This is the value of exports less the value of imports. It is also referred to as net exports.*

Definition 4 (Gross National Product, GNP) *Nominal GNP measures the value of output accruing to domestic factors of production. It is the value of output produced by citizens of a country regardless of where they are. (By contrast, GDP refers to output produced by people within a country's borders, regardless of the producer's nationality.)*

Consider: if you travel to the U.S., and work there for the summer, then the value of output you produce there is part of U.S. GDP *and* Irish GNP. Since no production has taken place within Irish borders, this has no effect on Irish GDP. Likewise, profits make by multinationals are part of U.S. GNP, but not Irish GNP.

Definition 5 (Potential Output) *Potential output, Y_n, is the level of output when the economy is working at a normal pace and is neither in boom or recession.*

Definition 6 (Output Gap) *This is the difference between actual and potential output, $Y - Y_n$. So when the economy is in a boom the output gap is positive; and when it's in recession, the output gap is negative.*

1.4 The Price Level and Inflation

Definition 7 (Consumer Price Index (CPI)) *The CPI is a price index that measures the price of an average basket of goods in an economy. As such, is an average of all the prices of consumer goods in the economy, weighted by the consumption shares of each good. One common measure of inflation is the annual percentage change in the CPI.*

Table 1.3: CPI: Two Apples, One Orange

Yr	***A.***	***O.***	***Basket Price***	***CPI***
1	4.5	1	**2**(4.5)+**1**(1)=10	10
2	6	2	**2**(6)+**1**(2)=14	14
3	7	1	**2**(7)+**1**(1)=15	15

For example, suppose our fixed basket comprises two apples and one orange. In this case, the evolution of the CPI is given in Table 1.3

Definition 8 (Deflation) *We define this as a sustained fall in the level of prices in an economy.*

Over time the prices of goods like computers fall steadily. Yet this does not represent deflation: this is a relative price change. Deflation refers to a situation where the price of almost all products are falling. Because this is generally associated with a marked fall in demand, deflation often occurs in economies where output lies well below potential.

Definition 9 (Hyperinflation) *Average inflation of around 50 percent a month.*

Don't confuse *disinflation* and *deflation*. Deflation is when prices actually *fall*. Disinflation is a reduction in the rate of inflation, say from 15% to 10%. So, under *disinflation*, we can typically have prices still *rising*. In contrast, hyperinflation refers to extremely high rates of inflation (about 50 percent a month). Think of it this way: hyperinflation is sprinting, inflation is running, disinflation is running at a *slower pace*, while deflation is going backwards.

Key Idea 1 (Policy Goals) *Good macroeconomic policy aims for low inflation, a zero output gap, and economic stability (as opposed to volatility). Demand side policies are aimed to increase aggregate demand, $Y = C + I + G + NX$, so as to bring the economy close to potential. Supply side policies (such as deregulation) are designed to increase potential output; i.e., to raise the productive capacity of the country.*

Table 1.4: Real Wage Changes

Year	*Nom. Wage*	*Price*	*Real Wage*	*Index*
1999	5	5	1	100
2000	20	5	4	400
2001	40	20	2	200
2002	30	10	3	300

1.4.1 Real Values

What we are typically interested in in economics is the *real* value of something, not the nominal or monetary value. What I mean by the real value is the *purchasing power* value: how many *goods* can we buy with a given amount of money? For example, one can think of the real wage as the number of goods you can buy with the monetary wage. Except in the case of interest rates, to obtain the real value we simply deflate by a price level such as the CPI (i.e., the price of a normal basket of consumer goods.) Table 1.4 shows the evolution of the real wage. Keep in mind that we are primarily interested in the *change* in the real wage over time. For this reason, we often simply normalize the first year to 100, as in the last column of Table 1.4. This way, we can clearly see the proportional changes over time.

To take another example, suppose I owe you \$1000, and the price level is \$100, then your real debt burden is ten baskets of goods. But if the price level was raised to \$1000, the real burden of debt is now a mere *one* basket of goods. *And all that matters is the real burden in terms of purchasing power*. This way, inflation erodes the real burden of debt. As another example, suppose I took a \$10 loan from you fifty years ago. At that stage, the purchasing power of the loan was relatively large, but given the substantial rise in the price level in the interim, the purchasing power of what I give back to you today is relatively low. I gain at your expense and, in this sense, inflation involves a redistribution of wealth from creditors to debtors. Deflation has the opposite effect: it *raises* the real burden of debt.

Because macroeconomics often entails analyzing growth rates, the following rule of thumb is useful:

Definition 10 (Rule of 70) *If a variable is growing at rate g% per year, then that variable will double in size after approximately $\frac{70}{g}$ years.*

Chapter 2

Savings and Investment

2.1 Interest Rates and Real Values

Especially in the media, interest rates are almost always quoted in monetary terms—what we call the *nominal* interest rate. But remember what we said in Chapter 1 about *real* values? In finance, what we are really concerned with are *real* returns: the *purchasing power* of returns. For instance, if I made a real return of 3%, then I'd be able to purchase 3% more goods and service with the funds that were returned to me. Nominal returns refer to the *monetary* return. The trouble is, inflation can eat away at those monetary returns. By contrast, the *real return* gives the percentage increase in purchasing power. Mathematically, it is given by the nominal interest rate less the rate of inflation; you can think of it as the monetary return less what is "eaten away" by inflation.

In fact, a lot of savers lost out in the $70's$ since they bought bonds and only after did they witness a resurgence in inflation, thereby diminishing their *real* returns. In other words, they lent out money, but the purchasing power of what they lent was much greater than what they got received back. Imagine you lent \$10 to someone a hundred years ago and get back a mere \$12 back today. Yet considering that the price level rises over time, this nominal return has hardly any *purchasing power* compared to what you initially lent out.

Definition 11 (Real Interest Rate) *The real rate of return r is given by $r = i - \pi$, where* *i denotes the nominal interest rate and π inflation. The real rate of return indicates the percentage change in purchasing power from making a loan.*

Because the real interest rate represents the ultimate reward and ultimate burden of payment, it is the real interest rate that determines savings and investment decisions.

2.2 Determination of the Equilibrium Real Rates: Loanable Funds Model

What I mean by investment is demand for funds for building new factories, machines, homes (i.e., residential investment), and so on.[1] When real interest rates fall, investment demand rises. The real interest rate represents the cost of loanable funds, and when that cost falls, funds become cheaper, making investment projects more attractive. For instance, a firm will typically have a rule whereby they should invest in all projects that satisfy the condition $r^p > r$; i.e., when the expected rate of return on the investment project, r^p, exceeds the real interest rate (i.e., the cost of funding). So when the real interest rate falls, more projects satisfy this condition and investment demand rises. For this reason, we say investment demand is a *decreasing* function of the real interest rate. Often we write the investment curve—representing investment demand—as

$$I(r) = a - br,$$

where $b > 0$ mediates the sensitivity of investment demand to interest rate changes, while a captures exogenous influences on demand. An example of an increase in a would be a rise in investment demand due to a new technology which firms wish to invest in. Rather than arising from a change in interest rates, this

[1]It is common in the media to refer to savers as investors. However, in our model, these are two distinct agents. One is the source of supply of loanable funds (the savers); another is the source of demand for those funds (the investors). Investment demand here strictly refers to demand for investment projects.

investment demand arises from a factor unrelated to interest rates. Graphically, we would represent this by a *shift* outwards in the investment demand curve; this way, for any given level of the interest rate, investment demand rises.

Turning to the other side of the market, when the return to saving is higher, people save more. There are three sources of savings: households, governments, and foreign savings. The sum of private and government savings is called *national savings*. We write the savings curve

$$S(r) = c + dr,$$

where $d > 0$. That is, savings are increasing in the interest rate: as the interest rate rises, saving becomes more attractive. In case you're wondering, savings are in fact fairly irresponsive to changes in interest rates; this translates into a low d and an inelastic savings curve. As with investment, c incorporates exogenous changes in savings behaviour. For example, if people become concerned about the future, they might save more; i.e., there would a rise in *precautionary savings.* In addition, people might decide to save more to leave greater *bequests* to their children. These changes are independent of the interest rate, but raise savings. Graphically, we would represent it as a shift outwards in the savings curve; i.e., the level of savings would rise for each level of the interest rate.

2.3 Savings/Investment Diagrams and Examples

Reflecting the relationships outlined above, we draw an upwardly sloping savings curve and a downward sloping investment curve. Think of the savings curve as simply a *supply* curve, with the investment curve being the source of *demand* for funds.[2] The slopes of each curve determine elasticities. As we shall see in the examples, the slopes play an important role in the determination of equilibrium interest rates. Implicitly we are assuming that all savers—those buying bonds, or equities, those saving in banks, and so on—and all those with investment projects

[2] Conveniently, we denote the Savings curve with an S, the standard way of indicating a supply curve.

meet together at some auction—our loanable funds market—and bid over funds. Although this is unrealistic, it is a useful way to analyze the basic forces determining the real interest rate in an economy.

How does the market adjust to equilibrium? When the level of investment demand exceeds the level of savings, those with the most profitable investment projects outbid those with less profitable ones. As a result, there is upward pressure on interest rates. Moreover, it will ultimately be those with the most profitable projects who manage to attain funds. When the price of loanable funds rises, those with the least profitable projects are priced out of the market. In a sort of Darwinian "survival of the fittest," the market leads to an efficient outcome, and allocates funds to the most worthy investment projects. The market system or "invisible hand" allocates funds in the most efficient way.

Finally, keep in mind that I am assuming output is always at potential. To see what this means, consider a closed economy with no government; in this case, we will always have $Y_n = C + I$, where Y_n denotes potential output. In this analysis, therefore, what changes behind the scenes is the *distribution* of output between consumption and investment. To give an example, suppose consumers decide to consumer more, causing saving to rise. What happens? Because $Y_n = C + I$, we know that I must fall. Central to this adjustment is the interest rate. As we shall see in the examples, when savings fall, the interest rate rises, which in turn reduces investment. As such, one can view this analysis as a way of determining how output is distributed across the economy. In particular, consumption is the flip-side to savings, so when savings fall, consumption rises; and because savings equals investment, investment also falls.

2.4 Graphs

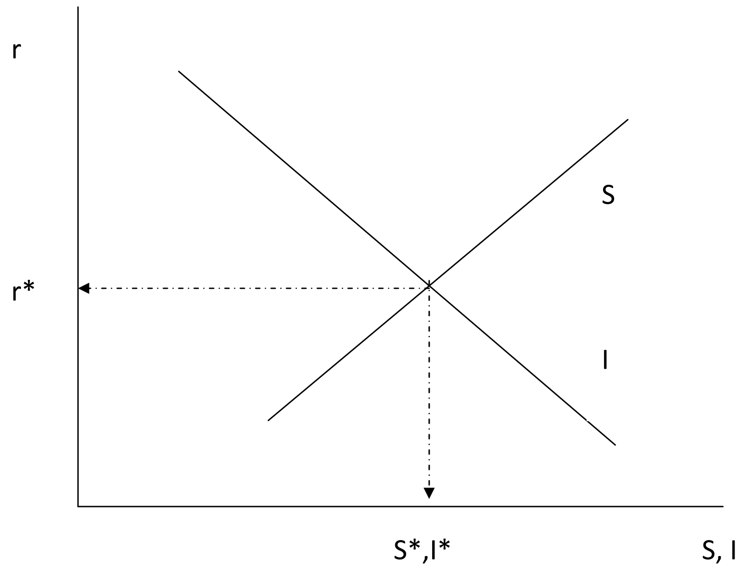

Figure 2.1: Financial market equilibrium. At equilibrium, savings equal investment. When the interest rate is above the equilibrium rate, savings supply exceeds investment demand. This surplus causes the price of loanable funds—i.e., the interest rate—to fall. As a result, two things happen. First, because saving is becoming less attractive, some savers decide to leave the market. Second, as the cost of funds falls, some investors are seduced into the market. The fall in savings and rise in investment demand causes the initial differential between savings and investment to fall. This process continues until both supply and demand for funds are equal—which occurs at the intersection of the curves. The opposite forces dominate if the economy starts below the equilibrium interest rate. In contrast to the Solow model, we assume these adjustments occur almost instantaneously.

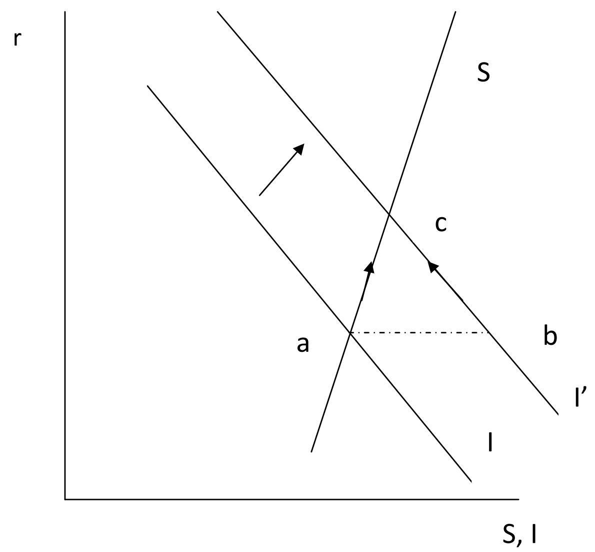

Figure 2.2: A rise in Investment Demand. We start off at point a. In particular, savings are initially at point a. When investment demand rises, investment demand immediately rises to point b: The horizontal distance between a and b measures the rise in investment demand. Because investment demand now exceeds savings supply, the financial market is in disequilibrium. At this point, the investors with the most profitable projects bid up the interest rate. Two things now happen. First, as the interest rate rises, savings rise. As we move from a to c, higher interest rates draw more savers into the market. Second, as we move from b to c, the interest rate is rising, causing some investors to leave the market, resulting in a decline in investment demand. This process continues until equilibrium is reached at point c. Investment and savings are both higher, but note that the rise in actual investment is less than the initial rise in investment demand. This is because the higher interest rates have caused some investors to leave the market.

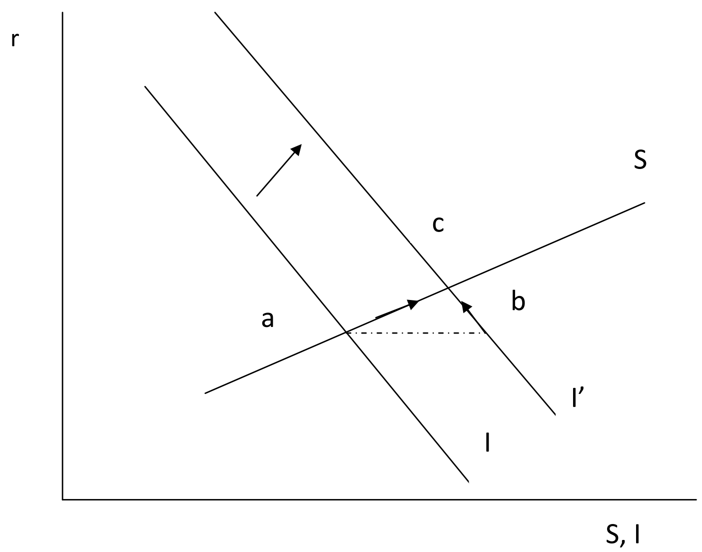

Figure 2.3: A More Elastic Savings Response when Investment Demand Rises. This represents the same increase in investment demand as in Figure 4.2. However, in this case, savers are highly responsive to rising interest rates. As a result, savings increases a lot when the interest rate rises. In equilibrium, both savings and investment are higher, while the interest rate is lower. The more elastic the savings response, the greater the rise in actual investment in equilibrium. This is because savers readily supply more funds as the interest rate rises, and this increase in supply can finance more investment.

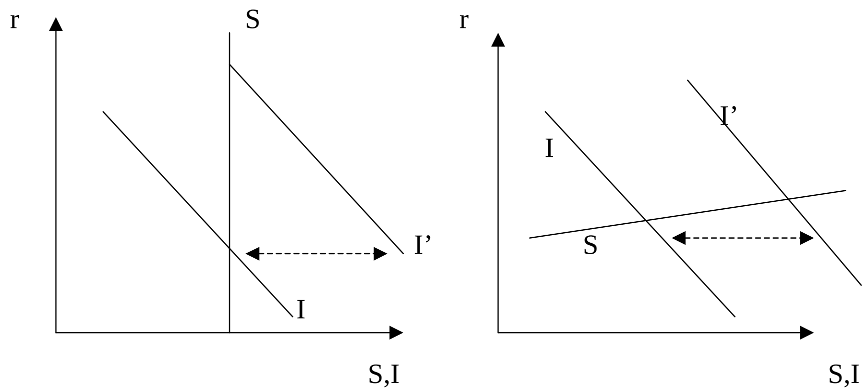

Figure 2.4: Rise in Investment Demand with Inelastic Savings Supply. (Note that an Inelastic curve looks like an I.) On the left, we assume savers are irresponsive to changes in interest rates. Despite higher interest rates, they always save the same amount. In this case, investment can’t increase (since its pinned down by the fixed stock of savings), so an increase in the demand for funds is reflected wholly in a rise in price of funds; i.e., a rise in *r*. That is, the interest rate rises a lot to “choke off” investment demand. The burden of adjustment falls entirely on price; i.e., the interest rate. In this case, the investors with the least profitable projects are driven out of the market. For a given increase in investment demand, we get two markedly different equilibria.

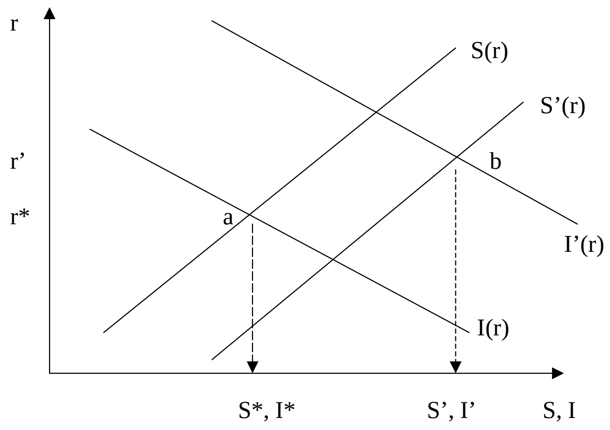

Figure 2.5: AN RISE IN INVESTMENT DEMAND AND AN INCREASE IN CAPITAL INFLOWS. IN THE U.S. IN THE MID-NINETIES, INVESTMENT DEMAND ROSE DUE TO COMPANIES SEEKING TO INVEST IN INFORMATION TECHNOLOGY. IN ADDITION, DURING THE ASIAN FINANCIAL CRISIS, THERE WAS A SURGE OF CAPITAL INFLOWS TO THE COUNTRY (SINCE THE U.S. IS ALWAYS SEEN AS A "SAFE-HAVEN" IN TIMES OF GLOBAL ECONOMIC TURMOIL.) WHETHER THE INTEREST RATE RISES OR FALLS DEPENDS ON THE MAGNITUDES OF THE RESPECTIVE SHIFTS; HERE THE INTEREST RATE RISES FROM r^* TO r'. BECAUSE OF THE CAPITAL INFLOWS, INTEREST RATES DON'T RISE AS MUCH: THE CAPITAL INFLOWS NEUTRALIZE SOME OF THE UPWARD PRESSURE ON THE INTEREST RATE.

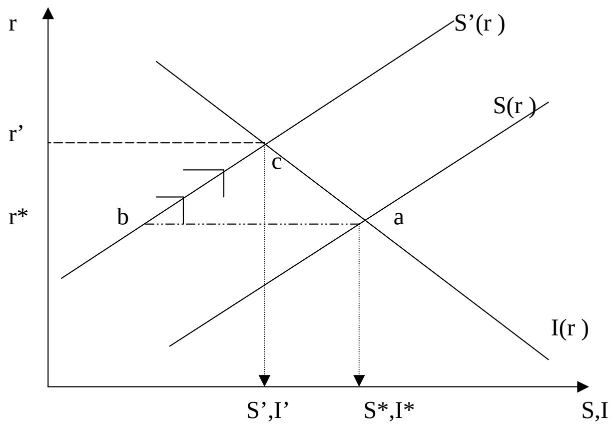

Figure 2.6: Crowding Out: A fall in government savings—due to permanent tax cuts, thus reducing $T - G$ (the budget balance)—leads to a shift inwards of the saving curve (we initially move from a to b), with the distance between a and b indicating the actual fall in savings. However, in response to rising domestic real rates, savings rise as the economy moves from b to c. In addition, because of the rising interest rate, investment demand falls as we move from a to c. Overall, because of the induced rise in savings, actual investment does *not* fall by the full extent of the fall in savings. Nonetheless, investment still falls from I^* to I', reflecting the notorious crowding out effect of government expenditure. We know from the Solow model that a lower investment rate ultimately reduces the standard of living in an economy.

2.5 Small Open Economy

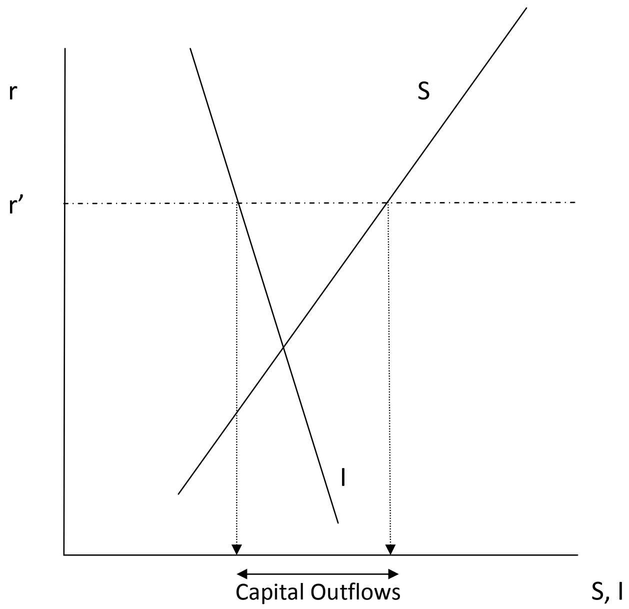

Figure 2.7: A SMALL OPEN ECONOMY EXPORTING SAVINGS ABROAD. BECAUSE THE INTEREST RATE IS HIGHER ABROAD, SAVINGS WILL LEAVE IRELAND. WE COULD REPRESENT THIS AS AN INWARD SHIFT IN THE SAVINGS CURVE.

