In this chapter you will learn

- The classical theory of inflation
  - causes
  - effects
  - social costs
- "Classical" -- assumes prices are flexible & markets clear.
- Applies to the long run.

U.S. inflation & its trend, 1960-2001
The connection between money and prices

- Inflation rate = ____________
- Price = amount of money required to buy a good.
- Because prices are defined in terms of money, we need to consider the nature of money, the supply of money, and how it is controlled.

Money: definition

Money is ______

Money: functions

1. ________ we use it to buy stuff
2. ________ transfers purchasing power from the present to the future
3. ________ the common unit by which everyone measures prices and values
Money: types

1. ________
   • has no intrinsic value
   • example: the paper currency we use

2. ________
   • has intrinsic value
   • examples: gold coins, cigarettes in P.O.W. camps

Discussion Question

Which of these are money?

a. Currency
b. Checks
c. Deposits in checking accounts
   (called demand deposits)
d. Credit cards
e. Certificates of deposit
   (called time deposits)

The money supply & monetary policy

• The __________ is the quantity of money available in the economy.
• __________ is the control over the money supply.
The central bank

- Monetary policy is conducted by a country’s ____________.
- In the U.S., the central bank is called the Federal Reserve ("the Fed").

The Federal Reserve Building
Washington, DC

Money supply measures, April 2002

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Assets included</th>
<th>Amount (billions)</th>
</tr>
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<tbody>
<tr>
<td>C</td>
<td>Currency</td>
<td>$598.7</td>
</tr>
<tr>
<td>M1</td>
<td>C + travelers’ checks, other checkable deposits</td>
<td>1174.0</td>
</tr>
<tr>
<td>M2</td>
<td>M1 + savings deposits, money market mutual funds, money market deposit accounts</td>
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<tr>
<td>M3</td>
<td>M2 + repurchase agreements, institutional money market mutual fund balances</td>
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The Quantity Theory of Money

- A simple theory linking the inflation rate to the growth rate of the money supply.
- Begins with a concept called "velocity"...
**Velocity**

- **basic concept:** the rate at which money circulates
- **definition:** ________________

**example:** In 2001,
- $500 billion in transactions
- money supply = $100 billion
- The average dollar is used in five transactions in 2001
- So, velocity = ___

**Velocity, cont.**

- This suggests the following definition:

  \[ V = \frac{P \times Y}{M} \]

  where
  - \( V \) = velocity
  - \( T \) = value of all transactions
  - \( M \) = money supply

**Velocity, cont.**

- Use nominal GDP as a proxy for total transactions.

  Then, \( V = \frac{P \times Y}{M} \)

  where
  - \( P \) = price of output (GDP deflator)
  - \( Y \) = quantity of output (real GDP)
  - \( P \times Y \) = value of output (nominal GDP)
The quantity equation

- The quantity equation
  __________
  follows from the preceding definition of velocity.
- It is an identity:
  it holds by definition of the variables.

Money demand and the quantity equation

- \( \frac{M}{P} = \) __________, the purchasing power of the money supply.
- A simple money demand function:
  \( \left( \frac{M}{P} \right)^d = \) ______
  where
  \( k = \) how much money people wish to hold for each dollar of income.
  (\( k \) is exogenous)

Money demand and the quantity equation

- money demand: \( \left( \frac{M}{P} \right)^d = kY \)
- quantity equation: \( M \times V = P \times Y \)
- The connection between them: __________
- When people hold lots of money relative to their incomes (\( k \) is _______), money changes hands infrequently (\( V \) is _______).
back to the Quantity Theory of Money

- starts with quantity equation
- assumes \( V \) is constant & exogenous:
  \[ V = \bar{V} \]
- With this assumption, the quantity equation can be written as
  \[ M \times \bar{V} = P \times Y \]

The Quantity Theory of Money, cont.

\[ M \times \bar{V} = P \times Y \]

How the price level is determined:
- With \( V \) constant, the money supply determines _______ \((P \times Y)\)
- _______ is determined by the economy’s supplies of \( K \) and \( L \) and the production function (chap 3)
- The price level is \( P = \) _______________

The Quantity Theory of Money, cont.

- The quantity equation in growth rates:
  \[ \frac{\Delta M}{M} = \frac{\Delta V}{V} = \frac{\Delta P}{P} + \frac{\Delta Y}{Y} \]
  The quantity theory of money assumes \( V \) is constant, so \( \frac{\Delta V}{V} = 0 \).
The Quantity Theory of Money, cont.

Let \( \pi \) (Greek letter "pi") denote the inflation rate:
\[
\pi = \frac{\Delta P}{P}
\]
The result from the preceding slide was:
\[
\frac{\Delta M}{M} = \frac{\Delta P}{P} \frac{\Delta Y}{Y}
\]
Solve this result for \( \pi \) to get

Chapter 4: Money and Inflation

Normal economic growth requires a certain amount of money supply growth to facilitate the growth in transactions.

\[ \Delta Y/Y \] depends on growth in the factors of production and on technological progress (all of which we take as given, for now).

