

## Chapter 4 Money and Inflation

Example:

March 2002 Robert Mugabe wins elections.

Aug 2006 Inflation rises above 1,000 per cent

Oct 2008 Official inflation hits 231 million per cent

Feb 2009 the price of a loaf of bread is nearly 200 trillion Zimbabwe dollars and rising.

Zimbabwe: inflation rate right now is roughly at  $5 \times 10^{21}$  per cent.

Zimbabwe \$500 million dollar notes



Zimbabwe \$100 billion notes



So the questions: why could this happen?

What is money: a store of value; a medium of exchange; and a unit of account.

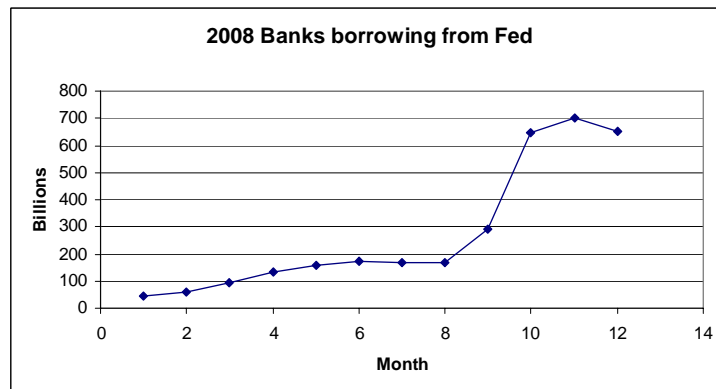
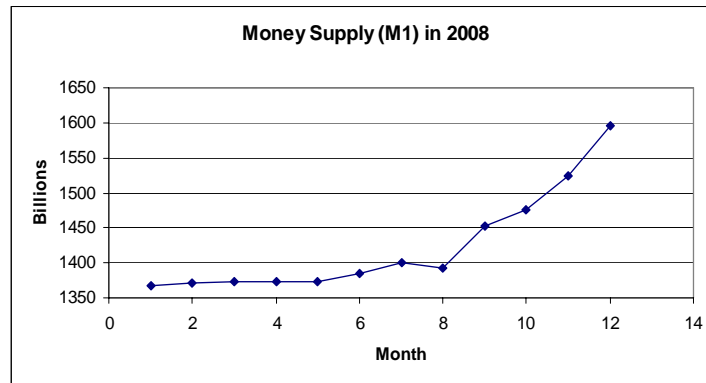
Three instruments of monetary policy (how the quantity of money is controlled):

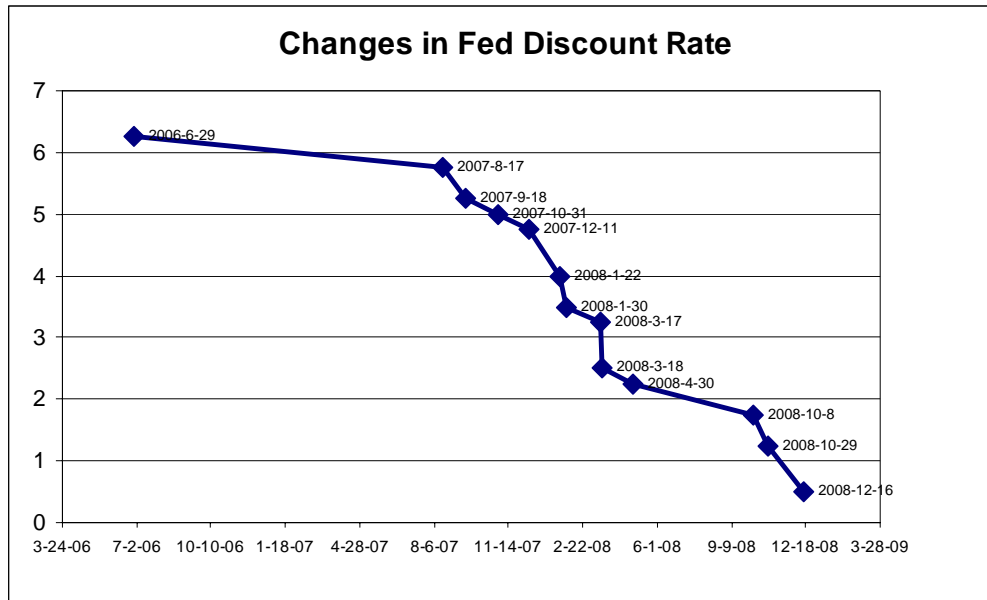
(1) The open-market operations – this is the policy instrument that Fed uses most often (almost weekly) -- the purchase and sale of government bonds.