So far, we have been implicitly examining the case of a *large* open economy. Matters are somewhat different for a *small* open economy like Ireland. How come? For such an economy, what determines the interest rate are developments in world financial markets. To see why, imagine Ireland had an interest rate of 10 percent, while rates were 1 percent everywhere else. In this case, foreign savers would place their funds in Ireland—and they would continue to do this until the increase in loanable funds in Ireland depressed the Irish interest rate to 1 percent. Note that this would only hold for a *small* economy.[3] If a *large* open economy like the U.S. had an interest rate of 10 percent, then there surely wouldn't be sufficient funds in the world to depress the U.S. rate *that* much. In this case, funds would flow to the U.S., but the rate would only fall to, say, 7 percent. Meanwhile, the outflow of funds from other countries would cause their interest rates to *rise* to 7 percent. In

[3]To consider an extreme example, content yourself that interest rates on the Aran Islands must be dictated by developments on the Irish mainland.

this sense, developments in a large open economy can have a bearing on interest rates worldwide. Indeed, when interest rates in the U.S. rose markedly in the early eighties, they also rose in other developed economies such as Japan.

Of course, the opposite occurs if Ireland initially has a low interest rate and rates are high everywhere else. In this case, funds would leave Ireland and would continue to do so, until Irish rates rose to the level of world rates. In equilibrium, the interest rate for a small open economy must equal the so-called "world interest rate"—the average rate prevailing in the world. Figure 2.7 illustrates this. In equilibrium, the Irish rate is r', above what it ordinarily would be. To make things more explicit, we could indicate an inward shift in the Irish savings curve. Notice that national savings now exceed investment demand. The discrepancy between this domestic supply and demand for loanable funds represents savings Ireland sends abroad; this is Ireland's *capital outflow*.

2.6 Other Factors Affecting Interest Rates

It is best to consider the rate we have derived as the risk-free real rate of interest. This is the real interest rate upon which all other interest rates are based. That is, you can consider it a *benchmark.* To explain why rates might diverge from this, we must go beyond the simple loanable funds model. In that model, we simply assumed all savers and investors met together and bid over funds. Yet in reality there are a variety of mechanisms in an economy, through which savers and investors can interact. One obvious example is a bank; savers leave their money in banks, and banks lend that money out to people who borrow for investment projects. Another common example of this interaction is a firm issuing a bond. This is essentially a situation where a saver gives the firm money, and the firm issues the saver—now a bondholder—with an IOU. This process of issuing bonds is the way governments borrow, but firms also regularly issue *corporate* bonds. A less obvious example of savers and investors interacting is the stockmarket. Savers give new firms funds—which they use to finance a new business—and the firm issues them with shares. These shares confer part ownership of the firm on the savers (who become *shareholders*). More generally, different borrowers have different risk profiles, and interest rates will typically be higher for them.

The rates of return on these various means of savings can differ quite substantially. Yet the crucial point is, the rates of returns from these assets are all benchmarked on the rate we derived in the loanable funds model. Below I list reasons why interest rates may differ from the rate derived in the loanable funds model.

1. *Inflation Premium*. In reality, almost all rates quoted are nominal, not real rates. To ensure savers earn the real return in the loanable funds model—often called the "required real return"—we must add an *inflation premium* to it, to compensate for inflation eating away at returns. For example, suppose the required real rate is 4 percent. If people expect inflation to be 5 percent, then the saver will demand a nominal rate of 9 percent. This way, the real rate will be $r = i - \pi = 9 - 5 = 4$ percent as required. Clearly, in economies where people expect inflation to be high, nominal interest rates are also high. This positive relationship between nominal interest rates and the rate of inflation is called the *Fisher effect*.

2. *Risk Premium*. In the case of bonds, a risk premium compensates for risk of default. There are a variety of so-called rating agencies—such as Moody's—which rate the quality of bonds from various companies and governments. The lowest quality bond is called a "junk bond"; because of the associated risk, they typically pay the highest returns. In the case of stocks, a risk premium is required, because their returns are so volatile.

3. *Liquidity premium*. This is to compensate bondholders for the fact that they might not be able to resell the bond to someone else. Because they are easy to sell, bonds issued by the U.S. government are the most liquid in the world. As a result, there would be little, if any, liquidity premium attached to them.

4. *Term premium*. The longer the period for which a bond is issued, the higher the interest rate it will command. This is because there is greater risk involved in such a loan. The *yield curve* illustrates graphically the interest rates (or yields)

offered on bonds of all maturities. For reasons mentioned, it almost always slopes upwards, indicating higher interest rates for loans of longer duration.

To sum up, higher nominal interest rates are not necessarily good. This underlies a general economic principle: *there's no free lunch.* High interest rates merely compensate savers for bearing greater risk. In reality, all assets are available to savers, so returns must adjust to make all assets equally attractive in equilibrium.

2.7 Bond and Stock Returns

How are returns generated in practice? In the case of a bank, it is straightforward: you just place 80 in a savings account and get back 100, say, a year later. First I will discuss bond returns, and then stock returns.

2.7.1 Bond Returns

To see what I mean by a bond return, say you buy a bond for 80, and it specifies it will return 100 in a years time. Therefore, the return on this bond is

$$r = \frac{100 - 80}{80} = \frac{20}{80} = 25\%.$$

Notice that the cheaper the bond, the greater the return.[4] There is an important inverse relationship between bond prices and interest rates/returns on bonds: *when bond prices rise, their return—or the interest rate they pay—falls.* For example, suppose the bond's price rises to 90. Then the return or interest rate from buying the bond will be

$$r = \frac{100 - 90}{90} = \frac{10}{90} \approx 11\% < 25\%.$$

Conversely, if the return or interest rate on the bond rises, the price must have fallen: the price falls *to generate* the higher return.

Key Idea 2 *There is an inverse relationship between bond prices and the interest rate/return they pay.*

[4] You can also find the return by solving the equation $80(1 + r) = 100$ for r.

Apart from the risk of default, bonds are risky if you wish to resell them. To see why, imagine I buy a bond from you: I give you 80 and you promise to pay me back 100 next year. Now suppose that 6 months later it transpires that I want cash quickly, so I decide to sell my bond to someone else. Yet, suppose that for some reason, everyone believes you are heading towards bankruptcy. In this case, people will be willing to pay me very little for the bond you issued me; namely, the risk of default has risen. Someone might only be willing to pay me only 50 for the bond—in which case I make a capital *loss*.

The example above deals with a 1-year bond. In practice, many bonds are issued for longer than one year. Suppose now that I buy a bond from you for 60, and the bond specifies it will pay back 100 in *two* years time. In this case I would make a total return of

$$r = \frac{100 - 60}{60} = \frac{40}{60} \approx 67\%.$$

This is the aggregate return you would get over two years. However, the return on bonds are usually quoted in terms of the interest rate you would get *annually*. In this case, to get a rough estimate of what this would be, you would divide the aggregate return by 2, giving around 33%.[5]

2.7.2 Stock Returns

To start with, let me give you an example. Say you purchase a stock for 50. Next period the stock price rises to 60 and you get a dividend—i.e., a share of firm profits distributed to you—of 15. In this case, you make a capital gain of $60 - 50 = 10$ and a dividend of 15. Therefore, your return is

$$r = \frac{15 + 10}{50} = \frac{25}{50} = 50\%.$$

For a given dividend and capital gain, a higher share price translates into lower returns. In reality, stock returns are quite volatile, with savers can make large capi-

[5]Technically, this is incorrect, and only gives a rough estimate. To find the equivalent annual return, you would solve the equation $60(1 + r)(1 + r) = 100$, which gives $r \approx 30\%$ a year.

tal losses on stocks, when stock prices fall. In addition, because future stock prices and dividends are uncertain, a saver is initially unaware of what the return will be. As already noted, it is because of this uncertainty that stock returns are, on average, relatively high. Rather than being a proverbial "free lunch," such returns are an award for risk. Economists view the stockmarket as a good savings mechanism over the long run. So if you purchase stocks, they should on average offer the best returns if you hold them for, say, twenty years.

In practice, most of the discussions of the stock market revolve around the prices of *existing* shares. In this case, however, when one purchases shares, you are simply buying them off an existing shareholder.[6] Stock prices change frequently, and for a variety of reasons. Fundamentally, what determines a stock's price are the forces of supply and demand. At any given time, the supply of stocks issued by a firm is fixed. As a result, when demand changes, the stock price changes. And why would demand fall? Well, demand for a stock falls when people believe the company is question is facing a risk to its future profitability.[7] In this case, it is natural to expect lower future dividends. This would reduce expected returns from the stock and hence reduce demand for it, causing its price to fall.[8]

[6]In this case, investment would not increase when shares are purchased. You would be saving, but the seller would be dissaving, so there would be no change in aggregate savings.

[7]Discussion of such share price movements dominate much of media coverage of financial issues. For example, on 23 February 2010 one article at the Bloomberg website reports "Stocks in Europe fell after German business confidence unexpectedly declined for the first time in 11 months." Lower business confidence indicates profits will likely be lower in the future; this in turn suggests future dividends will be lower, and this expectation reduces the value of existing shares.

[8]When a firm initially sells shares to obtain funds for investment, this is called an *initial public offering* or IPO. Facebook, for example, will soon make in IPO, which will enable *you* to own part of the company. Yet most of the discussion of the stockmarket in the media refers to the price changes of *existing* shares. Sometimes an established firm may issue new shares, thereby "diluting" the existing shareholders. Because firms typically use the funds from the new share offering for investment, this should lead to higher future profits. And because higher profits lead to higher dividends, this dilution of existing shareholders is not as bad as it seems.

The Efficient Markets Hypothesis

The famous *efficient markets hypothesis* says that all publicly available information about a firm's prospects are almost instantly impounded into its share price. Underlying this important dynamic are people in financial markets who continually scrutinize firms' prospects, and sell or buy shares once they hear of news about future profitability. For instance, if news is just released suggesting a firm's future profitability will rise, certain people in financial markets—say, those paid to analyze the firm in question—will almost instantly buy the firm's shares, causing its share price to rise. We saw this kind of activity in lecture when looking at markets wagering on the outcomes of soccer games. Noting our formula above, this makes it quite difficult for the average person to make above-average returns from stocks; namely, the shares of firms with good prospects will *already* have high share prices, tending to offset the fact that future dividends will be high. The fact that *the price is right*, implies there are no "good deals" out there for you or I. That is, it is hard for *anyone* to beat the market systematically. For example, to purchase an *undervalued* stock, two conditions must hold. First, you need an uninformed *seller*, who is willing to sell at a low price. But with the internet, twitter, and other forms of instant communication, almost everyone has access to the same information. Besides, sellers who continually make bad sales will quickly lose money and leave the market. Second, you need to get there *first* to exploit the undervaluation, before the price is bid up. The thing is, it is *you* against 7 billion people. That's a lot of competition. True, in the same way as you might occasionally find money, you might get there first once or twice, but not *systematically.* For these reasons, the best investment advice is to purchase shares in an index fund, which invests in a diversified portfolio of shares—such as all firms in the S & P 500—and doesn't seek apparent "good deals" each day.[9] Empirically such index funds—*passive* investors—do better than mutual funds—*active* investors—when accounting for the fees mutual funds charge for their services.

[9] *Diversification* implies you don't have all "your eggs in one basket." This reduces risk and ensures that your returns are not unduly affected by the fate of a particular stock.

You might wonder, if there were a lot of bad investors, wouldn't they buy shares, causing the price to deviate upwards from its true, fundamental value. Yes they would. But all we need is a *single* well-informed investor to ensure the price returns to its fundamental value. As noted above, over time bad investors lose money and are forced to leave the market, so actions by smart investors determine prices on average.

2.8 Private Savings and the Permanent Income Hypothesis

Having looked at investment, we now turn to savings. So far, we haven't discussed rigorously the issue of what determines savings by the private sector. In other words, what motivates people to save? For analyzing savings decisions, it is useful to consider the *permanent income hypothesis.* Essentially this states that a person's consumption level today depends on *all* lifetime income—and not necessarily *current income.* According to the theory, a person figures out what his lifetime wealth is, and then simply consumes a fraction of that each period (with the fraction depending on how many periods the person expects to live.) Think about that for a moment. That means, for example, that if I live for 10 periods, and my only income is 1000 euros in the final period, I will borrow today and for the next nine years, and consume 100 each period.[10] In particular, my consumption should not change in 10 years time: my consumption pattern is *independent* of my income stream.

To see one implication, imagine you win a prize of 1000 euros, raising your income this period. If people base consumption on lifetime income, then winning the prize this year should have relatively little effect on consumption *this year.* Yet, to the extent that the prize changes lifetime income, it *does* affect consumption to some extent. Seeing that lifetime income has risen, people will consume a *little* of it this year, but will *smooth* the rest of it over their lifetime. Now ask yourself: would your consumption response be the same if you received a *permanent* income rise of 1000 (due say to promotion)? Hardly. Because lifetime income goes up a lot with a *permanent* change in income—arising from, say, promotion—consumption rises by

[10] I am ignoring interest here.

1000 *each period*.

Underlying the permanent income hypothesis is the basic idea of diminishing marginal utility to consumption. Just imagine listening to a song or eating food: the last unit of consumption is never quite as good as the first. Point is, the "bang per buck" falls as consumption of a good rises. Precisely because of diminishing marginal utility to consumption in any *given* period, to maximize utility, consumers spread consumption as thinly as possible across *all* periods. Like the way people spread butter over bread, it's optimal to spread consumption over a number of periods. And for the same reason too: would it make sense to put too much butter on part of the sandwich, leaving other parts dry? Of course not.

Chapter 3

The Solow Model

> *"Is there some action a government of India could take that would lead the Indian economy to grow like Indonesia's or Egypt's? If so, what exactly? If not, what is it about "the nature of India" that makes it so? The consequences for human welfare involved in questions like these are simply staggering: Once one starts to think about them, it is hard to think about anything else."*
>
> - Robert Lucas, Nobel Laureate (1995).

One of the most striking features of the world economy is the vast disparity in standards of living and rates of economic growth. For example, in 2000, real GDP per capita in the United States was more than fifty times that in Ethiopia. And over the period $1975 - 2003$, while real GDP per capita in China grew at a rate of 7.6% annually, real GDP per capita grew at a rate of only .1% in Argentina—seventy six times slower. Moreover, there are often vast reversals in prosperity over time. Argentina, Venezuela, Uruguay, Israel, and South Africa were in the top 25 countries (by real GDP per capita) in 1960, but none made it to the top 25 in 2000. From 1960 to 2000, the fastest growing country in the world was Taiwan, which grew at 6%. The slowest growing country was Zambia, which grew at -1.8%. That is, people in Zambia were markedly worse off in 2000 than they were in 1960. The theory of economic growth seeks to explain these differentials and provide explanations. The Solow model is a long-run model that seeks to explain how these vast income disparities and growth differences across the world arise. It describes the evolution of *potential* output or the productive capacities of countries over time. Because we assume an economy is always at potential in the long run, there are no recessions or booms in this analysis. Furthermore, because the *classical dichotomy* holds, there is no mention of nominal quantities such as money and prices in this analysis. Money has no effect on output in the long run and is thus irrelevant for explaining output differences. Think about it: over the long run, printing pieces of paper cannot generate increases in prosperity.

Before going on, it is important to note that we are not really interested in aggregate income/output, Y, in this world. What we are really concerned with is income *per capita*, $\frac{Y}{L}$—our conventional measure of *standard of living*.[1] This shows how well each of us, on average, is doing.[2] For simplicity, I assume throughout that the population of size L is *constant*; that is, there is no population growth.[3] As a result, when Y changes, $\frac{Y}{L}$ will also rise; and when K rises, $\frac{K}{L}$ rises.

The Aggregate Production Function

For starters, the *production function* for the economy is:

$$Y = AK^{\alpha}L^{1-\alpha}, \qquad 0 < \alpha < 1. \tag{3.1}$$

The production function is our *first key equation*. An important feature of this function is that it exhibits *decreasing returns to scale* to capital. What this means is that a second laptop, say, will not confer as much *bang per buck* as the first laptop, and so on. Formally, we say there's *diminishing marginal productivity* to capital accumulation. Bear in mind that we assume all the units of capital (say, laptops) are *the same*. So what I mean by increases in the capital stock are *more of the same* units.

Examining the production function more carefully, we see immediately that differences in GDP are attributable to differences in A, differences in physical capital,

[1] This is often referred to as *labour productivity*.

[2] In the United States, and indeed most industrialized Western countries, this has been growing at an average rate of 1.8% since 1870 or about 2% since 1900.

[3] Don't get too disheartened: this assumption does not affect the main insights of the model.

K, and differences in population, L. The A term denotes *total factor productivity*; it is anything (in a broad sense) that, for a given K and L, leads to greater output. Rather than simply incorporating technological advances, it also encompasses such factors as climate, skills, health, work ethic, social capital (i.e., culture), human capital (education), institutions (the political system, rule of law, protection of property rights etc), and so on. Basically, A measures the efficiency with which K and L are combined: total factor productivity rises if output per worker increases for any *given* K and L. It could reflect people working more hours or simply greater skills. Another example is climate: in a country with a persistently hot and inhospitable climate, Y will likely be lower for a given level of capital per worker; hence A is relatively lower. Just imagine Trinity on a great day—no matter how good your PC is, most likely you'll still get less done; that is, A will fall. Yet, for now, I assume A is constant at any point in time. You might think that the broadness of A makes it relatively unimportant compared to physical capital. As we shall see, this reasoning is incorrect: A is by far the most important determinant of living standards and growth.

To graph this, just let $\beta = AL^{1-\alpha}$ for a moment, and so the production function becomes

$$Y = \beta K^{\alpha}, \qquad 0 < \alpha < 1. \tag{3.2}$$

Using this formulation, we can treat β as a constant and just draw a graph of Y against K. Figure 3.1 shows the result.

The slope of the function subsides as we move outwards. As we shall see, this is what really frustrates things in this economy in the long run. Note crucially that an increase in A raises Y for any *given* level of K. Graphically, the way to represent this rise in A is to shift the production function upwards. Figure 3.2 shows the result. For example, if computers become more *powerful*, we could represent this as an increase in technology, A: just think of each existing computer getting more power via new software.

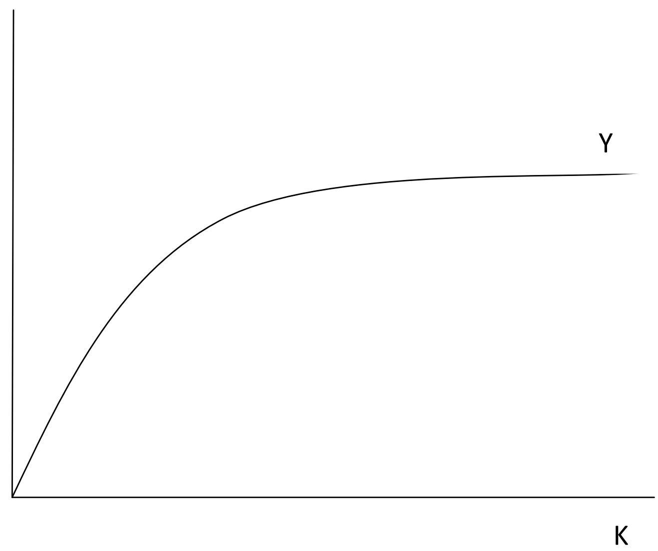

Figure 3.1: Basic Production Function. The first laptop is extremely useful; the second less so; the third hardly any use at all; and so on. Formally, the marginal product of capital (i.e., its usefulness), falls as K increases. This is called the diminishing marginal product of capital.

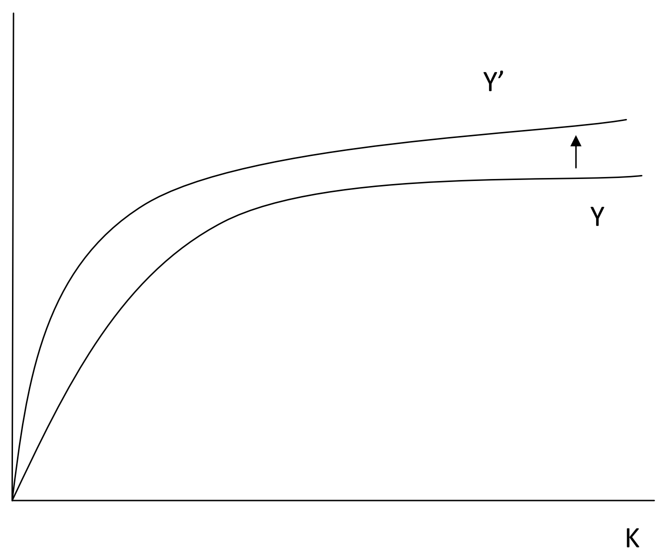

Figure 3.2: An Increase in A shifts the production function upwards. Such increases in A are a way of overcoming the curse of diminishing returns.

Growth in A

Seeing that L is fixed, there are only two factors that increase Y, and hence the standard of living, $\frac{Y}{L}$: capital K and total factor productivity A. Because the marginal product of capital tends to zero, increments in capital are little use to us after a certain point. In the long run, moving outwards to the right along the x-axis becomes somewhat futile, yielding only negligible increases in Y. Clearly we need something else to generate *sustained* growth of Y. That something else is *total productivity growth*; i.e., growth in A. Without growth in A, we see that growth essentially stalls.[4] If we can't grow by moving out to the right (that is, by capital accumulation), then *the only way is up*; in the long run, the productivity factor, A, *must* grow to shift our function upwards and generate sustained growth. And considering developed economies *do* grow steadily over time, this must be what is happening in those economies. That's the only way we can have sustained rises in income per capita and the standard of living. Yet notice that capital accumulation is important at the *outset* of development. But once developed (i.e., when diminishing returns are acute), capital accumulation is less useful, and now it's productivity that drives sustained growth. Also, capital accumulation is the "easy" part; it's much harder to generate increases in A. In other words, inspiration, not perspiration, is the key to sustained growth. Many countries such as Russia were remarkably successful in accumulating capital (through forced savings, generating so-called "Stalinist growth") and grew rapidly for a while, but couldn't subsequently generate increases in A.

