MODULE 3

Money and Inflation

This lesson begins with a review of what money is and why people hold it. It is noted that the government must finance its expenditures by either levying taxes, selling bonds to the public or printing money. Price-level determination is then analyzed using standard supply and demand analysis for nominal money balances, with the reciprocal of the price level on the vertical axis. After presentation of the equation of exchange, inflation is shown to be a tax on money holdings with the demand for real money balances determined by the real income and the nominal interest rate. The reasons why significant inflation is bad are then outlined and the political forces driving money creation noted. The relationship between the exchange rate and the price level is then explained along with the law of one price and purchasing power parity. The concept of the real exchange rate is introduced and the forces that would be expected to determine it outlined. The discussion then turns to cost-push inflation and an analysis of the forces determining the prices firms charge and the wage rates that will emerge from union behaviour. It is shown to be against workers' interest to force wages higher and higher in the absence of monetary finance by the government. Finally, some empirical evidence on the relationship between nominal money growth and inflation is surveyed along with the effects of inflation on nominal exchange rates in the face of non-constant real exchange rates.

1. The Nature and Functions of Money

In this module we will show that the cause of all major inflations is excess expansion of the money supply. The first step is to understand what money is and why people hold it. Here we extend the arguments developed in the beginning module, called the *The Dimensions of Economic Activity*. The next step is to understand what determines the supply of money in the economy.

Without money, exchange between individuals has to take the form of barter, which requires the double coincidence of wants—each party to the exchange must want to sell what the other wants to buy. In the absence of money, an enormous fraction of peoples' time and effort will be used up making exchange by pursuing and arranging barter opportunities. These resources could be better used producing goods and services that can be consumed or invested.

Why can't the double coincidence of barter be avoided by a system of loans or credits cleared through a clearing house? A particular commodity could be designated a numeraire, and all individuals could simply note all sums owing to them for end-of-month clearance. Such an arrangement has two problems. First, substantial resources would be used up handling the mechanics of clearing transactions, even in the era of modern computers. Second, not everyone is honest, so the credit-worthiness of every transactor would have to be constantly verified. This would, be prohibitively expensive, especially for small transactions. A credit-clearance system has thus never been practical, even in traditional societies with strong cultural and religious controls. Something has always been used throughout history, not only as a *unit of account*, but as a *medium of exchange*. This is the basic function of money—to reduce the resource cost of making transactions.

Money is often viewed as having an additional function—to act as a store of value through time. In this respect, however, money is not special. All forms of capital are stores of value—being a store of value simply designates money as a form of capital. The output flow from money is the goods and services that can be produced with labour and capital that would otherwise have been tied up doing barter or checking people's credit-worthiness.

Historically, precious metals—usually gold or silver—were typically the unit of account and medium of exchange until 100 years ago. In medieval times, kings and feudal lords minted gold (or silver) into coins to provide a standard for transactions—hence the term *gold standard*. As the financial system evolved it became inconvenient to hold actual gold coin and people would customarily deposit the gold for safe-keeping with a bank in return

for bank-notes that the bank agreed to redeem for gold at any time. Then, instead of issuing bank notes, it became convenient for banks to give depositors accounts from which they could withdraw paper money, or gold, and on which they could write cheques. The medium of exchange then consisted of not only gold coin and paper money, but bank deposits as well.

At this point problems arose when banks issued paper money that they subsequently were unable to redeem in gold on request. This led to government regulations on who could own banks and government monitoring of day-to-day bank operations. It was then but a short step for the government to assume responsibility for issuing all paper money—the government then assumed the obligation to redeem this paper money in gold on request.

The gold standard system evolved to the point where very few people held monetary gold—everyone operated with paper money, token coins (which like paper money were redeemable in gold) and bank deposits. Gold was the standard for the monetary system in the sense that all deposits and circulating media were convertible into gold on demand. This implied that, even though gold was not used in transactions, the total quantity of money in circulation (token coins, paper money and deposits) was limited by the quantity of gold held by the government as backing for it. The only function of the link of paper money to gold is the limiting effect of available gold reserves on the quantity of money the government can issue.

If the government is a trustworthy custodian of the money supply resources can be saved by simply having it issue and control the money supply directly, without any gold-reserve backing. Paper money would no longer be convertible into gold, but that would not matter because no one needs to hold monetary gold anyway. The supply of money in circulation is simply controlled directly by the *monetary policy* of the government. The advantage is that resources do not have to be wasted digging gold out of the ground for storage in government vaults.

In most countries, a government agency called the *central bank* is entrusted with responsibility for managing the money supply. This agency is usually somewhat independent of the government currently in power to prevent politicians from using money creation to finance "handouts" to voters right before elections. The details of the process of money creation are covered thoroughly in a subsequent module, *Monetary Policy Under Fixed Exchange Rates*. This process is complicated by the fact that the banking system plays an important role in determining the money supply. Since these complications are not relevant to the discussion that follows, we can ignore them here.

The central bank has essentially two avenues of money-supply control.

First, it can buy and sell bonds from the private sector. This is called *open market operations*. When the bank buys bonds from the public, it gives money in return, putting it into circulation. Similarly, by selling bonds to the private sector the central bank can take money out of circulation. A second way the central bank can increase the money supply is by purchasing bonds from other branches of government which then spend the money in the provision of government services—this money thus goes directly into circulation. This method of money creation is typically called *the printing press*. The government as a whole, which includes the central bank, is essentially borrowing from itself and spending the proceeds—i.e., printing money and spending it. The reason why countries make their central banks independent of the political electoral process is to prevent the government from borrowing from itself and printing money in this fashion. This independence is achieved by appointing central bank governors for long terms and not requiring them to be answerable to the currently elected prime minister or president.

Essentially, the government faces a budget constraint of the sort

$$G = T + \frac{\Delta B}{\Delta t} + \frac{\Delta M}{\Delta t} \tag{1}$$

where G is government expenditure, T is the revenue from taxes, B is the public's holdings of government bonds and M is the money supply. This says that the government must finance its expenditure by either levying taxes or selling bonds to the public or printing money. The government has to pay interest on bonds it sells, the outstanding stock of which is called the *public debt*.

Before turning to the role of money in price level determination and in generating inflation, we need to think about how the quantity of money can be measured. Cash and bank deposits are obviously part of the money supply because they can be used directly to acquire goods and services. Because they can be painlessly converted into goods and services they are said to posses a quality called *liquidity*. Cash is perfectly liquid. Bank deposits are slightly less liquid because cheques can bounce and are therefore a bit less acceptable than cash in making transactions—i.e., not absolutely convertible into cash at all times and places.

Time deposits—that is, deposits that can be converted into cash by going to the bank or making a phone call but cannot be transferred by cheque—are also quite liquid and are sometimes counted as part of the money supply. Cash plus demand deposits are referred to as M1 (the narrowest definition of money) and cash plus both demand and time deposits is called M2. An

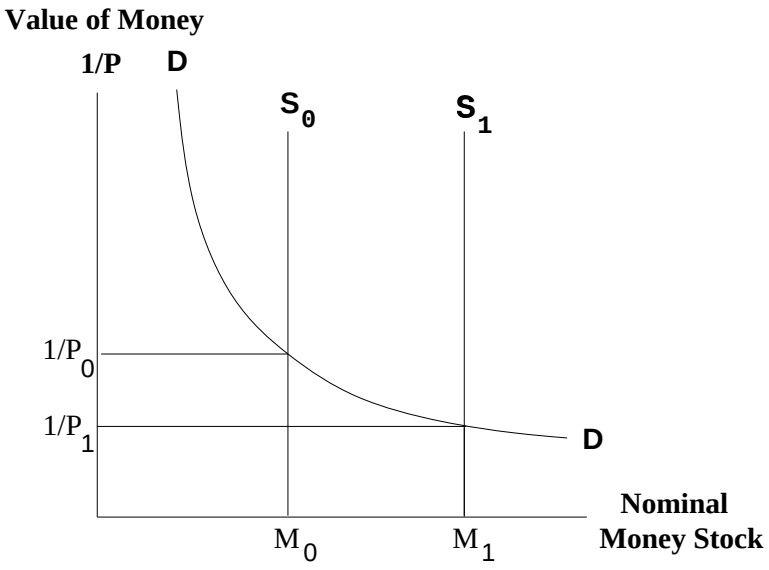
even broader definition of money would include additional assets less directly usable for making exchange, such as shares in money market funds, etc. This definition of money is called M3.

