

**Monetary Theory and Policy
Notes**

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INTRODUCTION AND REVIEW

I Introduction

A what is Monetary Theory and Policy

This course is divided into 3 parts:

1. Money, inflation and interest rates.
 - (a) Key variables: Money, inflation, and interest rates.
 - (b) Key relationships: how changes in the money supply and interest rates affect inflation and unemployment.
 - (c) Institutions: How is money supply controlled? How does the banking system work? How do such institutional details affect credit?
 - (d) Welfare effects of inflation: what harmful effects result from inflation.
2. Monetary Policy.
 - (a) Optimal Policy: How much money or what interest rate should we have to keep inflation and unemployment low?
 - (b) Instrument choice: What macro-economic variables should the the monetary system target (US targets Federal Funds rate, Mexico the dollar exchange rate, and Europe the inflation rate)?
3. Case Studies.
 - (a) US monetary history: the great depression.
 - (b) Hyperinflations after WWI and in Latin America.
 - (c) Credit crises.

With inflation rampant in the 1970s and unemployment high, the FED and many central banks adopted policies recommended by recent economics research. To a large extent, these ideas have in fact worked quite well. Indeed, monetary policy is one of the great success stories of modern economics research. In this course, we will see exactly how monetary policy works.

Nonetheless, many argue monetary policy has recently fueled several bubbles, and many have criticized the FED's management of the credit crises. We will examine the credit crises and the FED's role and evaluate these arguments.

B Some Stylized Facts

1 Inflation and Money

Recall that the price level is the amount of money required to buy a basket of goods.

- The price level has risen by a factor of 12 since 1945.
- From 1776 to 1944, prices rose by a factor of only 1.01.
- During the US civil war prices doubled in 3 years. In Ecuador prices increased by 1000x in one year. In Hungary, 1944 prices increased by 20,000x in one year.
- US money stock rose by a factor of 20 since 1945.
- Nearly all asset price bubbles follow a period of unusually strong money growth and low interest rates. In Figure 7, we see the Taylor rule, which calculates the interest rate the FED would typically target given the current state of the economy. In the housing bubble years of 2002-7, interest rates were much lower than the is typical when the economy is doing well.

2 Unemployment and Inflation and Money

- US unemployment has stabilized greatly since WWII, when the money stock and inflation started to increase. Recessions are much shorter on average.
- Unemployment and inflation seem negatively related for short periods of time. Alternatively, growth and inflation seem positively related. Yet the relationship does not hold up over time. Across countries, there appears to be no relationship, except for high inflation countries where the relationship is negative.

3 Current credit crises/recession/recovery

- GDP and unemployment have still not recovered to pre-crises levels, despite many policies pursued by the FED.
- The recession is largely concentrated in investment spending, specifically housing, which remains far below pre-recession levels.
- Banks are holding large quantities of deposits in reserve at the FED, which could be lent out.

II Money

A What is money?

MONEY is anything that fulfills 3 purposes:

- MEDIUM OF EXCHANGE members of the economy will accept money in exchange for their goods and services.
- STORAGE OF VALUE can keep accumulated wealth in the form of money.
- UNIT OF ACCOUNT can use money as a numeraire good. Can give a price for all goods and services in terms of money.

1 Medium of Exchange

Money reduces shopping time. This is because money requires only a single coincidence of wants (the buyer must find a seller). The alternative to money, trading goods for goods, requires a double coincidence of wants (the buyer must find a seller, AND the buyer must have something the seller wants to trade).

Definition 1 *DOUBLE COINCIDENCE OF WANTS: a seller must find a buyer who wants the goods being sold, and at the same time has goods to exchange which the seller wants.*

Definition 2 *BARTER: The exchange of goods for other goods.*

Definition 3 *LIQUIDITY: The ability to buy and sell on short notice without penalty.*

Money also provides liquidity services. To sell illiquid goods quickly, one must lower the price and incur transaction costs.

One can always exchange something quickly if the price is low enough. Conversely, can always exchange something at full price if one is willing to wait long enough. Thus a “liquid asset” such as money refers to the ability to sell something (1) quickly and (2) without much penalty.