Capital Accumulation

Central to the model is the evolution of the capital stock; once we know the level of capital, we can find every other variable. So our *second key equation* describes the evolution of the capital stock or *capital stock accumulation.*

First, we assume the stock of *savings* in the economy are some constant fraction,

[4] In reality, we *have* sustained growth in Y and $\frac{Y}{L}$; in developed economies such as the United States, for example, $\frac{Y}{L}$ increased tenfold in the U.S. from 1870 to 2000.

$0 < s < 1$ of output Y. This leaves people with $(1-s)Y$ to consume. What I mean here by savings are *private* savings by individuals and firms. Yet in a more general model, it would also incorporate *public* savings by the government; the sum of private and public savings is called *national savings*. Other things equal, government deficits reduce national savings and hence the savings rate.

In the model, savings finance investment; i.e., people use savings to buy more laptops etc.[5] As a simple example of the saving/investment decision, consider corn: each period you can either eat the corn (i.e., consumption), or place the corn in the ground, and new corn will grow next period; i.e., investment. It is a similar process here. Now, denoting investment by I and aggregate savings by S, we have:

$$S = sY = I,$$

where s denotes the national savings rate.[6] Figure 3.3 shows the *savings line.*

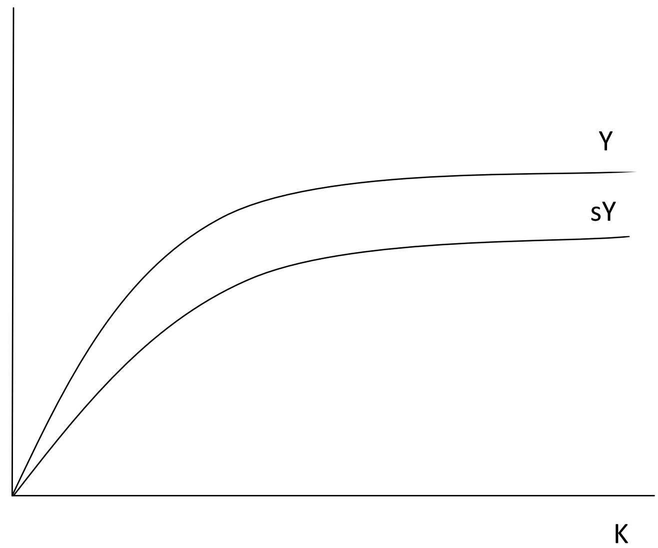

Figure 3.3: SAVINGS IS SOME FRACTION s OF OUTPUT. AT EACH LEVEL OF K, THE SAVINGS LINE, sY, INDICATES WHAT ADDS TO THE CAPITAL STOCK.

[5]Note the importance of *financial intermediation* or banks here. It's crucial to have a credible banking system so as to people can save and so as to channel those savings to the right investment projects.

[6]Considering the GDP equation $Y = C + I$ and the fact that $C = (1-s)Y$, we have $Y = (1-s)Y + I$. It follows that $sY = I$.

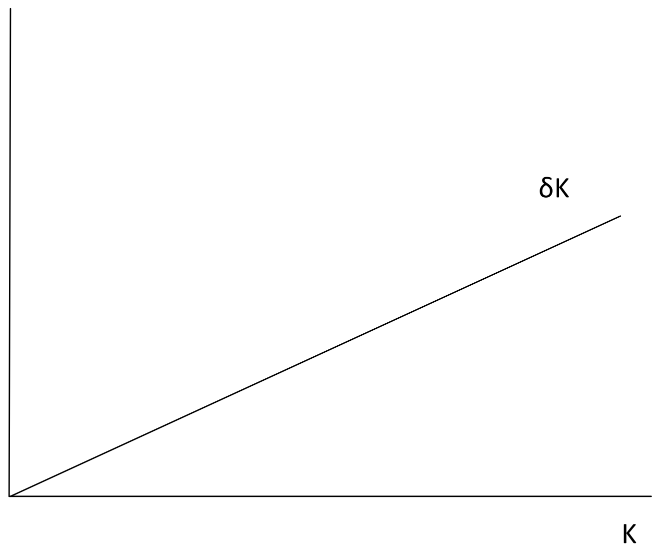

Figure 3.4: AT EACH LEVEL OF K, THE DEPRECIATION LINE INDICATES HOW MUCH CAPITAL DEPRECIATES IN THE ECONOMY. IN OTHER WORDS, THIS TELLS US WHAT LEAVES THE CAPITAL STOCK.

By raising investment, savings leads to an increase in the capital stock. But a fraction $0 < \delta < 1$ of that stock depreciates (or *melts*) each period. Figure 3.4 shows the *depreciation line.* Overall, the equation for the evolution of the aggregate capital stock, K, is:

$$\Delta K = I - D = sY - \delta K \tag{3.3}$$

where D denotes depreciation, assumed to be some fraction δ of the capital stock, K. So the net increase in the capital stock is investment minus depreciation. Think of it this way: what determines the increase in *you* is the amount of calories you consume, minus the number of calories you burn up. It is precisely the same idea here.[7]

At the heart of the model is the tension between investment and depreciation. It is useful to think of these as a tug-of-war between the "good" and "bad" force. This tension between total depreciation and investment determines the evolution of the capital stock and ultimately the standard of living. But now for the sad

[7] People attempting to lose weight decrease their food intake (i.e., their "investment") and engage in exercise (i.e., trying to create more "depreciation.")

part. Depreciation is linear in capital, so this "force" is equally intense at all stages. By contrast, the gains to saving are high initially, but fall as diminishing returns to capital set in; that is, this "force" becomes *less* intense as time passes. As a result, we must reach a point where the depreciation force just offsets the gains to investment. And what happens then? At this point, there is no further growth K or Y. This point is called the *steady state* level of capital, K^*. Associated with this level of capital is the steady state level of output, Y^*.

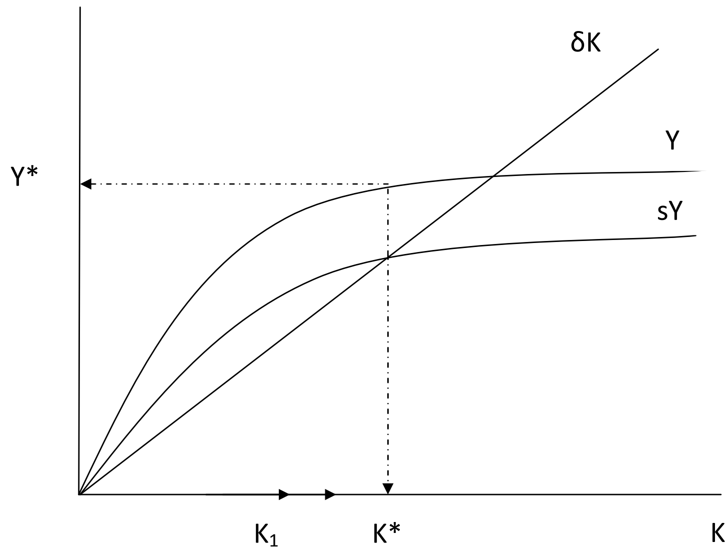

Figure 3.5: THE COMPLETE SOLOW MODEL. ONCE THE SAVINGS/INVESTMENT FUNCTION IS ABOVE THE DEPRECIATION LINE (AS AT POINT K_1), THE CAPITAL STOCK INCREASES. IN CONTRAST, WHEN THE DEPRECIATION LINE IS ABOVE THE SAVINGS/INVESTMENT FUNCTION, THE CAPITAL STOCK FALLS. POINT IS, THE ECONOMY WILL ALWAYS GRAVITATE TO STEADY STATE. AT THE STEADY STATE, THE TWO FORCES JUST OFFSET EACH OTHER AND GROWTH IN THE CAPITAL STOCK STALLS. IT CAN TAKE AN ECONOMY AT LEAST A DECADE TO GO FROM K_1 TO K^*.

The Transitional Path to Steady State

Figure 5 shows the complete Solow model. The steady state capital stock is at the intersection of the savings and depreciation lines. When the economy is the the left of the steady state, investment exceeds depreciation. As a result, the capital stock K must increase. And given that K is increasing as it moves towards steady state, we know from the production function, $Y = AK^{\alpha}L^{1-\alpha}$, that Y is increasing too. When the savings/investment function and the depreciation line intersect, then total depreciation and investment just offset each other. Now, absent growth in A, there is no further growth in K or Y. The economy is now at *steady state* and in its *golden years*. At this point, growth in A must drive sustained rises in the standard of living.[8]

To summarize, we have two key equations that describe the evolution of the economy. They are:

$$\boxed{Y = AK^{\alpha}L^{1-\alpha}} \tag{3.4}$$

and

$$\boxed{\Delta K = sY - \delta K} \tag{3.5}$$

So when the savings line is above the depreciation line, mathematically we have, $sY > \delta K$, and hence from Equation (3.5), $\Delta K > 0$. Then from Equation (3.4), output will also increase. At the steady state level of capital $\Delta K = 0$, and hence from Equation (3.4), output, Y, will also stop growing.

Key Idea 3 *If the savings/investment function is above the depreciation line, then the capital stock and output are rising. The opposite applies if the savings/investment function is below the depreciation line.*

The Steady State

Returning to the issue of steady state, it's important to bear in mind that steady state Y and hence $\frac{Y}{L}$ (i.e., welfare/standard of living) are constant. What determines these values are the exogenous parameters of the model: s, δ, and A (the "fundamentals".) While increases in s and A lead to higher standard of living, increases in δ lowers it. Increases in s and A ultimately result in more savings and investment, and so lead to a higher steady state capital stock.[9] On the other hand, a higher rate of depreciation causes a greater losses in capital stock, which ultimately

[8] You could continue to increase the savings rate, but the attendant increases in output would be tiny.

[9] Note that a higher A leads to a higher $Y = AK^{\alpha}L^{1-\alpha}$ and so to higher stock of savings, sY.

lowers the steady state level of capital. Because countries across the world have different values of s, δ, and A, they converge to different steady states. Also, just because an economy is in equilibrium, it does not mean the equilibrium is good; rather, it could settle at a point of impoverishment.

All of the growth we see in the model is thus *transitional* and occurs on the *transition* to steady state. To ensure continually rising living standards, A must rise. Such continuous rises in A are attributable to technological progress. While a better political system would lead to a once-off increase in A, it is unlikely that it would lead to a continual rises in A over time. For this reason, it is technological progress that ultimately drives growth in developed economies. And seeing that technological advances can be "shared" across advanced countries, the model predicts advanced economics should grow at about the same rates—a prediction that is confirmed in the data.

Key Idea 4 *When an economy reaches steady state (or its golden years), there is no further growth in Y or $\frac{Y}{L}$ (without growth in A), since the forces of depreciation just offset the forces of investment. What determines the steady state level of Y are the "fundamentals": s, δ, and A. To generate sustained growth in Y, A must rise continuously.*

Convergence

Remember, each country grows towards its own steady state determined by its *fundamentals*, A, s, and δ. So clearly, countries with *different* parameters converge to *different* steady states. From the basic Solow diagram in Figure 3.5, we can see that countries further below their steady states grow faster since $\Delta K > 0$; for these countries the marginal product of capital is high. The economy, in this sense, is analogous to a *spring*—the further the economy is "stretched" from its steady state point, the faster it will grow. Fundamentally, the reason for this is that there countries have not yet encountered severe diminishing returns. For them, the *marginal product of capital* is relatively high, leading to large increases in output for any amount of investment.[10] To see what I'm talking about, think of *running* from Pearce St.

[10] The marginal product of capital is the increase in output from adding one more unit of capital.

to the Arts Block: you start off pretty quickly, but this is unsustainable, and your speed slows down as you approach the Arts Building. It's the same intuition for the growth of nations towards their respective steady states.

But wait. What about Africa, is this continent now poised for rapid growth? Not at all. According to the model, Africa would *not* be expected to grow fast: it has a low steady state due to poor fundamentals (mainly, low A and low s). It's only countries with good fundamentals that are *starting off* poor that would be expected to grow faster. What determines growth is the distance between where they are now and their steady state (i.e., where they are going.) This is called *conditional convergence* or *catch-up growth*. You can see good evidence to support this; examples of such rapid growth include China and the other Asian "tiger" economies like Taiwan and South Korea. But forget about macro for a moment and think of it like this: little squirrels converge to become big squirrels, while foals converge to become horses. Just like animals, economies converge to steady states, depending on their "fundamentals" or "DNA." There is no reason for a squirrel to converge to a horse.[11]

Key Idea 5 *The further the economy is from its steady state, the faster it will grow.*

Definition 12 (Conditional Convergence) *Poor countries that are heading to a good steady state can experience rapid growth. Namely, such countries have not yet hit severe diminishing returns, and so output grows quickly as they head towards their steady state.*

3.0.1 Savings and Development

One central insight from the Solow model is its prediction for what happens when the savings rate changes. Suppose the savings rate, s, changes due to a rise in personal savings. The investment/saving function shifts up, and we initially grow towards a new high steady state. As we move towards the new steady state, K and hence Y rise. In the new steady state, K and Y are both higher and remain constant at a higher rate. Significantly, there is no *permanent* effect on the long-run growth of K and Y. It was only along the *transition path* to steady state that we

[11] Unlike animals, economies *can* fortunately change their fundamentals.

had a spurt of growth. But that growth effect is ultimately transitory and leads us merely to a higher *level* of Y in the long run. What is striking is we don't get a permanently higher growth rate of Y. Underlying this important result is the principle of *diminishing returns*. More savings just means more investment, but this is not *that* much use to us. Because all the precursors to the Solow model predicted that the long-run growth of Y was *increasing* in the savings rate, Solow himself described this as a "real shocker." And just to be clear, the time to complete the transitional path to a new steady state is long in this model—probably decades—so we can actually have *transitional growth effects* for quite a while. Empirical studies show that the elasticity of output with respect to the saving rate is about .5. That is, a 10% increase in the saving rate raises the level of output per person in the long run by about 5%, only a modest increase.

To understand these effects, it is useful to consider the topic of *body weight.* One often reads something to the effect that eating an extra bar of chocolate a day will cause you to put on, say, 2 pounds a week. Just consider that for a moment. After a year you'll put on 104 pounds, and after two years you'll put on 208 pounds, and so on. You see, this is self-evidently *wrong*. If you think about it, if your consumption of chocolate permanently rises, there cannot realistically be a *long-run growth effect*. Most likely you will grow for a while in size—i.e., a *transitory growth effect*, to be sure—<u>but</u> you will asymptote eventually to some greater weight/*level*. This prediction seems more reasonable. In other words, there's a transitory growth effect and long-run effect on your weight level. Of course, this is analogous to what happens when the savings rate increases in the Solow model.

3.0.2 Examples

Getting back to macro, here are three examples of changes to the model. In all cases, there are three mains steps to figuring out how Y (and hence $\frac{Y}{L}$) changes. First, you figure out which curve shifts. Second, determine where the new intersection of the savings and depreciation line is. This will nail down the new steady state capital stock. Third, from the new steady state capital stock, go up to the production function to find the new steady state level of Y.

Example 1: An Fall in the Savings Rate

Suppose we are at the steady state K^*, and there is a sudden and permanent fall in the savings rate from s to s' time t. This is shown in Figure 3.6. This change causes the savings line to shift downwards. We start off at K^*. Just after the change, then, we now have the depreciation line above the new savings line. As a result, the capital stock falls, and will continue to fall until the depreciation line intersections with the new savings line. This point of intersection is the new steady state K', where the associated output level is Y'.

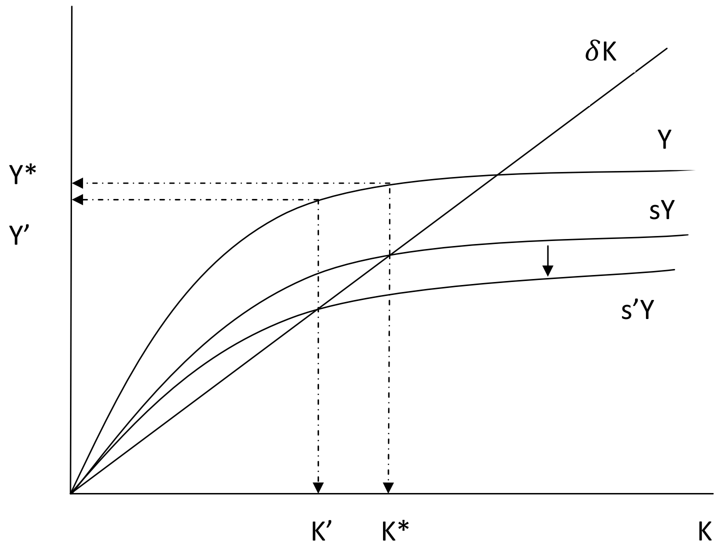

Figure 3.6: A FALL IN THE SAVINGS RATE FROM s TO s' IN THE SOLOW MODEL.

Example 2: A Rise in the Depreciation Rate

Figure 3.7 shows a rise in the depreciation rate. A rise in the rate of depreciation from δ to δ' causes an increase in the slope of the depreciation line. As a result, the line pivots upwards. The intersection of this line with the the savings line determines the new steady state level of capital, K', which is lower than before. The associated steady state output Y' is also lower.

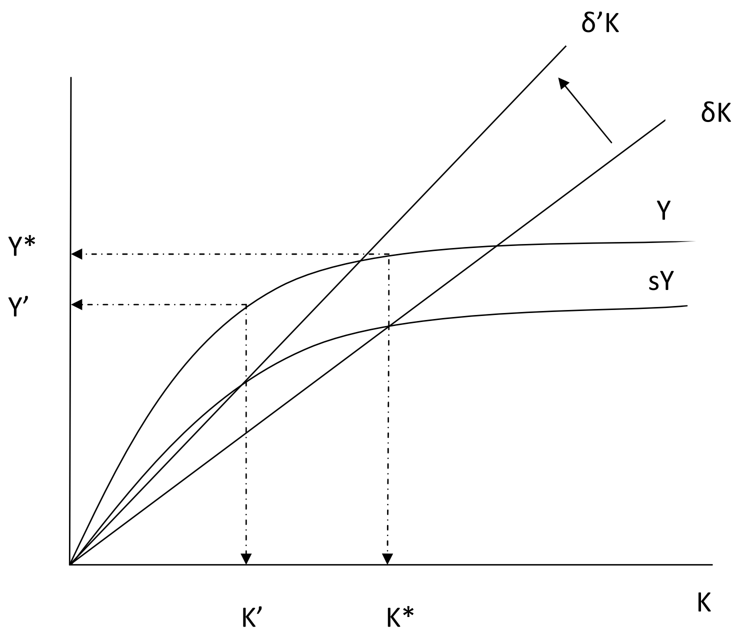

Figure 3.7: AN INCREASE IN DEPRECIATION FROM δ TO δ' IN THE SOLOW MODEL.

Example 3: A Rise in Total Factor Productivity, A

A rise in A has two effects. First, it causes the production function to shift upwards: A rise in A causes $Y = AK^{\alpha}L^{1-\alpha}$ to rise for any given level of K; i.e., the production function shifts up. Second, because savings is a constant fraction of Y, the savings stock is now a constant fraction of a *higher* Y. That is, for any given K savings are higher, so the savings curve moves upwards. As a result, the savings line shifts upwards. The intersection of this new savings line with the depreciation line pins down the new steady state capital stock K'. As already noted, it is such increases in A that ultimately cause sustained increases in living standards in developed economies. See Figure 3.8.

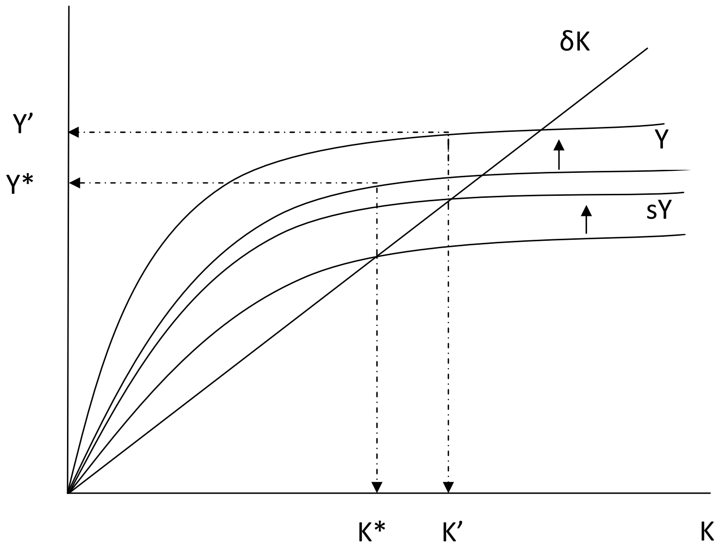

Figure 3.8: An increase in A. Ultimately, it is continual increases in A that sustain increases in living standards in developed countries. Observe how an increase in A induces an increase in K too.

Chapter 4

Further Growth Theory

"Little else is requisite to carry a state to the highest degree of opulence from the lowest barbarism but peace, easy taxes, and a tolerable administration of justice: all the rest being brought about by the natural course of things."

- Adam Smith.

4.0.3 Growth Accounting

For determining the level of output, we use our production function:

$$Y = AK^{\alpha}L^{1-\alpha}.$$

Exactly how changes in each input leads to changes in output is an important question; for example if China's growth today arise mainly from either capital accumulation or total factor productivity growth? The objective of *growth accounting* is to quantify the contributions of growth by each of A, K, and L to growth in Y. In particular, it enables us to infer the contribution of total factor productivity A to growth in Y. Denoting the growth rate of variable X by g_X, a little manipulation of the production function—don't worry about the details—gives:

$$g_Y = g_A + \alpha g_K + (1-\alpha)g_L. \tag{4.1}$$

That is, the growth rate of real GDP is equal to the growth rate of total factor productivity (TFP) plus a weighted average of the growth rates of labor supply and the capital stock (where the weights indicate how important these latter factors are in the production process).[1] Now, you might wonder: how do we measure total factor productivity growth g_A? Well this is done *indirectly*. Isolating the TFP growth rate g_A gives

$$g_A = g_Y - \alpha g_K - (1-\alpha) g_L. \tag{4.2}$$

Seeing that we can collect data on α, g_Y and g_K, we can deduce what g_A is. Because we are inferring g_A from what's left after accounting for the contributions of labour and capital to growth, we call g_A the *Solow residual*. It is the growth unaccounted for by labour and capital. For example, when we go to U.S. data, we find that g_A accounts for a large part of output growth, g_Y. By contrast, when we perform growth accounting for "catch-up" countries—such as the "Asian tigers" in the eighties and China today—we typically find that the contribution from g_K is the most important determinant of g_Y. How come? Since these rapidly countries haven't yet hit diminishing returns, capital accumulation is especially productive in developing economies. Yet because developed economies have already done considerable capital accumulation, g_A is more important as a source of growth in developed economies.