There is no clear line separating money from non-monetary assets. And different measures of the money supply sometimes move in opposite directions, making it difficult for central banks to conduct monetary policy. Clearly, however, corporate bonds, common stocks, mortgages, automobiles and houses, cannot be viewed as part of the money supply. Assets become increasingly less liquid as they become more difficult to convert quickly into a predictable amount of cash.

2. What Determines the Price Level?

The price level is the average of all prices in the economy, taken as a percentage of that same average in some earlier base period. And the annual rate of inflation is the year-to-year percentage growth of the price level. The price level measures the amount of money that has to be given up to buy a unit of aggregate output. The amount of output one must give up to obtain a unit of money is equal to the reciprocal of the price level which thus represents the *value of money*.

FIGURE 2.1:



It is natural to think of the value of money as determined in the same way as the value of any other good or service—by the supply and demand for it. While in the case of typical commodities the quantities demanded and supplied refer to flows of output, we focus here on the *stock* of nominal money holdings supplied and demanded. Accordingly, price level determination is analyzed with respect to Figure 2.1.

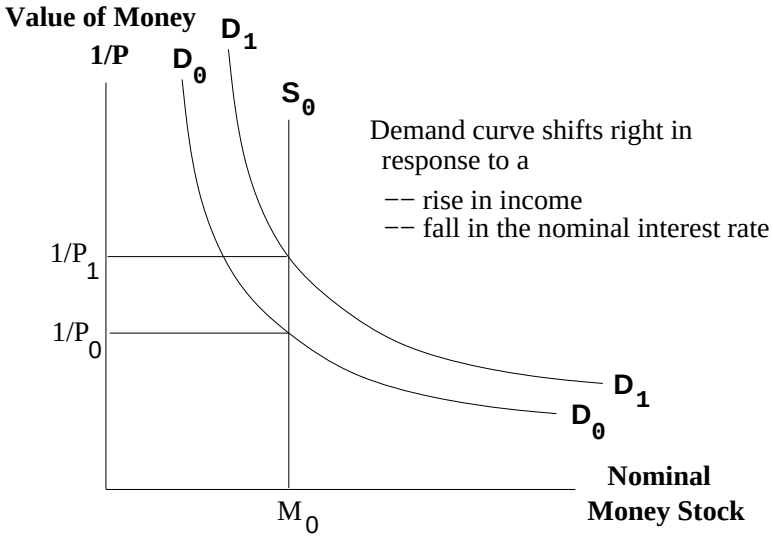
Ideally, we conceive of the stock of money as the amount of liquidity in the economy. For the remainder of this module we will think in terms of a conceptual stock of money that we will call M which can be approximately measured by either M1 or M2.

The supply curve in Figure 2.1 is a vertical line positioned to the right of the vertical axis by an amount equal to the existing stock of nominal money balances in circulation. When the central bank increases the money supply this vertical line shifts rightward. The demand for nominal money stock, given by the curve *DD* in Figure 2.1, is downward sloping to the right like any demand curve but cannot be a straight line.

If the price level were to double any existing nominal level of money holdings would finance only half of the previous volume of transactions. To maintain any given level of desired real money holdings, the nominal quantity of money demanded will vary in direct proportion with the price level and in inverse proportion with the nominal value of money. Given the public's desired real money stock, M/P, the rectangular area under *DD* associated with each given level of M will be a constant equal to $1/P$ times M. The curve *DD* will thus be a rectangular hyperbola.

One obvious factor determining the desired level of money holdings will be the real flow of transactions, which can be roughly measured by the level of real income. A rise in real income, and the associated increase in the transactions demand for money, will thus shift *DD* to the right as shown in Figure 2.2.

FIGURE 2.2:



A second factor determining the desired level of money holdings will be the cost of holding money relative to other assets. Assuming that money holdings earn no interest, that cost will be the interest that could have been earned by holding bonds and other assets instead of money. As can be seen from the Fisher Equation,

$$i = r + \tau, \tag{1}$$

bonds and other assets that are fixed in nominal value will earn interest at i percent, real assets will earn a return equal to r percent and the difference between them is the expected inflation rate τ. Where money bears no interest, the sacrifice from holding it will be the real interest that could have been earned by holding other assets plus the expected annual deterioration in the real value of money holdings—i.e, the nominal interest rate. A decline in the nominal interest rate will shift *DD* to the right in Figure 2.2.

The demand for real money holdings will also be affected by changes in transactions technology such as the introduction of automatic teller machines and credit cards. These technologies make made money holdings more accessible, reducing the amount of real money balances needed to effect a given volume of transactions. The *DD* curve will shift to the left. Speculative shocks to desired real money holdings can also occur in response to

expected future changes in nominal interest rate and the resultant capital gains or losses from holding bonds instead of money.

The cause of inflation can now be easily seen from Figures 2.1 and 2.2. A rise in the price level, or fall in the value of money, can result only from an increase in the supply of money or decline in the demand for money. While the general growth of income will increase the demand for money and improvements in the technology of making transactions will reduce it, these effects will be gradual over time. They can thus account for changes in inflation rates of only a few percentage points. And the government can offset these effects by appropriate adjustments of the money supply. The cause of major inflations, of 10 percent per year or more, will inevitably be excess expansion of the money supply on account of the policies of the government—in particular, the monetary finance of government expenditures.

We conclude this topic by introducing the concept of *velocity of circulation*. The *income velocity* of money is defined as the ratio of nominal income to nominal money holdings or, equivalently, the ratio of real income to real money holdings

$$V = \frac{PY}{M} = \frac{Y}{M/P} \tag{2}$$

where V is income velocity and Y is the level of real income. When we multiply both sides of this equation by M we obtain

$$MV = PY \tag{3}$$

which is called the *equation of exchange*. Using some elementary calculus we can take the relative changes of both sides of (3) to obtain

$$\frac{\Delta M}{M} + \frac{\Delta V}{V} = \frac{\Delta P}{P} + \frac{\Delta Y}{Y} \tag{4}$$

Rearranging this expression to bring $\Delta P/P$ to the left side, we obtain

$$\frac{\Delta P}{P} = \frac{\Delta M}{M} + \frac{\Delta V}{V} - \frac{\Delta Y}{Y} \tag{5}$$

To maintain the inflation rate equal to zero the central bank must increase the money supply at the rate

$$\frac{\Delta M}{M} = -\frac{\Delta V}{V} + \frac{\Delta Y}{Y} \tag{6}$$

3. Inflation: A Tax on Money Holdings

Our next task is to show that inflation is, in fact, a tax on money holdings. Then, after exploring some implications of this fact, we will examine again the reason why some countries have high inflation rates. We start by reproducing the fiscal budget constraint that every government faces:

$$G = T + \frac{\Delta B}{\Delta t} + \frac{\Delta M}{\Delta t} \tag{1}$$

The government budget deficit, $G-T$, must be financed by either borrowing (selling bonds) or printing money.

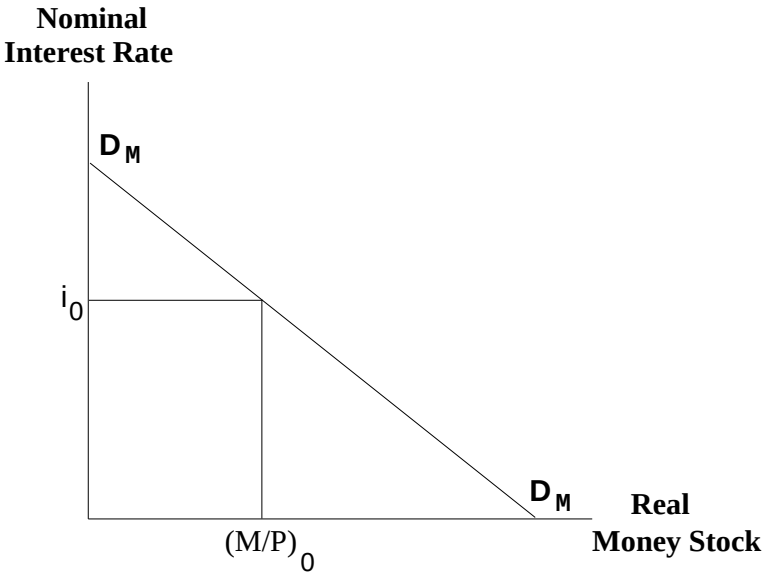
Suppose that the government runs a deficit and finances it by printing money. It gives this newly created money to the public in return for real goods and services in the amount $G - T$. While the public gets an amount of nominal money equivalent to the nominal value of the goods and services given to the government, its desired real money balances will not have changed. The price level will therefore be bid up in proportion to the increase in the nominal money stock and the public's real money balances will return to their original level. The public has, in effect, given real goods and services to the government for nothing in return. The government has taxed the public by the amount of new money it put in circulation. Since the price level rises in proportion to the tax, everyone has had that proportion of their initial money holdings taken by the government and has had to give up current income to acquire sufficient additional nominal money holdings to maintain their real money holdings at the desired level. An important feature of the inflation tax is that people are taxed in proportion to the amount of money they hold.

