Lecture Notes: Chapter 8: Money, Prices, and Inflation

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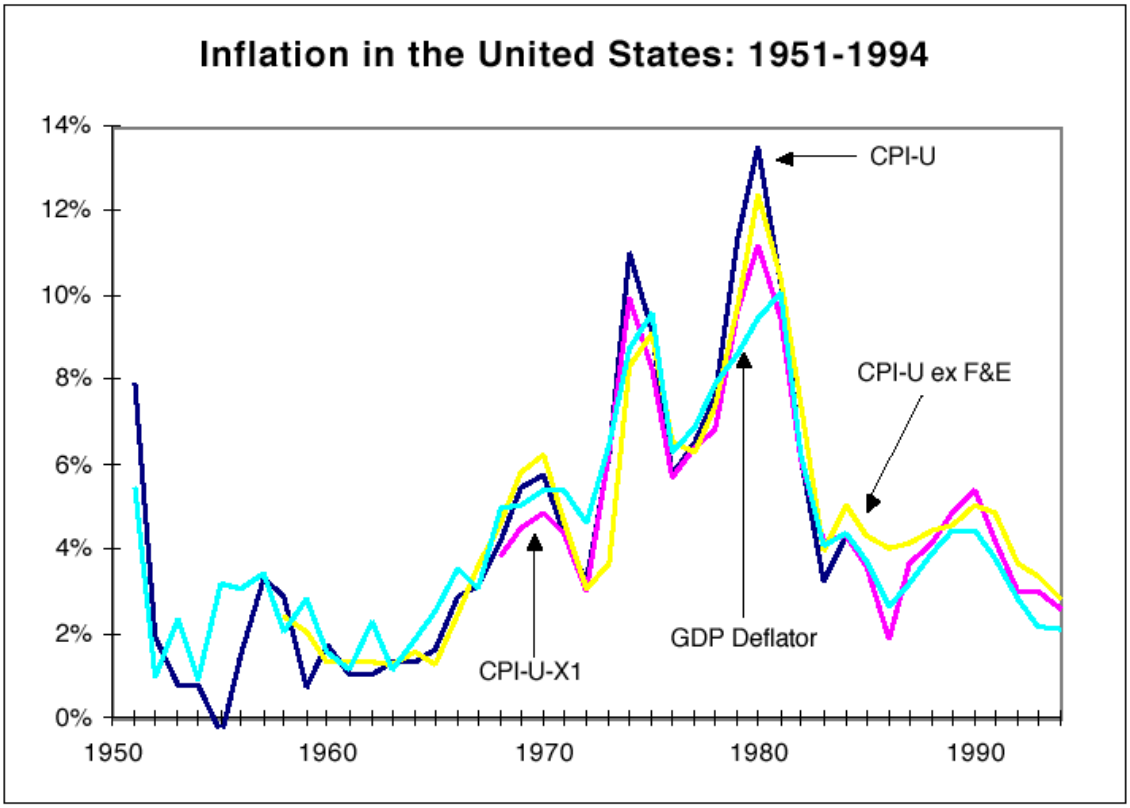
Money

Newspaper and television commentators devote a lot of attention to inflation. Inflation disrupts the economy in a number of different ways. Moreover, even when inflation is absent fear that it will emerge has a powerful effect on the economy. The actions of economic policy-making agencies like the Federal Reserve are tightly constrained by fear that certain courses of action will lead to inflation.

The U.S. experienced an episode of relatively mild inflation--prices rising at between five and ten percent per year--in the 1970s. Although relatively mild, that inflation was large enough to cause significant economic and political trauma. Avoiding a repeat of the inflation of the 1970s remains a major goal of economic policy even today, a quarter century later.

Many countries have experienced inflations that are *not* mild. In Russia in 1998 the price level rose at a rate of 60 percent per year. In Germany in 1923 prices rose at a rate of 60 percent per *week.* So-called *hyperinflations* have been seen in many other countries in this century, from Argentina to Ukraine, from Hungary to China. They are extremely destructive. They inflict severe damage on the ability of money to grease the wheels of the social mechanism of exchange that is the market economy. The system of prices and market exchange breaks down, and production can fall to a small fraction of potential output.



Legend: All measures of price changes show a burst of inflation in the U.S. in the 1970s.
Source: 2000 *Economic Report of the President* (Washington: GPO).

The power to analyze real variables without ever referring to the price level is a special feature of the full-employment flexible-price model of the economy. Economists call this the *classical dichotomy*: real variables (like real GDP, real investment spending, or the real exchange rate) can be analyzed and calculated without thinking of nominal variables like the price level. You will also hear economists speak of this as the property that "money" is *neutral,* or that "money" is a *veil*--a covering that does not affect the shape of the face underneath.