Definition 4 *LEGAL TENDER: The government sets a law that says one must accept a certain currency in exchange for goods.*

The government declares the dollar as the medium of exchange. Households and firms will not comply with legal tender laws if money loses value too quickly.

2 Store of Value

Money does not pay interest when used as a store of value. In fact, money loses value through inflation. We prefer to store value in money over say stocks or real estate, because money is a liquid asset.

In effect, a trade-off exists since money is a poor store of value, yet is very liquid and therefore a good medium of exchange. If the money loses value quickly enough, people will not hold much money despite the liquidity services and instead barter.

3 Unit of Account

We say an Eco 403 credit cost 1,400 dollars, not 2.5 Ipads.

4 Examples

Three types of money.

1. FIAT MONEY: has no value other than as money.
2. COMMODITY MONEY: has an alternative use.
3. IMPURE COMMODITY MONEY: May be exchanged for something of value.

B Measuring the amount of money

When measuring money, we are measuring the total amount of dollars that are *available* to be spent. The total amount available to be spent includes:

- cash and currency held by the public.
- check account balances including travelers checks and money market accounts.
- savings account balances.

1 Why checks are money

Suppose there are \$100 floating around the economy. Then \$100 of cash and currency may be spent. Thus cash and currency add to the total amount of money available. Now suppose \$10 is deposited in a checking account in a bank. Then the depositor has \$10 of check making ability, and the bank has \$10. The bank does not hold all of the \$10, but instead loans out some of it. Thus some the cash returns to the economy, and the checking account adds to the money supply.

2 Why credit cards are not money

Credit cards are not money. When you purchase on credit card, the bank pays cash to the retailer. The ability to pay is limited by the Bank's supply of cash. Counting credit cards would be double counting. A credit card is simply the right to spend other people's money. Figure 1 gives an example:

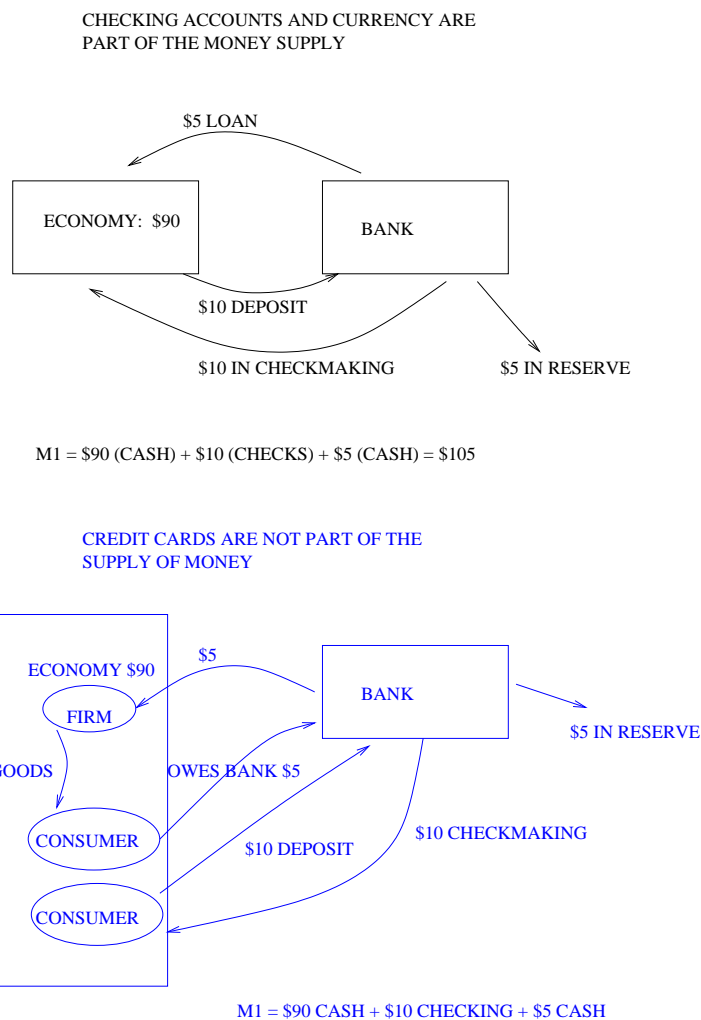


Figure 1: Why checking accounts are money and credit cards are not.

