

# **LECTURE NOTES ON MACROECONOMIC PRINCIPLES**

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# Ch 30 Money Growth and Inflation

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## Introduction

Remember our previous example from Chapter 23, “Measuring the Cost of Living.” In 1931, the Yankees paid Babe Ruth an annual salary of \$80,000. But then again, in 1931, an ice cream cone cost a nickel and a movie ticket cost a quarter.

The overall increase in the level of prices, as measured by the CPI or the GDP deflator, is called **inflation**.

Although most economies experience at least some inflation most of the time, in the 19<sup>th</sup> century many economies experienced extended periods of falling prices, or **deflation**. And deflation became a threat once again in the US during the recession of 2008 and 2009.

Further, over recent decades, there have been wide variations in the inflation rate as well: from rates exceeding 7 percent per year in the 1970s to the current rate of about 2 percent per year.

And in some countries during some periods, extremely high rates of inflation have been experienced. In Germany after World War I, for instance, the price of a newspaper rose from 0.3 marks in January 1921 to 70,000,000 marks less than two years later. These episodes of extremely high inflation are called **hyperinflations**.

But exactly what economic forces produce inflation, and lead to variations in the rate of inflation?

An economic theory called the **quantity theory of money** indicates that excess money creation is the underlying cause of inflation. Interestingly, the 18<sup>th</sup> century Scottish philosopher David Hume was one of the first to formulate a version of the quantity theory of money. A more recent proponent was Milton Friedman.

After developing the quantity theory of money to explain inflation, this chapter goes on to identify the costs that inflation, particularly when it reaches very high rates, imposes on the economy.

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## The Classical Theory of Inflation

The quantity theory is often called the **classical theory of inflation**, because it can be traced back to Hume and other early writers on economics.

### The Level of Prices and the Value of Money

We've already observed that, for example, an ice cream cone costs a lot more today than it did in the 1930s:

- Is this because ice cream cones are so much better today, that people are willing to pay more for them? Probably not.
- More likely, the rise in the price of an ice cream cone indicates that dollars have become less valuable, not that ice cream cones have become more valuable.
- In essence, that's what the quantity theory is all about: the value of money as opposed to the value of goods.

To make this idea concrete, let  $P$  denote the price level, as measured by the CPI or the GDP deflator:

$P$  = number of dollars needed to purchase a basket of goods and services

$$P = \frac{\text{dollars}}{\text{basket of goods}}$$

Now flip the reasoning around:

$$\frac{1}{P} = \frac{\text{baskets of goods}}{\text{dollars}}$$

$1/P$  = number of basket's of goods needed to "purchase" a dollar

This last equation highlights that inflation, an increase in  $P$ , represents a *decline* in the value of money.

Another way to think about this idea:

- $P$  is the "dollar price of goods"

- $1/P$  is the “goods price of a dollar”

## Money Supply, Money Demand, and Monetary Equilibrium

Let’s build on this idea that  $1/P$  measures the goods price of a dollar.

Figure 1 applies standard microeconomic supply-and-demand theory to money:

- The quantity of the good – in this case money – appears on the horizontal axis.
- The price of the good – in this case  $1/P$  – appears on the vertical axis.
- The money demand curve slopes downward. There are two ways to think about this:
  - o When the price of money rises, the demand for money falls.
  - o When the goods price of money  $1/P$  rises, the dollar price of goods  $P$  falls. Since fewer dollars are needed to buy the same number of goods, the demand for money falls.
- The money supply curve is vertical, as the money stock is determined by Federal Reserve policy (and by the response of banks to that policy).
- The goods price of money  $1/P$  is determined by the intersection between demand and supply.
- When the goods price of money is below its equilibrium value, there is excess demand for money, putting upward pressure on the goods price of money until equilibrium is restored.
- When the goods price of money is above its equilibrium value, there is excess supply of money, putting downward pressure on the goods price of money until equilibrium is restored.
- Translate the goods price of money  $1/P$  back into the money price of goods  $P$ , and the same theory determines the price level.

## The Effects of a Monetary Injection

Figure 2 illustrates what happens when the Fed acts to increase the money supply, either by

- Using open market operations to increase the supply of reserves to the banking system, which then increases the money supply working through the money multiplier, or
- Lowering its target for the federal funds rate, which requires it to use open market operations to increase the supply of reserves to the banking system.