Here we explore what determines the overall level of prices and the rate of inflation (or deflation) in our full-employment flexible-price model of the macroeconomy. This is worth doing for two reasons. First, it provides a useful baseline analysis against which to

contrast the conclusions of future chapters. Second, whenever we look over relatively long spans of time--decades, perhaps--wages and prices *are* effectively flexible, they *do* have time to move in response to shocks, and the flexible-price assumption is a fruitful and useful one.

Money: Liquid Wealth That Can Be Spent

When normal people use the word "money," they may mean a number of things. "Money" may be used as a synonym for wealth: when we say "she has a lot of money," we mean that she is wealthy. "Money" may be used as a synonym for income: when we say "he makes a lot of money," we mean that he has a high income.

When an economist uses the word "money," however, he or she means something different. To an economist, "money" is wealth that is held in a readily-spendable form. Money is that kind of wealth that you can use immediately to buy things because others will accept it as payment. Today the economy's stock of money is made up of:

- Coin and currency, that are transferred by handing the cash over to the seller (which almost everyone will accept as payment for goods and services.
- Checking account balances, that are transferred by writing a check (which most people will accept as payment for goods and services).
- Other assets--like savings account balances--that can be turned into cash or demand deposits nearly instantaneously, risklessly, and costlessly.

Why do economists adopt this special definition of money? I do not know. Giving normal household words special definitions is probably a bad thing to do. It causes confusion and mistunderstanding. Yet economists do so for not only "money" but also for terms like "investment" and "utility."

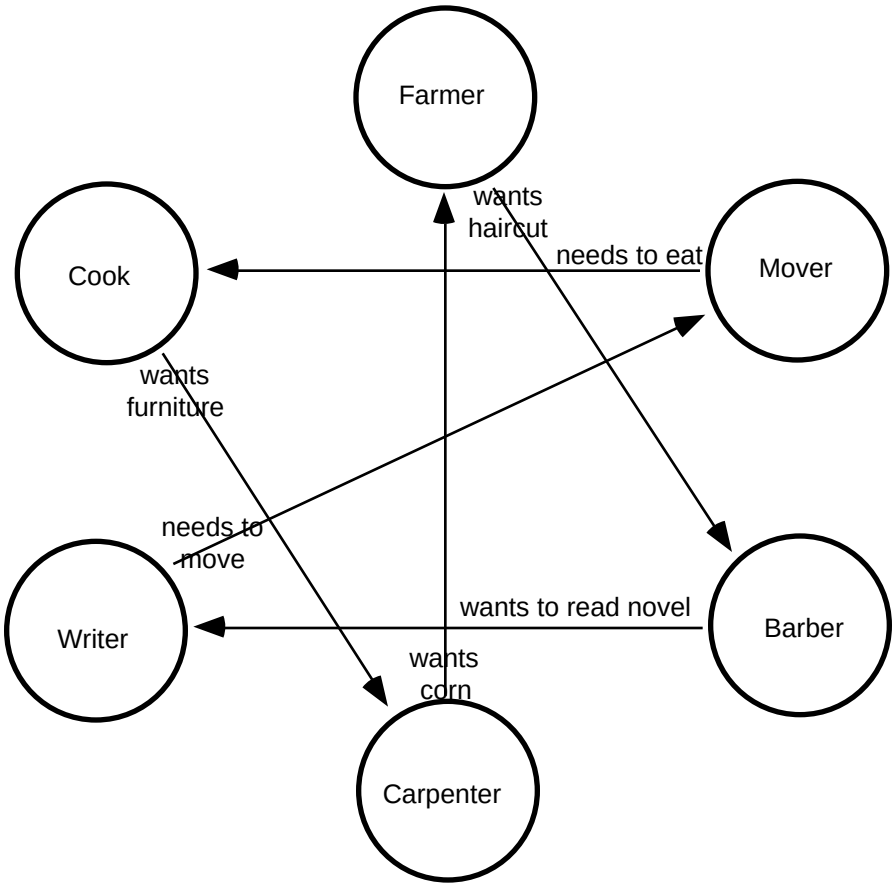
Whether assets that can be quickly and cheaply turned into cash like savings account balances, money market mutual funds, liquid Treasury securities, and so on are included in the money stock is a matter of taste and judgment. At what level of cost and inconvenience is an asset no longer "readily spendable"? There is no clear, hard, bright-line, unambiguous answer. Thus economists have a number of different measures of the money stock—identified by symbols like H, M1, M2, M3, and L--each of which draws

the line around a different set of assets that it counts as wealth readily *enough* spent to be "money."

The Usefulness of Money

Try to imagine a barter economy, an economy without the social convention of money. In our world all you need to carry out a market transaction--whether you want to buy or sell some good or service--is to either have money (if you want to buy) or for the purchaser to have money (if you want to sell). In a barter economy market exchange would require the so-called *coincidence of wants.* You would have to have physically in your possession some good or service that they wanted, and they would have to have in their possession some good or service that you wanted. As Figure 8.2 shows, finding consumption goods to satisfy the coincidence of wants would get remarkably complicated remarkably quickly. Without money, an extraordinary amount of time and energy would be spent simply arranging the goods one needed to trade.

