Chapter 7: Money and Inflation

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Money and Its Functions

Money is an asset that can be used to support transactions.

Functions of money:

1. A Store of value: use money to support transactions in future periods.
2. A unit of account: money provides the terms in which prices are quoted and debts recorded; a unit of measurement of economic transactions.
3. A medium of exchange: a means to support transactions (a 'legal tender'). The ease with which an asset can be converted into goods and services is called the asset's liquidity.

Types of Money

Money that has no intrinsic value is called fiat money. Established as money by government decree, fiat.

Money that takes the form of commodity and so has an intrinsic value is called commodity money (e.g., gold).

Fiat money evolves in the economy naturally.

Money supply in the economy: who controls it and how?

The quantity of money in the economy is called the money supply. In economies with fiat money, government has a legal right to print the money and, thus, to effectively control the money supply.

Monetary policy is typically delegated to an institution called central bank. In Canada, it is Bank of Canada.

Bank of Canada controls money through the open-market operations—the purchase or sale of government bonds. To increase the money supply, the Bank of Canada buys government bonds from the public; to reduce money supply, it sells government bonds in its possession, thereby exchanging bonds for money bills in hands of the public.

Another mechanism for controlling the money supply by a central bank is to change the required reserve-deposit ratio. We'll talk about it later...

Different measures of money supply

Money supply is the quantity of money used for transactions.

Besides coins and paper money bills, we also use checking and other accounts to support transactions.

Economists group assets into different measures of money—B, M1, M2, etc. E.g., B—the base money—is the sum of currency in circulation and required deposits of commercial banks held in the central bank; M1 includes currency in circulation and money in checking accounts, etc.

The quantity theory of money

Money is used to support transactions.
The quantity equation (identity):

$$M \times V = P \times T,$$

where T is the total number of transactions, say, during a year; P is the price of a typical transaction—the number of dollars exchanged; M is the quantity of money; V is the transactions' velocity of money—a number of times one dollar bill changes hands, say, in a year.

Example

While M, P, and T can be observed, V is not, and need to be defined from the quantity equation.

Assume the economy produces 60 loaves of bread and nothing more (T=60); the price of one loaf is \$0.50 (P=0.50); and the quantity of money in the economy is \$10 (M=10).

V=(60 loaves/year $\times$0.50\$/loaf)/\$10=(\$30/year)/\$10=3 times per year.

The Quantity Equation of Money

The number of transactions, T, is difficult to measure. Thus, we replace T with Y, the real output of goods and services produced in the economy.

T and Y are proportionate to each other, but not the same. We can express the quantity equation of money as:

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

V is now called the income velocity of money; $P \times Y$ is the nominal GDP.

The Money Demand Function

$\frac{M}{P}$ are called real money balances, and measure the quantity of goods you can afford given the amount of money M you have and the typical price of a good, P.

A money demand equation can be expressed as:

$$(M/P)^d = k \times Y,$$

where k is a constant of proportionality. Money demand tells you that the desired real money balances in the economy are proportional to the total real output (income).

The Money Demand and the Quantity Equation

In the equilibrium of the money market, the money supply is equal to the money demand, and so: $M/P=(M/P)^d$.

Using the money demand equation, we obtain: $(M/P) = k \times Y$.
Rearranging, we obtain:

$$M \times (1/k) = P \times Y.$$

Making use of the quantity equation of money, we obtain $1/k=V$.

Thus, when public wants to hold a lot of money per unit of real income—k is large, and the velocity—the number of times the money changes hands to support aggregate transactions in the economy—is small. Conversely, when k is small, V should be large—to support the same amount of real purchases.

Constant Velocity

In general, k, and therefore V are not constant. k may depend on innovations in financial industry (e.g., invention of ATM machines leads to lower k).

Assume that k and V are constant.

Then, the quantity equation is:

$$M \times \overline{V} = P \times Y$$

Money, Prices and Inflation

In percentage terms, the quantity equation becomes:

$$\frac{\Delta M}{M} + \frac{\Delta \overline{V}}{\overline{V}} = \frac{\Delta P}{P} + \frac{\Delta Y}{Y}.$$

Since we assumed that $\overline{V}$ is a constant, $\frac{\overline{\Delta V}}{\overline{V}}=0$, and therefore $\frac{\Delta M}{M} = \frac{\Delta P}{P} + \frac{\Delta Y}{Y}$.