Hence, the Quantity Theory of Money predicts a
International data on inflation and money growth

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<tr>
<th>Inflation rate (percent, logarithmic scale)</th>
<th>Money supply growth (percent, logarithmic scale)</th>
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<tr>
<td>0.1</td>
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<tr>
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</tr>
<tr>
<td>1,000</td>
<td>1,000</td>
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U.S. data on inflation and money growth

<table>
<thead>
<tr>
<th>Inflation rate (percent)</th>
<th>Growth in money supply (percent)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
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<tr>
<td>2</td>
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<td>4</td>
<td>4</td>
</tr>
<tr>
<td>6</td>
<td>6</td>
</tr>
</tbody>
</table>

Seigniorage

- To spend more without raising taxes or selling bonds, the govt can print money.
- The “revenue” __________________________
- The ________________:
  Printing money to raise revenue causes inflation. Inflation is like a tax on people who hold money.
Inflation and interest rates

- **interest rate, \( i \) not adjusted for inflation**
- **interest rate, \( r \) adjusted for inflation**: \( r = i - \pi \)

The Fisher Effect

- The Fisher equation: __________
- Chap 3: \( S = I \) determines \( r \).
- Hence, an increase in \( \pi \) causes an **equal** increase in \( i \).
- This one-for-one relationship is called the __________.

U.S. inflation and nominal interest rates, 1952-1998
Exercise:

Suppose $V$ is constant, $M$ is growing 5% per year, $Y$ is growing 2% per year, and $r = 4$.

a. Solve for $i$ (the nominal interest rate).

b. If the Fed increases the money growth rate by 2 percentage points per year, find $\Delta i$.

c. Suppose the growth rate of $Y$ falls to 1% per year.
   • What will happen to $\pi$?
   • What must the Fed do if it wishes to keep $\pi$ constant?

Answers:

Suppose $V$ is constant, $M$ is growing 5% per year, $Y$ is growing 2% per year, and $r = 4$.

a.

b.

c.
Two real interest rates

- \( \pi \): actual inflation rate (not known until after it has occurred)
- \( \pi_e \): expected inflation rate
- \( i - \pi_e \) = real interest rate:
- \( i - \pi \) = real interest rate:

Money demand and the nominal interest rate

- The Quantity Theory of Money assumes that the demand for real money balances depends only on real income \( Y \).
- We now consider another determinant of money demand: the nominal interest rate.
- The nominal interest rate \( i \) is the __________ (instead of bonds or other interest-earning assets).
- Hence, __________.

The money demand function

\[
\frac{M}{P} = \text{real money demand, depends}
\]
- \( i \): the opp. cost of holding money
- higher \( Y \) \( \Rightarrow \) more spending
  \( \Rightarrow \) so, need more money
- \( L \) is used for the money demand function because money is the most liquid asset.
The money demand function

\[
\frac{M}{P}^d = L(i, Y)
\]

When people are deciding whether to hold money or bonds, they don't know what inflation will turn out to be. Hence, the nominal interest rate relevant for money demand is ________. 

Equilibrium

\[
\frac{M}{P} = L(r + \pi^e, Y)
\]

What determines what

\[
\frac{M}{P} = L(r + \pi^e, Y)
\]

variable how determined (in the long run)

\[
M, r, Y, P
\]
How \( P \) responds to \( \Delta M \)

\[
\frac{M}{P} = L(r + \pi^e, Y)
\]

* For given values of \( r \), \( Y \), and \( \pi^e \),
  a change in \( M \) causes \( P \) to _____
  ___________________________ --- just like
  in the Quantity Theory of Money.

What about expected inflation?

* Over the long run, people don’t consistently over- or under-forecast inflation,
  so \( \pi^e = \pi \) on average.
* In the short run, \( \pi^e \) may change when people get new information.
* EX: Suppose Fed announces it will increase \( M \) next year. People will expect next year’s \( P \) to be higher, so \( \pi^e \) rises.
* This will affect \( P \) now, even though \( M \) hasn’t changed yet.
  (continued…)

How \( P \) responds to \( \Delta \pi^e \)

\[
\frac{M}{P} = L(r + \pi^e, Y)
\]

* For given values of \( r \), \( Y \), and \( M \),
  \( \uparrow \pi^e \Rightarrow \)
  \( \Rightarrow \)
  \( \Rightarrow \)
Discussion Question

Why is inflation bad?
- What costs does inflation impose on society? List all the ones you can think of.
- Focus on the long run.
- Think like an economist.

A common misperception
- Common misperception: inflation reduces real wages
- This is true only in the short run, when nominal wages are fixed by contracts.
- (Chap 3) In the long run, the real wage is determined by labor supply and the marginal product of labor, not the price level or inflation rate.
- Consider the data...

The classical view of inflation
- The classical view: A change in the price level is merely a change in the units of measurement.