Coincidence of Wants



Legend: Without money, how is the carpenter to persuade the farmer to give him corn when the farmer wants a haircut but doesn't need furniture--which the cook wants? How is the mover going to persuade the cook to feed him when the cook doesn't need the moving truck--the writer does? With money, all can sell what they have for cash and have confidence that they can then turn around and use the cash to buy what they need.

Units of Account

There is one other feature worth noting. The same assets that serve as the most common form of readily-spendable purchasing power also serve us as *units of account.* Dollars or euros or yen are not only what we use to settle transactions, but also what we use to quote prices to one another. At some times and places the function of money as a *medium of*

exchange and of money as a *unit of account* have been separated, but today they almost invariabley go together.

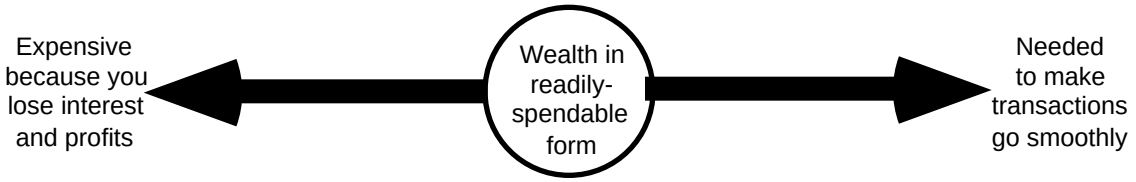
This is a potential cause of trouble. Anything that alters the real value of the domestic money in terms of its purchasing power over goods and services will also alter the real terms of those existing contracts that use the money as the unit of account. The effect of changes in the price level on contracts that have used the domestic money as a unit of account is a principal source of the social costs of inflation and deflation. The effect of changes in the exchange rate on contracts that have used foreign monies as units of account is a principal source of the social costs of currency crises.

The Quantity Theory of Money

People have a *demand* for money just as they have a demand for any other good. They want to hold a certain amount of wealth in the form of readily-spendable purchasing power because the stuff is useful. The more money in your portfolio, the easier it is to buy things. Too little money makes living one's life pointlessly difficult. You have to waste time running to the bank for extra cash or waste energy and time liquidating pieces of your portfolio before you can carry out your normal daily transactions.

On the other hand, you don't want to have too much of your wealth in the form of readily-spendable purchasing power. Cash sitting in your pocket is not earning interest at the bank. Wealth you will not want to spend for five years could earn a higher return as a certificate of deposit or invested in the stock market than sitting in your checking account.

Reasons for and Opportunity Cost of Holding Money



Legend: As with every other economic decision, the amount of wealth households and businesses wish to hold in the readily-spendable form of money depends on the benefits of holding money and the opportunity cost—the lost interest and profits—of doing so.

The theory that the only important determinant of the demand for money is the flow of spending is called the *quantity theory of money.* It is summarized in either the Cambridge (England) money-demand function:

$$M = \frac{1}{V} \times (P \times Y)$$

or in the (American) quantity equation:

$$M \times V = P \times Y$$

In either form of the quantity theory, P x Y represents the total nominal flow of spending. For each dollar of spending on goods and services, households want to hold 1/V dollars worth of money. The parameter V—a constant, or perhaps growing slowly and predictably trend (in this section of the chapter only—later on things become more complicated!)--is the *velocity* of money. The velocity of money is a measure of how "fast" money moves through the economy: how many times a year the average unit of money shows up in someone's income and is then used in to buy a final good or service that counts in GDP.

Thus if we know real GDP Y, the velocity of money V, and the money stock M, we can calculate that the price level is:

$$P = \left(\frac{V}{Y}\right) \times M$$

Should the price level be momentarily higher than the quantity equation predicts, households and businesses will notice that they have less wealth in the form of readily-spendable purchasing power than they wish. They will cut back on purchases for a little

while to build up their liquidity. As they cut back on purchases, sellers will note that demand is weak and cut their prices, so the price level will fall.

Example: Calculating the Price Level from the Quantity Equation

It is straightforward to use the quantity theory of money:

$$P = \left(\frac{V}{Y}\right) \times M$$

to calculate the price level. For example, in the third quarter of 1998 real GDP (in chained 1992 dollars) was equal to $7,566 billion, the M1 measure of the money stock was equal to $1,072 billion, and the velocity of money was equal to 7.964. Therefore:

$$P = \left(\frac{7.964}{\$7,556}\right) \times \$1,072 = 1.1284$$

In the third quarter of 1998 the price level was equal to 112.84% of its 1992 level, which works out to an average rate of inflation of about 2.14% per year from 1992 to 1998.