3 Savings Accounts

Savings accounts are similar to checking accounts. One can use a debit card to spend cash in savings accounts. The money is loaned out just as checking accounts are. Key differences: banks are required to keep less savings deposits in reserve, and savings accounts pay interest.

4 Measures of money

There are four ways to measure the amount of money in the economy. M1 is the most liquid measure.

Definition 5 *M1 is the sum of all currency (C) and travelers checks and check making accounts (D) held by the non bank public.*

M1 can be spent quickly with no penalty. However, most or all categories of M1 pay no interest, and in fact lose value due to inflation. $M1 = C + D$.

Definition 6 *M2 is the sum of M1, and savings accounts (S): savings deposits, money market accounts, overnight repurchase agreements, overnight Eurodollars, and small time deposits (CD's under \$100,000).*

Small time deposits are short duration certificates of deposit (CDs), which can be spent only after paying a penalty. Money market and savings accounts allow only 6 withdraws per month without penalty.¹ M1 is more liquid than M2. A trade-off exists between liquidity and interest. If you cannot withdraw, the bank does not need to hold reserves, and thus increases loans. Thus the bank can afford to compensate you with interest, for not withdrawing. $M2 = C + D + S$.

Definition 7 *M3 is the sum of M2, large time deposits (CD's over \$100,000), money market mutual funds, and term repurchase agreements (maturity longer than overnight).*

Definition 8 *L is the sum of M3, short term treasury debt, savings bonds, and commercial paper.*

Note that M3 and L have many items not accepted for purchases. They act instead as short term stores of value which are often quickly converted to money.

Technology has reduced the percentage of deposits stored as M1. M2/M1 has increased from 2:1 in 1959 to about 5:1 in 2008. Further, when interest rates are high people store more money in interest bearing accounts like M2-M3.

¹Sometimes, ATM withdraws count, in other cases the restriction is only on withdraws to a third person (checks).

C The banking system

The banking system uses high powered money to create additional money in the form of checking account balances.

Definition 9 *The monetary base or high powered money (H) is the sum of currency held by the non bank public plus bank reserves (BR). $H = C + BR$.*

Definition 10 *The Required Reserve Ratio (rrr) is the percentage of deposits banks are required to hold by law at the Federal Reserve Bank.*

Definition 11 *The Reserve Rate (R_0) is the interest rate paid by the FED for reserves held at the FED.*

The required reserve ratio is currently 0-10% and the reserve rate is currently 0.25%. Reserve requirements vary by type of account and size of the bank. Savings accounts have no reserve requirements. Since savings accounts do not require reserves, banks can loan out all of the money and make more profits. Thus banks can pay interest on savings accounts.

The FED began paying interest on reserves only two years ago. This interest rate is much lower than the interest rate that can be earned by a loan, so the difference in the loan rate and the reserve interest rate is the opportunity cost of holding reserves. Without reserve requirements, banks generally hold much less reserves.

Figure 2 is an example of how banks create money:

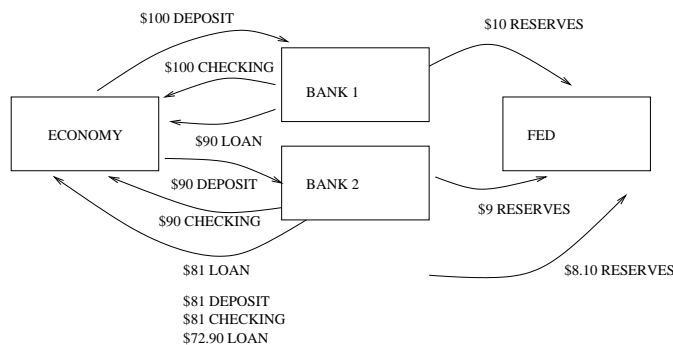


Figure 2: Banks creating checking accounts.

So starting from $H = \$100$, much more money is created. We will calculate the exact number later.

1 How Banks Manage Reserves

- Due to ATMs, most reserves are now held as “vault cash” which includes cash at ATM machines. These reserves do not pay interest.
- The rest are held as deposits at the FED, which do earn interest (currently 0.25%, and countries vary on whether or not they pay interest on such deposits).
- Typically, banks hold some excess reserves. If at the end of any day, reserves fall below the minimum, then banks must borrow to increase reserves, which is costly. Currently, banks are holding large amounts of excess reserves.