Even non-inflationary growth of the money supply that satisfies the public's desire to hold additional real money balances as real income grows provides revenue to the government, which simply prints the money and uses it to purchase goods and services. Revenue from money creation is called *seignorage*.

When the government imposes an inflation tax on money and the public realizes what is happening nominal interest rates will rise by the increased expected inflation. This will cause people to hold smaller stocks of real money balances. This prompts us to model the demand for money in a different way than we did in the previous topic, putting the real money stock on the horizontal axis and the cost of holding money on the vertical axis, as shown in Figure 3.1. The demand curve for money on this graph is downward sloping because people hold more money when the cost of holding

it falls. Following the analysis in the module *Rents and Externalities* the benefit from holding an additional unit of money is given by the vertical distance between the demand curve and the horizontal axis at the quantity of real money balances initially held.

FIGURE 3.1:



Suppose that, starting with a zero rate of actual and expected inflation, the government begins increasing the money supply at a faster rate than previously. The expected inflation rate will soon rise by the amount of the increased money growth as shown in Figure 3.3.[1] The public reduces its real money holdings from $(M/P)_0$ to $(M/P)_1$. Given the nominal money stock in circulation at any point in time, there will have to be a one-shot rise in the price level to bring about the appropriately lower real money stock. The inflation tax on real money holdings is the shaded area in Figure 3.3.

[1]Figure 3.2 is not shown here because it is the same as Figure 2.1.

FIGURE 3.3:

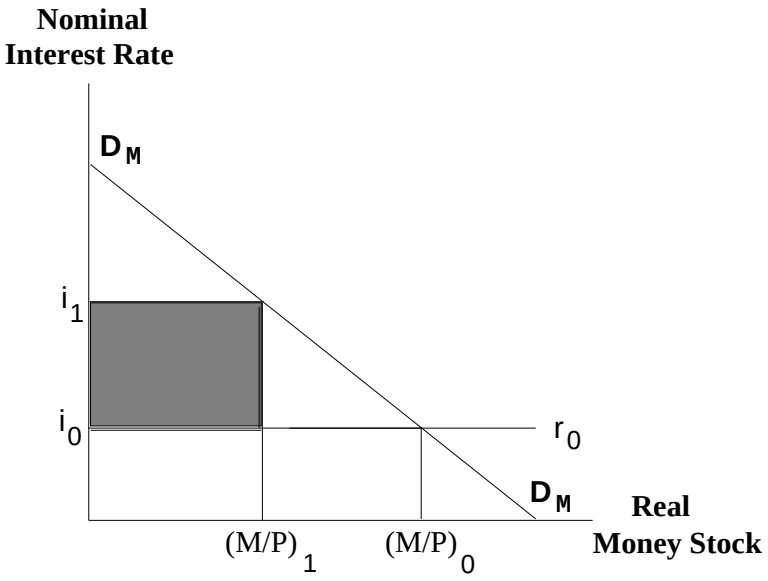
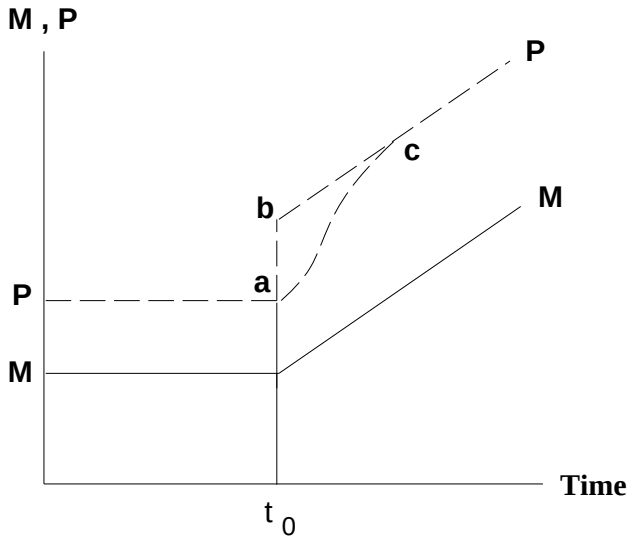


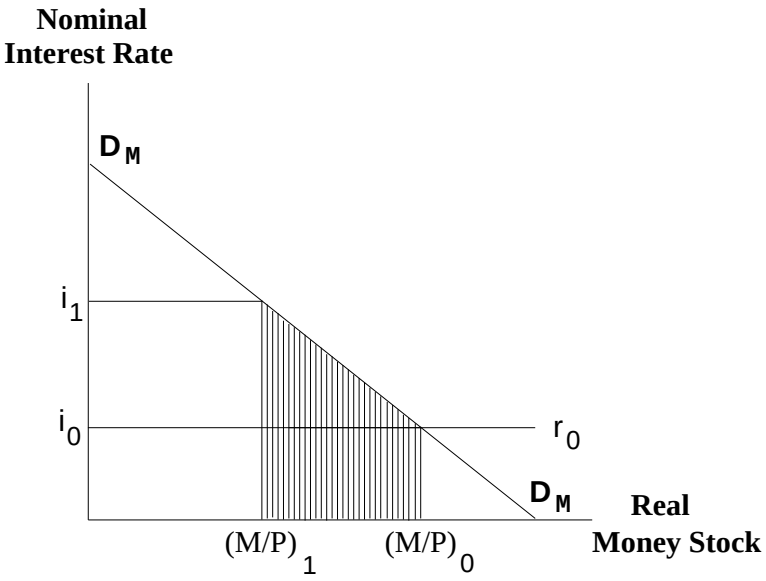
FIGURE 3.4:



The decision of the government to finance a deficit by printing money will thus have two effects on the price level. First, by increasing the rate of

inflation it will increase the rate at which the price level is increasing. Second, once the public realizes that the inflation rate has increased there will be a once-and-for all jump in the price level to reduce real money holdings to the new lower desired level. These two effects are shown in Figure 3.4. Nominal money holdings and the price level are on the vertical axis and time is on the horizontal one. The line MM gives the time path of nominal money holdings and the line PabcP shows the time path of the price level. If the public realizes immediately that the government has decided to finance its budget deficit by printing money, the price level will jump up immediately from point a to point b in Figure 3.4. If it takes people some time to realize what is happening, the jump will be spread over an interval of time as shown by the curved line running from point a to point c.

FIGURE 3.5:



Inflation, even when it is fully expected, is bad for several reasons. First, it causes people to hold less money and thereby use up time and effort running back and forth to the bank and transferring funds between interest earning assets and chequing accounts. This cost is shown by the shaded area in Figure 3.5. The entire area is lost because fiat money can be created by the government at virtually zero real resource cost. By having a lower

inflation rate the government can induce the public to hold more money and reduce the *shoeleather costs* of running back and forth to the bank.

A second cost of inflation is that firms and workers have to be constantly raising prices, printing new catalogues and changing signs. These are called *menu costs*. A third cost is the resources that the government has to use up constantly adjusting nominal tax rates, pensions, welfare benefits, and so forth, to keep the real impact of its actions on the economy the same. These adjustments do not come without political wrangling and other costs. Further costs arise when inflation is unexpected and highly variable—it is almost always the case that countries with high inflation also have large variations in their inflation rates. The result is continual wealth redistributions back and forth between debtors and creditors.