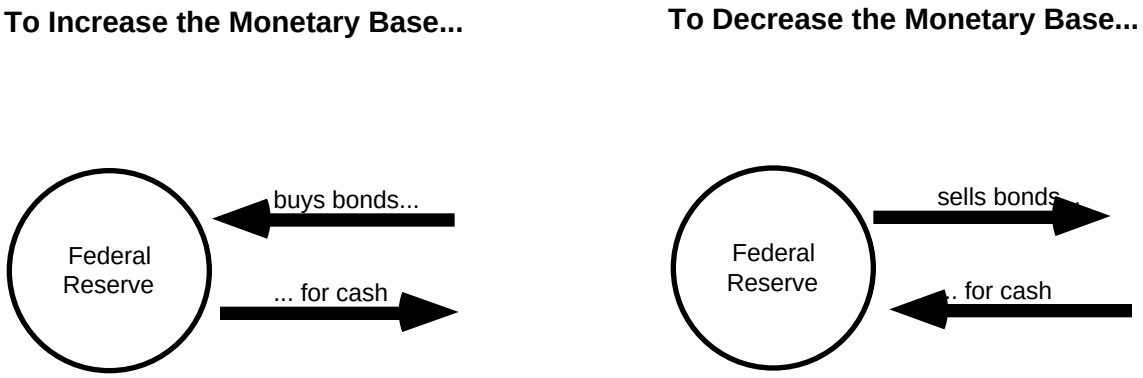
Had velocity grown an additional 10% between 1992 and 1998, the price level would have grown an additional 10% as well if the money stock and real GDP were unchanged from their historical values. Had the money stock growth by an additional 10% between 1992 and 1998, the price level would have grown by an additional 10% as well if velocity and real GDP were unchanged from their historical values. And had real GDP grown by an additional 10% between 1992 and 1998, this would have reduced the 1998 price level by 10% relative to its historical value if velocity and the money stock were unchanged from their historical values.

In the United States the Federal Reserve, the nation's central bank, determines the money stock. That is the basic task of *monetary policy*: the determination of the money stock.

The central bank directly determines the *monetary base*, the sum of currency in circulation and of deposits at the Federal Reserve’s twelve branches. When the central bank wants to reduce the monetary base it sells short-term government bonds and accepts currency or deposits at its regional branches as payment. The currency is then removed

from circulation and stored in a basement somewhere; the deposits it receives as payment are then erased from its books. Thus the monetary base declines. When the Federal Reserve wants to increase the monetary base it buys short-term government bonds, paying for them with currency or by crediting the seller with a deposit at the Federal Reserve. These transactions are called *open-market operations,* because the Federal Reserve buys or sells bonds on the open market. The procedures that govern when and how the U.S. central bank, the Federal Reserve, undertakes these transactions are decided at periodic meetings of the *Federal Reserve Open Market Committee [FOMC].*

Open Market Operations



Legend: The Federal Reserve controls the money supply through open market operations: purchases and sales of bonds on the open market. A purchase of bonds increases the economy's money stock. A sale of bonds sucks cash out of the economy and reduces the money stock.

The Federal Reserve directly controls the monetary base. The other measures of the money stock are determined by the interaction of the monetary base with the banking sector. Banks accept checking and savings account deposits. They loan out the purchasing power deposited in the bank, earn interest, and provide the depositor with a claim to wealth in readily-spendable form. But central banks limit commercial banks' ability to accept deposits. Central banks require that commercial banks redeposit at the Federal Reserve a certain proportion of their total deposits. Financial institutions also find it prudent to hold extra liquid reserves in case an unexpectedly large number of depositors seek to withdraw their money. There is nothing worse for a financial institution than for it to be unable to meet its depositors' demands for money. Thus as

Box 8.2 shows, broader measures of the money stock are larger than but limited in their growth by the size of the monetary base; the regulatory reserve requirements imposed on banks and other financial institutions; and financial institutions' extremely powerful incentive never to get caught without the cash to satisfy depositors' demands..

In this chapter (and, if truth be told, in later chapters too: these subjects are given short shrift in this book, but are explored in great depth in Money and Banking textbooks.

Details: Different Definitions of the Money Stock

The different definitions of the money stock all draw the line separating "money" from "not-money" in different places. Economists' definition of "money" considers any wealth held in the form of readily-spendable purchasing power to be money. But ready spendability is, to some degree at least, a thing found in the eye of the beholder.

The narrowest definition of money—called "H" for "**H**igh-Powered Money," or sometimes B for "Monetary **B**ase"—includes only cash and deposits at branches of the Federal Reserve. The assets that make up the monetary base are special because only they can serve as reserves to satisfy the Federal Reserve's requirement that institutions that accept deposits also maintain funds to cover any emergency spike in withdrawals.