Our expression g_A gives total factor productivity growth's contribution to output growth. It is the growth that can't be explained by either changes in capital or labour. For instance, if we had output growth, without *any* change in inputs, from above we would have $g_Y = g_A$, so all output growth in this case would be attributable to *total factor productivity*. So somehow, we must be utilizing our inputs in a different manner. In particular, if g_A rises, then we must have been using our inputs more *efficiently*. Bear in mind that it is not necessarily technology, but is *anything that somehow changes the relationship between our inputs*. As an extreme example, imagine a corrupt government comes to power and expropriates *any* output

[1] Note that over the long run, the growth rate of labour supply is approximately equal to population growth.

produced by firms and workers. In this case, people go to work each day, but don't produce *anything* (why should they?) and the factories simply come to a halt. Thus we clearly have an enormous fall in output Y, but we certainly have no change in the capital stock K or the number of workers L. All the change in Y stems from a fall in A. (Sure enough, this little story describes pretty well a lot of developing countries.) Having said this, most of the growth in A in advanced economies indeed arises from technological progress. And since technology transfer can occur seamlessly across borders, advanced economies tend to grow at approximately the same rate.

4.0.4 TFP, Incentives, and Growth

Recall our production function again:

$$Y = AK^{\alpha}L^{1-\alpha}.$$

An important question is what causes differences in Y across countries. Although the Solow model stresses the importance of capital K, this is ultimately an empirical matter. A widely cited paper in this area notes that *"the dominant cause of large international dispersion in levels of output per worker is due to differences in total factor productivity."* Determining what causes the low levels of TFP in developing countries is difficult, but the two main contenders are geography and institutions.[2] Yet there is a growing consensus that poor governments are the main cause of low income levels. Probably the most convincing evidence in favour of the government's role in development is that of Korea. After World War 2, the South become capitalist, while the North become communist. In 1953, when they were divided, GDP per capita in both the North *and* the South was around \$770. But by 1998—45 years of this "experiment"—North Korea had an income per capita of \$1183, while South Korea had an income per capital of \$13317. In addition, by 2002 life expectancy in the North was 60, while it was 73 in the South. The consequences of

[2]The term *institutions* is a broad one, referring to the economic environment or "rules of the game" established by the government.

different institutions in East and West Germany and in Hong Kong and China was similar. Most importantly, geography and culture was initially similar before the institutional changes.

Characteristics of a *good* economic environment—leading to a high A—are the preservation of property rights, good bureaucracy, sound financial institutions, lack of corruption, high degree of political/economic freedom, openness to trade, lack of ethnic conflict, and good law enforcement. Yet governments can adversely affect all of these factors. For instance, if there are no property rights (i.e., legal claims to what I produce), I have no incentive to innovate. If an economy is closed to trade, domestic firms have no incentive to remain competitive (via lower costs, product development, and so on), and can't benefit from the adaption of new technologies from abroad. And if there's reams of bureaucracy, firms have little incentive to start any kind of enterprize and invest (and recall how investment determined income levels in *Solow*). Moreover, a lot of their time will be spend, not on production, but on adhering to or seeking to avoid regulations (filling out forms etc.)[3] Likewise, if people can't use their education productively due to the aforementioned issues, then they have no *incentive* to get an education (again lowering human capital and A).

Geography

The view that it's bad geography that stifles growth has become less prominent as the importance of good government and *economic freedom* have become more apparent. As well, there are many successful countries such as Hong Kong located in climates not typically perceived as conducive to growth. Another example is Las Vegas, which although located in a desert, is currently the fastest growing city in the U.S. It seems that if the economic environment is favorable, growth can take place

[3] Hernando de Soto, in his revealing book *"The Mystery of Capital"*, reports that in Lima, Peru, it took 289 days for a team of people working six hours a day to meet the regulations required to legally open a small business producing garments. In New York City, it took a day. (In an earlier book, "The Other Path," he revealed that along the way, ten bribes were solicited, and it was necessary to pay two of the requested bribes in order to get permission to operate legally.)

almost *anywhere*. Nonetheless, there is little doubt that favourable geography—such as access to water, fertile soil, and a temperate climate—can facilitate economic development.

The Malthusian Model

The commencement of sustained growth in real GDP per capita, $\frac{Y}{L}$, began in Britain around 1760. Before that, the world was generally described by the *Malthusian model*. According to this model, rises in GDP, Y, induced rises in population L, thereby depressing real GDP per capita $\frac{Y}{L}$ again. So, over most of historical experience (that is, the period prior to 1760), standards of living remained relatively stable. Only after that, did Britain break experience *sustained* increases in the standard of living.

How did countries escape the *Malthusian trap*? After 1760 increases in output were so large that they were able to overwhelm any associated increase in L; overall, therefore, real GDP per capita, $\frac{Y}{L}$ rose. In addition, as incomes continued to rise, fertility rates declined. There are three reasons for this. First, as females' wages rose, the opportunity cost of having children also rose. As a result, instead of having large families, many women choose to have fewer children and spend more time in the workplace. Second, in developing countries, children are frequently viewed as potential workers—for the family farm, say—and as carers who will tend to parents in their old age. Yet as economies develop, economic activity becomes less focussed on agriculture and more geared towards manufacturing and services; this in turn reduced the need for children. Third, as infant mortality fell, people engaged in less *precautionary childbearing*; i.e., having a large number of children to ensure at least some survivors.

4.0.5 New Growth Theory

The emphasis in the Solow model was capital accumulation. Yet ultimately the model explains *everything but the reason for long-run growth itself*—total factor productivity growth. Herein lies a serious problem: the main reason for long-run growth is almost incidental to the mechanics of the model, it is just *assumed* at the end. To redress this, the *New Growth Theory* seeks to explain where the A comes from and how it evolves. Because the New Growth Theory largely addresses growth in developed economies, it takes the view that A evolves as a result of technological progress (and so ignores other factors such as improvements in institutions, climate, and so on.) As already noted, most increases in A across developed economies stems from technological progress.

In this framework, therefore, we think of A as ideas and inventions. One important implication of the theory is that we must give firms *incentives* to undertake research and improve technology—and that incentive is profit. This way, they can recoup the *large fixed costs* that innovation entails. One way of ensuring firms that they can reap profits from innovating is to grant them *temporary monopoly power* via intellectual property rights; i.e., patents and copyrights. Without such guarantees, they wouldn't embark in research in the first instance. In the U.S., patents—which confer property rights on innovations, and hence guarantee a firm monopoly power—last for twenty years. The theory suggests that attempts to curtail monopoly power for innovative companies should proceed cautiously.

According to this theory, the government has a crucial role to play in maintaining property rights and a stable economic/political environment conducive to innovation and entrepreneurship. For example, by granting tax subsidies to those involved in scientific research, the government can actively promote research and development. Finally, another important insight from New Growth Theory is that a higher population can be beneficial for growth. There are two reasons for this. First, when there are more people, there are more creators/researchers; and because of *positive externalities* from research, their innovations can eventually benefit everyone. Second, a larger population creates a greater *market* for new goods, thereby raising prospective profits and encouraging innovation.

Chapter 5

The Money Supply and Inflation

"I don't care too much for money, money can't buy me love."

The Beatles

The Equation of Exchange

Over the period 1987 – 1996, Brazil had an annual inflation rate of 656%; yet by 2005, that inflation rate had been reduced to 5.9%. This chapter addresses the question: what causes such large differentials in inflation? Before presenting the *quantity theory of money*, we must first discuss the *equation of exchange.*

Let me start with an example. For a moment, pretend I give you a $10 bill in return for some new good you produced. In turn, I make something and you purchase that good off me for $10. At the end of the trades, the following equation—the *equation of exchange*—must be satisfied:

$$MV = PY,$$

where PY is the monetary value of all the transactions: the price of each good multiplied by the number of goods. Here it is $20. M is just the $10 bill. Now V is what we call the *velocity* of that bill: it represents how many times the bill gets around, or how many times it has been "recycled."[1] In our homely example,

[1] You could think of it as measuring *how much work* the bill is doing.

the velocity is just *two*. Note that the quantity equation (or equation of exchange), $MV = PY$, *has* to hold: there is no getting out of this equation. That is, the monetary value of the bill ($10) multiplied by the number of people (2) has to equal the value of total transactions. When dealing with the equation of exchange, we assume the value of total transactions is simply *nominal GDP*.[2] Recall that nominal GDP is the monetary value of new goods produced in an economy. In a more general setting, where there are different prices for different goods, P refers to the *price level*—e.g., the CPI—which is the average price of a good in the economy. Empirically, we measure velocity, the speed at which money "gets around," by $V = \frac{PY}{M}$ (which equals 2 in the example.)

The Long Run and the Quantity Theory

Having presented the equation of exchange, we now turn to the quantity theory. We assume the *quantity theory of money* holds in the *long run.* Underlying the theory are two assumptions. First, the theory assumes the velocity of money V is *constant*. Even more important, it assumes that money has no effect on output Y. This is called *money neutrality*. To understand this, satisfy yourself that increasing bits of paper cannot increase output over the long run. Take a look at the table showing vast dispersion in the rate of U.S. inflation (broadly reflecting money growth) and *no corresponding relationship* to unemployment (broadly reflecting *real economic activity*). Over the long run, there's no clear relationship between unemployment and inflation. We can see above that unemployment is approximately the same over the long run, but inflation varies a lot. This is consistent with money neutrality.

Combining these assumptions with the *equation of exchange*, $MV = PY$, we see that rise in the money supply causes a proportional rise in the price level. That is, $\uparrow M \Rightarrow \uparrow P$. A doubling of the money supply merely leads to a doubling of the price level, with output unaffected. One implication of this is that nominal and real variables are *independent* in the long run; this is the *classical dichotomy*. Conveniently,

[2]We are implicitly assuming all the trades were for *newly produced goods* and not second-hand goods. The exchange of second-hand goods does not reflect new production and so are not part of nominal GDP.

Table 5.1: Money Neutrality: United States, 1954-2004

Year	***Unemployment Rate***	***Inflation Rate***
1954	5.6	-.37
1964	5.2	1.198
1974	5.64	12.1
1984	7.5	4.0
1994	6.1	2.6
2004	5.6	2.4

this enables us to talk about and analyze real variables without worrying about how high the price level or inflation is. Certainly this is what we did in the Solow model.

Yet, in the short run, money *can* affect output, and the classical dichotomy breaks down. To see why, notice from the equation of exchange, $MV = PY$, that if prices are fixed and velocity is constant, a rise in M leads to a rise in Y.

5.0.6 Inflation Rates

Moving away from *levels*, what implications does the quantity theory have for inflation, the rate of change of the price level? Seeing that the growth rate of a product is approximately equal to the product of growth rates, take growth rates of the *equation of exchange* to get:[3]

$$g_M + g_V = g_P + g_Y,$$

where g_X denotes the growth rate of variable X. As already noted, the quantity theory assumes that the velocity of money is stable or constant; i.e., $g_V = 0$. Then, from above we have

[3]To obtain the growth rate of a *product*, we *add* the individual growth rates; i.e., if $Y = XZ$ then $g_Y = g_X + g_Z$.

$$g_M = g_P + g_Y \Rightarrow g_P = \underbrace{g_M}_{demand} - \underbrace{g_Y}_{supply}.$$

What is going on? In the long run, any level of money growth exceeding the level of output growth manifests itself as inflation. For example, suppose money growth is 12% and output growth is 10%. Then we need 10% money growth just to be able to buy the new output. For this reason, output growth (i.e., more *supply*) attenuates inflationary pressure. Just think of output growth as *absorbing* or "soaking up" some of the money growth. Or think of g_M as creating a *demand* for goods, and g_Y creating a supply. And any increase in money growth *beyond* the level of 10% (i.e., demand exceeding supply) leads to a higher level of price growth (i.e., inflation). So in the case of 12% money growth, 10% is used to buy the new goods (since they've increased in quantity by 10%), while the other "excess" 2% rears its head as a higher inflation rate.[4]

According to the quantity theory, what happens if money growth, g_M, increases? From above, we have:

$$g_P = g_M - \underbrace{g_Y}_{\text{not affected by changes in } g_m}$$

Because money growth g_M has no effect on output growth in the long run, higher money growth leads to a higher rate of inflation; $\uparrow g_M \Rightarrow \uparrow g_P$. In the long run, therefore, $\frac{\partial g_P}{\partial g_M} = 1$; i.e., there is a $1-1$ relationship between changes in inflation and money growth; both move in concert—"*sustained inflation is always and everywhere a monetary phenomenon*."

Now, you might wonder: if it's inflationary, why do governments increase the level of money growth beyond the level of output growth? The trouble is, weak tax systems and underdeveloped financial markets are pervasive features of many developing economies. Faced with little revenue, governments in developing countries often *have* to finance a significant share of their expenditure by resorting to the

[4]With high levels of inflation and relatively low levels of output growth—i.e., $g_Y \approx 0$—it is common to write the relationship above as $g_P \approx g_M$.

printing press. This is called *debt monetization* or *seigniorage* and is *the* unambiguous, underlying cause of high inflation or hyperinflation. As such, persistently high inflation rates are always and everywhere a *fiscal* phenomenon; namely, they are an inevitable consequence of an unsustainable level of government expenditure; because the fiscal issues typically arise from political problems (think: Zimbabwe), inflation is more fundamentally a *political phenomenon.* So although a hyperinflation is inherently a *monetary* phenomenon, the root cause of the problem lies in the fiscal domain. This is called *fiscal dominance*; the demands on the fiscal side frequently override concerns about rising inflation. Fiscal reform/restraint is *the* way to halt high inflation. Of course, financing through inflation is not a free lunch. When prices rise, the purchasing power of peoples' money falls. Therefore, inflation acts like a tax and deprives people of purchasing power; this is referred to as the *inflation tax.*

Key Idea 6 (The Quantity Theory) *In the long run, changes in money growth induce proportional changes in the rate of inflation.*

5.1 Monetary Policy: An Experiment

Here I want to show how the quantity theory can break down in the short run and how money can have short-run *real* effects. I present a very basic story that captures the essence of how monetary policy works. To appreciate the tale in earnest, you really have to think back to an amusement park from your childhood and just sit back and watch the tale unravel.

For a start, let's say there are only two periods in our simple world: the first Sunday and the second Sunday, which represent our *short run* and *long run*. The amusement park is our economy and the guy at the gate—let's call him Ben—represents the central bank. At the gate before you go in, you hand him, say, \$10 and he gives you ten tokens. So it's a token a ride. At the end of the day, the ride operators inside submit their tokens and receive their due cash.

Suppose the park is typically a normal, functional economy at *potential*; all operators are usually kept going, but never unduly busy. Yet, one Sunday, instead of giving out 10 tokens for $10, Ben gives out 20 tokens instead. Now ask yourself: what will happen? Well, with all these extra tokens, the guys at their rides are kept real busy and have to do overtime. Most even skip lunch and some even have to drag in others—their relatives—to help them meet the extra demand. More worryingly, many of the machines start to overheat, and workers start demanding overtime. At the end of the day, *real GDP* in the park has dutifully doubled, and the park clearly goes beyond potential output. In other words, Ben has masterfully engineered an economic boom in the park. But can this be done systematically? By increasing the number of tokens in the park, can Ben increase the level of prosperity permanently?

At the end of the day, so happy he is with the boom, Ben announces he will do the same thing again next week. But unhappily for the operators, they find out that the amount of money they receive for handing in *twice* the number of tokens is *exactly the same.*

What happens the following Sunday? Well, all the kids turn up, get their 20 tokens and head in. But guess what, all the prices have now doubled; it's now *two* tokens a ride. The ride operators figured that, if demand is going to double again, with their real monetary earnings remaining unchanged, they'd be better off charging *two* tokens a ride. After all, they remember well the fatigue of the previous Sunday, with the overheating machines and the overtime they had to pay. More importantly, if the kids were initially content with 10 rides for their $10, then they'd surely be content with the same deal again. As a result, this time round the monetary expansion has *no real effects*. All that changes this time is *nominal GDP*, which indeed doubles. Yet the crucial figure, real *GDP*, remains the same. Kids pay $10 at the gate, get twenty tokens, and pay two tokens a ride. *That's ten rides.* Anyway, let's take stock:

1. The story demonstrates that money neutrality is a good description of the long run. Increasing the money supply has no effect on output in the long run. Instead, what determines economic activity in the fairground are labour hours, the number of machines, the technological sophistication of the ma-

chines, and so on—*not* the number of tokens.

2. Yet in the short run, when prices are *fixed*, changes in the money supply *can* generate increases in economic activity. However, this increase is unsustainable and ultimately leads to rising prices.

Chapter 6

The Open Economy

"He wanted to know why the dollar was plunging... I told Alexander that several Arabs had sold massive holdings of gold, for which they received dollars. They were selling those dollars for marks and thereby driving the dollar lower…I spent much of my working life inventing logical lies like this. And it's amazing what people will believe. Heavy selling out of the Middle East was an old standby."

- Michael Lewis, "Liars Poker."

6.1 Exchange Rates and the Forex Market

So far I have implicitly assumed all trade between countries was in a single currency. Yet in reality countries have different currencies. We define the *nominal exchange rate*, e, as the number of units of foreign currency you receive per unit of domestic currency. For instance, let's say we are dealing with the euro and the dollar, and $e = 5$; what this means is one euro purchases 5 dollars. Then if a good in New York costs \$20, it costs you 4 euros. Now let me ask you a question: how would you feel if you were travelling to the U.S., and e falls from 5 to 2? If the euro weakens like this, then dollars become more expensive, so travelling to the U.S. becomes more costly; most likely you will have second thoughts about your trip.

However—and here is the good part—a weaker currency makes our goods *cheaper* for foreigners. For any given unit of their currency, they now receive *more* of our *weaker* currency in return; while previously they had to pay 5 dollars to receive a euro, now they only have to pay 2 dollars. As a result, a weak exchange rate should lead to greater export demand. Likewise, because imports now become more *expensive* for domestic residents, a weaker currency should lead to lower import demand. Overall, therefore, the current account should improve.

Definition 13 (Nominal exchange rate) *e indicates how many units of foreign currency you get for one unit of domestic currency. So if $e = 9$, then one euro purchases 9 dollars. A rise in e represents a euro appreciation, since we now get more dollars for each euro. Conversely, a rise in e represents a dollar depreciation.*

Key Idea 7 *A weak exchange rate leads to greater exports, lower imports, and an improved current account.*

6.1.1 Determination of Exchange Rates

There is almost 2 trillion of foreign exchange traded each *day* on the foreign exchange market. (A lot.) But what determines the value of the nominal exchange rate? To understand exchange rate determination, we must consider the forces of supply and demand. To start with, *demand* for domestic currency arises from *foreigners* purchasing our goods and assets: to purchase our assets in euro terms, they must convert their currencies into euros, creating euro *demand.* Meanwhile, the *supply* of domestic currency arises from *domestic residents* purchasing foreign goods and assets; when they demand foreign currency, they *supply* domestic currency. Because demand and supply for currencies can change so often and for a variety of reasons, exchange rates are difficult to predict at short horizons.

Graphically, the demand curve for our currency is downward sloping. As e rises, our currency appreciates, making it more expensive for foreigners to purchase our goods and assets. As a result, *demand* for our currency *falls*, implying the demand curve is downward sloping. Similarly, the supply curve is upward sloping. As e rises, the home currency appreciates, which implies that domestic residents receive a lot of foreign currency for each unit of domestic currency. As a result, they purchase more foreign goods and assets, and so the supply of domestic currency rises. Figure 6.1 shows the basic setup, and Figures 6.2—6.5 present examples.

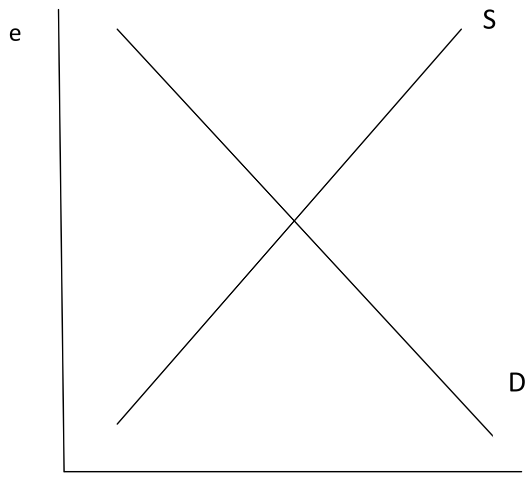

Figure 6.1: EQUILIBRIUM IN THE FOREIGN EXCHANGE (FOREX) MARKET. KEEP IN MIND THAT SUPPLY IS DETERMINED BY DOMESTIC RESIDENTS, WHILE FOREIGNERS DETERMINE DEMAND.

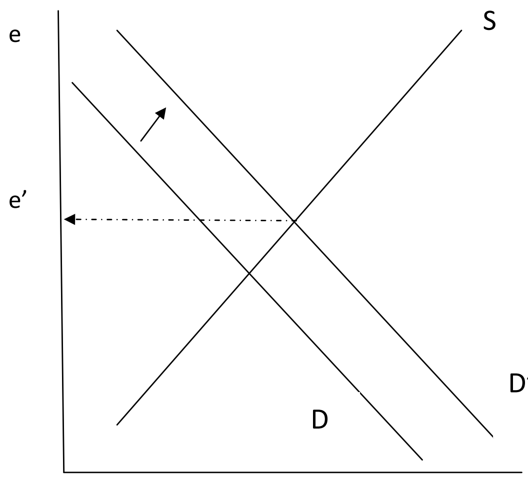

Figure 6.2: A RISE IN DEMAND FOR DOMESTIC GOODS BY FOREIGNERS; THIS COULD BE CAUSED BY AN ECONOMIC BOOM ABROAD. TO PURCHASE OUR GOODS, THEY INCREASE DEMAND FOR DOMESTIC CURRENCY, CAUSING IT TO APPRECIATE.