Finally, we must deal with the question of why, since inflation is bad and can be avoided, many countries nevertheless have it. The reason is that the underlying cause of high inflation is political. A country, faced with high inflation can do one of three things. First, it can borrow from the public instead of printing money. To do this, governments of countries with high inflation have to pay very high interest rates—they must compensate borrowers for the expected loss in real value of the public debt due to the prospect of future inflation. Unless it can convince the public that it is going to control inflation, the government will face prohibitive borrowing costs. A second thing the government can do is raise taxes to eliminate the deficit. To do this it must have the political support to be able to force people to pay the higher taxes. Since every segment of the community wants some other segment to pay the taxes, the government may not be able to raise taxes and keep itself in power. Finally, the government can eliminate its budget deficit by reducing government expenditures. This usually means that it will have to employ less people and provide less services. Government employees may have the political power to prevent widespread layoffs in the public sector, particularly if it is a large fraction of the economy, and powerful special interest groups may be able to prevent the elimination of government subsidies. Again the government's ability to retain power will be at risk. It is not an accident that countries experiencing very high inflation rates suffer from political instability that makes it difficult for their governments to maintain monetary control.

4. The Exchange Rate and the Price Level

At this point we must recognize that the economy we are analyzing is part of a larger world and examine the relationship between the price level and the exchange rate. The *exchange rate* is the price of foreign money in units of domestic money or, under an alternative definition, the price or value of domestic money in units of foreign money. It is of fundamental importance because every time domestic residents want to buy something abroad they must exchange domestic currency for foreign currency, and every time foreigners want to buy domestic goods they must exchange foreign currency for domestic currency.

The exchange rate has an important relationship to the price level because it represents a link between domestic prices and foreign prices. For the i^{th} commodity that is traded internationally we can write, ignoring taxes, subsidies, shipping costs and market imperfections,

$$P_i = \Pi P_i^* \tag{1}$$

where P_i is the domestic price (in domestic currency), P_i^* is the price abroad (in foreign currency) and Π is the exchange rate (price of foreign currency in units of domestic currency). This relationship is called the *law of one price.*

If every good produced in the domestic economy is also produced in the foreign economy, and if the shares of each good in aggregate output are the same in both economies, then the domestic price level will equal the exchange rate times the foreign price level.

$$P = \Pi P^* \tag{2}$$

where P and P^* are the domestic and foreign price levels. If there is inflation in the domestic economy, not matched by inflation abroad, the domestic currency price of foreign currency has to rise—the domestic currency must depreciate in terms of foreign currency.

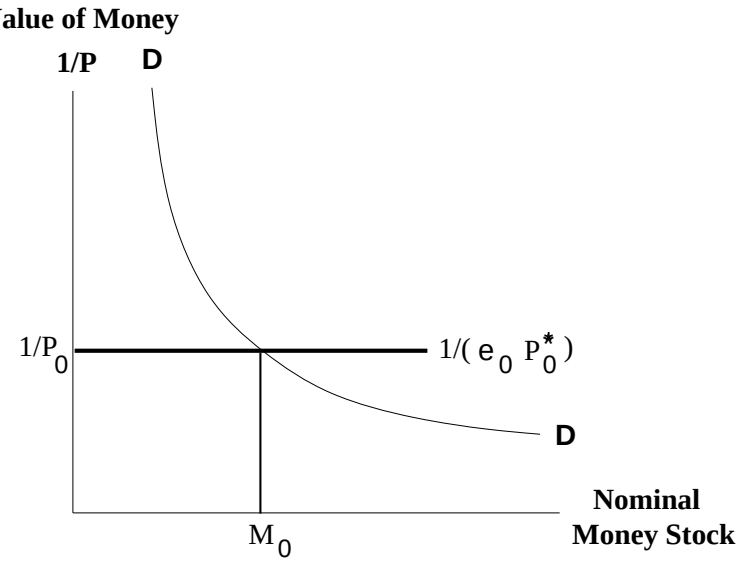
Suppose that the government decides to adopt a *fixed exchange rate* by fixing the price of its currency in terms of some foreign currency. In this case, Π in equation (2) will be fixed at some level Π_0. If the price level in the foreign country happens to be P_0^*, the the domestic price level will be fixed at

$$P_0 = \Pi_0 P_0^*. \tag{3}$$

As we can see from Figure 4.1, this will require that the domestic money supply be fixed at M_0. By fixing the exchange rate, the domestic authorities

tie their hands with respect to monetary policy—the government can control *either* the domestic money supply *or* the country's exchange rate but not both.

FIGURE 4.1:



In order to fix the exchange rate, the government must stand ready to purchase or sell domestic currency for foreign currency at its announced price. If the domestic money supply is too high, people will spend the excess abroad, buying foreign currency with home money to enable those purchases. To maintain the exchange rate at the official level, the government has to sell foreign currency from its *foreign exchange reserves* in return for domestic currency, taking home money out of circulation in the process. If the domestic money supply is too low, the opposite will happen. Too much will be sold abroad and people will be exchanging too much foreign currency for domestic currency. The government has to buy foreign currency to keep the price of foreign currency in terms of domestic currency from falling below the official level. This increases the country's stock of foreign exchange reserves and puts additional domestic money in circulation.

If the government chooses not to purchase and sell foreign currency for domestic currency when there are excess sales or purchases by domestic residents abroad the exchange rate will adjust to reflect the different domestic

and foreign rates of money growth and inflation—there will be a *flexible exchange rate*.

In the analysis in the other topics in this module, we always assume flexible exchange rates. This enables us to think about domestic money and prices without worrying about what is happening in the rest of the world. We will be four modules further along in the sequence before we look again at exchange rates, and a full understanding of how they are determined and their relationship to domestic economic policy will only emerge with completion of the entire sequence of modules. Nevertheless, before concluding this present module we need to discuss further the law of one price and the relationship between the domestic and foreign price levels.

In order to write down equation (2) we had to assume that all goods are produced in every country and can be freely bought and sold across international boundaries without the impediment of transport costs, tariffs, taxes, or subsidies, so that equation (1) holds for every good. Then we also assumed that each good represents the same fraction of aggregate output in each country so that countries' price indexes (which are assumed to be output-weighted averages of the prices of goods produced) are the same when the currencies exchange for each other on a one-for-one basis.

Since none of these assumptions are true we need to think about what will happen when they are false. Transport costs, taxes, tariffs and subsidies are not a problem because we can think of prices as being net of these distortions. But many goods are not traded internationally. Since people cannot migrate freely between countries, the labour share of production represents a non-traded component of every good. This is why the price of a McDonalds hamburger, when measured in U.S. dollars, is not the same in all countries. Sides of beef and wheat flour can be purchased at roughly the same real price everywhere, but the labour used to make the patties, bake the bread, and provide the transport, cooking and clerical services is cheaper some places than others. Buildings, too, are built with local labour.

For these reasons a unit of aggregate output will not have the same price in all countries when measured in a single currency. The ratio of a country's price level to the price level in the rest of the world when all prices are converted into local currency is called its *real exchange rate*. It is the relative price of domestic output in terms of foreign output and can be written as

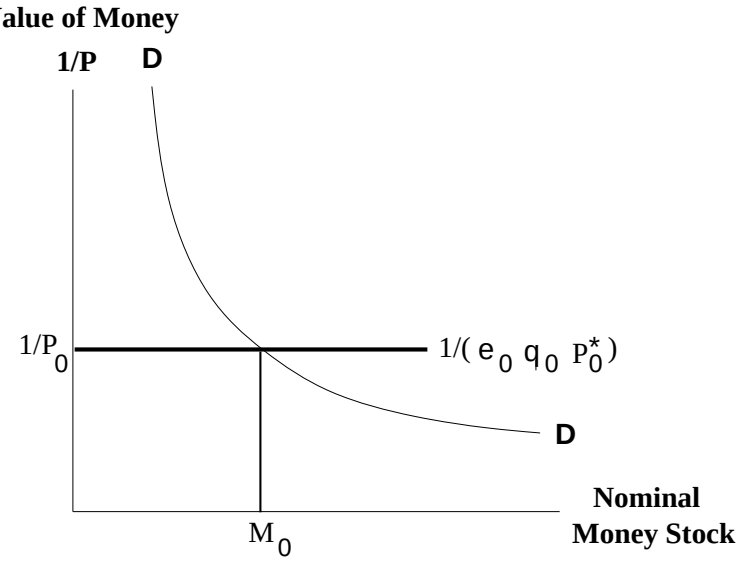
$$q = \frac{P}{\Pi P^*}. \tag{4}$$

where q is the real exchange rate and the other variables are as previously

defined.