The narrowest commonly-used definition of money is M1, which consists of currency plus checking-account deposits, travelers checks, and any other deposits where the depositor can demand his or her money back and get it instantaneously from the bank. Almost anyone will accept M1-type money as a means of payment for almost any purchase. M2 adds to M1 wealth held in the form of savings accounts, wealth held in relatively small term deposits, and money held in money-market mutual funds. Some of the money included in M2 cannot be spent without paying a penalty for early withdrawal. Moreover, if the bank wishes it has the legal right to delay your withdrawal for a period of time. M2-type money is a little bit less spendable than M1-type money.

There are still broader definitions of money. One of the broadest is M3, which includes large term deposits and institutional money-market fund balances. Still

larger is L, which includes savings bonds and Treasury bills. But a large chunk of these assets are not readily spendable by any stretch. Have you ever tried to buy something with a savings bond, or a Treasury bill?

The quantity equation:

$$P = \left(\frac{V}{Y}\right) \times M$$

leads immediately to an equation for the inflation rate π--the proportional rate-of-change of the price level if you recall our rule from Chapter 2 about how to calculate the proportional growth rates of products or quotients. Put simply, the proportional growth rate of a product is the sum of the growth rates of the terms multiplied together; the proportional growth rate of a quotient is the difference between the growth rates of the individual terms. Thus:

(inflation) = (velocity growth rate) + (money growth rate) - (real GDP growth rate)

To write this relationship in more compact form, use a lower-case m and a lower-case v for the proportional growth rates of the money stock and velocity, and use a lower-case y for the growth rate of real GDP. Then:

$\pi = m + v - y$

If the proportional growth rate of real GDP is 4% per year, the velocity of money V increases at a proportional rate of 2% per year, and the money stock M grows at 5% per year, then:

$\pi = 5\% + 2\% - 4\% = 3\%$

The inflation rate is three percent per year.

The Interest Rate and Money Demand

Representing the velocity of money as a constant or slowly-moving steady trend is misleading. In the real world, inflation is not always proportional to money growth.

For example, in the 1980s in the United States both inflation and the velocity of money fell sharply, but money growth in the 1980s was as fast as in the 1970s. Inflation fell even though money growth did not. In the first half of the 1990s there were further rapid declines in velocity, which meant that even relatively high money growth did not trigger accelerating inflation. The second half of the 1990s saw equally rapid increases in velocity, and so nominal money supply growth had to dip well below zero in order to keep inflation from rising.

Economic theory suggests that money demand should be *inversely* related to the nominal interest rate, which is the sum of the real interest rate and the current inflation rate. The cash in your purse or wallet does not earn interest. Your checking account balances earn little or no interest as well. As a result, their purchasing power over real goods and services erodes at the rate of inflation. The expected real return on keeping your money in readily spendable form is $-\pi^e$, the negative of the expected inflation rate.

By contrast, were you to take a dollar out of your checking account and invest it, its real return would be the real interest rate r. The difference between the rate of return on money balances and the rate of return on other assets is the *opportunity cost* of holding money. This opportunity cost is the sum of the inflation rate π^e and the real interest rate r: that is, the nominal interest rate i. The higher is this opportunity cost of holding money, the lower is the demand for money balances, as Figure 8.8 shows. Economic theory thus tells us that the velocity of money will be a function like:

$$V = V^L \times (V_0 + V_i \times (r + \pi^e))$$

where V^L is the financial technology-driven trend in the velocity of money, and $V_0 + V_i(r+\pi^e)$ captures the dependence of the demand for money on the nominal interest rate. The higher is the nominal interest rate $i = r+\pi^e$, the higher is the velocity function V, and the lower is the demand for money.

Such a function for velocity means that the demand for nominal money balances is:

Because the level of money demand depends on the current rate of inflation, we need to keep track of two equations to determine the behavior of money, prices, and inflation. The first comes directly from the money demand function, and is the equation for the price level:

$$M = \frac{P \times Y}{V^L \times (V_0 + V_i \times (r + \pi^e))}$$

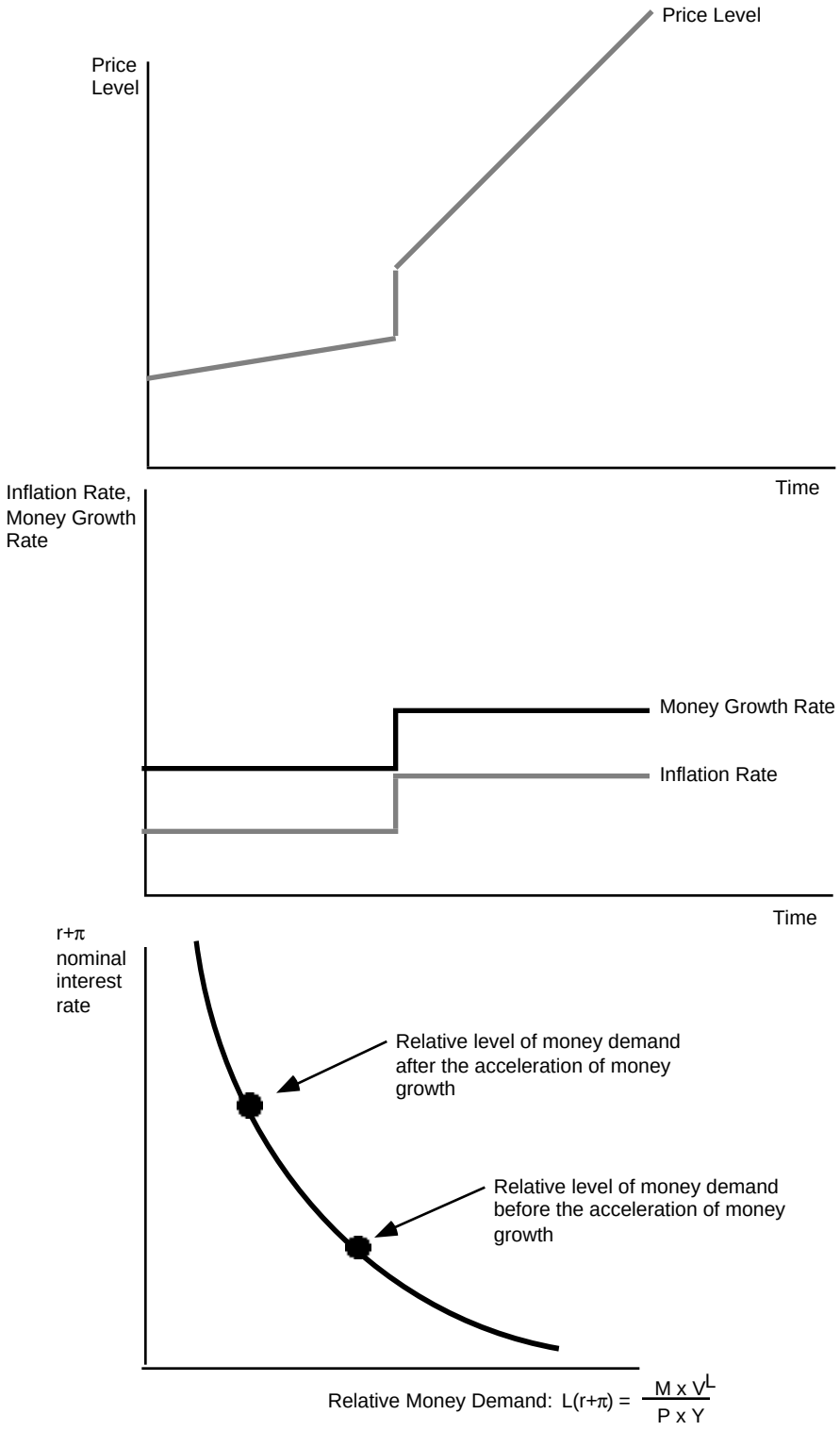
The second comes from the rate of change of the demand for money. If inflation is constant, and the proportional rate of change of the velocity trend is v, then as before:

$$\pi = m + v - y$$

Thus if the rate of growth of the money stock is +6% per year, the velocity trend is +1% per year, and real GDP growth is +4% per year, then inflation is 3% per year.

Now suppose that the rate of growth of the money stock suddenly increases permanently from 6% per year to 10% per year. When the economy settles down, the new inflation rate will be 4% per year higher--7% instead of 3% per year. But at an inflation rate of 7% per year, the opportunity cost of holding money was higher. If the real interest rate is stable at 3% per year, then the opportunity cost of holding money has just jumped from 6% to 10% per year.

Effects of an Increase in Money Growth



Legend: An increase in the rate of growth of the money stock leads to an immediate jump in the price level, to a step-up of the inflation rate, and to a fall in the quantity of money demanded as a fraction of nominal GDP.

A higher opportunity cost of holding money will raise the velocity of money. If the money stock and real GDP remain fixed, this increase in the velocity of money will cause the price level to jump suddenly and discontinuously, as is shown in Figure 8.9! By how much will the price level jump? It depends on how sensitive money demand is to changes in the nominal interest rate. The more sensitive is money demand to the nominal interest rate, the larger will be the sudden jump in the price level.

Thus in the flexible-price macroeconomy, a change in the rate of growth of the money stock not only changes the long-run inflation rate, it also causes an immediate jump in the price level at the moment that households and businesses become aware that the rate of money growth has changed.