2 Sources of Capital

Banks need dollars to make loans. Where do banks get money to make loans?

1. CHECKING DEPOSITS. Banks pay no interest, but must maintain checking accounts (i.e. process checks) and must maintain reserves which lose value due to inflation.
2. SAVINGS DEPOSITS. Banks must pay interest on savings deposits, but savings accounts require little or no reserves and less maintenance.
3. OTHER BANKS. The bank may borrow funds to lend from another bank.

Definition 12 *FED FUNDS RATE: the interest rate paid by banks for overnight loans from other banks (currently 0.13%).*

4. THE FED. The bank may borrow funds to lend from the FED.

Definition 13 *DISCOUNT RATE: the interest rate paid by banks for overnight loans from the FED (currently 0.75%).*

The FED is a lender of last resort since the Fed monitors banks it lends to very closely and will not let banks make risky loans. For this reason, banks prefer to borrow from other banks.

5. RAISE MONEY IN THE BOND MARKET. The bank may make the loan and quickly sell the loan on the mortgage backed securities market (MBS). The loan principle is provided by investors and the bank receives a processing fee. The MBS market now funds more than half of all mortgages (see graph).

Two advantages and one problem of the MBS market:

- Insures local banks from local economics shocks.
- Allows banks to specialize in retail banking.
- Banks have an incentive to sell only loans with unobserved default risks (adverse selection).

Question: Why loan money on the FED funds market at 0.13% when you can earn 0.25% risk free at the FED? Fannie and Freddie MAC, the Federal Home Loan Banks, and other government owned banks, plus some international institutions have deposits at the FED. The FED does not pay government and foreign banks interest. These institutions then make loans on the FED funds market. So most of the currently limited supply of FED funds is not provided by private banks.

3 Taxing Reserves

Required reserves are often viewed as a tax on banks. The banks cannot loan out 10% of deposits, and in fact reserves lose value over time due to inflation. This is somewhat offset by the interest the FED pays on reserves. Currently the FED pays 0.25% interest on reserves, and inflation is about 3.4%. So reserves are losing value.

This is a tax because when the government prints money, then the reserves lose value, and the government has printed currency to spend, like tax revenue. It is no different than simply taking the bank's reserves.

On the other hand, the Federal Government guarantees deposits under \$100,000 if the bank goes under. Thus banks have an incentive to make very risky loans at high interest rates. If the bank is paid back, the bank makes high profits. If not, the bank lets the Federal Government (taxpayer) pay the depositors. This is known as a Moral Hazard problem: insurance creates incentives for risky behavior. Reserve requirements may help to alleviate the moral hazard problem by forcing banks to hold 10% of their deposits in a risk free account.

4 Bank Runs

Banks in normal times has only 10-12% of the depositors money in reserve. On a daily basis, this is not a big problem. Deposits come in and checks need to be cashed. These tend to cancel. Further, if one depositor writes a check to another at the same bank, no funds are

needed. The bank can simply adjust the balances on computer. If reserves fall low, the bank can borrow or sell mortgages as noted above.

But suppose the bank's loan portfolio deteriorates. Suppose for example, half the loans default. The fraction of the depositors money in the form of loans is $.5 \cdot 0.9 = 0.45$. Add in the 10% in reserve and the bank has only 55% of the depositors money. Suppose further the public is aware of this. Then if you get to the bank first, you get all of your money, but if you are the last you get nothing, because the bank doesn't have enough cash. The solution is for everyone to rush to withdraw at once, which is a bank run.

Definition 14 *BANK RUN: A rush by depositors to withdraw as much money as possible.*

A run can also happen even if no loans default. Since loans are illiquid, in the event of a run the bank can only sell loans quickly at a substantial penalty. Paying this penalty means the bank will not have enough funds to reimburse all depositors.

Definition 15 *INSOLVENT: liabilities (deposits) exceed assets (loans plus reserves).*

Definition 16 *SOLVENT BUT ILLIQUID BANK: bank cannot pay depositors quickly, but is solvent.*

In the above example, loans are only 55% of deposits, so the bank is insolvent. A bank that has no defaults but for some reason cannot sell loans to get cash to give to depositors is illiquid. For example if the bank keeps 10% in reserve and depositors ask to withdraw 12% and the bank cannot sell loans to cover the remaining 2%.