It is obvious that each country's real exchange rate will depend on which goods it produces (not every good is produced in all countries), how highly those goods are valued in world markets and on how high the marginal product of domestic labour (in producing domestic aggregate output) is relative to the marginal product of foreign labour (in producing rest-of-world aggregate output). The respective marginal products of labour will determine the real costs of producing non-traded goods at home relative to abroad. In a world where technological change is occurring and all countries are not equally endowed with natural resources, it is unreasonable to expect that any country's real exchange rate will be constant through time. The idea that the real exchange rate will be constant through time is called *purchasing power parity*.

FIGURE 4.2:



Nevertheless our argument that governments lose control over their monetary policy when they fix the nominal exchange rate holds regardless of what determines countries' real exchange rates. Given the definition of the real exchange rate in equation (4), the domestic price level must equal

$$P = \Pi\, q\, P^*. \tag{5}$$

If the government fixes Π, then P will be determined by the current levels of P^* and q as shown in Figure 4.2. The money supply must be maintained at some level such as M_0. Moreover, changes in q as a result of technological change both at home and in the rest of the world will lead to changes in P that are beyond the control of domestic monetary policy.

To maintain control over the domestic price level, the government must adopt a flexible exchange rate. The nominal exchange rate will then be determined by the degree of domestic relative to foreign inflation and the movements in q that occur as the domestic and rest-of-world economies grow through time.

When conflicting domestic political forces make it impossible for the government to control the money supply it may be possible for the majority of voters to agree on a commitment to fix the price of the domestic currency in terms of the currency of some low-inflation country like the U.S. Fixing the exchange rate in this way takes control of the domestic money supply away from the domestic political process and ties the domestic price level to that of the foreign country. Argentina in fact did this a number of years ago to try to deal with its perennial problem of high inflation.

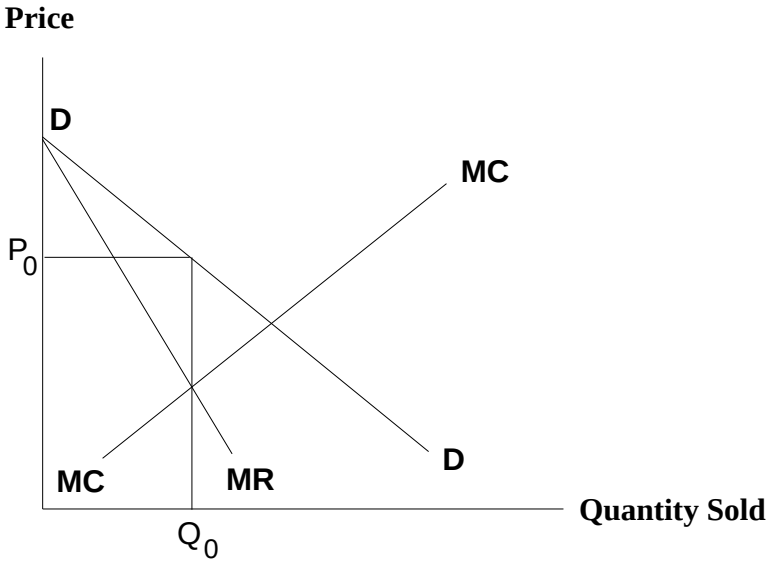
5. Firms, Unions and Inflation

The fact that it is workers and firms that actually raise prices prompts what might be thought of as a greed theory of inflation—inflation results when workers and firms, greedy for increased shares of the national output, continuously push up wages and prices. Inflation driven by the pricing behaviour of workers and firms is commonly termed *cost-push inflation* which results, it is claimed, from the pass-through of higher wages and profit margins into final product prices.

For firms to be able to set prices they must have monopoly power. Let us therefore assume that all firms in the economy are monopolies and see what can be concluded in this extreme case about their contribution to inflation.

Monopoly firms will only reduce output and thereby raise the prices they charge if marginal revenue is less than marginal cost, as can be seen from Figure 5.1.

FIGURE 5.1:



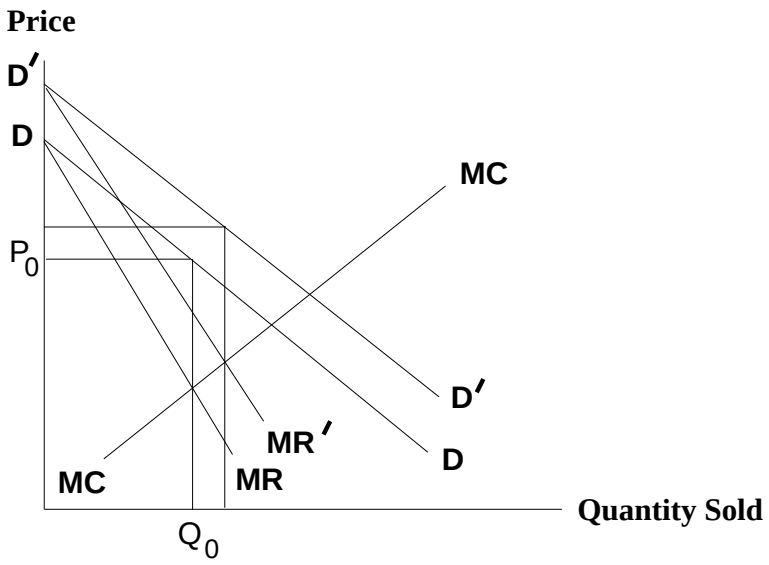
The curve relating the firm's marginal revenue to its output, shown as *MR* in Figure 5.1, will touch the demand curve *DD* when output is one unit because the increase in total revenue from selling that unit is the price obtained for it. At higher output levels *MR* must lie increasingly below the demand curve. The firm's marginal cost curve, *MC*, will typically be upward sloping to the right. As the firm produces more and more output, each additional unit adds more to costs than the previous unit because there are usually diminishing returns from the application of labour and capital to a fixed stock of organizational or entrepreneurial ability—as the firm gets larger and larger it becomes more and more difficult to manage and control. Our conclusions below will be the same, however, if it turns out that the firm's marginal cost curve is a horizontal line and costs are constant with respect to output.

Since the firm will increase its output if marginal revenue exceeds marginal cost and reduce its output if marginal revenue is less than marginal cost, equilibrium will occur at output Q_0 where marginal revenue equals marginal cost. This will happen as long as the firm is greedy and not stupid. The firm's total cost curve, which is not shown in Figure 5.1, must also be low enough that total profit is not negative—we assume this to be the case because otherwise the firm would not be in business.

Greedy monopolistic firms have no incentive to increase their selling prices above some equilibrium level unless their demand curves shift to the right or their cost curves shift up. The greed theory fails because it is not in greedy firms' interest to continually raise prices.

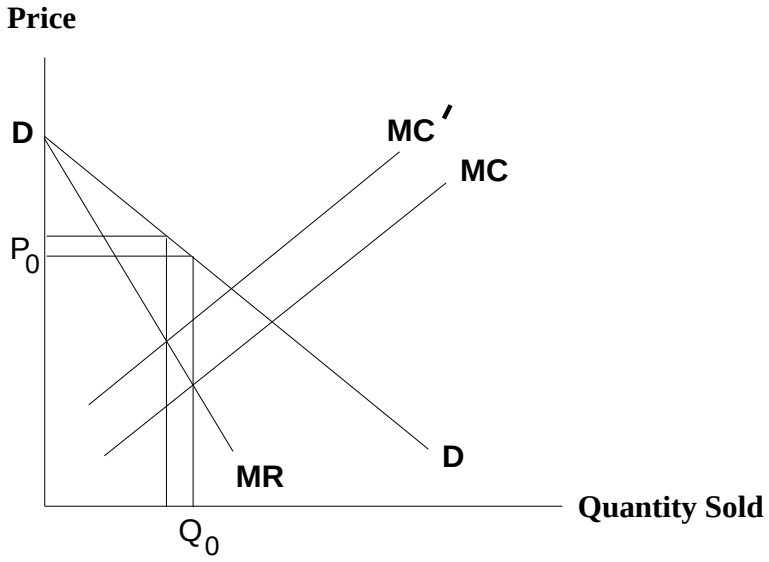
Of course, if the demand curve shifts to the right the firm will increase its selling price, as shown in Figure 5.2. But for the demand for the outputs of all firms to increase there must be an increase in aggregate demand for output in the economy and, hence, in the equilibrium price level. This can only happen if the demand for money declines or the government increases the supply of money too rapidly.