Sell bonds → to reduce the money supply.  
Buy bonds → to increase the money supply.

(2) The reserve requirements. Fed imposes on banks a minimum reserve-deposit ratio. An increase in reserve requirements raises the reserve-deposit ratio and thus lowers the money supply.

(3) The discount rate: the interest that Fed charges when it makes loans to banks. The lower the discount rate, the more banks borrow at the Fed's discount window.





### Money supply measure

<i>C</i>	Currency	\$715.4 billion
<i>M1</i>	Currency + demand deposits	\$1363.4 billion
	Checking accounts	
<i>M2</i>	M1 + retail money market mutual fund	
	Saving deposits	\$6587.9 billion
<i>M3</i>	M2 + repurchase agreements	\$9976.2 billion

### The Quantity Theory of Money

Velocity:

- Basic concept: the rate at which money circulates.
- Example: Suppose in 2007,
  - \$500 billion in transactions
  - Money supply = \$100 billion
  - The average dollar is used in five transactions in 2007.
  - So velocity = 5

This suggests the following equation:  $V = T/M$

$V$  = velocity

$T$  = value of all transactions ( $T = PY$ )

$M$  = money supply.

Money \* Velocity = Price \* Output

$$M * V = P * Y$$

Discussions:

- Assume  $V$  is constant and exogenous.
- $P = MV/Y = \text{normal GDP} / \text{real GDP}$

Take the log of previous equation:

$$\log M_t + \log V_t = \log P_t + \log Y_t \quad (1)$$

Since this works for time  $t$ , it also works for time  $t-1$ :

$$\log M_{t-1} + \log V_{t-1} = \log P_{t-1} + \log Y_{t-1} \quad (2)$$

Equations (1) – (2), we have:

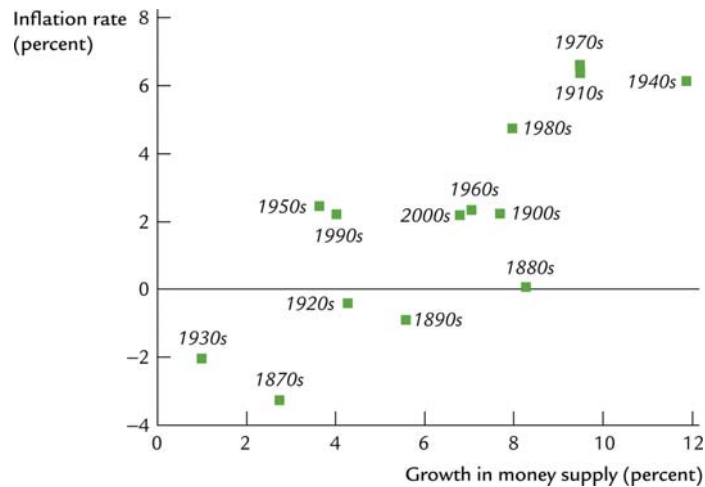
$$\Delta \log M_t + \Delta \log V_t = \Delta \log P_t + \Delta \log Y_t \quad (3)$$

Equation (3) says:

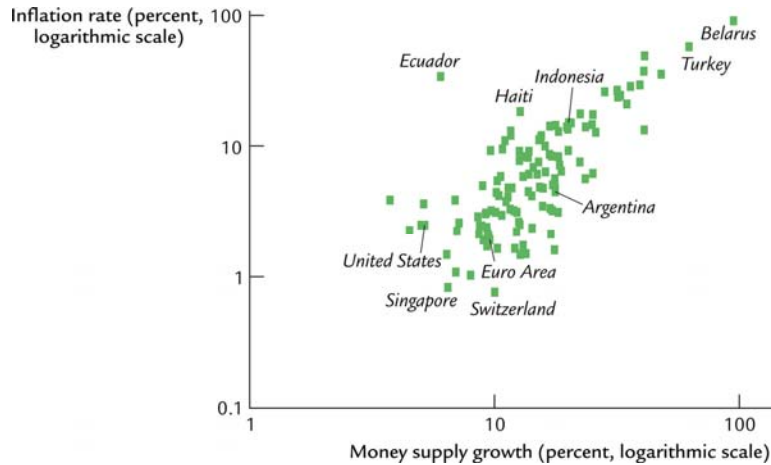
$$\% \text{ change in } M + \% \text{ change in } V = \% \text{ change in } P + \% \text{ change in } Y$$

In the short run, it is typical that % change in  $V$  and % change in  $Y$  do not vary much. Therefore, % change in  $P$  (inflation) is basically determined by % change in money supply.