The Costs of Inflation

Inflation does have costs, but they are subtle. For the most part, the costs of moderate inflation appear to be relatively small, smaller than one would guess given the strength of today's political consensus that price stability is a very desirable goal.

The Costs of Moderate Expected Inflation

The costs of *expected inflation* are especially small. Expected inflation raises the nominal interest rate, which you will recall is equal to the real interest rate plus the rate of inflation. Since the nominal interest rate is the opportunity cost of holding money balances, when the nominal interest rate is high you devote more time and energy to managing your cash balances. From the viewpoint of the economy as a whole, this extra time and energy is just wasted. Nothing useful is produced, and valuable resources that could be used to add to output or simply spent enjoying yourself are used up.

Expected inflation wastes time and energy in other ways as well. Firms find that they must spend resources changing their prices not because of any change in their business but simply because of inflation. Households find that it is harder to figure out what is a good and what is a bad buy as inflation pushes prices away from what they had perceived normal prices to be. The most serious costs of expected inflation surely come from the fact that our tax laws are not designed to deal well with inflation. Lots of productive activities are penalized, and lots of unproductive ones rewarded, simply because of the interaction of inflation with the tax system. The fact that debt interest is treated as a cost means that in times of high inflation it is artificially cheap to finance businesses by issuing bonds are borrowing at the bank, and so businesses adopt debt-heavy capital structures that may make the economy more vulnerable to financial crises and certainly increase the amount of resources wasted paying bankruptcy lawyers, as businesses with lots of debt tend to go bankrupt relatively easily.

Nevertheless when the rate of inflation is low—perhaps when inflation less than ten percent per year, probably when inflation is less than five percent per year, and certainly when nflation is less than two percent per year--these costs are too small to worry about because they are counterbalanced by benefits. Suppose the central bank wishes to push the real interest rate below zero in some economic crisis? It cannot do so unless there is some inflation in the economy, because nominal interest rates cannot be less than zero and the real interest rate is the difference between the nominal interest rate and the inflation rate. Many economists and psychologists have speculated that worker morale is greatly harmed if worker wages are clearly and unambiguously cut. A small amount of inflation may then grease the wheels of the labor market, allowing for wage adustment without the damaging effect on morale of explicit wage cuts.

The Costs of Moderate Unexpected Inflation

Unexpected inflation does have significant and worrisome costs, for unexpected inflation redistributes wealth from creditors to debtors. Creditors receive much less purchasing power than they had anticipated if a loan falls due during a time of significant inflation. Debtors find the payments they must make much less burdensome if they borrow over a period of significant inflation. The process works in reverse as well: if inflation is less than had been expected, creditors receive a windfall and debtors go bankrupt. Most people are averse to risk. We buy fire insurance, after all. People who are averse to risk

dislike uncertainty and unpredictability--and unexpected inflation certainly creates uncertainty and unpredictability.

Yet perhaps these economic costs of moderate unexpected inflation are relatively low. Why don't debtors and creditors want to insure themselves against inflation risk by *indexing* their contracts and using some alternative, more stable unit of account? In economies with high and variable inflation, we do see such indexation. The fact that we do not in countries with moderate and low inflation suggests that the costs of inflation to individual debtors and creditors (though perhaps not to society as a whole) must be relatively low.

On the other hand, there is a powerful political argument that the costs of moderate inflation are high. Voters do not like moderate inflation. The 1970s saw government after government in the industrialized world voted out of office. Polls showed that voters interpreted rising rates of inflation as signs that political parties in power were incompetent at managing the economy. Since the end of the 1970s, no major political party in the industrialized world has dared run on a platform of less price stability, and more inflation.