FIGURE 5.2:



Also, the firm will keep increasing its selling price in the absence of a rightward shift of the demand curve if its costs keep rising, shifting *MC* upward as shown in Figure 5.3. This can only happen for all firms in the economy if the wages paid to workers are continually being pushed up by labour unions without regard to the demand conditions for labour.

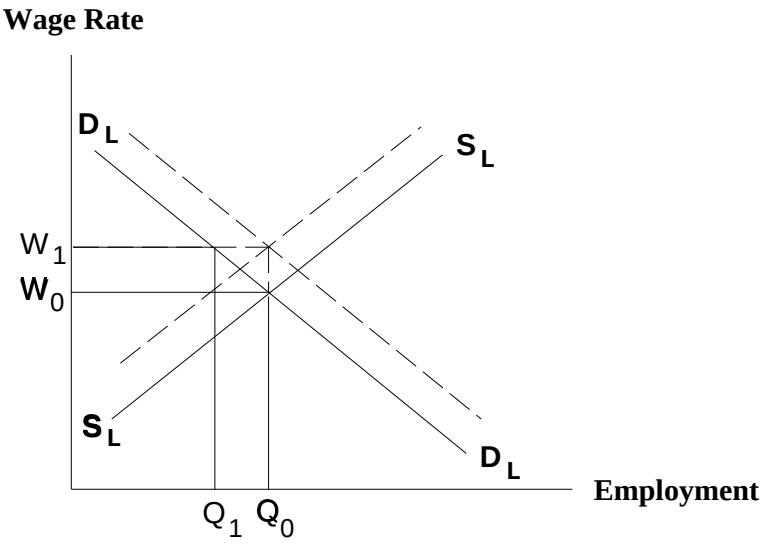
FIGURE 5.3:



So the question now arises as to whether labour unions, acting on behalf of greedy workers, will cause inflation by continually pushing up wages and labour costs that firms are forced to pass on in the form of higher prices. Again, we take the extreme case, assuming that the entire economy is unionized.

It is not in the interest of workers for unions to force up wages continuously because the demand curve for labour is negatively sloped. As we shall argue in more detail in the next module entitled *Unemployment*, the demand for labour in any industry and in the economy as a whole is negatively sloped for two reasons. First, a rise in the wage rate increases costs and causes firms to reduce output—this reduces the quantity of labour that firms can profitably employ. Second, an increase in the wage rate makes labour more expensive relative to capital, causing firms to substitute capital for labour, further reducing the quantity of labour employed. Every union thus faces a trade-off between higher wages and lower employment in its industry as shown in Figure 5.4. By forcing up the wage rate it puts some of its members out of work.

FIGURE 5.4:



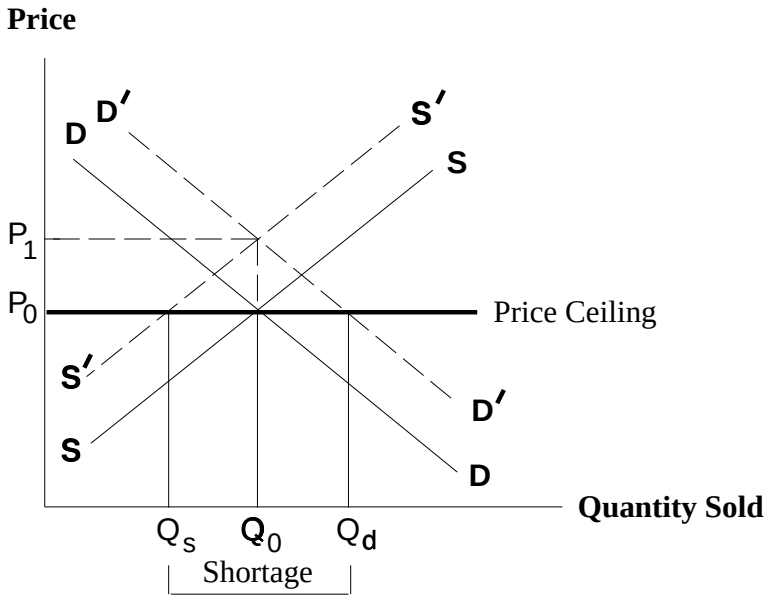
Choosing the best wage for its workers is a difficult task for every union. Since the union members ultimately choose the policies their unions follow they must somehow jointly choose the level of wages the union will agree to. However this is done, it is not in the interests of workers, given a stable demand curve for labour, to push wages up indefinitely. At most, it would be in workers' joint interest to set the wage rate at the level at which the elasticity of demand is unity and total wage payments by the firm are therefore maximized—those who remain employed can then compensate those driven out of work and the average earnings of all union members, working or not, will be maximized.

Unless the government forces firms to use only unionized workers, those workers forced out of employment by high wages will have an incentive to seek employment with non-unionized firms who will then be able to outcompete the high-wage unionized ones. And even if the government forces all firms to use only unionized workers, those workers displaced by high-wage unionized firms can form their own unions and charge wages low enough to obtain employment. Unions thus cannot force wages continually upward without direct wage-setting by the government. And the government has no incentive to create unemployment by fixing wages at a level it is not willing to finance with an appropriate money supply.

Consider the situation in Figure 5.4, which represents the market for labour in the economy as a whole. Suppose that unions bargain the wage

up to W_1 from W_0. Employment falls as a result from Q_0 to Q_1. The government can restore full employment by increasing the money supply in proportion to the increase in wages. This will increase the equilibrium price level in the same proportion so that the real wage rate will return to its original level. Both the demand and supply curves for labour will shift up in proportion to the increase in the price level and the increase in nominal wages achieved by the union. If the government chooses not to finance a higher price level, employment will necessarily fall with a rise in the wage rate. If it provides the money supply to finance the new level of money wages at full employment, then the union will not have successfully increased real wages.

FIGURE 5.5:



It is clear that unions have no incentive to increase wages without limit if the government refuses to provide the monetary finance. And the government has no incentive to finance union wage escalation because the only real consequence will be inflation. And were the government to provide the finance, the unions have no incentive to keep increasing nominal wages because they are achieving no increase in real wages. If the government maintains a stable monetary policy, there is no benefit to workers from

continual increases in wages. If the government does not conduct a stable monetary policy, nominal wages will continuously rise with the resulting inflation while workers will always pay for any increase in real wages through reductions in the level of employment.

It can thus be established that ongoing inflation cannot be caused by the price setting behavior of workers and firms—it can only arise from monetary expansion by the government. It follows that policies designed to eliminate inflation by fixing wages and the prices firms can charge are inappropriate. The effects of such policies can be seen with reference to Figure 5.5. Let *DD* and *SS* be the demand and supply curves for a typical commodity in the economy. When the government expands the money supply and the equilibrium price level rises, all supply and demand curves shift up vertically, with the price rising from P_0 to P_1 and quantity remaining unchanged. If the authorities try to eliminate this inflation by fixing the price at P_0, they simply create a shortage in the amount $Q_d - Q_s$. By fixing prices in the face of excess monetary expansion, the government masks the underlying inflation by creating shortages in every market in the economy. This leads to black market dealings and long queues that cause time and effort to be spent standing in line and working around the price ceilings rather than producing useful goods and services.

6. Money and Inflation: Some Evidence

In ending this module we examine some empirical evidence about the effect of the money supply on the price level and the effects of expected inflation on real money holdings. We would expect to observe two things—first, that major inflations were associated with major increases in the countries' nominal money supplies, and second, that high inflation rates tended to result in high expected inflation rates, leading people to economize on their real money holdings, inflation being a tax on money.

Figures 6.1 and 6.2 plot the rate of money and price level increase over three nine-year periods for forty-five countries using data obtained from the International Monetary Fund publication *International Financial Statistics*.[2] For each country, data permitting, three sets of ratios were

[2]The countries in the sample are Argentina, Australia, Austria, Bangladesh, Bolivia, Canada, Chile, Columbia, Costa Rica, Denmark, Dominican Republic, Egypt, France, Germany, Greece, Honduras, Iceland, India, Indonesia, Israel, Japan, Korea, Luxembourg, Malaysia, Mexico, Morocco, Netherlands, New Zealand, Nicaragua, Norway, Paraguay, Peru, Philippines, Portugal, Singapore, South Africa, Spain, Sweden, Switzerland, Thailand, Turkey, United Kingdom, United States, Uruguay, and Venezuela.

constructed. The growth (end of period over beginning of period) of the Consumer Price Indexes (CPIs) and nominal money supplies using both narrow (M1) and broad (M2) definitions where calculated for the the three nine-year intervals, 1981/1972, 1990/1981 and 1999/1990. The comparison of CPI growth (horizontal axis) and M1 growth (vertical axis) is shown in Figure 6.1. The scatter diagram shows the CPI-M1 growth combinations extending outward along a ray from the origin along which CPI growth is roughly proportional to M1 growth.