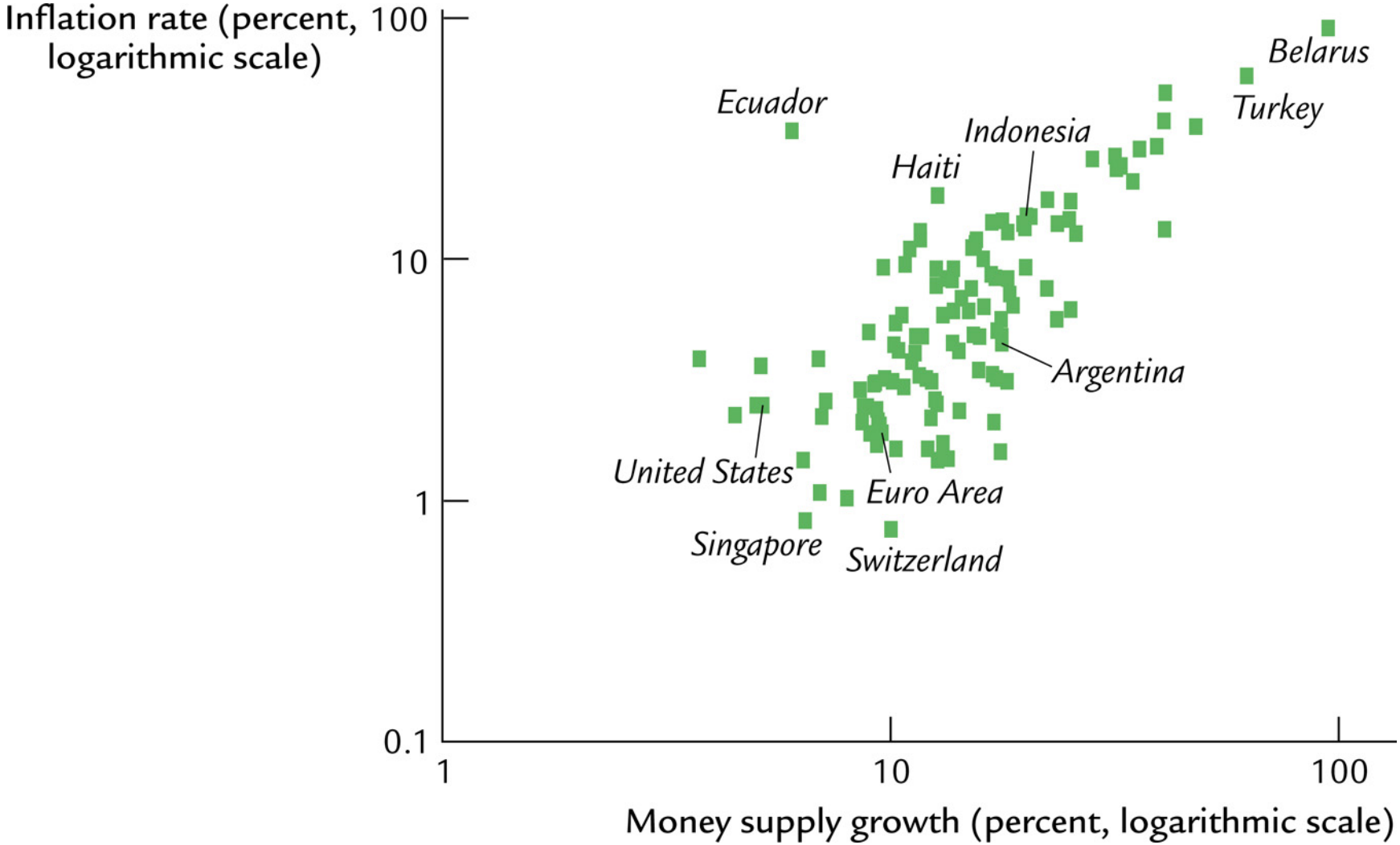
In the long-run, the production of output is limited by the availability of the factors of production. In a version of Solow model with technological growth, $\frac{\Delta Y}{Y}=n+g$. Thus,

$$\frac{\Delta M}{M} = \frac{\Delta P}{P} + (n+g)$$

The Quantity Theory of Money

Note that $\frac{\Delta P}{P}$ is the inflation rate, and n, g are exogenous parameters.