Federal Deposit Insurance (FDIC) has greatly reduced the probability of a bank run. Banks pay into an insurance fund which is used to reimburse depositors in the event of a run. If the fund is empty, taxpayers reimburse. The probability of a run is not zero because it takes time to get money from the FDIC and because the FDIC only insures loans to a certain amount.

When the FDIC reimburses depositors it takes over the bank and sells the assets. Typically this is only done if the bank is insolvent. If the bank is solvent but illiquid, the FED will likely step in and make loans to the bank at the discount rate.²

²Insolvent banks have a clear incentive to hide this information (usually through dubious accounting). They hide their insolvency from the FDIC to prevent a takeover and from the public to prevent a bank run.

D The Federal Reserve Bank and Changing the High Powered Money

Definition 17 *FEDERAL RESERVE BANK (FED): The central bank of the United States, which oversees the creation of money and regulates banks.*

The FED has many methods for changing the supply of money. Here are four.

1. Change the Required Reserve Ratio.
2. Change the Reserve Rate.
3. Change the Discount Rate.
4. Open Market Operations.

Criteria in deciding which method to use:

- Precision. How exact is the change in $M1$?
- Small or large changes. Can both small and large changes be made?
- Other considerations.

1 CREATING MONEY BY CHANGING THE REQUIRED RESERVE RATIO

By lowering rrr , banks may loan out reserves, increasing the money supply.

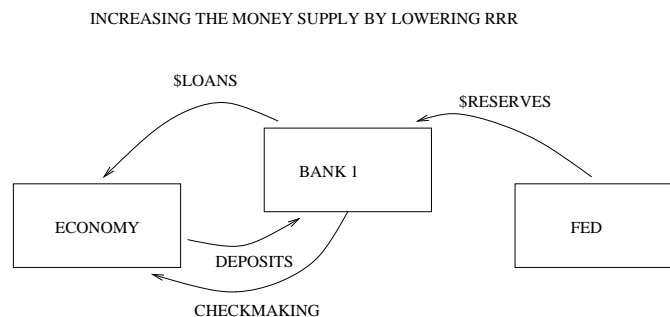


Figure 3: $M1$ rises after the required reserve ratio falls.

Pro's and cons of using adjusting with the rrr :

- Medium precision. If banks held exactly the required reserves, one could calculate the exact change in the money supply (see formula in next section). However, banks currently hold large excess reserves. When the required reserve ratio is lowered, it is not clear how many banks are constrained and will lower reserves.
- Large changes only. Small changes in rrr have big effects on the money supply.
- Other consideration: banks don't like changes in rrr . Lowering rrr bathes banks with excess reserves when they have no immediate borrowers.

Generally the cons outweigh the pros here and the FED rarely changes the rrr .

2 CREATING MONEY BY CHANGING THE RESERVE RATE

By lowering the reserve rate, banks have an incentive to remove excess reserves from the FED and make loans, since the difference in interest rates between the loan rate and reserve rate are now higher.

The graph is identical to lowering rrr .

- Precision. Low precision. Difficult to determine how much excess reserves will fall when the reserve rate falls.
- Small or large changes? Yes, the FED can make small or large changes to the reserve rate.
- Despite the low precision, the FED has announced raising the reserve rate will be the FED's preferred method of removing money from circulation once the economy recovers. Presumably because high reserves will instill confidence in the banking system. Raising the reserve rate is great for banks. They get high interest, risk free loans.

3 CREATING MONEY BY CHANGING THE DISCOUNT RATE

A bank that is low on reserves or needs money to make loans might borrow from another bank (at the FED Funds Rate) or may borrow from the FED (at the discount rate or discount window). Since the bank borrows printed money, the money supply increases.