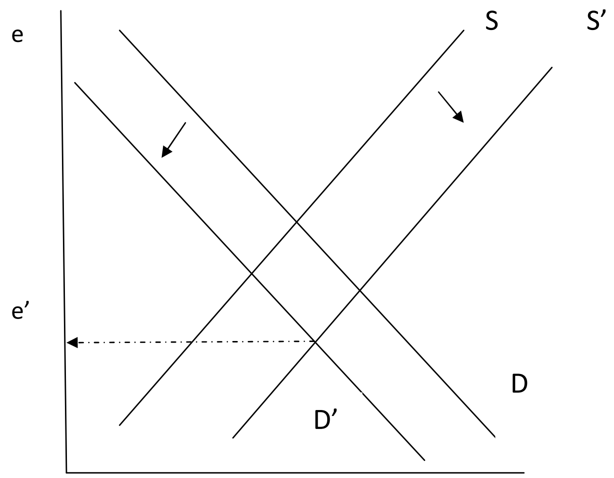

Figure 6.3: A fall in domestic interest rates. This has two effects. First, demand by foreigners for our assets falls, thereby causing the demand for our currency to fall. Second, because of higher returns abroad, domestic residents now invest relatively more abroad, causing the supply of our currency to rise (as residents convert domestic currency into foreign currency.) Note that a rise in foreign interest rates would have the same effect. Of course, what matters is the interest rate differential: if both foreign and domestic interest rates rise, there is no reason to expect a currency change.

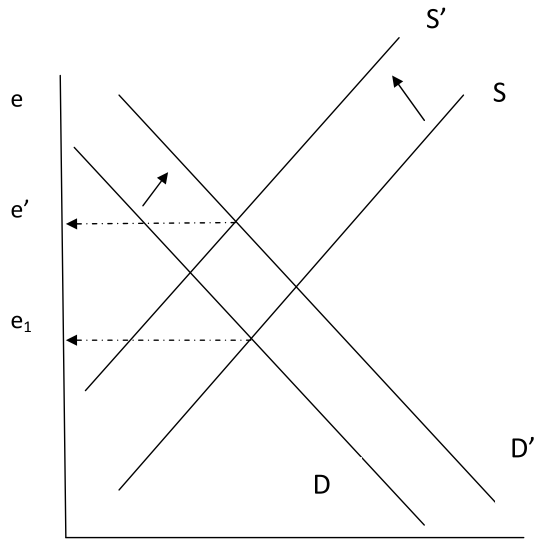

Figure 6.4: A FALL IN THE DOMESTIC PRICE LEVEL. THIS HAS TWO EFFECTS. FIRST, DEMAND FOR OUR EXPORTS RISES, CAUSING DEMAND FOR OUR CURRENCY TO RISE. SECOND, DOMESTIC RESIDENTS NOW PURCHASE MORE GOODS DOMESTICALLY, WHICH CAUSES A FALL IN THE SUPPLY OF DOMESTIC CURRENCY TO THE FOREIGN EXCHANGE MARKET. AS A RESULT, THE EXCHANGE RATE APPRECIATES FROM e_1 TO e'.

Application: Interest rates and exchange rates

Determining the path of the exchange rate in the short run is notoriously difficult. Short-run currency fluctuations are driven by *fear* and *greed*. Here's why. Consider *greed* first. As you can see in Figure 6.4, lower domestic interest rates cause the domestic currency to depreciate. According to that analysis, a fall in domestic interest rates causes a *capital outflow* as *greedy* domestic investors exploit better investing opportunities abroad. They sell domestic currency and buy foreign currency; this increases the *supply* of domestic currency. In addition, *greedy* foreigners invest less in our economy, so demand for domestic currency falls. Because demand for domestic currency then falls, while supply rises, the exchange rate depreciates. Certainly this is an important relationship: higher interest rates lead to a stronger exchange rate, and vice versa. Conveniently, you can just think of the interest rate and the exchange rate moving in the *same direction* in that a <u>lower</u> interest rate <u>weakens</u> the exchange rate and vice versa. By contrast, a rise in domestic interest rates increases the attractiveness of investing domestically. Because investors sell foreign currency and purchase domestic currency they need to buy our assets, this bids up the value of the our currency in the foreign exchange markets.

Now consider *fear*. If risk-averse money managers become even a little wary of an economy, they frequently "bail out" very quickly: they dump the country's assets, and purchase assets from some other apparently safer country. So in times of financial stress—like the collapse of Lehmans bank—we frequently see investors purchasing safe-haven currencies, notably the U.S. dollar and the Swiss franc.

Key Idea 8 *A rise in domestic interest rates leads to a capital inflow and, in turn, an exchange rate appreciation. The opposite applies for a fall in domestic interest rates.*

6.1.2 Fixed and Flexible Exchange Rates

Because the exchange rate was free to move around as supply and demand for it varied, the preceding analysis is really a description of a world of *flexible* exchange rates. While most industrialized countries today operate under flexible exchange rate regimes, this wasn't always the case. The fact is, up until 1973 many countries operated under what's known as *fixed exchange rate regimes*. Within such a system, the central bank was obliged to prevent any deviation of the exchange rate from a previously committed level. Take, for example, the French franc. If the French central bank committed to pegging its currency at 10 francs to one dollar, then it had to take whatever measures necessary to maintain that *peg*. But remember, this is just *supply and demand.* To manipulate currency values, it would have to increase or decrease the supply of francs on the foreign exchange markets, so as to manipulate the price of francs (i.e., the currency value). For instance, if the French franc started to rise above the pegged value (that is, to *appreciate*), then the central bank would have to print money and purchase dollars on the forex market; this way, the franc would depreciate again, while the dollar would appreciate. Notably, *there is no limit to which the central bank can weaken its currency*. It can print money *ad infinitum* and reduce its value to *any* desired level. It is really that simple. Figures 6.6 and 6.6 illustrate these dynamics.

Now, what happens if the French franc started *falling* in value below the peg? Selling more francs would cause the currency to fall further. Instead, the central bank would have to *purchase* francs in the forex market. Yet to do so, it needs to have foreign currency to buy them with; for this it must use its *foreign exchange reserves*.[1] However, because it cannot print foreign currency, if the central bank runs out of reserves, it can no longer intervene to defend a weakening currency. At this point, there's what's called a *currency crisis* and the peg collapses.

Definition 14 (Flexible Exchange Rates) *With flexible exchange rates, market forces determine the value of the nominal exchange rate on the foreign exchange markets. In particular, there is no intervention by the central bank.*

Definition 15 (Fixed Exchange Rates) *With fixed exchange rates, the central bank commits to maintaining a fixed rate of conversion for its currency. If the domestic currency starts to strengthen and deviate from the peg, the central bank prints money and purchases*

[1] If the bank held its reserves in the form of assets denominated in the foreign currency—like the why the Chinese authorities hold U.S. Treasury bonds—it can sell these easily in exchange for foreign currency. With that currency, it can then buy their own currency on the forex market.

other currencies on the foreign exchange market. As a result, the supply of the currency increases and it depreciates again. In contrast, if the domestic currency starts to weaken, the central sells foreign reserves and purchases domestic currency. This reduces the supply of domestic currency, which causes it to strengthen again towards the pegged rate.

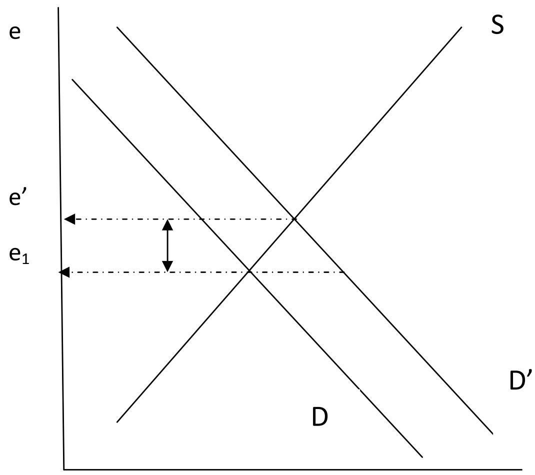

Figure 6.5: AN INCREASE IN DEMAND CAUSES THE EXCHANGE RATE TO APPRECIATE TO e', ABOVE THE PEGGED LEVEL e_1.

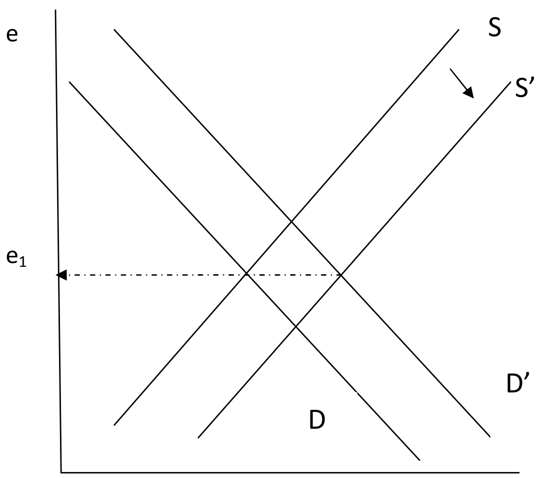

Figure 6.6: TO MAINTAIN THE PEG, THE CENTRAL BANK SELLS DOMESTIC CURRENCY ON THE FOREX MARKET. THIS INCREASES SUPPLY AND THE EXCHANGE RATE DEPRECIATES FROM e' TOWARDS ITS PEGGED LEVEL e_1.

6.2 The Real Exchange Rate

Suppose the cost of a good in the U.S. is 100 dollars. Let's call this P^*. Let's say the exchange rate e is 2; that is, one euro purchases 2 dollars. Then in euro terms, the cost of the good is $\frac{100}{2} = \frac{P^*}{e} = 50$. Suppose now the good costs 60 at home; let's call this P. Then the good is relatively expensive domestically. Formally, the relative price of the good at home is

$$\frac{P}{\frac{P^*}{e}} = \frac{eP}{P^*} = \epsilon$$

Considering its importance, the term above is called the *real exchange rate.* When calculating the real exchange rate, we are not really interested in comparing the prices of individual goods; rather, we are concerned about the relative prices of *baskets* of goods. Therefore, the prices in the formula refer to *price levels* such as the CPI. The real exchange rate is a true measure of *competitiveness* of a country. If the real exchange rate is high, foreign goods are relatively cheap, and domestic goods are relatively expensive. And you know what this means? Sure enough, net exports will fall; hence we often write $CA(\epsilon)$; i.e., the current account is a (decreasing) function of the real exchange rate.

What causes the real exchange rate to change? A fall in ϵ can be attributable to three things a) a rise in P^* or b) a fall in e; i.e., a currency depreciation, and c) a fall in the domestic price level, P. Note that each of these movements makes us *more competitive*. As such, a fall in ϵ is a good thing. Conversely, a rise in ϵ makes us less competitive vis-à-vis the foreign country.

Definition 16 (Real Exchange Rate) *The real exchange rate ϵ is the relative price of a basket of goods in the domestic economy relative to that in the foreign country (when denominated in the same currency.) Mathematically, $\epsilon = \frac{eP}{P^*}$.*

Key Idea 9 *A rise in ϵ represents an real exchange rate appreciation. As a result, this makes us less competitive and decreases net exports/the current account.*

6.3 Purchasing Power Parity

If the price of a basket costs the same in both countries, then

$$P = \frac{P^*}{e}$$

According to the theory of *purchasing power parity* (PPP), exchange rates adjust until this holds. That is, PPP predicts that exchange rates eventually adjust until baskets of goods cost the same when denominated in the same currency. PPP provides us with an indication of where exchange rates tend towards in the long run. For instance, if the domestic price level falls, PPP predicts that e will rise (assuming P^* remains fixed.) What is the economic rationale for this? It is quite simple: lower domestic prices raise demand for our goods and hence our currency, causing it to appreciate. This appreciation will continue until it is no longer a "good deal" for foreigners to purchase our goods. Remember, this is just what our model of the foreign exchange market would predict when domestic prices fall; thus PPP merely formalizes something we could have derived from that analysis. Observe finally that PPP predicts that the real exchange rate should equal one, $\epsilon = 1$.

From the equality above, it can be shown that

$$\%\Delta e = \pi^* - \pi, \tag{6.1}$$

where $\%\Delta e$ denotes the percentage change in e. Therefore, if there is higher inflation abroad than at home, then we should see an appreciation of our currency. To see why, imagine foreign goods are rising in price via inflation. To preserve PPP above, there has to be an offsetting appreciation of our currency. If you think about it, this makes sense. The rise in foreign prices will induce foreigners to demand more of *our* relatively cheaper goods, and will induce us to purchase less of their goods. As a result, the demand for our currency will rise, and the supply will fall—inducing an appreciation of our currency. This way, we converge to a situation where goods remain the same price when denominated in the same currency.

PPP implicitly assumes that people readily switch to purchasing abroad if domestic prices rise. However, if there are transportation costs and barriers to trade, people still mightn't engage in such trade, and so there could be permanent price differentials for similar goods across countries. Because there *are* in fact often large transportation costs to trade, PPP is a poor predictor of exchange rate movements when price differentials are rather small. Typically, PPP only holds when there are large and persistent deviations in price levels across countries. By contrast, interest rate changes are a better guide to exchange rate movements in the short run.

Definition 17 (Purchasing Power Parity) *This theory predicts that the nominal exchange rate adjusts so as to equate the price of the same basket of goods across countries.*

Why fix exchange rates?

You might think it strange that a country would want to *fix* its exchange rate. There are two main reasons for maintaining a peg. First of all, it maintains exchange rate stability and so might promote trade. Another goal of a fixed exchange rate is that it acts as a *commitment device*: it signals to financial markets that a country is serious about averting inflation. You see, if a country maintains a fixed exchange rate, it can't *print money* when it so wishes. Because printing money creates an excess supply of currency, it causes the currency to *depreciate*, violating the peg. Yet when the central bank is committed to maintaining a *fixed* exchange rate, this is not permitted: instead of focussing on domestic objectives, monetary policy is solely focussed on maintaining the peg. For this reason, a fixed exchange rate regime ties its hands and acts as a commitment device, promoting responsible policy. Ultimately this should make the country a more attractive place to save and invest.

6.4 International Exchange

In 2004, the U.S. ran a current account deficit of $600bn. As a result, $600bn left the U.S. and entered foreign hands. But what do the foreigners do with those dollars? Well, considering they are not buying U.S. goods—remember, the U.S. is running a current account *deficit*—they must purchase U.S. *assets*—assets like real estate, stocks, bonds, and so on. In other words, the money is *re-invested* in U.S. assets.

In this regard, we say the foreigners are investing their savings in U.S. assets, and we call these savings—denoted S_I—*international savings*. So in 2004, international savings in the U.S. economy were \$600bn. If you want an analogy, the fact that foreigners reinvest the dollars in the U.S. makes those dollars act like *boomerang.* But more formally, we have

$$-NX = S_I.$$

Think of international trade as being *an exchange of goods for assets.* Current account deficits aren't a free lunch.

Another way to think of this is as follows. Seeing that the U.S. is running a current account deficit of \$600bn, it is living beyond its means by \$600bn. For this reason, the country must "borrow" savings from abroad. And since it's absorbing \$600bn more than its producing, it must be borrowing \$600bn; and, as a country, it is borrowing from foreign savers. Those borrowings represent deferred consumption on behalf of foreigners. That is, they represent *international savings*, and we again have $S_I = -NX = \$600$. You can see what I mean if you just think of you and I doing an exchange. If you purchase goods from me and I receive no goods in return—i.e., you run a current account deficit with me—than I *must* be accumulating claims on you. Surely I am not giving you goods for *free*! What I am saying is, you must be giving me some kind of financial asset like an IOU. When I accumulate those IOUs, it's just as if you are borrowing from me, and committing to repay me in the future. If you think about it, it's just the same for countries.

No matter how we look at it, *the counterpart to an exchange of goods is an exchange of assets.*[2] In particular, a current account deficit means a country is accumulating foreign debt/liabilities. The sum of all a country's past net foreign borrowing is called its *net foreign liabilities.* In the U.S. case, this is effectively the amount of U.S. Inc. that foreigners "own" or have claims to. Because the U.S. has been running

[2] You might wonder, what happens if the foreigners keep the dollars. Although this case is unlikely (since U.S. assets offer positive returns), here we would *still* say foreigners are investing in U.S. assets. Namely, dollar bills *are* U.S. assets that represent a claim on output produced by the U.S. economy; i.e., a claim on U.S. Inc.

persistent current account deficits for over twenty years, it has experienced a dramatic rise in net foreign liabilities. Sure enough, the U.S. is now the world's largest debtor.

Key Idea 10 *When a country runs a current account deficit, it is buying foreign goods and selling domestic assets (on net.) Likewise, when a country runs a current account surplus, it is selling domestic goods and buying foreign assets.*

Chapter 7

The Labour Market

"I like work; it fascinates me. I can sit and look at it for hours".

Jerome K. Jerome

Definition 18 (Labour Force) - *those actually working and those available and seeking work.*

Definition 19 (Labour Force Participation Rate) - *the labour force as proportion of the working age population.*

Definition 20 (Unemployment rate) *The proportion of the labour force who don't have work.*

Definition 21 (Discouraged workers) *Workers who are unable to find work and leave the labour force. The number typically rises in times of high unemployment, suggesting that unemployment rates underestimate the degree of unemployment.*

7.1 Long Run Determination of Real Wage Rates

The analysis of the labour market is remarkably simple. First, there is an upward sloping supply curve, indicating that labour supply rises as the *real wage* rises.

What matters for labour supply is the *real wage*: what can workers actually purchase with their wage? Second, there is a negatively sloped demand curve, indicating that labour demand falls as the real wage rises: higher real wages reduce the attractiveness of employing workers. Figure 7.1 illustrates the basic labour market equilibrium. Figure 7.2 shows the consequences of an increase in labour demand; a rise in demand causes the real wage to rise. Because the real wage also induces a rise in labour supply, the level of employment also rises. In practice, the labour supply curve is relatively steep. Over time, labour demand continually rises, causing real wages to rise fairly steadily over time.

Because workers have different characteristics, it is often useful to break our analysis of the labour market into different sub-markets. Figure 7.3 illustrates the market for unskilled labour. Over the past thirty years, a number of developments have occurred to temper increases in real wages for unskilled workers in developed economies. First, the increase in globalization and trade has lowered demand for unskilled workers across developed economies. Goods which were previously manufactured (largely by unskilled workers) domestically are now imported. As a result, labour demand for the unskilled falls. Second, there has been an increase in technological progress. Technology has a similar effect to trade: for example, computers now effectively substitute for work previously done by many unskilled. Finally, increases in immigration of relatively unskilled workers to developed economies increase labour supply, also tending to depress real wages.

7.2 Unemployment

There are there main types of unemployment:

- *Cyclical* - This is unemployment associated with economic fluctuations/the business cycle.

- *Frictional* - This is unemployment associated with *job search*. This can be beneficial and is analogous to looking for partner (we don't want a *bad* match.) However, because they reduce the incentive to find work, generous welfare

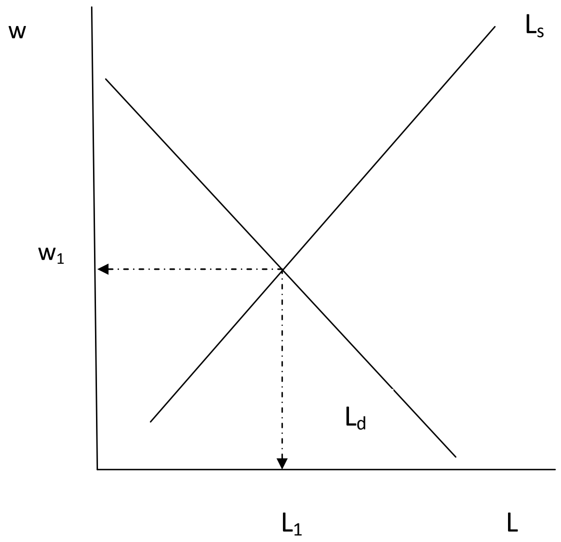

Figure 7.1: EQUILIBRIUM IN THE LABOUR MARKET, WITH LABOUR DEMAND L_d EQUAL TO LABOUR SUPPLY L_s. THE EQUILIBRIUM WAGE IS w_1, AND THE EQUILIBRIUM LEVEL OF EMPLOYMENT IS L_1.

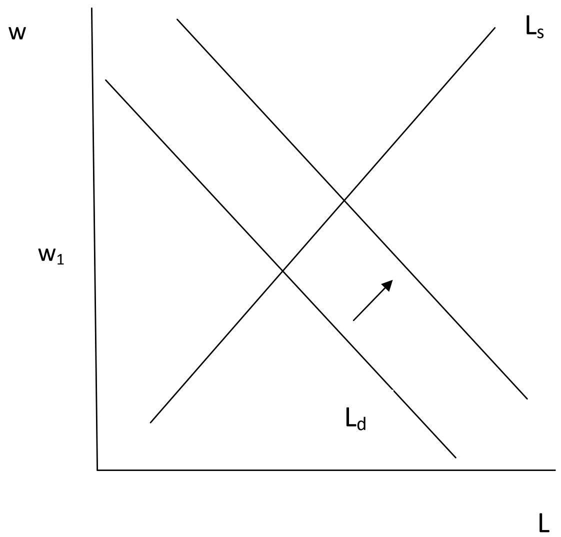

Figure 7.2: AN INCREASE IN LABOUR DEMAND, CAUSING THE REAL WAGE TO RISE ABOVE ITS INITIAL LEVEL w_1. BECAUSE OF AN INDUCED RISE IN LABOUR SUPPLY, THE EQUILIBRIUM LEVEL OF EMPLOYMENT ALSO RISES.