A comparable scatter plot using CPI and M2 growth is presented in Figure 6.2. Here the fit is not as tight as for the M1 comparison although the evidence clearly suggests a strong positive association between M2 growth and CPI growth.

FIGURE 6.1:

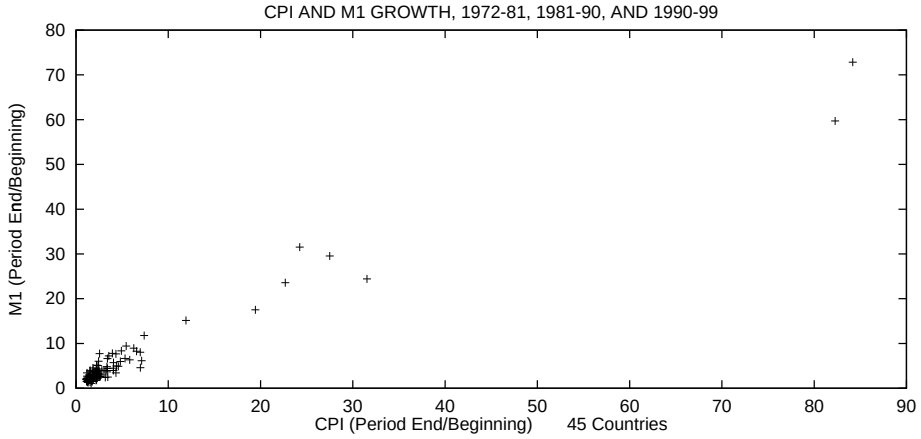
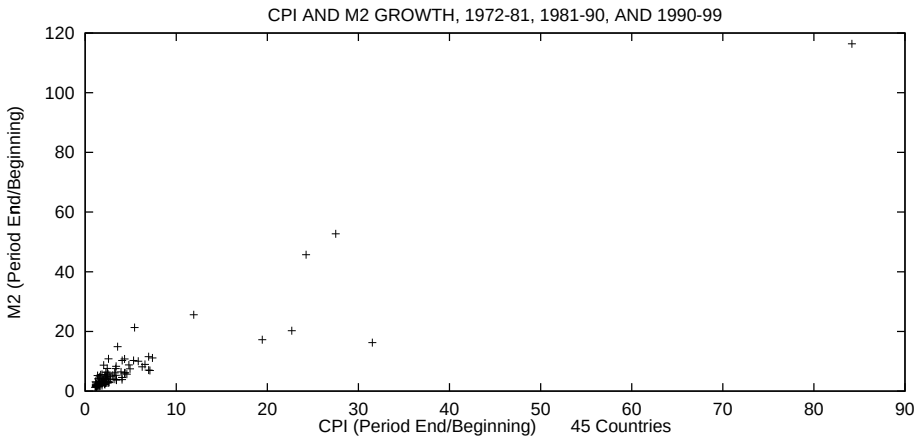


FIGURE 6.2:



There are two countries, Mexico and Uruguay, for which the CPI, M1 and M2 aggregates have increased more than 70 times and for whom the scatter points appear in the upper right corners of the charts. Other countries, such as Turkey (1981-90 period), Peru (1990-99), Venezuela (1990-99) and Iceland (1972-81 and 1981-90) had high enough money growth and inflation rates to place them upward and to the right of the majority of countries whose scatter points form the dark masses in the bottom left corners of the figures. Also, there were many countries, among them Israel (for the period 1981-90), and Chile (for the period 1990-99) for whom the CPIs and monetary aggregates grew over 300 and over 2000 times, respectively, and whose scatter points would be way off the charts. Many other countries had to be excluded from the sample because their inflation rates and money growth rates were so high that useful data were not recorded. In all cases, high inflation was associated with high money growth.

For the great majority of country-period-combinations, for which the scatter points lie in a mass in the lower left corners of the charts, only loose relationships between growth of the money aggregates and growth of the CPIs obtain. This is because the demands for real money balances changed over the nine-year periods as a result of real income growth, changes in expected inflation and changes in the technology of making transactions. As would be expected, these demand-for-money effects on the price level tend to obscure the supply-of-money effects. To properly measure the money supply effects on the price levels of these countries we would have to correct for the changes in their demands for money.

FIGURE 6.3:

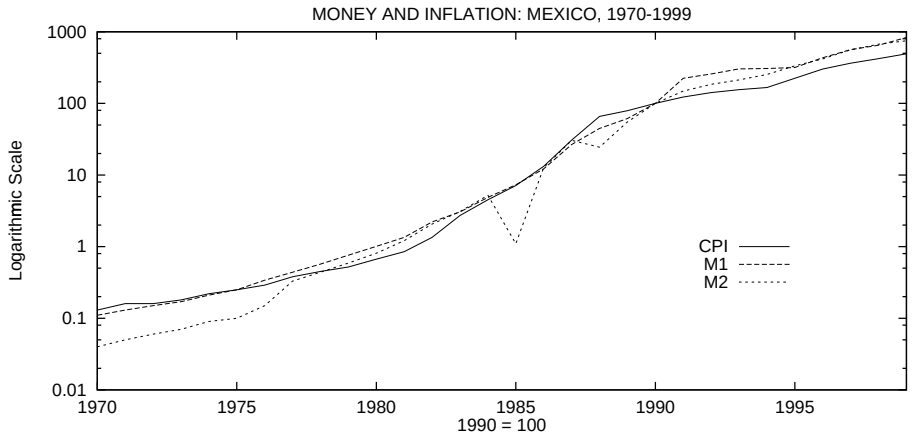


Figure 6.3 plots Mexico's money supply aggregates and CPI in time-series form. The series are indexed to 1990 = 100. Because the growth of money and prices has been so enormous, it is necessary to use a logarithmic scale on the vertical axis. Apart from a blip in the M2 series in 1985, which may well be due to a problem with the data, the money supply and CPI series correspond rather closely.

FIGURE 6.4:

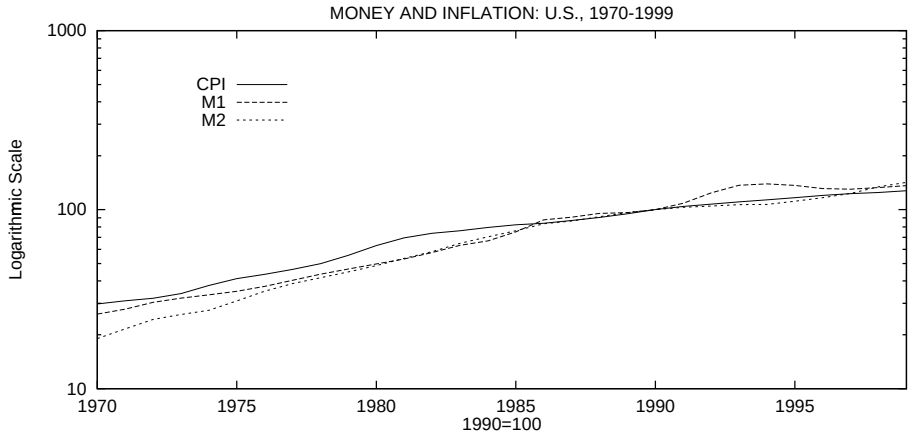


FIGURE 6.5:

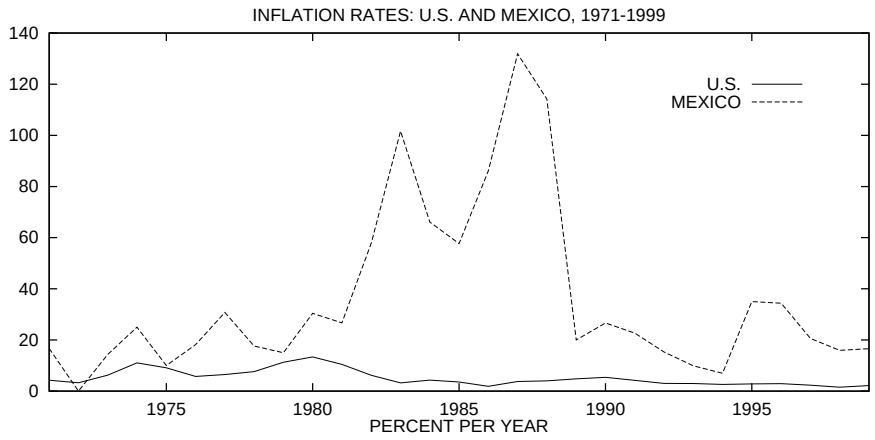


Figure 6.4 presents a time-series plot of the two monetary aggregates and the CPI, also indexed to 1990 = 100, for the United States, a low-inflation country. The differences in money growth and inflation between Mexico and the U.S. can be seen by comparing the scales on the two charts. The U.S. money supply aggregates and price level increase from in the neighborhood of 25 or 30 to a bit over 100. The Mexican aggregates increase from around 0.1 to 1000. As in the Mexican case, there is a close relationship between the paths of money and price-level growth for the United States.