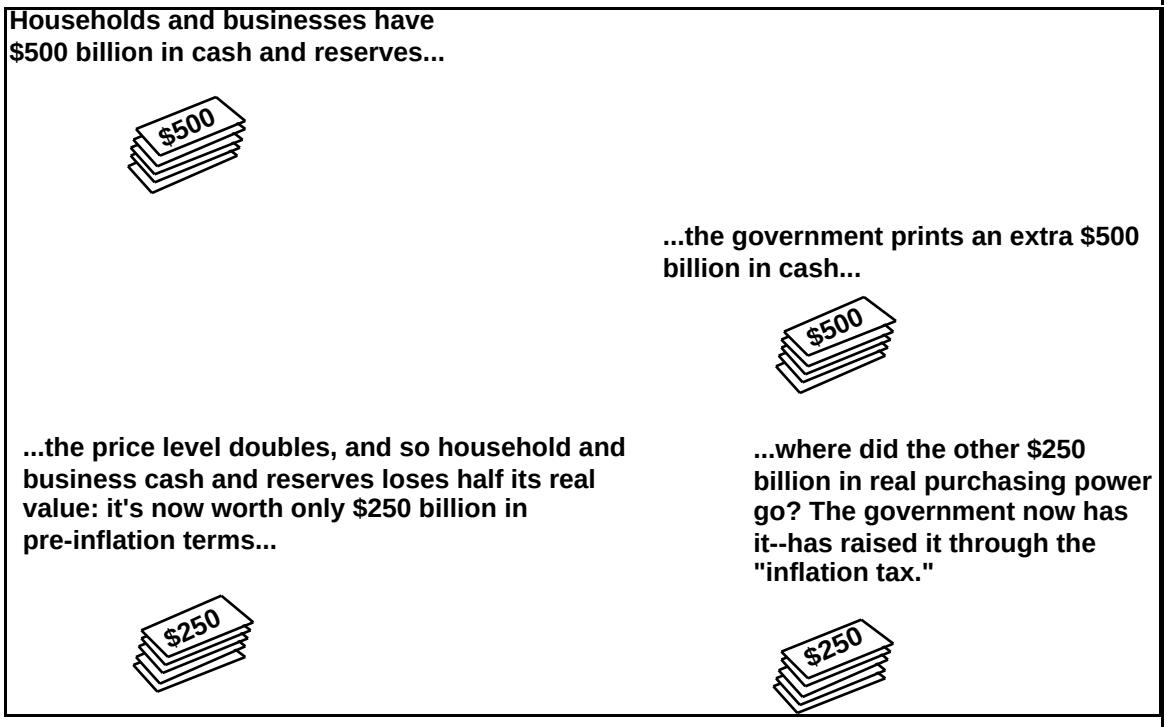
Hyperinflation and Its Costs

We can see the costs of inflation mount to economy-destroying levels during episodes of so-called *hyperinflation*, when inflation rises to more than 20 percent *per month*. Hyperinflations arise when governments attempt to obtain extra revenue by printing money, and overestimate how much they can raise. For some governments, printing money is an important source of revenue. Most governments tax their citizens, or borrow from people who think that the government will pay them back. But if a government finds that it does not have the administrative reach to increase its explicit tax take and that no one will lend to it, it can simply print money and use the bills hot off the press to purchase goods and services.

Where do the resources--the power to buy goods and services--that the government acquires by printing money come from? The answer is that a government that finances its spending by printing money is actually financing its spending by levying a tax on holdings of cash. Suppose I have $500 in cash in my pocket when the government

suddenly announces it has printed up enough extra dollar bills to double the economy's cash supply. With Y and V unchanged, doubling the money supply doubles the price level. The $500 in my pocket will buy only as much after the government's money-printing spree as $250 would have bought before. It is as if the government levied a special one-time 50% tax on cash holdings.

The Inflation Tax



Legend: The inflation tax is a way for the government to get command over goods and services just as much as is any other tax. Those who pay the inflation tax are those who hold assets that lose value in the event of inflation.

Where did the $250 real dollars in my pocket go? The government has them: it now has 500 newly-printed dollars, even if each of them is worth half a pre-inflation dollar in real terms. Clearly, printing money can be easier than imposing a 50% explicit tax. To collect an explicit tax a government needs need an entire wealth-tracking, money-collecting, and compliance-monitoring bureaucracy. To print money all the government needs is a

printing press, some ink, some paper, and a working connection to the electric power grid.

Almost everyone agrees that this *inflation tax*--also called *seigniorage* because the right to coin money was originally a right reserved to certain feudal lords, certain *seigneurs*--is a bad policy. One of the first principles of public finance is that taxes should be broad-based and lie relatively lightly on economic activity. The inflation tax is a heavy tax on a narrow base of economic activity, the activity of holding money. Moreover, the inflation tax is a heavy tax on one small slice of money-holding: cash and deposits at the central bank.

Other components of the money stock--your checking account, say--are not a potential source of purchasing power for the government through the inflation tax. Suppose that you deposited your money in your checking account and the bank then took that purchasing power and used it to buy an office building. If the price level doubles you have lost half the real value of your checking account, yes. But the gainer in real terms is not the government. The gainer in real terms is the bank that now finds the value of the office building it owns to be twice as large relative to the value of the money it owes to its depositors is not only a bad tax, but in its operation it disrupts the rest of the financial system as well.

For these reasons, the inflation tax is only resorted to by a government that is falling apart and lacks the administrative capacity to raise money in any other way. Even so, such a government usually finds out afterwards that the costs of the inflation tax and hyperinflation outweigh the benefits . Eventually prices rise so rapidly that the monetary system breaks down. People would rather deal with each other in barter terms than use a form of cash whose value is shrinking measurably every day. GDP starts to fall as the economy begins to lose the benefits of the division of labor. In the end the government finds that its currency is next to worthless. It runs the printing presses faster and faster and yet finds that the money it prints buys less and less. At the end of the German hyperinflation of the 1920s, one trillion marks were needed to buy what one mark had bought less than ten years before.