When the supply curve shifts, a new equilibrium occurs at a lower goods price of money  $1/P$  and hence a higher price level  $P$ .

The upshot is that inflation, a rising price level, is associated with a policy of money creation.

This theory is called the **quantity theory of money**, as it asserts that the quantity of money available determines the price level and the growth rate of money available determines the inflation rate.

## A Brief Look at the Adjustment Process

Figure 2 can also be used to think about the process through which money creation leads to a higher level of prices.

Suppose again that the money supply curve shifts, reflecting an increase in the money supply.

- If  $1/P$  does not change, there is an excess supply of money. In other words, people find themselves with more money than they need.
- Some people will use the extra money to buy more goods and services. This causes the money price of goods  $P$  to increase, and the goods price of money  $1/P$  to fall.
- Other people will deposit the extra money in the bank. But then the bank will lend the money to a borrower who wants to buy more goods and services. Again,  $P$  will rise and  $1/P$  will fall.
- This process will continue until monetary equilibrium is restored at a higher price level.

## The Classical Dichotomy and Monetary Neutrality

The quantity theory of money describes how changes in the money supply affect the price level. But how do those changes affect other economic variables, like GDP, unemployment, and interest rates?

David Hume and his contemporaries suggested that economic variables be divided into two groups.

1. **Nominal variables** that are measured in units of money (monetary units).
2. **Real variables** that are measured in units of goods (physical units).

According to this classification, for example:

- Nominal GDP is a nominal variable because it measures the dollar value of an economy's output of goods and services.
- Real GDP is a real variable because it measures the value of an economy's output of goods and services correcting for inflation, that is, eliminating the effects of changes in the value of money.
- The CPI is a nominal variable because it measures the number of dollars that are required to purchase a basket of goods and services.
- The unemployment rate is a real variable because it measures the percentage of the labor force that is unemployed.

This theoretical separation of nominal and real variables is called the **classical dichotomy**.

The quantity theory of money implies that changes in the money supply affect nominal variables.

The theory of **monetary neutrality** goes a step further, and says that changes in the money supply do *not* affect real variables.

Hume's thought experiment:

- Suppose that the money supply doubles from \$100 million to \$200 million.
- Everybody has twice as much money, but the ability to produce goods and services has not changed.
- Introspection suggests that the overall price level  $P$  should double, leaving output and all other real variables unchanged.
- An analogy: suppose that the definition of a foot was changed from 12 inches to 6 inches. Would this make everyone twice as tall? No! Everyone would physically be the same height as before, but their height when measured in feet would be twice as big.

- Similarly, when the government doubles the money supply, the physical quantity of goods produced would be the same as before, but prices measured in dollars would all be twice as big.

Hume conceded that it might take time for the price level to fully adjust to a change in the money supply. Today, most economists agree that the adjustment process takes time.

But Hume and most economists today also agree that in the long run, monetary neutrality holds true.

## Velocity and the Quantity Equation

A complementary perspective on the quantity theory of money builds on the idea of the **velocity of money**, defined as the rate at which money changes hands, as measured by the number of times each dollar in the economy gets spent during a year.

Mathematically, the velocity of money  $V$  is defined as

$$V = (P \times Y)/M$$

Where  $Y$  is real GDP,  $P$  is the GDP deflator,  $P \times Y$  is nominal GDP – recall that nominal GDP measures the dollar value of expenditures in the economy as a whole – and  $M$  is the quantity of money.

Example:

- Suppose that an economy produces only a single good, pizza.
- The economy produces 100 pizzas per year, so that  $Y = 100$ .
- Each pizza costs \$10, so that  $P = 10$ .
- The quantity of money is \$50, so that  $M = 50$ .
- In math,  $V = (P \times Y)/M = (10 \times 100)/50 = 1000/50 = 20$ .
- In words, total spending is  $\$10 \times 100 = \$1000$ . But the money is \$50. So each dollar has to be spent  $1000/50 = 20$  times.