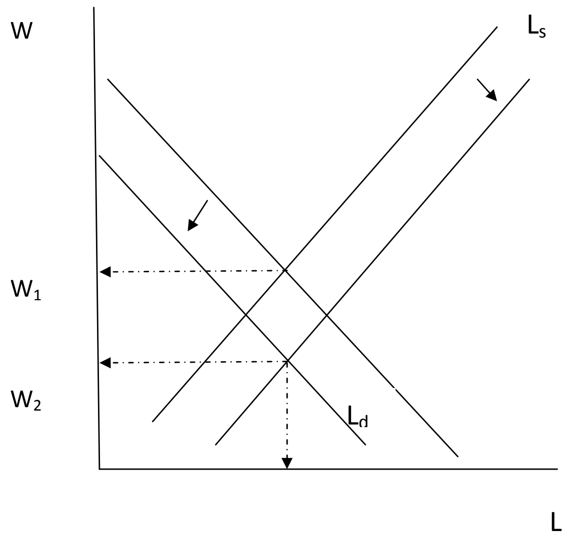

Figure 7.3: THE LABOUR MARKET FOR UNSKILLED WORKERS IN RECENT TIMES. NOTICE THE FALL THE REAL WAGES.

systems (long benefit duration) can increase frictional unemployment. For example, welfare benefits in Europe are of very long duration and can often pay up to 90% of the original salary, creating a disincentive for job search; in turn this causes greater frictional unemployment. The *replacement* rate refers to the fraction of one's previous wage an unemployed worker receives on average. In contrast to the U.S., European replacement rates are high. Another factor affecting frictional unemployment is hiring and firing legislation: if it is costly to fire workers, firms will be reluctant to hire and therefore it will be more difficult to find a job. Finally, *sectoral shifts* involve economic activity moving to new sectors. Because it is typically difficult for a worker to find a suitable position in a new sector, sectoral shifts raise frictional unemployment.

- *Structural* - Generally speaking, this is unemployment caused by real wages being above their equilibrium level.Note that inflation can reduce these real wages and hence structural unemployment; for this reason, inflation is often referred to as *greasing the wheels of the labour market.* Why are wages above the market-clearing level?

1. Trade unions demand high real wages for their members. Yet those high real wages make firms reluctant to higher new workers. Unionization rates differ internationally; e.g., it is 16% in US and 33% Germany.
2. Efficiency Wages: firms pay high wages to engender greater effort and loyalty to the firm. But paying such high wages also makes them reluctant to hire many workers.
3. Almost by construction, minimum wage legislation maintains real wages above the market-clearing level, causing unemployment.
4. Adverse Selection: to attract the best candidates, firms have incentives to pay high wages. If they paid low wages, the best candidates mightn't apply for the position.

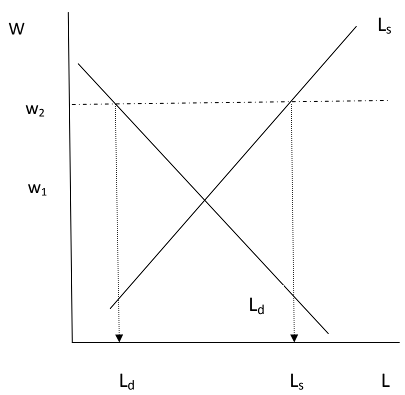

Figure 7.4: STRUCTURAL UNEMPLOYMENT, WHERE REAL WAGES OF w_2 ARE ABOVE THE MARKET-CLEARING LEVEL w_1. AS A RESULT, THERE IS AN EXCESS OF LABOUR SUPPLY L_s OVER LABOUR DEMAND L_d, CAUSING AN UNEMPLOYMENT LEVEL OF $L_s - L_d$.

Frictional and structural unemployment comprise the *NAIRU* or *natural rate of unemployment*. In the U.S., this is almost half of what it is in Continental Europe. This is basically the long run average rate of unemployment. Most importantly, the NAIRU is not attributable to economic fluctuations. Any unemployment above the NAIRU is said to be *cyclical* or induced by recessions. Yet cyclical unemployment is typically a short-run issue; people have lost jobs due to some recession, but eventually labour demand will rise as the output reverts to potential. One issue, however, arises if cyclical unemployment lasts a long time. If this is the case, those unemployed might become *deskilled* in that they're deprived of all the on-the-job training which enhances one's skills. Eventually their skills atrophy and they become *unemployable*. This phenomenon, called *hysteresis*, suggests the cyclical unemployment can in fact leave permanent scars on an economy.

Fundamentally, the NAIRU is due to factors endemic to the economy such as government policies and labor market institutions—the strength of trade unions, the generosity of welfare payments, and so on. Yet the NAIRU *can* change over time. Because they facilitate better matching, more employment agencies, for instance, can reduce the NAIRU. By reducing frictional unemployment, reducing social welfare benefits would also have the effect of reducing the NAIRU.

In Europe, the NAIRU is relatively high relative to the U.S.; this is largely reflection of different labour market legislation (such as minimum rates), different degrees of unionization, together with different levels of unemployment benefits. Yet another issue is there's a multitude of employment protection regulations in Europe making it vary hard to fire workers; as a result, labour demand falls, reducing the level of job creation and employment. The fact that European labour markets are so regulated and inflexible is called *Eurosclerosis.* One consequence of this is that a fall in labour demand causes unemployment and stable wages in Europe, but a fall real wages and less unemployment in the U.S.

7.2.1 Okun's Law

According to Okun's law

$$U = U_n - .5\left(\frac{Y - Y_n}{Y_n}\right),$$

where U denotes the rate of unemployment, Y the level of output, U_n the NAIRU, and Y_n the level of potential output. Basically, Okun's law says there is an inverse relationship between unemployment and output. In other words, once we know what's happening to output, we also know what's happening to unemployment.

A positive output gap (i.e., $Y > Y_n$) is associated with unemployment below the natural rate/NAIRU (i.e., $U < U_n$). Think about it: an increase in real GDP raises demand for labor, so an increase in output leads to a fall in U. If we are at potential (i.e., $Y = Y_n$), then $U = U_n$. To summarize, note the following important relationships that Okun's Law gives us:

$$\boxed{Y > Y_n \Leftrightarrow U < U_n \quad \text{and} \quad Y < Y_n \Leftrightarrow U > U_n \quad \text{and} \quad Y = Y_n \Leftrightarrow U = U_n}$$

The Labour Market Today.

The unusually slow recovery of the labour market in the U.S. has attracted a lot of recent academic research. Some theories, which are relevant elsewhere as well are:

i.) Housing: the existence of negative equity means workers cannot move to other locations to find suitable positions. Because such homeowners would be reluctant to sell (and cystallize a large loss), they are restricted to finding jobs locally. In other words, frictional unemployment has risen.

ii.) Sectoral shifts: the decline in construction has forced construction workers to find positions in other sectors. In many cases, this might involve retraining, and this takes time.

iii.) Unlike in previous recessions, this recession is marked by a high level of household debt. This will lead to an unusually low level of aggregate demand until most of the debt is paid off. The fall in aggregate demand lowers labour demand and raises unemployment.

iii.) Extended unemployment benefits. President Obama extended unemployment benefits, which raises frictional unemployment. In contrast to Europe, such benefits expire after six months in the U.S.

iv.) Implicit taxation: President Obama introduced a policy which assisted those with negative equity. However, the policy was only available to those with incomes below a certain threshold. This could have the result in unemployed workers turning down job offers, since otherwise they would not be able to avail of the mortgage assistance.[1]

[1] An economist at the University of Chicago, Casey Mulligan, has written an appropriately named book, *The Redistribution Recession* claiming that almost all of the rise in unemployment is attributable to the last two points.

Chapter 8

The Short Run

"The long run is a misleading guide to current affairs. In the long run we are all dead. Economists set themselves too easy, too useless a task if in tempestuous seasons they can only tell us that when the storm is long past the sea is flat again."

- Keynes, *A Tract on Monetary Reform.*

To start with, recall that growth theory sought to explain the evolution of potential output, and ultimately human welfare over long stretches of time. Yet, in that long-run analysis, there was no discussion of such issues as unemployment or the periodic deviations of output from potential. In the next chapters, we seek to examine these economic fluctuations around potential.

We are now going to examine goods market equilibrium in the short run. In our analysis of the long run (i.e., the Solow model), we implicitly assumed that prices were flexible and adjusted instantaneously to clear markets and ensure that aggregate demand is equal to potential output; thus, there was no talk of recessions or booms. Yet the assumption of *perfectly flexible prices* was a big assumption. If we indeed had this kind of price flexibility we would not have recessions or unemployment at all: prices and real wages would always adjust to clear the goods and labour markets, respectively.

Motivated by the Great Depression, Keynes argued that that the classical, long-run theory was inappropriate for analyzing short-run fluctuations. Rather than prices adjusting, he argued that *output* adjusted instead. Central to this theory was the idea that prices were *sticky* (due to so-called "menu-costs") in the *short run*, and that the price adjustment process takes possibly years, and would only occur in the *long run*. Maintaining that this was simply too long, he famously quipped that "in the long run, we're all dead" This chapter analyzes the short run and what has become called *Keynesian economics*.

8.0.2 Basic Keynesian Idea

To illustrate the basic Keynesian insight of *demand-determined* output, I present an example. Imagine some baker, Brad, produces 100 muffins a day. This is his *potential output*. His price is $1 a muffin, so on a normal day he makes $100. Yet, one day—let's call it day one—people are feeling a bit down or depressed and only demand 70. As a result, aggregate demand on day one is just 70. Brad thus has inventory accumulation (these are "stay fresh" muffins) of 30. What should he produce on day 2? Perhaps day one was a real bad day, and people couldn't make it in or something. Or perhaps people have developed an acute distaste for his produce. Who knows?

Not knowing quite what's going on, Brad produces produces 75 muffins on the second day (he still has 30 left over from yesterday). But, alas, demand on day two is *still* 70. So, now he has more unsold stock, this time 35 muffins left over. Finally, the message begins to sink in: demand for his stock is only 70 a day. So eventually we reach a stage where he simply produces 70 muffins a day to meet to new lower level of aggregate demand. According to Keynesian economics, this is our new equilibrium output (formally, where inventories do not accumulate.) Below are the key insights from this simple tale:

- Crucially, the price is stuck. The big question is, why doesn't Brad lower his price so as to raise aggregate demand to 100? Because there are "menu costs" to price adjustment, he keeps in prices fixed. "Menu costs" is a broad term, incorporating all the costs to changing menus, but more subtly it could refer to the fact the firms might be reluctant to lower prices for fear of perceived quality reductions. Unlike in conventional micro, the market here doesn't clear. The price ($1) is *not right*.

- The sticky price equilibrium is not optimal in that the economy may settle at a point where output is less that potential. In this case, our equilibrium represents a recession, since we have an output gap, $Y^* - Y$, of 30. If Brad had other people working for him, he would surely lay some off, causing unemployment to rise above the NAIRU (this is just Okun's law.)
- With sticky prices, equilibrium output is *demand-determined*. In this case demand is 70, and this indeed is equilibrium output. *Output falls to equal demand.* Thus in the Keynesian equilibrium, output equals the level of aggregate demand. By contrast, with flexible prices, output is *supply-determined*. Supply is given by potential output (100 in this case) and prices adjust to ensure that aggregate demand just equals 100. Yet here the quantities adjust, not the prices.
- We assume that the flexible price case will prevail in the *long run*. After months/years of producing 70 muffins, he'll eventually say "I'm capable of producing 100. I'll just lower my price of muffins from $1 to 80 cents, say, and I'll sell all of what I can supply." Yet in the meantime, we're mired in recession.

Overall, the equilibrium condition in the short run is that the level of production equals the level aggregate demand. That is,

$$\boxed{Y = AD.} \tag{8.1}$$

In the long run, we assume the level of production equals the level of *potential output*. As a result, the long run equilibrium condition is

$$\boxed{Y_n = AD.} \tag{8.2}$$

where Y_n denotes potential output.

Key Idea 11 *In the short run, prices are sticky or fixed. In this case, output is not determined by potential. Instead, it is determined by the actual level of demand in the economy. Aggregate demand is* $AD = C + I + G + NX$*. The price is stuck and does not adjust to clear the goods market. In other words, the price is not right.*

8.1 The AS-AD Model

Taking Keynesian assumptions as a starting point, the AS-AD model analyzes the short-run output effects of various changes, and shows what happens as the economy adjusts to its long-run equilibrium. In particular, it indicates what happens to output in the short run, and what ultimately happens to the price level (e.g., the CPI) in the long run. To start with, the AD curve indicates the level of aggregate demand in the economy for each price level. It slopes downwards because:

- A high price level leads to a high level of the real exchange rate. By making the country uncompetitive, this higher real exchange rate reduces net exports. Because net exports are a component of aggregate demand, a fall in net exports causes aggregate demand to fall.
- A high price level causes negative "wealth effects"; namely, a high price level reduces the purchasing power of peoples' money, which makes them feel poorer; in turn this reduces consumption, which reduces aggregate demand.
- A high price level means people need more money to buy goods and services. Confronted with higher prices, people place less money in the loanable funds market. This leads to higher real interest rates, which reduces investment and consumption, and hence aggregate demand. The higher interest rates would also cause an appreciation of the exchange rate, which would reduce net exports.
- If the price level is high today, people might expect it to fall in the future. For this reason, they might postpone expenditure until the future, leading to a fall in aggregate demand *today*. This is called the *intertemporal substitution channel*.

Anything that changes the level of aggregate demand for a given price level *shifts* the curve. For example, if consumers become more optimistic and consume more, this would shift the curve outwards. Both monetary and fiscal policy shift the AD curve, as would a weaker exchange rate.

The long-run aggregate supply curve (LRAS) indicates the level of potential output; this is given by the production function in the Solow model. Consistent with the classical dichotomy, this is independent of the price level, and so the curve is vertical. Changes in the economy's *ability* to produce good and services shift this curve. The economy's long-run equilibrium is given by the intersection of the AD and LRAS curves.

The short-run aggregate supply (SRAS) curve simply indicates the level of prices in the economy at any point in time. Because it indicates that firms will supply any amount of output at the given price level in the short run—as in the Keynesian model—it is called the short-run aggregate supply curve. As firms change their prices, the line moves up and down; for this reason, it is convenient to simply consider it a *price adjustment* line. In particular, when output is above potential, the economy "overheats" and firms' costs rise—e.g., they must pay overtime to workers, while trade unions have more bargaining power due to labour shortages. The rise in costs induces firms to ultimately raise their prices. Conversely, costs fall in a recession, which eventually motivates firms to lower prices.

When combined with the AD curve (as in Figure 8.1), the SRAS curve simply picks out a point on the AD curve, and shows the equilibrium level of output in the short run. More generally, the economy's short-run equilibrium is given by the intersection of the SRAS and AD curve.

In this analysis, I assume prices are fixed for a year, say, and then prices adjust slowly towards the long-run equilibrium (which is given by the intersection of the AD and LRAS curves.) Throughout, I implicitly assume that the level of potential GDP growth and the long-run rate of money growth are both zero.

Key Idea 12 *The economy's long-run equilibrium is given the intersection of the LRAS, SRAS,and AD curves. In the long run, the economy is always at potential. In the long run,* *the burden of adjustment falls on prices.*

Key Idea 13 *The economy's short-run equilibrium is given by the intersection of the SRAS and AD curves. In the short run, the price level is fixed, and the burden of adjustment falls on output.*

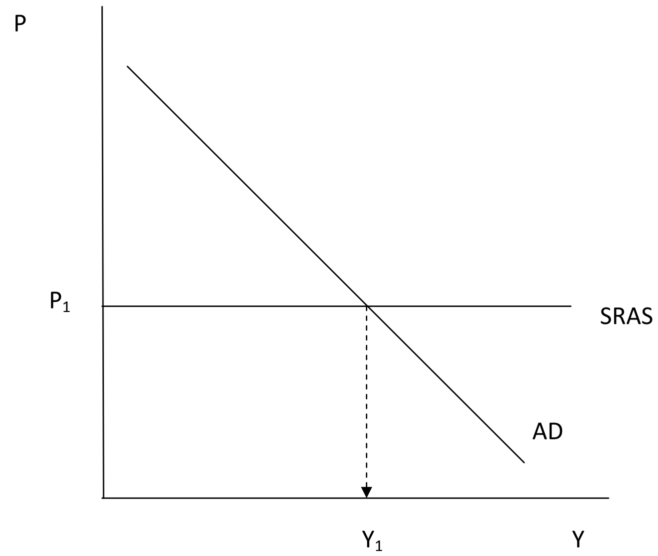

Figure 8.1: THE INTERSECTION OF THE AD AND SRAS CURVES GIVES THE SHORT-RUN EQUILIBRIUM. HERE THE PRICE LEVEL IS P_1, WHILE OUTPUT IS Y_1. HOWEVER, THIS LEVEL OF OUTPUT IS NOT NECESSARILY EQUAL TO POTENTIAL.

8.1.1 Analyzing the Model

In the short run, the price level is fixed, and output changes. If output is not at potential, prices will eventually either rise or fall until $Y = Y_n$. Price adjustment is the way the economy returns ultimately to potential output. Graphically, the SRAS curve adjusts until we return to potential. The economy *always* reverts to this potential; this is the *natural rate hypothesis*.[1] Yet the price adjustment process can take years; as Keynes famously quipped "*we're all dead in the long run.*" Although the economy returns to potential, policies and economic developments can *permanently* affect the price level. In addition, some economic polices may also alter potential;

[1]This assumes no hysteresis.

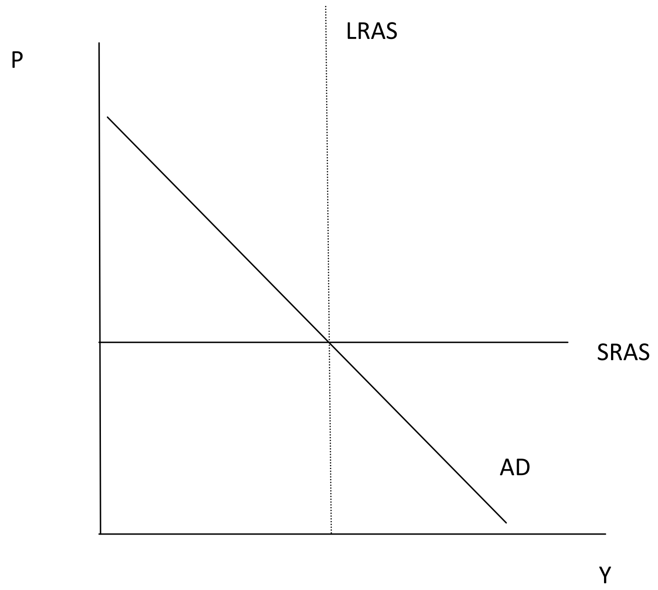

Figure 8.2: IN THE LONG-RUN EQUILIBRIUM, THE AD, SRAS, AND LRAS CURVES ALL INTERSECT.

e.g., a fall in the NAIRU would raise the number of workers and so shift the LRAS curve to the right.

Key Idea 14 *The economy will always revert to potential (to $Y = Y_n$), while unemployment will revert to the NAIRU. This is the natural rate hypothesis.*

Key Idea 15 *What $Y > Y_n$, the economy is in a boom and prices will rise. So when $Y > Y_n$, the SRAS line shifts upwards. Analogously, if $Y < Y_n$, then prices will fall and the SRAS curve will shift downwards.*

Key Idea 16 *The magnitude of the movement of the SRAS curve is proportional to the difference between current output and potential. As a result, the deeper the recession, the greater the subsequent deflation (assuming no supply shocks, which cause prices to change, regardless of the level of output.)*

8.2 The Phillips Curve

We derive the Phillips curve from the AS-AD model. When the economy is in recession and when unemployment is above the NAIRU, the AS-AD model predicts

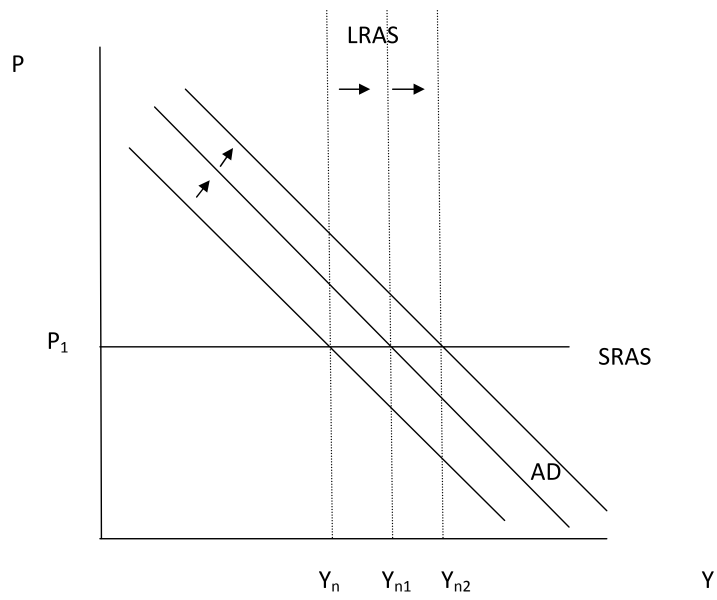

Figure 8.3: Long-run money and output growth. In reality, potential output grows over time, while the central bank is always increasing the money supply. As drawn above, both forces can maintain a stable price level.

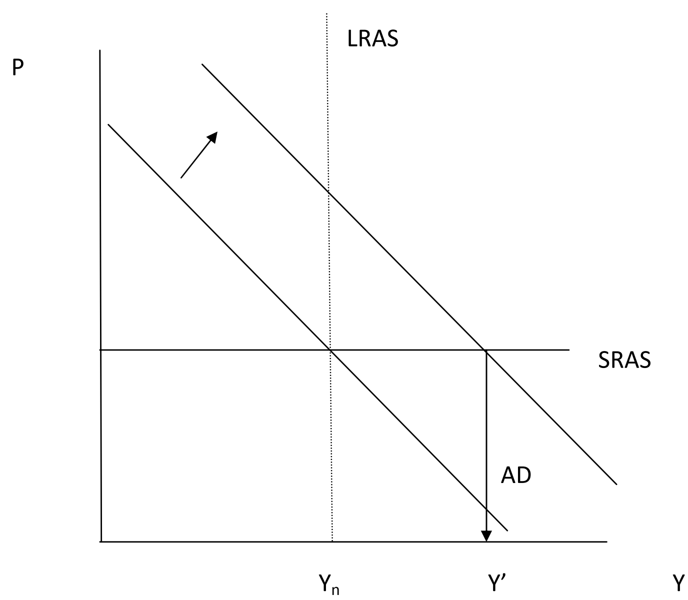

Figure 8.4: Expansionary Fiscal Policy: Short-Run Response. Note that the difference between Y_n and Y' is a function of the multiplier.