- ★ The quantity theory of money predicts that changes in money supply determine inflation in the long run.


Inflation rate (percent, logarithmic scale)
100
10
1
0.1
Belarus
Turkey
Ecuador
Indonesia
Haiti
Argentina
United States
Euro Area
Singapore
Switzerland
1
10
100
Money supply growth (percent, logarithmic scale)

Seigniorage

- If government finances its purchases, G, by printing money, the revenue collected this way is called seigniorage.
- Printing money increases money supply, and leads to inflation, and reduced purchasing power of money held by the public.
- Printing money to raise revenue is conceptually similar to imposing a tax—called the inflation tax.

Inflation and Interest Rates

Let's call the interest rate paid by banks and financial institutions the nominal interest rate, i; and the increase in your purchasing power (once money is put into the interest bearing accounts) the real interest rate, r.

Then, $r = i - \pi$, where π is the inflation rate.

E.g., if the nominal interest rate is 10%, and the inflation rate is 4%, then the real interest rate, or the increase in the purchasing power of money put into an interest bearing bank account, is 6%.

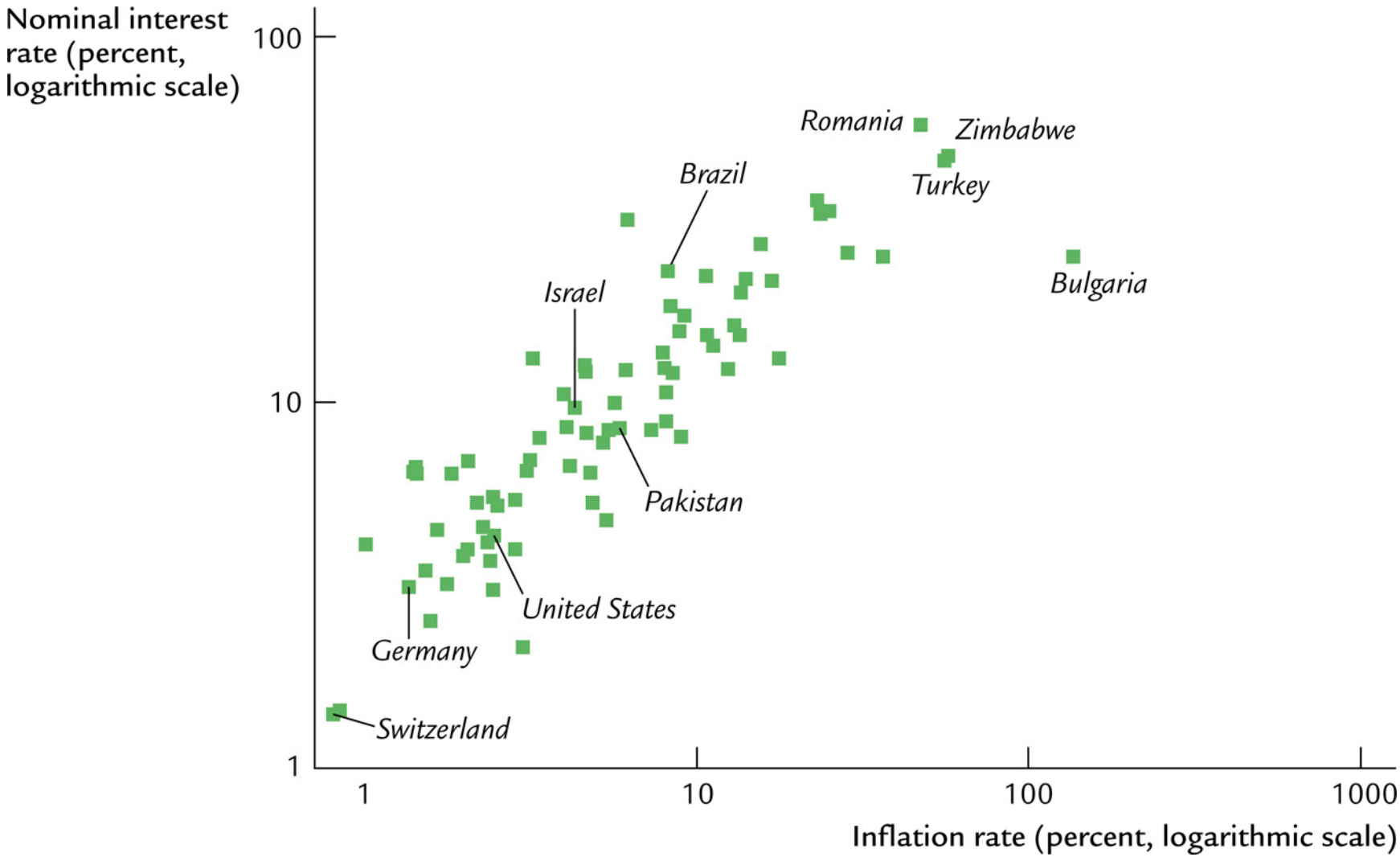
The Fisher Equation

Fisher postulated the following relation, known as the Fisher equation:

$$i = r + \pi$$

Note that r, the real interest rate, is a function of real factors in the economy. Thus, using the quantity theory of money, a 1% increase in money supply leads to a 1% increase in inflation and a 1% increase in the nominal interest rate.

The one-to-one correspondence between inflation rate and nominal interest rate is called the Fisher effect.


Nominal interest rate (percent, logarithmic scale)
100
10
1
Romania
Zimbabwe
Turkey
Brazil
Bulgaria
Israel
Pakistan
United States
Germany
Switzerland
1
10
100
1000
Inflation rate (percent, logarithmic scale)