Rearranging the equation defining the velocity of money leads to the so-called **quantity equation**:

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

Figure 3 plots the money supply  $M$ , nominal GDP  $P \times Y$ , and velocity  $V$  in the US since 1960:

- Velocity  $V$  has remained relatively stable.
- Hence, long-run increase in  $M$  has been paralleled by a long-run increase in nominal GDP.

In terms of the quantity equation, the quantity theory of money and the closely related idea of monetary neutrality can be stated as:

1. The velocity of money  $V$  is relatively stable over time.
2. Because velocity is stable, an increase in the money supply  $M$  leads to an increase in nominal GDP  $P \times Y$ .

3. The increase in  $M$  does not affect real GDP  $Y$  in the long run, because the economy's output of goods and services  $Y$  is primarily determined by the availability of factors of production (labor, physical capital, human capital, and natural resources) and by the stock of technological knowledge (recall our analysis from Chapter 24).
4. Hence, in the long run, the increase in nominal GDP brought about by an increase in the quantity of money is reflected in the price level  $P$  rather than real output  $Y$ .
5. And so, when the central bank increases the money supply, the result is inflation.

Figure 4 shows the behavior of money supplies and inflation rates during four periods of hyperinflation.

- In all four cases, price levels rose dramatically in tandem with money supplies.
- And in all four cases, when the extreme growth in the money supply ended, so did the hyperinflation.
- Analysis of these extreme historical cases bolstered economists' confidence in the quantity theory of money.

## The Inflation Tax

Why do some economies experience hyperinflation?

Almost always, it is because the government needs to raise revenue to finance spending, but for political reasons cannot obtain that revenue through standard income taxation. Hence, it must pay for the goods and services it purchases not with existing money collected through taxes, but instead using newly-created money.

Since money creation leads to inflation, the **inflation tax** refers to the revenue that the government raises through money creation.

Historically, many cases of hyperinflation occur during or after a war, when the government is in need of large amounts of revenue to finance high levels of spending, and may not have the ability to raise this revenue through standard income taxation. All of the hyperinflations shown in Figure 4, for example, occurred in the aftermath of World War I.

## The Fisher Effect

Another application of the classical dichotomy is to interest rates:

- The **nominal interest rate** is the interest rate measured without correcting for inflation.
- The **real interest rate** is the interest rate measured after correction for inflation.

Recall from Chapter 24 that mathematically,

$$\text{Real Interest Rate} = \text{Nominal Interest rate} - \text{Inflation Rate}$$

Example:

- A bank pays interest at the rate of 7 percent per year.
- You deposit \$100 today, and have \$107 at the end of one year.

- But the inflation rate is 3 percent, so your money next year buys 3 percent less.
- Your real, or inflation-adjusted, return, is 7 percent – 3 percent = 4 percent.

We can rearrange this equation to read

$$\text{Nominal Interest Rate} = \text{Real Interest Rate} + \text{Inflation Rate}$$

Under monetary neutrality, an increase in the rate of money growth will increase the rate of inflation, but leave the real interest rate unchanged.

Hence, under monetary neutrality, an increase in the rate of money growth will lead to a higher nominal interest rate as well as a higher rate of inflation.

This application of monetary neutrality to interest rates is associated with the economist Irving Fisher, and the predicted association of the nominal interest rate and the inflation rate is called the **Fisher effect**.

Figure 5 plots the inflation rate and the nominal interest rate in the US economy since 1960. Note that these two variables move together, providing evidence for the Fisher effect.

## The Costs of Inflation

Generally, economists and non-economists alike believe that inflation is costly for the economy. But why?

### A Fall in Purchasing Power?

Many people dislike inflation because they believe it erodes the purchasing power of their income.

What this argument fails to recognize is that while inflation leads to an increase in the dollar prices of goods and services, it also leads to an increase in nominal (dollar-denominated) wages and incomes.

Real (inflation-adjusted) wages and incomes should, according to the principle of monetary neutrality, remain unaffected.

This argument would appear to be a fallacy, so long as monetary neutrality holds.

### Shoeleather Costs

But inflation does erode the value of money that each person holds in his or her wallet.

Thus, when inflation rises, people make greater efforts to reduce the amounts of money that they hold, for example, by going to the bank or the ATM more often, but withdrawing smaller amounts each time.