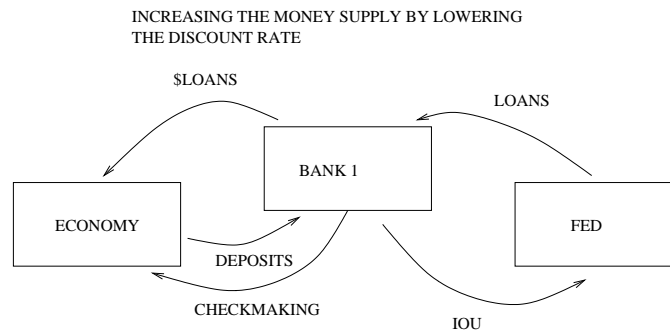


Figure 4: M1 rises after the discount rate falls.

- The Discount rate is the least precise method. Who knows how many banks will borrow from the fed if it lowers the discount rate?
- Only small changes are possible since few banks borrow at the discount rate.
- The discount rate is used to signal future monetary policies by the FED.

4 CREATING MONEY BY CONDUCTING OPEN MARKET OPERATIONS

Definition 18 *OPEN MARKET OPERATIONS: Buying and selling assets with printed money.*

Trillions of dollars worth of government bonds known as treasury bills are sold on the open market on Wall Street. Suppose the FED wanted to increase the money supply. Then the FED could print money and then go to Wall street and buy some tbills. Money enters the economy and the tbills are kept in a vault or destroyed.

INCREASING THE MONEY SUPPLY VIA
OPEN MARKET OPERATIONS

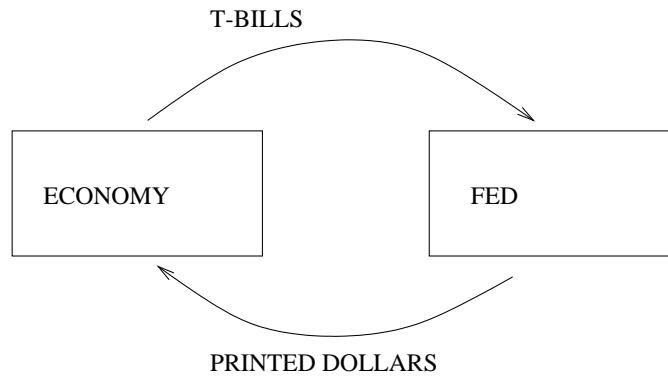


Figure 5: M1 rises when the FED buys tbills.

This is the easiest and most common method of adjusting the money supply.

- Precise. We will derive a formula shortly that is accurate to $\pm 1\%$.
- Small or large changes are possible.
- Low transaction cost.

Alternative assets to tbills:

- **OVERNIGHT REPURCHASE AGREEMENTS.** Here the FED buys tbills for printed cash, but agrees to buy the tbills back in 1-7 days for principal plus interest. Such an open market operation provides a temporary increase in the money supply, with low transaction costs, since the FED makes only one transaction.
- **FOREIGN CURRENCY.** The FED may also buy and sell dollars and foreign currencies in the foreign exchange markets in order to alter exchange rates. Altering the exchange rate is a questionable policy, since as soon as the FED stops intervening, the currency returns to the normal trading range. So the FED often loses out on such transactions (buys high and sells low).
- **PRIVATE ASSETS:** The FED can buy mortgage backed securities, commercial loans, or any other type of loan. The term asset-backed loan facility (TALF) provides loans of printed money, for which the FED takes the private asset as collateral. This is similar to the overnight repurchase agreements in that it provides a temporary increase in the money supply.

- **GOLD OR OTHER COMMODITIES.** If the currency system is commodity based, open market operations involve the buying and selling of the commodity.

5 More on the FED

Summary of FED functions:

1. Control the money supply and therefore monetary policy (including interest rate, money supply, and exchange rate).
2. Lender of last resort.
3. regulates the banking industry.

Miscellaneous information on the FED:

- The FED is part of the government, but is fairly independent. Members are appointed by the president to 14 year terms (the chair gets a 4 year term). Thus the FED can look out for the long term interest of the economy and banking system.
- The FED's goals are to keep inflation low and improve economic performance (high growth, low unemployment). The goal of many other central banks, such as the EU Central Bank, is simply to keep inflation low, rather than improve economic performance.
- The FED can lend and borrow in the FED Funds Market and so influence the FED Funds Rate. When the FED lends printed money, the money supply rises. A "loose" monetary policy consists of a high rate of growth in the money supply and a low FED Funds Rate. A "tight" monetary policy consists of a slow rate of growth in the money supply and a high FED Funds Rate.