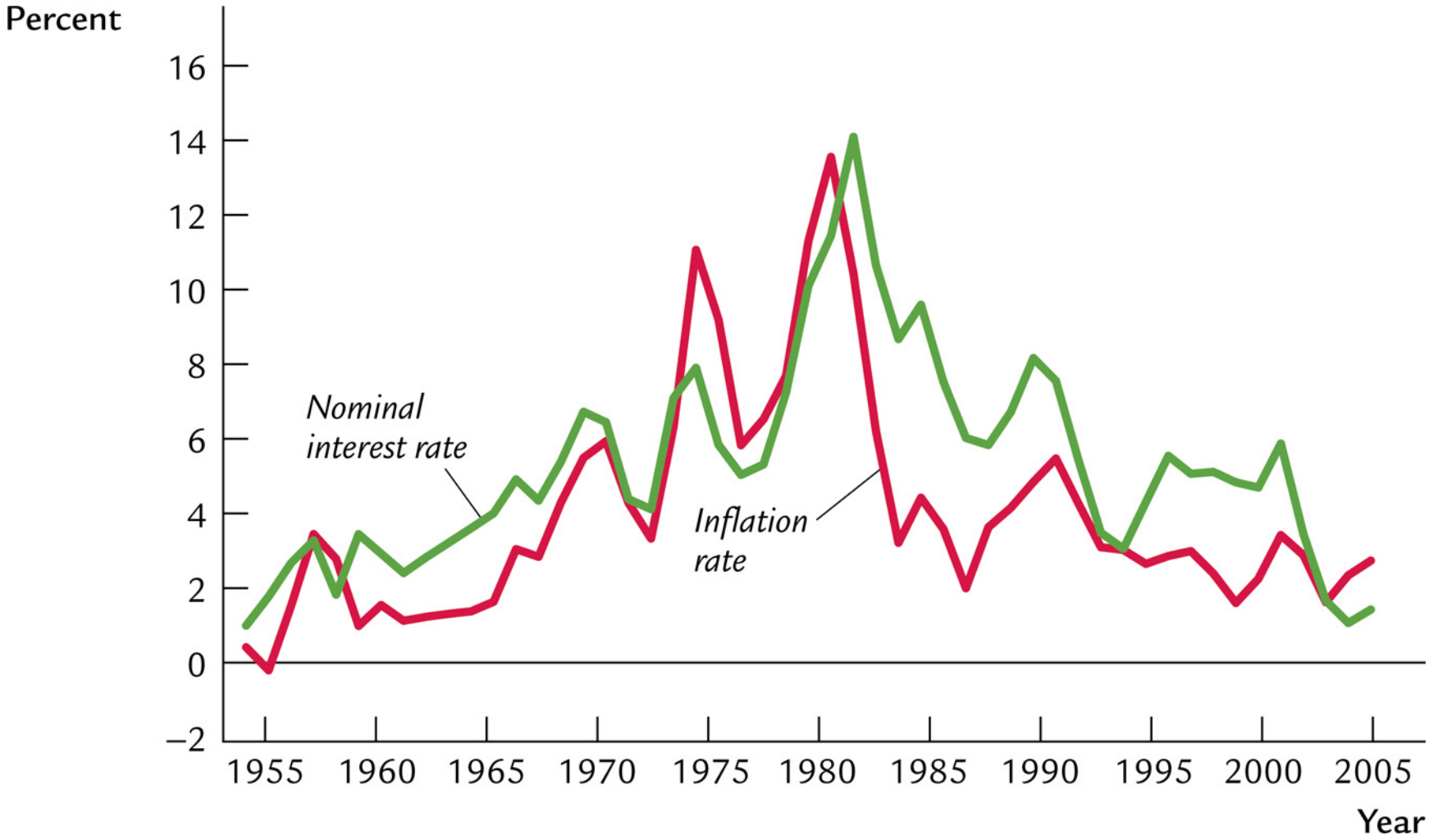
The (Precise) Fisher Equation

Before the nominal interest rate is set, the inflation rate π is not known. The nominal interest rate is determined on the basis of an anticipated (expected) rate of inflation, π^e.

The (precise) Fisher equation is:

$$i = r + \pi^e$$

Thus, the nominal interest rate deviates from the actual inflation rate if the latter deviates from the expected inflation rate.
$r = i - \pi^e$ is called the ex ante real interest rate; $r = i - \pi$ is called the ex post (realized) real interest rate.


Percent
16
14
12
10
8
6
4
2
0
–2
Nominal interest rate
Inflation rate
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
Year

The Demand for Money and the Nominal Interest Rate

The nominal interest rate is the cost of holding money balances.

The (expected) real return of money is $(-\pi^e)$, and therefore the cost of holding money is $r - (-\pi^e) = i$.

Therefore, the money demand can be better expressed as:

$$(M/P)^d = L(i, Y) = L(r + \pi^e, Y),$$

where L stands for the functional relationship and reminds us that money demand is the demand for liquidity.

Future Money and Current Prices

Given the money market is in equilibrium,

$$(M/P) = L(r + \pi^e, Y). \tag{1}$$

From equation (1), note that current price level, holding current money supply and real income and interest rate constant, is a function of future money supply.

Costs of Inflation—the Classical Response

Our standards of living measured by W/P are determined by the productivity of labor, and, given full flexibility in prices and wages, changes in prices should feed into changes in nominal wages, not affecting our real purchasing power.

E.g., in Solow model the long-run (SS) level of capital per effective worker is determined by the production function, and exogenous parameters such as depreciation, population growth and technological growth. Real wage (per effective worker) is equal to:
$w = f(k^*) - MPK(k^*) \times k^*$, clearly a function of the economy's productive abilities in the long-run.

The Costs of Expected Inflation

- Shoeleather costs
- Menu costs
- Disincentives for savings arising from the tax laws (taxing the nominal gains).

After-tax $r=i(1-t)-\pi$. If i=10%, π=10%, and t=50%, then the after-tax real return on savings is $t \times i=0.05 \times 0.1=0.05$ lower compared to the zero inflation rate case.

If, instead, the ex-post real returns were taxed, savings incentives wouldn't be distorted: After-tax $r=(i-\pi) \times (1-t)$.

The Costs of Unexpected Inflation

- Arbitrary redistribution of wealth between debtor and creditor: debtor gains if the realized inflation rate is larger than the expected rate; conversely, if the realized π is smaller than π^e debtor loses.

- Hurts individuals with fixed pension agreements.

Hyperinflation

Hyperinflation is defined as inflation >50% per month.
If the inflation rate is 50% per month, prices increase 100-fold over a year.

Additional costs of hyperinflation: relative prices do not reflect scarcity in the economy.

The causes of hyperinflation: excessive money growth due to the government's inability to finance its purchases by other means.

Usually hyperinflation ends with fiscal reforms—reduction in government spending and increase in taxes.

The Classical Dichotomy

In this chapter, we assume the classical dichotomy—the irrelevance of nominal variables (such as prices and money supply) for the determination of real variables (such as real output and real interest rate).

The irrelevance of money for the determination of real variables is called monetary neutrality.

While being useful for the long run analysis, the assumption of monetary neutrality should be abandoned in the short run.

Practice: Problems 2, 5, 7, 8.