The costs that are associated with these efforts are called **shoeleather costs**, based on the imagery of someone wearing out his or her shoes walking to the bank more often.



Generally, under moderate rates of inflation like those currently prevailing in the US, shoeleather costs appear small – maybe even trivial.

But these costs can be substantial during episodes of hyperinflation.

- During the Bolivian hyperinflation of 1985, prices rose at an annual rate of 38,000 percent.
- This translates into a *daily* rate of inflation of about 1.65 percent. Over the course of a week, money loses 12 percent of its value.
- As soon as people received their paychecks, they rushed to either spend the money or convert pesos into US dollars.

## Menu Costs

**Menu costs** refer to the costs that firms incur when changing their prices, based on the imagery of a restaurant having to print up new menus.

Again, these costs appear quite small under modest rates of inflation, but get much bigger as inflation rises.

## Relative Price Variability and the Misallocation of Resources

Building on the menu cost story, suppose that a restaurant prints new menus with new prices once per year, while the economy experiences continual inflation throughout the year.

At the beginning of the year, just after the new menus have been printed, the restaurant's prices are high relative to the overall price level. But, as the price level rises because of inflation, the restaurant's relative prices decline.

But these changes in prices have nothing to do with changes in the costs of preparing and serving food.

In this example, inflation interferes with the market's ability to use prices to efficiently allocate scarce resources.

## Inflation Induced Tax Distortions

While all of the costs mentioned so far appear to be minor in a low-inflation economy like the US, costs relating to the operation of the tax system may be more important.

Table 1 illustrates an example of how inflation interacts with the tax system.

- Consider two economies, one in which the inflation rate is zero and the other in which the inflation rate is 8 percent.
- In both economies, the real interest rate is 4 percent.
- The differences in interest rates lead, through the Fisher effect, to differences in nominal interest rates. With zero inflation, the nominal interest rate is 4 percent, but with 8 percent inflation, the nominal interest rate is 12 percent.
- Suppose that interest income is taxed at the rate of 25 percent.

- This means that with a 4 percent *before tax* interest rate, the saver pays 1 percent in taxes.
- But with a 12 percent *before tax* interest rate, the saver pays 3 percent in taxes.
- With zero inflation, the *after tax* real return to saving is 3 percent.
- But with 8 percent inflation, the *after tax* return is just 1 percent.

Hence, saving may be much lower in the economy with 8 percent inflation.

### Confusion and Inconvenience

Recall the analogy used earlier in our discussion of monetary neutrality: in a sense, a doubling of the money supply and a corresponding doubling of the price level is like changing the definition of a foot from 12 inches to 6 inches.

If the definition of a foot, or a pound, or a mile were continually changed, it would be confusing and inconvenient to make comparisons over time.

Extending the analogy, the same might be said about the effects of inflation.

### Arbitrary Redistributions of Wealth

Suppose that you take out a 30-year mortgage at 7 percent interest, expecting the inflation rate to be 3 percent.

The real interest rate that you are paying is 4 percent.

But now suppose that unexpectedly, inflation turns out to be 1 percent.

Now the real interest rate that you are paying is 6 percent – considerably higher. The bank wins, but you lose.

On the other hand, if inflation turns out to be 5 percent, the real interest rate you pay is only 2 percent. You win, but the bank loses.

Unexpected changes in inflation lead to redistributions of wealth across borrowers and lenders. On net the effects cancel out, but before knowing who wins and who loses, everyone might object to the arbitrariness of these potential redistributions.

### Inflation is Bad, But Deflation May Be Worse

The mortgage example from above highlights why inflation is bad, but also suggests why deflation, especially unexpected deflation, may be even worse.

Deflation hurts people who have borrowed – farmers during the Great Depression and homeowners more recently – who may already be suffering the most from an economic downturn.

### Conclusions

Both theory and evidence points to excessive money growth as the principal cause of inflation.

Many sources of the costs of inflation appear trivial when inflation is low, but become much more significant when inflation is much higher.

However, even at modest rates of inflation, interactions between inflation and the tax code can have negative effects of saving. And even small changes in inflation, if unexpected, can lead to large and arbitrary redistributions of wealth across borrowers and lenders.