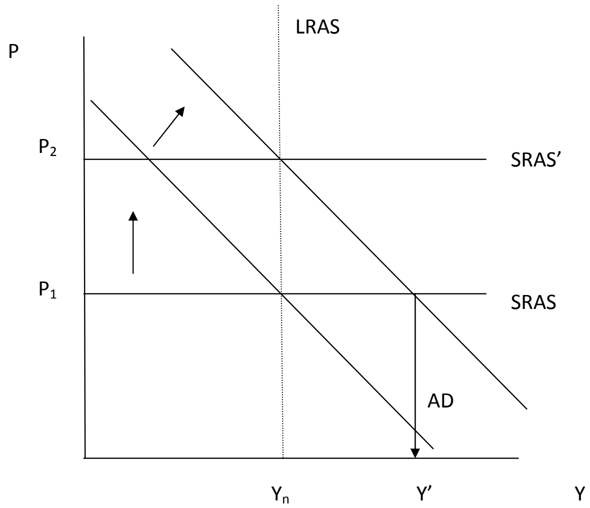

Figure 8.5: EXPANSIONARY FISCAL POLICY: LONG-RUN RESPONSE. THE POLICY CAUSES PRICES TO RISE EVENTUALLY, AND THE ECONOMY REVERTS TO POTENTIAL. YET NOW THE PRICE LEVEL IS HIGHER.

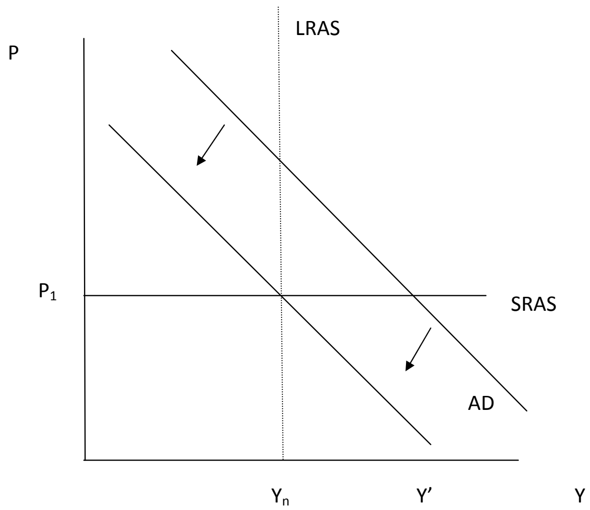

Figure 8.6: IF THE ECONOMY STARTS OFF IN A BOOM WITH OUTPUT AT Y', THE CENTRAL BANK WILL LIKELY CONTRACT THE MONEY SUPPLY AND SHIFT THE AD CURVE INWARDS. THIS WAY, IT AVERTS THE IMPENDING RISE IN INFLATION. GOOD MONETARY POLICY IS PREEMPTIVE.

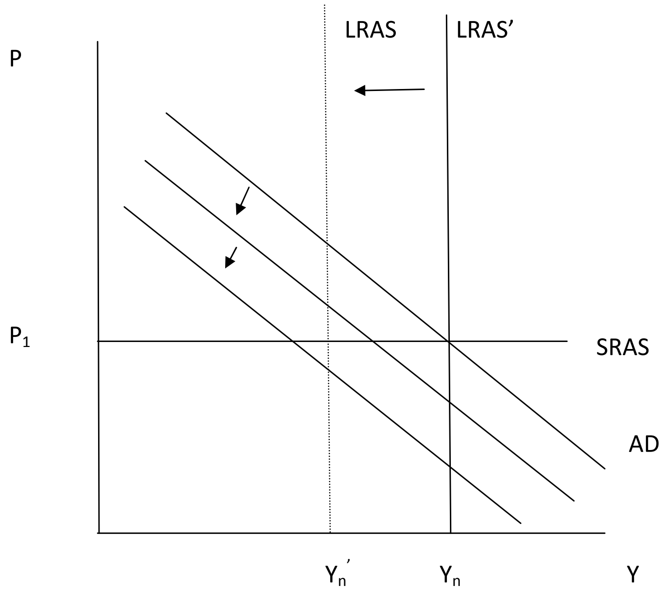

Figure 8.7: DURING THE GREAT DEPRESSION, AGGREGATE DEMAND FELL DUE TO A LARGE FALL IN CONSUMPTION DEMAND AND A CONTRACTION OF THE MONEY SUPPLY. IN ADDITION, BECAUSE THE GOVERNMENT ROSE TAX RATES TO EXTREMELY HIGH LEVELS, LABOUR FORCE PARTICIPATION FELL, WHICH CAUSED POTENTIAL OUTPUT TO FALL.

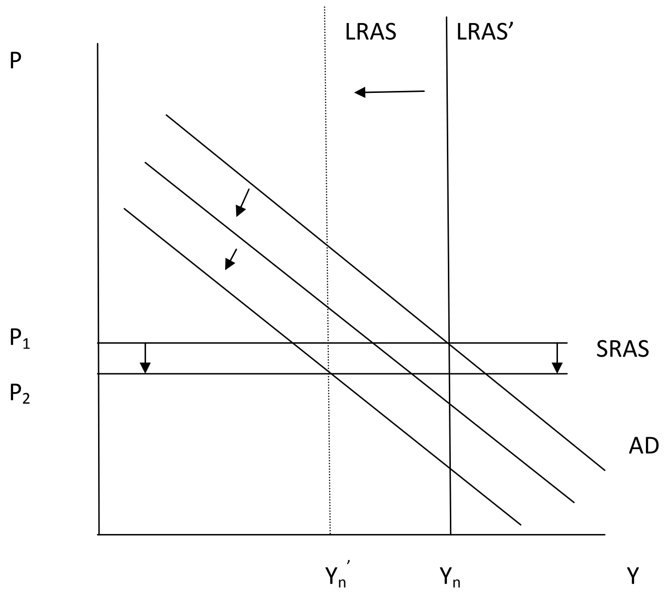

Figure 8.8: PRICE ADJUSTMENT DURING GREAT DEPRESSION: PRICES FELL UNTIL THE ECONOMY RETURNED TO ITS NEW LOWER LEVEL OF POTENTIAL OUTPUT.

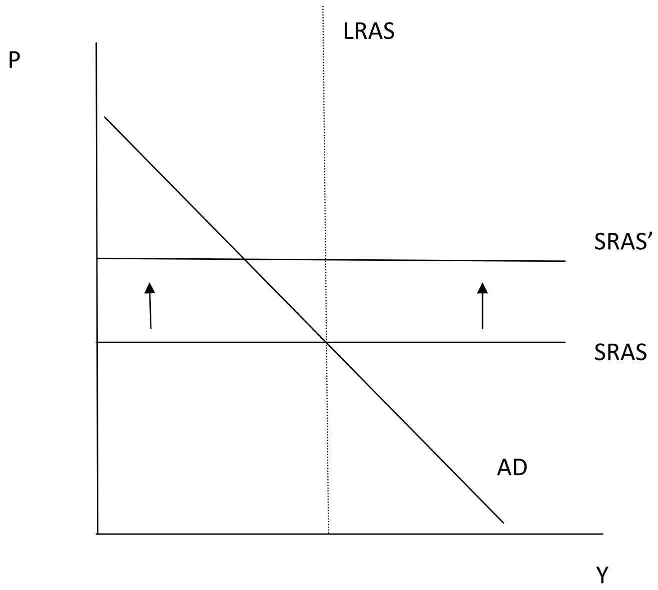

Figure 8.9: A SUPPLY SHOCK: E.G., A LARGE INCREASE IN OIL PRICES FORCES FIRMS TO RAISE THEIR PRICES. THIS LEADS TO A HIGHER PRICE LEVEL AND A RECESSION, AND IS CALLED STAGFLATION (I.E., A STAGNANT ECONOMY AND INFLATION.)

the economy will experience *deflation*. In contrast, when output is above potential and when unemployment is below the NAIRU, the AS-AD model predicts the economy will experience *inflation.* When unemployment is at the NAIRU, there is no inflation.[2] The Phillips curve just illustrates these respective relationships between inflation and unemployment. Figure 8.10 illustrates the basic relationship. Often the Phillips curve is described in terms of a tradeoff faced by policymakers; namely, the can attain unemployment below the NAIRU, but at the cost of inflation. Yet the tradeoff only holds in the short run. In the long-run, the economy will always revert to potential, while unemployment will revert to the NAIRU. Formally, we say the long-run Phillips curve is vertical; in other words, there is no relationship between inflation and unemployment in the long run (this is just the classical dichotomy. See?)

Figure 8.11 illustrates a more common depiction of the Phillips curve. This is the case, where there is a positive rate of money growth (and inflation) in the long

[2]Indeed, this is where the term NAIRU comes from; the Non-Accelerating Inflation Rate of Unemployment.

run. What this basically says is the economy experiences inflation higher than its long-run rate in a recession, while the opposite holds for a boom.

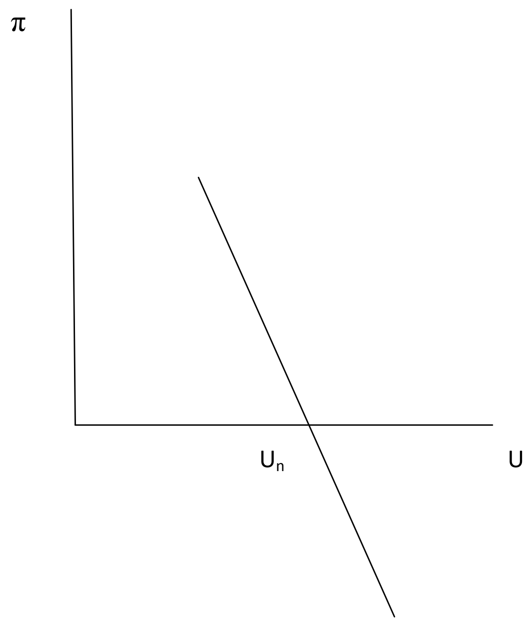

Figure 8.10: THE PHILLIPS CURVE: WHEN UNEMPLOYMENT IS ABOVE THE NAIRU U_n, INFLATION π IS NEGATIVE, AND VICE VERSA.

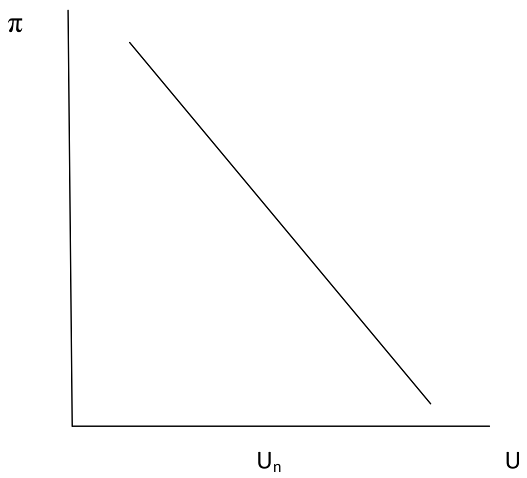

Figure 8.11: The more general Phillips Curve, when there is always some positive level of money growth. In this case, there is inflation even when the economy is at potential. In a boom, however, inflation rises above the long-run equilibrium rate (caused by permanent money growth).

Chapter 9

Fiscal Policy

"If you think health care is expensive now, wait until you see what it costs when it's free."

P.J. O'Rourke

9.1 The Keynesian Model

To start with, consider the *Keynesian consumption function*. For any individual or for the aggregate economy, consumption is

$$C = a + mpc\ (Y - T),$$

where a is a catch-all term for non-income factors affecting consumption; e.g., interest rates, consumer confidence, expectations, household wealth, and so on. This is called *autonomous consumption*. $Y - T$ is simply *disposable income*—i.e., income less taxes, T—while mpc denotes the *marginal propensity to consume*; that is, the fraction of disposable income, $Y - T$, that is consumed. Y denotes aggregate income, and as we know from Chapter 1, this also equals the level of output/production. Note that this Keynesian consumption function predicts consumption depends mostly on *current* income. Just in case you are wondering, this indeed contrasts with the *permanent income hypothesis*, which predicts consumption depends on *lifetime* income. But more on this later.

As in Chapter 8, our equation for expenditure/aggregate demand is simply $AD = C + I + G + NX$. Investment here denotes actual investment demand and planned inventory investment. To keep things simple, I assume a closed economy, so $NX = 0$, and also that $T = 0$. Noting that our Keynesian consumption function now reduces to $C = a + mpc\ Y$, aggregate demand becomes

$$AD = C + I + G = a + mpc\ Y + I + G.$$

Now, in equilibrium the level of production is equal to aggregate demand. That is,

$$\boxed{Y = AD.} \tag{9.1}$$

This is our *equilibrium condition*, and at this level of GDP, firms sell exactly what is demanded. There is nothing inherently good or bad about this level of output; we could end up in a recession or boom, but ideally we would have $Y = Y_n = AD$ (where Y_n denotes *potential output*.) Substituting in our consumption function and writing the above condition out in full we have

$$Y = a + mpc\ Y + I + G.$$

Because Y lies on each side, we can use our equilibrium condition to solve for our equilibrium output. Solving for Y yields

$$Y = \frac{a + I + G}{1 - mpc}.$$

Having adjusted production to meet demand, the economy will eventually settle at this equilibrium.

9.1.1 The Multiplier

Using our expression for equilibrium output above we have

$$\frac{\partial Y}{\partial G} = \frac{1}{1 - mpc} > 1$$

That is, when government expenditure increases by one, the increase in equilibrium output *exceeds one*. This is the famous *multiplier* effect. What's going on here? To see this, suppose the government increases demand by ΔG from some firm. That injection itself represents an increase in demand of ΔG. As the firm meets this demand, Y will initially increase by ΔG. As a result, the owner of the firm receives ΔG. But—and here's the punch—because the marginal propensity to consume is greater the zero, the owner *too* is going to spend some fraction ($mpc\ \Delta G$) of it. In turn, this increases Y *again*, and the same applies for the next recipient, and so on. And the process just goes on and on, as people spend and respend across the economy. Ultimately the increase in production/income is *greater* than the initial ΔG. See?

To take a numerical example, suppose I hire you has a research assistant and pay you \$100. Then you spend \$80 of it (assuming $mpc = .8$), and then the next person spends \$64, and so on. Thus the initial expenditure of \$100 has already increased expenditure by \$244. So the multiplier effect amplifies the effect of the initial stimulus. More formally, consider the equilibrium condition $Y = AD = C + I + G$. You see, an increase in G leads to an increase in Y, *but since C itself is a function of Y*, the rise in Y causes an increase in C, which leads to *further* increases in Y, and so on. Note that a rise in investment or any other component of demand would lead to the same dynamics. Bear in mind that the multiplier effect works *both ways*: a fall in demand would lead to a greater fall in production.

9.1.2 Expansionary Fiscal Policy

According to Keynes, the government ought to increase expenditure in a recession. More generally, government expenditure ought to behave in a *countercyclical* way: it should rise in recessions, and fall in booms. The thing is, the fiscal authorities need only embark in *moderate* spending increases so as to mitigate recessions (and eliminate the so called *recessionary gap*); the multiplier process will then take over and spur *further* increases in economic activity. Moreover, because tax revenues would rise as economic activity increased, part of the stimulus would effectively be self-financing. Keynes argued that government should spend money on anything—*anything*—so as to generate subsequent rounds of spending in the economy. On this note, Paul Krugman, an economist at Princeton, writes about fiscal policy in Japan in the nineties:

> *"In* 1996 *Japan spent about* \$300*bn on infrastructure, compared with only* \$180*bn in the US..... Superb roads run through sparsely populated regions, ferries to small islands have been replaced by bridges, and many of the country's riverbeds have been paved..."*

Key Idea 17 *In the short run, prices are sticky or fixed, and the level of demand determines the level of output in an economy. To close the output gap, Keynes advocated that the government increase expenditure via expansionary fiscal policy; this increase would have a multiplier effect on output.*

9.1.3 Issues with with Keynesian Fiscal Policy

Although Keynesian economics was highly influential initially, economists became disillusioned with the theory over time. There are two reasons for this. First, empirical evidence did not support the idea of high multipliers. Empirically, it was hard to identify compelling evidence of fiscal policy having a stabilizing role. For example, despite Ireland today, fiscal policy is *expansionary* in the sense that government expenditure exceeds revenues. Yet the economy remains stagnant. The same can be said for Japan's large fiscal expansions throughout the nineties—causing their debt-to-GDP ratio to rise above 200%—which failed to stimulate the Japanese economy. Ditto for the recent U.S. fiscal stimulus.[1] Second, the *permanent income hypothesis* is now the dominant theory in macroeconomics, and this suggested current income played little role in current consumption. This implies the marginal

[1] Despite the poor results, one could argue that the performances would have been worse without the stimulus.

propensity to consume out of current income is low—implying a low multiplier. Below I list issues with fiscal policy.

- By the time the government approves an expenditure programme, the economy could be *above* potential again, in which case the stimulus would only *destabilize* the economy.
- Note that any fiscal expansion could be partly spent in imports and need not stimulate the domestic economy. So fiscal policy has become less potent with increasing globalization/trade. For this reason, in a small open economy like Ireland, the multiplier effect would be small.
- The magnitude of the fiscal multiplier depends crucially on the marginal propensity to consume. But according to the modern permanent income hypothesis, this is small; this theory predicts people will only consume a small fraction of any increase in *current* income.
- Expansionary fiscal policy can have various perverse effects. Who pays for the fiscal stimulus? You see, there is no free lunch: the very prospect of higher taxes in the future might cause an increase in saving today, thereby offsetting the increase in government expenditure.[2] This anti-Keynesian theory follows from the permanent income hypothesis, where people consider their *lifetime* income when they consume *today*.
- Financing government expenditure invariably entails raising taxes in the future. Raising taxes introduces distortions in economies as people try to avoid/evade the tax. In turn, this may reduce work effort/labour supply, investment, and so on, reducing potential output.
- According to Keynesian theory, governments should run surpluses in booms. Yet this is politically difficult, as special interest groups lobby for readily available funding in booms. This leads to a situation where there are budget deficits in booms *and* recessions, causing government debt to rise. Compared to monetary policy, fiscal policy is quite politicised.

[2] This is called *Ricardian Equivalence.*

- In the basic Keynesian analysis, prices and interest rates are fixed. Yet, in reality, these can change in the short-run, which reduces the size of the multiplier. In particular, as we know from the loanable funds model, more government expenditure can raise interest rates and lead to a *crowding out* of investment. Empirical estimates of the multiplier vary wildly, but most estimates are relatively small.

9.1.4 Summary

The most compelling evidence for fiscal policy comes from wars—situations where there is obviously a large *exogenous* increase in government expenditure in an economy. Such evidence suggests relatively small multipliers of .5; i.e., an expenditure increase of 100 causing output to ultimately rise by 50. This suggests expansionary government policy indeed increases output, but only moderately; likewise, contractionary policy decreases output but not severely.[3] In open economies, the effect would be even less.

Probably the best kinds of fiscal expansion are temporary policies such as one year reductions in VAT or temporary subsidies to those employing new staff. Such policies affect incentives would act like Christmas sales, in that their transitory nature would cause large behavioural effects; one issue of course, is such policies *shift* economic activity and would not necessarily raise overall in the medium run. Another form of fiscal expansion is simply to give people lump-sum tax rebates, say. To be most effective, the government should direct such rebates at those with high marginal propensity to consume, who are typically poorer income groups.[4] However, in an environment with high levels of household debt—like Ireland today—there is no assurance funds will be spent. For all of these reasons, economists are generally skeptical of fiscal policy and regard monetary policy as the prime way to stabilize economies.

[3] This implies the austerity programmes reduce output in the short run and can be counterproductive.

[4] Yet, giving money conditional on having low income acts like a tax, and can reduce the incentive to earn income. This could depress economic activity. Nobody said economic policy was easy.

Yet regardless of any deliberate attempt to stabilize an economy, *automatic stabilizers* are always operative. Automatic stabilization refers to the fact that fiscal policy *automatically* becomes more expansionary in a recession—even without any legislative changes. Most notably, unemployment benefits rise and, because of less economic activity, tax revenues fall. For both reasons, the government takes less away from an economy in a recession, rendering fiscal policy somewhat expansionary *automatically.*

9.2 Government Finance

The budget balance is given by:

$$T - G - rD$$

i.e., taxation minus the sum of government expenditure and interest payments on debt. This is the government's net income; what they receive in taxes less what they spend.[5]

Definition 22 (Actual Budget Balance) *This is the budget balance when the economy is at its present level; i.e., what's reported in the media.*

Definition 23 (Structural Budget Balance) *This is the budget balance when the economy is at potential output, Y_n. It is also called the cyclically-adjusted budget balance.*

This gives the balance that's solely due to endemic features of government policy such as the normal level of government taxation and the normal level of governmental discretionary expenditure. The structural balance should ideally be zero. A negative balance indicates that the government is spending too much and there is a permanent shortfall of revenue.

Definition 24 (Cyclical Budget Balance) *This is given by the actual balance minus the structural balance. It is the part of the actual balance that's attributable to economic fluctuations around potential; in a recession, for example, there will be a cyclical deficit.*

[5] In this discussion, I assume G includes government transfers such as unemployment benefits.

The cyclical budget balance is the part of the actual balance that's attributable to the business cycle. For instance, because of automatic stabilizers, government revenues always decline in a recession due to less economic activity and greater unemployment benefits. These kind of shortfalls represent cyclical once-off imbalances that are not due to structural features of the government finances. To see what I'm talking about, let's take an example. Suppose that the *structural* budget balance is -10, and the *actual* budget balance is -50; in this case the *cyclical* budget balance is -40. This basically means that the economy would *normally* have a balance of -10, but due to a recession, is running a deficit of -50, which is 40 less than it would usually be. The structural deficit indicates expenditure typically exceeds revenues, and this is unsustainable in the long run. Today, Ireland has an actual deficit of around 8.5% of GDP; this comprises large cyclical *and* structural components and is large by any international or historical standards.

Debt-to-GDP Ratio

Because it indicates the *scale* of the debt, it is common to present the ratio of the national debt to GDP. Since the level of GDP provides a rough indication of how much tax revenue the government can raise, this ratio is useful for determining whether the current fiscal stance is *sustainable.* Investors who purchase government bonds use the debt-to-GDP ratio to provide an indictor of likely default in the future; for instance, is the imposition of the future tax burden politically feasible for the government? Another measure of default risk is *who the creditors are*. The debt may be owed to domestic residents or foreigners; owing debt to domestic residents is less serious, since it's the country owing debt "to itself". Most of Japanese debt is owed to Japanese citizens, and this is the reason few discuss Japan in the context of default. By contrast, most of the PIIGS debt is owed to foreigners, and this raises issues about the *political willingness* to repay.