III Inflation

A The price of goods and inflation

Definition 19 A *PRICE INDEX* is a ratio of the expenditure on a basket of goods and services in some given period to the expenditure in some base period.

Price indices differ only in terms of what goods are included in the basket. Two major price indices:

- GDP DEFLATOR: basket is all goods in the GDP in the current year. The goods are weighted by the number sold. For example if 20% of the GDP is spent on food then prices of food make up 20% of the GDP deflator. Formula:

$$\text{Deflator}_t = P_t = \frac{P_{1,t}Q_{1,t} + P_{2,t}Q_{2,t} + \dots + P_{n,t}Q_{n,t}}{P_{1,b}Q_{1,t} + P_{2,b}Q_{2,t} + \dots + P_{n,b}Q_{n,t}} \quad (1)$$

Here P is price, Q is quantity sold, $1 \dots n$ are the n goods in the basket, b is the base year, and t is the given (current) year.

- CONSUMER PRICE INDEX (CPI) Basket contains only goods purchased by a “typical urban family” in the base year. Prices are done by the survey of stores method.

$$CPI_t = P_t = \frac{P_{1,t}Q_{1,b} + P_{2,t}Q_{2,b} + \dots + P_{n,t}Q_{n,b}}{P_{1,b}Q_{1,b} + P_{2,b}Q_{2,b} + \dots + P_{n,b}Q_{n,b}} \quad (2)$$

Definition 20 *The INFLATION RATE (π) is the rate of change in a price index.*

$$\pi = \frac{P_{t+1} - P_t}{P_t} \quad (3)$$

The CPI is currently at about 226 (something costing \$100 in 1983 costs \$226 today) about a 3.4% increase since last year, most of this due to higher food and energy prices.

B The costs of inflation

1. MENU COSTS. There is a cost to changing catalogs/menus with higher prices. Chalkboards in Brazil.
2. MONETARY MISPERCEPTIONS. Consider a seller faced with increased demand. Two possibilities:
 - (a) The product is cooler/better than other products. This is called a RELATIVE CHANGE IN DEMAND. In this case, the seller should increase prices, but also increase production, pulling resources away from projects that are not doing well.
 - (b) People could just have more money in their wallets due to an increase in the money supply. This is a NOMINAL CHANGE IN DEMAND. Every other business is

experiencing an increase in demand, with no change in relative quality. Therefore, all firms should just raise prices.

Sometimes it is not clear to sellers which situation they are in. Misperceptions leads to a misallocation of resources.

3. **HOLD TOO LITTLE MONEY.** In strong inflation, holding money has an extremely low return. Therefore, hold wealth in other assets such as stocks and real estate. Too much time is spent shopping and bartering.
4. **BRACKET CREEP** in investment taxes. Investment taxes are not adjusted for inflation. Therefore, an increase in nominal rates causes an increase in taxes and thus a decrease in investment and economic growth.
5. **WAGE EFFECT.** If wages are fixed (some employees have fixed wage contracts), inflation brings down real wages which acts to increase employment, but reduces the real wages of the employed.

C The costs of deflation

Deflation can be just as problematic as inflation, all of the above apply in reverse.

IV Interest Rates and inflation

Definition 21 *INTEREST RATE:(R)* Charge per dollar per period that borrowers pay or lenders receive.

What affects the interest rate:

- risk, taxes, when a loan is repaid.
- inflation

When a loan is repaid, it is repaid with dollars that are worth less than the dollars that were lent, due to inflation. Hence the real interest rate (the interest rate in constant purchasing power) is lower than the nominal rate (the dollar interest rate in the newspaper).

$$r_t = R_t - \pi_t. \tag{4}$$

Therefore, as a rule, increases in inflation increase nominal interest rates.

Some interest rates we will use:

Target fed funds	0-0.25%
Actual fed funds	0.13%
Reserve rate	0.25%
Discount rate	0.75%
Prime rate	3.25%
One month tbill	0.02%
One month CD	0.11%
Six month CD	0.52%
Overnight Repurchase Agreements	0.20%
CPI	3.4%