This suggests that the inflation rate is basically determined by the money supply.



Across time, money supply and inflation rates are clearly positive correlated.



Across countries, clearly a higher money supply leads to a higher inflation rate.

In Zimbabwe case, the extreme hyperinflation is the result of increasing money supply.

### The Fisher Equation

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

Why: Suppose Bill has \$1 million dollar. He has two options: deposit the money into the bank to earn a preset nominal interest rate  $i$ . At the end of the year, he would get

$$\$(1 + i) \text{ million}$$

Alternatively, he can use this amount of money to invest. At the current price  $p$ , he can use this money to buy  $1/p$  units of machines. Each unit of machines would produce  $(1+r)$  units of output. So at the end of the year, Bill would have:

$$1/p * (1 + r) \text{ units of output.}$$

But what Bill wants is money. So he is going to sell the output to get money back. The price, because of inflation, is:  $p(1 + \pi)$ . So at the end of the year, he would get:

$$1/p * (1+r) * p(1 + \pi) = (1+r) * (1 + \pi) = 1 + r + \pi + r * \pi$$

Because no uncertainty is involved, these two alternatives must produce same amount of money.

$$1 + i = 1 + r + \pi + r * \pi$$

Given that  $r$  and  $\pi$  both are relative small, we ignore the  $r * \pi$ , we must have:

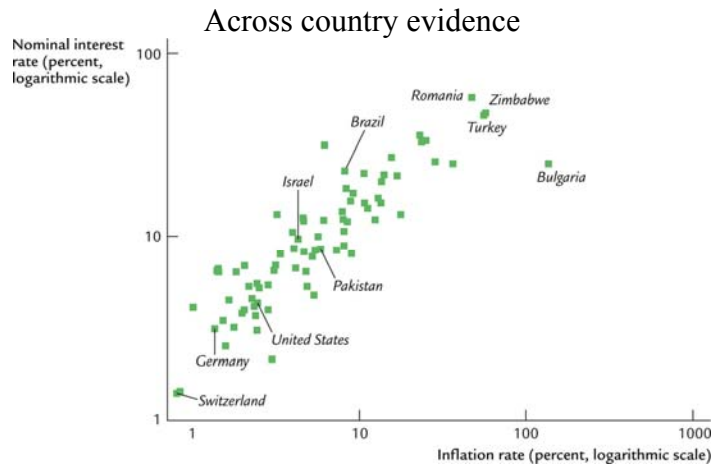
$$i \approx r + \pi$$

Since at the beginning of the year we do not know inflation for sure, we use the expected inflation:

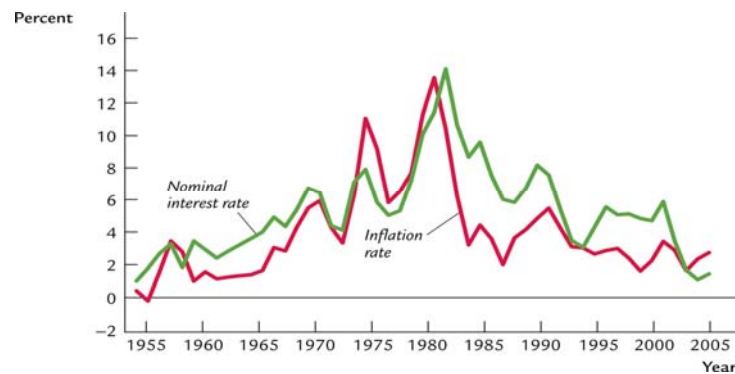
$$i = r + \pi^e$$

Discussions:

- Since real interest rate does not vary much, nominal interest rate and inflation should be highly correlated. The data show they are. See the following graphs.



**Time series evidence**



- From time series graph, it is not always the case that inflation and nominal interest rate are together. Between mid 1980s and mid 1990s, the inflation and nominal interest rate differ quite a bit.

One possible reason is the difference in expected inflation and the actual inflation. The Fisher equation is true for expected inflation, but the data is about the actual inflation.

### Money Demand (for dollar bills)

Higher nominal interest rate → demand less money, because people are more likely to put the money into the bank to earn interest.