The evolution of a country's stock of debt, D, is given by

$$\Delta D = rD + G - T,$$

where r denotes the average interest rate on existing debt. Debt changes as a result of interest payments, rD, and the *primary* deficit, $G - T$.

People frequently cite the debt to GDP ratio as an indicator of the tax burden for future generations; ultimately, all the debt must be paid off by taxpayers in the future. An unusually high debt-to-GDP ratio (above 100%) suggests possible default, in which case investors would raise the risk premium they would charge the government for borrowing. Assuming a primary balance of 0 and that nothing is paid off, the numerator—the stock of debt—grows at rate r, while the denominator grows at the rate of economic growth—let's say g. What this implies is that the debt to GDP ratio will rise if $r > g$. This is a rough rule of thumb often used to determine if a country's debt level is sustainable. Currently, the fact that $r > g$ for many Eurozone countries suggests that many countries' debt burdens are unsustainable. Historical experience suggests that economic growth—raising g—and inflation—lowering $r = i - \pi$—play central roles in the resolution of debt crises.

9.3 Taxation

The simplest form of tax is a lump-sum tax, which means everyone simply pays some fixed amount to the government that is independent of their income. Yet rather than being lump-sum, in reality most taxes depend on income.

Definition 25 (Marginal tax rate) *This is the rate of tax you pay on any extra income earned. For example, if the government taxes any additional income I earn at a rate of 40 percent, then my marginal tax rate is 40 percent. For economic decision making, it is the marginal rates that are most important.*

Definition 26 (Average tax rate) *The average tax rate you pay is the total level of tax you pay, divided by income. For instance, if I derive 100 euros income from labour and must pay 20 overall in tax, then my average tax rate on labour is 20 percent. Yet my marginal rate—the rate I pay on any income exceeding 100—could be, say,* 50%.

Definition 27 (Progressive tax) *This is when the average tax rate rises with income. Most tax systems are progressive.*

Definition 28 (Regressive tax) *This is when the average tax rate falls as income rises. For example, a tax on smoking is often considered regressive; namely, smoking is most prevalent among low income people, yet the tax rate on tobacco is high.*

Definition 29 (Flat tax) *This is when the tax rate is independent of income. Some Eastern European economies have flat tax systems.*

To see the difference between marginal and average tax rates, consider an example. Suppose the marginal tax rate on any income earned amounting to between 0 and 100 is 10%. Meanwhile, the marginal tax rate on income earned on any income beyond 100 is 50%. Notice that if I am currently earning 100, my *average* tax rate is $\frac{10}{100} = 10\%$, but my marginal rate is 50%. So if I earn 150, then I must pay $10 + 25 = 35$ in tax, and my *average* tax rate is $\frac{10+25}{150} \approx 23\%$.

9.4 Optimal Taxation

The problem with taxation is people take actions to avoid taxes, causing *deadweight losses*. To minimize such distortions from taxation, the government should tax activities that are relatively *inelastically* supplied or demanded. By definition, such activities or goods are relatively insensitive to price changes and would minimize distortions to economic activity. By taxing such goods, we minimize distortions, and keep the economy close to its initial and presumably optimal equilibrium (i.e., the one dictated by the "invisible hand.") The classic example of such an *efficient*, non-distortionary tax is a "head tax": with this, everyone receives the same tax bill of 1000, say. Another such tax is a property tax: everyone must live somewhere.[6]

Optimal tax theory has a number of novel implications. For example, research shows that male labour supply is relatively inelastic; as a result, taxing males' labour supply is relatively efficient. In a mainly provocative paper, Greg Mankiw suggests that the government should tax taller people more. Idea is, research shows

[6] Yet a *land tax* would be more efficient. While you can't change the value of land, you *can* change the *value* of property. In this sense, the property tax acts as a disincentive to renovate or upgrade your home.

that taller people have higher incomes; one possible reason, he claims, is that taller people are more self-confident. Assuming we want a progressive tax system, optimal tax theory suggests that taller people should be taxed more; namely, height is a good proxy for income, but *crucially*, you can't change how tall you are (i.e., height is perfectly inelastic.) By contrast, tall people *can* take action to reduce *income*—e.g., work less. Another implication of tax theory is that consumption taxation is preferable to income taxation. While people can take action to reduce their incomes, everyone must consume. Income taxation involves taxing and distorting *production*. For example, a progressive income tax on labour reduces the incentive to work, while a tax on the income from savings—i.e., interest payments—reduces the incentive to save.[7] By contrast, consumption taxation avoids these distortions. In this sense, it is *efficient*.

In some cases it can be optimal to place taxes on goods like cigarettes *so as to* distort behaviour *away* from consumption of that given good. If some activity/good confers a negative externality, we know that society produces/consumes a sub-optimally high level in the first place. For this reason, a tax on the good will distort this initially sub-optimal equilibrium and ideally direct the economy towards the optimal one. Such taxes are called *Pigou taxes.*

Incidence of Taxation

The *statutory* incidence of a tax refers to *who pays the bill.* By contrast, the *economic* incidence refers to who is ultimately affected. For determining the distributional consequences of taxation, the latter is important. To illustrate this, think of the corporation tax; i.e., a tax on profits. Many claim that such a tax would oblige the rich to pay more. Yet in an open economy, a rise in the corporation tax would induce firms to move elsewhere. And when they move elsewhere, the employees would initially become unemployed and likely end up with lower paid jobs. Meanwhile, the owners would *still* be making profits, albeit in another country. In this case, the workers bear the economic incidence. What this implies is that the tax on profits

[7] From the Solow model, we know that a higher savings rate leads to a higher standard of living.

is in fact *regressive*: it disproportionately affects the relatively poorer workers. But what would happen in a closed economy? With lower prospective profits, people would decide to invest less and build fewer factories. In turn, there would be less labour demand, which would reduce real wages. The lower level of production would raise prices in the economy, again lowering real wages. As you can see, workers are again adversely affected by this policy and bear some of the economic incidence.

9.4.1 Supply-Side Economics

So far, most of our discussion of fiscal policy has been concerned with increasing the level of demand to attain a given potential output level. Yet disillusionment with such policies become common in the late seventies, leading to the ascendancy of another school of thought, *supply-side economics*.[8] This emphasized the *supply* of labour and savings. Rather than viewing tax cuts as a way to stimulate demand, *supply-siders* viewed them as a means to stimulate work effort and investment. For example, by raising wages and profits, lower marginal tax rates on labor and capital income—i.e., interest and capital gains—should stimulate more labor force participation and entrepreneurship, thus raising potential output. Many supply-siders contend that a fall in the tax rate would stimulate so much economic activity that tax revenues could in fact *rise*. Yet this effect most likely occurs when the existing rate is already high.[9] The hump-shaped *Laffer curve* illustrates this idea. As you can see, there is some tax rate on each source of revenue that maximizes revenue from

[8]Indeed, it was the recently deceased Margaret Thatcher who first disavowed the more interventionist Keynesian theory, and embraced supply-side theories in the political spectrum. Her approach was subsequently followed by Ronald Reagan in the U.S., heralding what many describe as a "supply-side revolution."

[9]What is the economics behind this? Well, suppose I earn 100 and the tax rate falls from 20% to 10%. As a result, my *after-tax income* rises from 80 to 90. By contrast, suppose the tax rate falls from 90% to 80%. So what I can keep rises from 10 to 20—a doubling! As a proportion of existing after-tax income, this change is more significant, and should induce a greater behavioural effect. Instead of taxing a few activities at a high rate, it is optimal to tax a lot of activities at a low rate. In other words, it is optimal to *broaden the base and lower the rates.*

that source. Any increase beyond the optimal rate will depress economic activity and thereby *lower* tax revenue. The relatively low rate of corporate tax in Ireland is a good example of how a low tax rate can *raise* revenue.

Supply-side economists also worry about the supply-side effects of welfare programmes, which often reduce the incentive to supply labour. More generally, to finance the welfare state, governments must tax those who *do* work, prompting *them* to work less too. Indeed, Edward Prescott, a Nobel Laureate and prominent supply-sider, has argued in a widely cited paper that *"Americans now work fifty per cent more than do the Germans, French and Italians."* He attributes almost all of this differential to differences in tax rates across these countries.

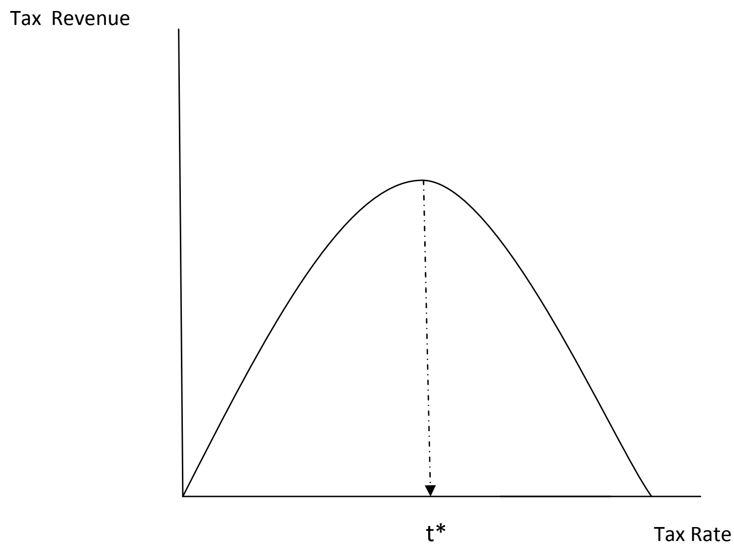

Figure 9.1: THE LAFFER CURVE

Chapter 10

Monetary Policy

> *"We have not succeeded in answering all our problems. The answers we have found only serve to raise a whole set of new questions. In some ways, we feel we are as confused as ever, but we believe we are confused on a higher level and about more important things."*

Unknown

10.1 Money

Formally, the money supply comprises anything that can be used to pay for goods and services. When determining what the money supply is, we wish to know what can potentially cause *demand* for goods to rise—and hence inflation. For example, if apples were regularly used in transactions, they too would be regarded as a component of the money supply. In this environment, an increase in the supply of apples would be inflationary. In reality, the most basic measure of the money supply is called the *monetary base*; this is the amount of physical currency in circulation (i.e., in pockets) and held in banks' reserves. By printing notes, the central bank has direct control over the monetary base, and this is what most people regard as "money."

However, the most common measure of the money supply in economics is $M1$; this measure includes all *currency in circulation* (i.e., money in pockets) and *chequing* *account balances.* All of these can be used to make transactions. In particular, because cheques can be used to purchase goods and services, the sum of all chequing account deposits constitutes part of the money supply.

Key Idea 18 *The money supply is the sum of currency in circulation and chequing account balances.*

10.1.1 Money Creation at Banks

To see how banks "create" money, bear with me for moment. Start with *currency in circulation.* Suppose the central bank prints you 100 euros, which you keep initially in your pocket (this is the *monetary base.*) But it is also the money supply: the sum of currency in circulation—100—plus chequing deposits—0. Then you go to a bank, and put the money in a chequing deposit (the money supply is still 100: while currency in circulation has fallen by 100, deposits have risen by 100). Now, each bank must maintain a certain fraction of new deposits on reserve—to meet *reserve requirements*—and may lend out the rest. Assuming the required reserve ratio is .8, the bank now lends out 80 to someone. Note that the money supply is now 180: currency in circulation is 80 and chequing deposits *still* amount to 100. Think about it: the money supply is what can ultimately cause inflation. And the 80 can clearly cause inflation, but cheques can be written to the value of 100, *and these can also cause inflation.*

Continuing the story, the borrower with the 80 then purchases something, and the seller deposits the 80 in a chequing deposit at another bank. That bank then lends out 64 of that, and so on. Formally, we say the *money supply* or $M1$ is

$$M = 100 + 80 + 64 + \dots$$

You can see that the money supply is a multiple of the physical amount of currency or monetary base, i.e., the 100 euros. Note crucially that the sum M is what can readily be used to make purchases; it is more M, not necessarily more physical *notes*, that causes inflation. Mathematically, it is convenient to write the money supply as

$$M = \mu MB,$$

where MB is the monetary base, and μ the *money multiplier.* Roughly, the money multiplier gives an indication of the degree to which the banking system uses monetary base to "create money."

For a high money multiplier, we need two things. First, rather than simply holding cash in reserves, banks must be *willing to lend*; this way, money is "recycled" more. Second, instead of keeping it under the proverbial mattress, *people must deposit currency in banks*. These features result in lots of "recycling" and so yield a high money supply.[1] Note that, although the central bank has direct control over the monetary base, it has only *indirect control* over the money *supply.* For convenience, however, we often assume the central bank has direct control over the money supply; yet keep in mind this is only true if the money multiplier is constant. So from now on, I will assume the central bank controls the money supply.

Given today's problems with financial intermediation, the money multiplier is particularly relevant. Because banks have been lending little, while at the same time, people have been withdrawing money from banks, the money multiplier has fallen in recent years. Large falls in the money multiplier are always associated with problems in the banking system, and were also a feature of the Japanese banking problem and the Great Depression. As a result, the money supply falls, and this has a contractionary effect on the economy. In the U.S., there has been an extraordinary increase in the monetary base to counter the fall in the money multiplier.

Key Idea 19 *According to the quantity theory, changes in the money supply cause inflation. Changes in the monetary base are usually inflationary, but not necessarily so; if the monetary base rises, while the money multiplier falls, the money supply could remain the same.*

[1]Consider a novel example: if there was a large rise in the black economy, the money multiplier would *fall*: to avoid paper trails, relatively few would deposit money in banks.

10.1.2 Changing the Money Supply

How does the central bank increase the money supply? Quite simply, it just prints money and *buys stuff.* In practice, to increase the money supply, the central bank prints money to buy short-run *government bonds* from banks, thereby injecting more money into the financial system. These are called *open market operations.* Likewise, to contract the money supply, it sells bonds to banks, thereby withdrawing money from the financial system. Open market operations are almost always done with *banks*, not private citizens. Point is, if the central bank purchases bonds from banks, the banks end up awash with funds and are thus more willing and able to lend. This is really the route through which the money ultimately enters our pockets. To summarize, the central bank really controls the money supply *indirectly* via the banks. Therefore, an efficient banking system is central to the mechanics of monetary policy.

10.1.3 Monetary Policy and Interest Rates

According to the loanable funds model, the interaction of savings and investment decisions determine the *interest rate.* Yet it is best to view this rate as a *long-run rate*—such as the rate on a ten year Treasury bond, or a five year bond issued by Ryanair. Because most important borrowing is done for longer periods, this rate is the most important interest rate in the economy. Yet you often hear that the central banks changes the "interest rate." What this refers to is the central bank's short-run interest rate or *policy rate*. In contrast with the long-run rate, this is more of an "artificial" rate engineered by the central bank in an attempt to affect economic activity. While not as important as the loanable funds rate, this rate certainly affects the economy and commands much of media attention. Moreover, movements in this policy rate typically have an effect—often small—on *all* interest rates in an economy.

Depending on the central bank, the mechanics underlying the operation of the policy rate differs. But the central idea in all cases is that commercial banks often run short of reserves and need temporary funding—often for a night—to meet their *reserve requirements.* To obtain this short-run funding, commercial banks can borrow funds at the central bank's policy rate for a very short duration. In turn, this affects the banks' cost of funding, and they typically pass on the higher or lower cost of funding to their customers. In this way, the policy rate affects the cost of borrowing in the economy. Keep in mind that a low rate would cause more demand for funding, which would entail the central bank in increasing the money supply. As a result, a low policy rate is equivalent to a higher money supply—and conversely. In Europe the policy rate is called the *main refinancing rate.* This is the rate at which the central bank lends to banks for short-term loans. The equivalent rate in the Bank of England is called the *repo rate*, and the rate in the U.S. is the *federal funds rate.*

10.1.4 Taylor Rule

The goal of monetary policy is to keep output at potential and to maintain inflation at target (typically, $2-3\%$.) What determines the level of the policy rate that the central bank will aim for? According to the *Taylor rule*, the rate which represents good monetary policy is

$$i^* = \gamma + \pi + .5(\pi - \pi^*) + .5(y - y_n),$$

where γ is a constant, π denotes inflation, π^* the inflation target, y output, and y_n potential output. For example, if output is below potential (i.e., $y - y_n < 0$), then the Taylor rule dictates that the central bank should *lower* the interest rate; by reducing the cost of borrowing, aggregate demand should rise to clear the output gap. If inflation exceeds target, the bank should try to contract the economy and raise the interest rate; we already know from the AS-AD model that this contractionary policy will reduce aggregate demand and hence inflation. Notice that if $i = 0$, the central bank is "out of ammunition." If it wishes to reduce rates further, the central bank faces a *liquidity trap*. At this point, the bank typically engages in unconventional *quantitative easing.* By purchasing a range of assets from the private sector, this is another way for the central bank to raise the money supply.

10.1.5 Some Points on Monetary Policy

- Good monetary policy is preemptive: adjust rates when you expect recession/inflation changes.
- Because of the inherent uncertainty regarding the future trajectory of the economy, the central bank should adjust interest rates slowly and monitor how things evolve.
- There is a lot of uncertainty in how long it takes for monetary policy to operate. Think of putting on a heater in a strange hotel: you don't know how long it will take to warm up etc. Money can take up to a year to have maximum effect on output. Milton Friedman famously stressed these "long and variable lags" in monetary policy.
- Within the Eurozone, there is only a single interest rate for a number of disparate economies, who could all be at different stages of the business cycle. This "one-size-fits-none" policy will be invariably unsuitable for some economies at any point. For example, up until the crisis, monetary policy was too expansionary in the PIIGS economies; the attendant inflation is one reason they became so uncompetitive. What is so problematic is that a devaluation to counter this is not possible.

The Banking Crisis and the Money Multiplier

- During the crisis, the U.S. central bank, the FED, hit a liquidity trap. What can the central bank do now? In this case, the bank engages in unconventional *quantitative easing*, whereby it increases the money supply by purchasing an array of assets—such as foreign currency and loan books—from the private sector. While this does not involve changing the federal funds rate, it ultimately ends up increasing the monetary base and ideally the money supply. But just to be clear: there is no assurance quantitative easing will raise lending. For starters, because they are trying to reduce their exposure to bad loans and risk, banks are reluctant to lend; instead, they are accumulating vast reserves. Second, high levels of household debt make people reluctant to engage in further borrowing. Third, future uncertainty—about levels of demand, the Euro, future taxes, and so on—are reducing firms' incentives to invest.[2]

- Because of problems in banking systems, money multipliers fell. One reason for this is banks' current policies of *deleveraging*. This refers to banks reducing their leverage ratios. In practice, the banks "clean up their balance sheets" and sell off assets such as foreign branches and loan books.[3] Most importantly, when a bank is deleveraging, it restricts lending for fear of further defaults. The goal of deleveraging is to reduce the overall risk a bank faces, but it invariably causes the money multiplier and money supply to fall.

- Apart from borrowing at the policy rate—which involves borrowing for *very* short periods—banks frequently lend to each other on *interbank markets* for longer duration (say, for 3 months.) Such markets are essential for a properly functioning financial system, and banks use them frequently. One measure of the cost of funding on such markets is the *TED spread*: a high value indicates that the risk premium in the intermarket has risen.[4] Why would this happen? You see, a higher TED spread indicates banks don't trust each other, and this often reflects greater insolvency risk in the banking system. For instance, if there was a fear that banks had made bad loans, the TED spread would assuredly rise. This has a number of implications for economic activity. Suppose Citibank borrows from Barclays bank for three months. If the TED spread rises, it indicates that the borrowing cost to Citibank has risen. In turn, this Citibank will charge more to its borrowers, and this will lead to a

[2]Quantitative easing works through other channels however. It causes a weakening of the currency, leading to a rise in net exports. When the central bank purchases long-run bonds and raises demand for them, the bond yields fall. This makes equities more attractive investments, which raises equity prices. In turn, this induces wealth effects, which would raise consumption.

[3]Think of a loan book as a collection of IOUs by people who the bank lent to; this is an asset, which can be sold. Combining loans into a marketable product like this is called *securitization.*

[4]Formally, the TED spread is the difference between the interbank rate and the rate on a risk-free short-run bond.

fall in credit and aggregate demand. In other words, a rise in the TED spread acts like a fall in the money supply.

During the financial crisis, the TED spread rose dramatically, reflecting that banks no longer trusted *each other*. Because interbank lending is crucial for the banking system to work efficiently, this development has serious implications for the financial system. The reason for the rise is banks became wary of each others' exposures to risky assets—especially property-related assets—and feared other banks would go bankrupt and thus default. Because of the rise, banks found it hard to get funding and this shortage of funding caused a fall in their customer lending. For this reason, the money multiplier fell. To counter this, central banks lowered *their* interest rates, and engaged in quantitative easing.

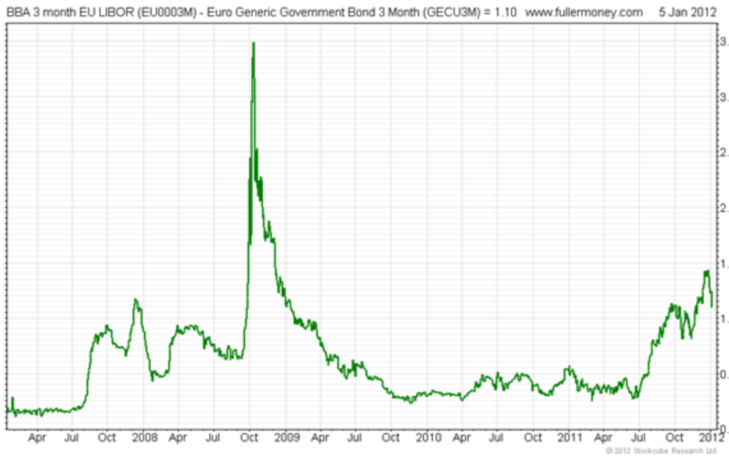

Figure 10.1: THE TED SPREAD. THIS HAS BECOME A GENERAL MEASURE OF PROBLEMS WITHIN THE BANKING SYSTEM. NOTE THAT THE TED SPREAD WAS INDICATING PROBLEMS IN THE BANKING SYSTEM WELL BEFORE THE COLLAPSE OF LEHMANS IN SEPTEMBER 2008. BECAUSE OF BANKS' EXPOSURES TO EUROPEAN DEBT, THE TED SPREAD ALSO ROSE AT THE END OF 2011.