So why, then, is inflation a social problem?
The social costs of inflation

...fall into two categories:
1. costs when inflation is expected
2. additional costs when inflation is different than people had expected.

The costs of expected inflation:

1. def: the costs and inconveniences of reducing money balances to avoid the inflation tax.
   $\pi \Rightarrow i \Rightarrow \downarrow \text{real money balances}$
   Remember: In long run, inflation doesn't affect real income or real spending.
   So, same monthly spending but lower average money holdings means more frequent trips to the bank to withdraw smaller amounts of cash.

The costs of expected inflation:

2. def: __________________________.
   Examples:
   – print new menus
   – print & mail new catalogs
   The higher is inflation, the more frequently firms must change their prices and incur these costs.
The costs of expected inflation:

3. Firms facing menu costs change prices infrequently.

Example: Suppose a firm issues a new catalog each January. As the general price level rises throughout the year, the firm's relative price will fall.

Different firms change their prices at different times, leading to relative price distortions...

...which cause microeconomic inefficiencies in the allocation of resources.

The costs of expected inflation:

4. Some taxes are not adjusted to account for inflation, such as the capital gains tax.

Example:

- 1/1/2001: you bought $10,000 worth of Starbucks stock
- 12/31/2001: you sold the stock for $11,000, so your nominal capital gain was $1000 (10%).
- Suppose $\pi = 10\%$ in 2001.
- Your real capital gain is $0$.
- But the govt requires you to pay taxes on your $1000$ nominal gain!!

The costs of expected inflation:

5. Inflation makes it harder to compare nominal values from different time periods.

This complicates long-range financial planning.
Additional cost of unexpected inflation:

- Many long-term contracts not indexed, but based on $\pi^e$.
- If $\pi$ turns out different from $\pi^e$, then some gain at others’ expense.
  
  Example: borrowers & lenders
  - If $\pi > \pi^e$, then ________ and purchasing power is transferred from ________.
  - If $\pi < \pi^e$, then purchasing power is transferred from ________.

Additional cost of high inflation:

- When inflation is high, it’s more variable and unpredictable: $\pi$ turns out different from $\pi^e$ more often, and the differences tend to be larger (though not systematically positive or negative).
- Arbitrary redistributions of wealth become more likely.
- This creates higher uncertainty, which makes risk averse people worse off.

One benefit of inflation:

- Nominal wages are rarely reduced, even when the equilibrium real wage falls.
- Inflation allows the real wages to reach equilibrium levels without nominal wage cuts.
- Therefore, moderate inflation improves the functioning of labor markets.
Hyperinflation

- def: $\pi \geq 50\%$ per month
- All the costs of moderate inflation described above become ***HUGE*** under hyperinflation.
- Money ceases to function as a store of value, and may not serve its other functions (unit of account, medium of exchange).
- People may conduct transactions with barter or a stable foreign currency.

What causes hyperinflation?

- Hyperinflation is caused by...
- When the central bank prints money, the price level rises.
- If it prints money rapidly enough, the result is hyperinflation.

Recent episodes of hyperinflation

- Brazil 1983-85
- Poland 1989-90
- Brazil 1987-94
- Argentina 1988-90
- Peru 1988-90
- Nicaragua 1987-91
- Bolivia 1984-85
Why governments create hyperinflation

- When a government cannot raise taxes or sell bonds,
- it must finance spending increases by printing money.
- In theory, the solution to hyperinflation is simple: ________________.
- In the real world, ________________.

The Classical Dichotomy

Real variables are ________________: quantities and relative prices, e.g.
- quantity of output produced
- _______: output earned per hour of work
- _______: output earned in the future by lending one unit of output today

Nominal variables: ________________, e.g.
- _______: dollars per hour of work
- _______: dollars earned in future by lending one dollar today
- _______: the amount of dollars needed to buy a representative basket of goods

The Classical Dichotomy

- Note: Real variables were explained in Chap 3, nominal ones in Chap 4.
- Classical Dichotomy: the theoretical separation of real and nominal variables in the classical model, which implies

- _______: Changes in the money supply do not affect real variables. In the real world, money is approximately neutral in the long run.
Chapter summary

1. Quantity theory of money
   - assumption: velocity is stable
   - conclusion: the money growth rate determines the inflation rate.

2. Money demand
   - depends on income in the Quantity Theory
   - more generally, it also depends on the nominal interest rate;

Chapter summary

3. Nominal interest rate
   - equals real interest rate + inflation.
   - Fisher effect: it moves one-for-one with expected inflation.

4. Hyperinflation
   - caused by rapid money supply growth when money printed to finance government budget deficits
   - stopping it requires fiscal reforms to eliminate govt's need for printing money

Chapter summary

5. Classical dichotomy
   - In classical theory, money is neutral--does not affect real variables.
   - So, we can study how real variables are determined w/o reference to nominal ones.
   - Then, eq'm in money market determines price level and all nominal variables.