Higher income → demand more money, because higher income spend more money in general, and higher income have a higher opportunity cost (go to banks to get dollar bills).

$$\left(\frac{M}{P}\right)^d = L(i, Y) = \alpha Y - \beta \cdot i$$

Relationship with the quantity theory of money:  $MV = PY$

Rewrite this:  $\frac{M}{P} = \frac{Y}{V}$ . It is possible to think that  $\alpha$  in the money demand equation is  $1/V$  (velocity).

### Hyperinflation:

Example: Interwar Germany. From the book of the daily newspaper:

Jan 1921: 0.30 mark

May 1922: 1 mark

Oct 1922: 8 marks

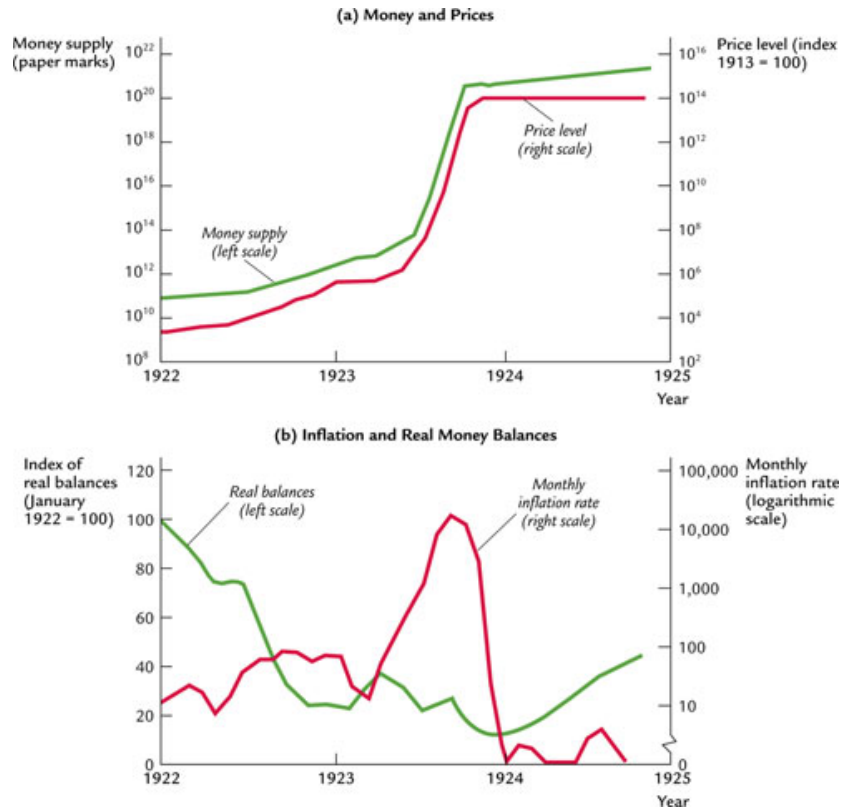
Feb 1923: 100 marks

Sep 1923: 1,000 marks

Oct 1, 1923: 2,000 marks

Oct 15, 1923: 1 million marks

Nov 17, 1923: 17 million marks



Example: the Zimbabwe case. To fight for inflation, the government has done:

- 8/28/2008 Zimbabwe chops 10 zeros from currency note
- 2/2/2009 Zimbabwe chops 12 zeros from currency note again



Zimbabwe new currency notes after chopping 10 zeroes

How to reduce inflation: money supply has to fall.

$$\Delta P = \Delta M + \Delta V - \Delta Y < 0$$

## Cost and Benefits of Inflation

### Cost Expected inflation:

- From money demand equation,  $\left(\frac{M}{P}\right)^d = L(i, Y) = \alpha Y - \beta \cdot i$ , higher interest rate, lower money demand. When the expected inflation is high, nominal interest must be high. Then money demand is low → people may go to banks more often. This is called shoeleather cost of inflation, because walking to bank more often causes one's shoes to wear out more quickly.
- Menu costs → firms may have to change their posted prices more often.
- For those firms who do not change nominal prices (catalog, for example), they would sell less products at the beginning of the year (because the effective price is too high) and more products at the end of the year, with expected positive inflation rates.
- Tax laws: many provisions of the tax code do not take account the effects of inflation. Example: capital gains tax: if inflation is 20%, and nominal price increase for a stock is 20%, then one gains nothing. But one has to pay capital gains tax for the 20% increase in nominal price.

### Cost of unexpected inflation:

- Redistribution of wealth. Individuals on fixed pensions are hurt.

### Benefits of inflation:

- Since rigidity in nominal wages, having inflation may help the firms to adjust real wages more effectively.

Some economists argue that inflation “grease the wheels” of labor markets. (Only a little inflation is sufficient, though).