FIGURE 6.6:

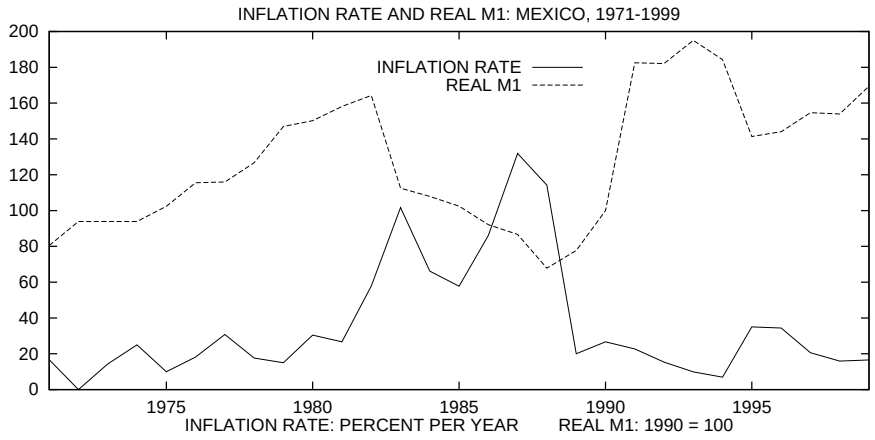


Figure 6.5 compares the year-over-year inflation rates of Mexico and the United States. The period of high inflation in the U.S. in the late 1970s, which prompted a change in the way monetary policy was conducted, pales to insignificance in comparison to the Mexican inflation rates ranging between 70 and 130 percent per year during the 1980s. Notice that the Mexican Government managed to get the country's inflation rate under some degree of control in the early 1990s, only to have a reoccurrence of somewhat higher inflation after the exchange rate crisis that occurred in late 1994.

The Mexican inflation rate and Mexicans' real M1 holdings are plotted in Figure 6.6. The money supply series is indexed to 1990 = 100. Notice how the level of real money holdings declined during the period of very high inflation in the mid-1980s and then rose back to its earlier level in the 1990s when more moderate inflation resumed. Real money holdings then fell again when the inflation rate increased in 1995.

The real money stock series tends to lag the inflation rate series slightly. This is what we would expect. When the inflation rate rises the public's expected rate of inflation also increases, but with a lag. This expected higher inflation rate increases the cost of holding money as compared to other assets, causing people to reduce their real money holdings. When the inflation rate returns to its old level, expected inflation declines, again with a lag. The cost of holding money thus declines and the quantity of real money balances held increases. Even the relatively small increase in the inflation rate in 1995 had an effect on real money holdings—the public may have viewed the 1994 crises and resulting increase in the inflation rate as a harbinger of things to come.

FIGURE 6.7:

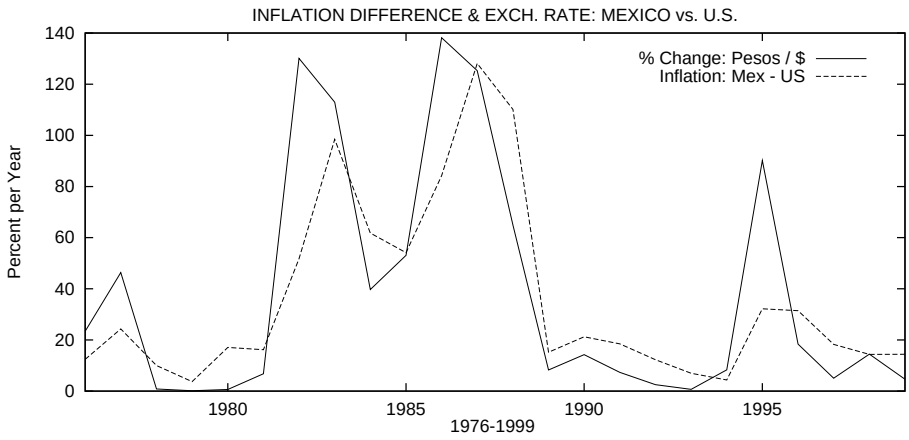
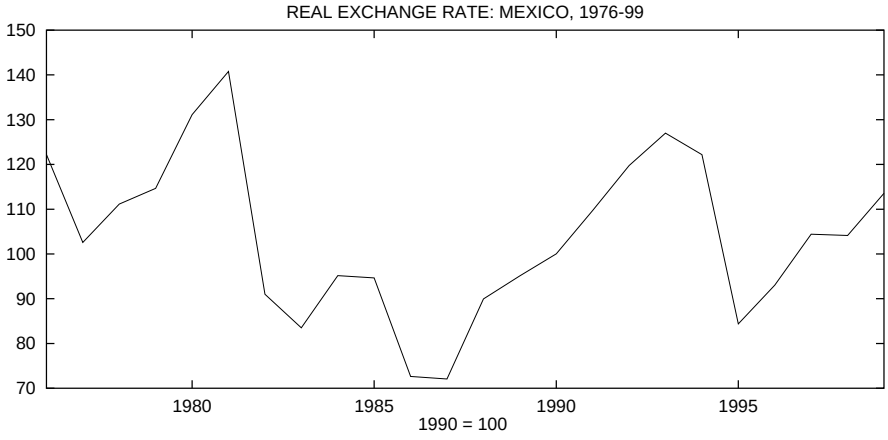


FIGURE 6.8:



The year-to-year percentage change in the peso price of the U.S. dollar is plotted in Figure 6.7 along with the excess of the Mexican inflation rate over the U.S. inflation rate. When the Mexican inflation rate was high relative to the U.S. inflation rate the rate of devaluation of the peso in terms of the U.S. dollar increased. This again is what we would expect. A decline in the internal value of the peso will be accompanied by a similar decline in the peso's external value. The difference between the Mexican and U.S. inflation rates does not exactly match the rate of devaluation of the peso.

This means that Mexico's real exchange rate with respect to the U.S.—that is, the relative price of Mexican goods in terms of U.S. goods measured in a single currency—was not constant during the period. The real exchange rate of Mexico vs. the U.S. is plotted in Figure 6.8. Variation in the real exchange rate is to be expected. The effects of technological change and differential real investment in Mexico relative to the U.S. would be expected to cause the relative price of Mexican goods in terms of U.S. goods to change as the two economies grow.

Study Questions

1. Write down an equation representing the demand for real money balances explain the factors determining the quantity demanded. How does your equation compare with the quantity equation?

2. Suppose that there is continuous full employment in the economy and that velocity is rising by 1% per year. If output is growing by 3% per year, what rate of money growth will produce zero inflation?

3. Explain why inflation is a tax on money.

4. The great economist Milton Friedman has said that "inflation is always and everywhere a monetary phenomenon." Explain what this statement means.

5. Explain why unions and firms cannot by themselves cause inflation.

References

N. Gregory Mankiw, *Macroeconomics*, Worth Publishers, 1992, 1994 or 1997 edition, Chapters 6 and 7.

Richard G. Lipsey, Paul N. Courant and Douglas D. Purvis, *Economics*, 8th Canadian Edition, HarperCollins, 1994, Chapters 12 and 13.