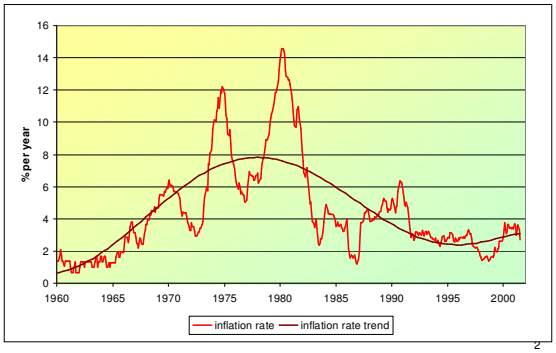
Chapter 4
Money and Inflation

Learning Objectives

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

U.S. inflation & its trend, 1960-2001



Money

- **Inflation rate** = the percentage increase in the average level of **prices**.
- **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

1.1 Defining Money

Money is the stock of assets that can be readily used to make transactions.

Money

1.2 Functions of Money

$ **medium of exchange**
we use it to buy stuff
→ Barter economy and "double coincidence of wants" problem solved!

$ **store of value**
transfers purchasing power from the present to the future

$ **unit of account**
the common unit by which everyone measures prices and values

Money

1.3 Types of Money

$ **fiat money**
- has no intrinsic value
- example: the paper currency we use

$ **commodity money**
- has intrinsic value
- examples: gold coins, cigarettes in P.O.W. camps

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Money

1.4 Evolution of Fiat Money

Imagine the gold standard

→Transaction Costs

→Government involvement (gold certificates in exchange for gold)

→Nobody carries gold, gold-backed bills become the monetary standard

→Gold backing becomes irrelevant (nobody bothers to redeem the bills)

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Causes of Inflation: Money

A. The Quantity Equation

Quantity Equation is given by

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

- RHS = Number of $ exchanged in a year
  1. P = price of a transaction
  2. T = number of times goods exchange hands
- LHS = Money used to make the transactions
  1. M = quantity of money
  2. V = velocity

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Causes of Inflation: Money

Velocity

- basic concept: the rate at which money circulates
- definition: the number of times the average dollar bill changes hands in a given time period
- example: In 2001,
  - $500 billion in transactions
  - money supply = $100 billion
  - The average dollar is used in five transactions in 2001
  - So, velocity = 5

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Causes of Inflation: Money

- This suggests the following definition:

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

where

V = velocity

PxT = value of all transactions

M = money supply

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Causes of Inflation: Money

- Use real GDP as a proxy for total transactions.

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

where

P = price of output

Y = quantity of output (real GDP)

$P \times Y$ = value of output (nominal GDP)

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Causes of Inflation: Money

- The **quantity equation**

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

- It is an *identity:* it holds by definition of the variables.

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Causes of Inflation: Money

B. Money Supply

- The **money supply** is the quantity of money available in the economy.
- **Monetary policy** is the control over the money supply.

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Causes of Inflation: Money

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

The Federal Reserve Building
Washington, DC

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Causes of Inflation: Money

C. Money Demand

- A simple money demand function:

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

where
k = how much money people wish to hold for each dollar of income. (k is exogenous)

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Causes of Inflation: Money

D. Money Market Equilibrium

- When money demand: $(M/P)^d = k\,Y$
- Money market equilibrium: $M/P = k\,Y$ *is a special case of the Quantity Equation.*
- The connection between them: $k = 1/V$
- When people hold lots of money relative to their incomes (k is high), money changes hands infrequently (V is low).

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Causes of Inflation: Money

E. Quantity Theory of Money

- starts with quantity equation
- assumes V is constant & exogenous (MDemand):

$$V = \overline{V}$$

- With this assumption, the quantity equation can be written as

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

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Causes of Inflation: Money

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

How the price level is determined:

- With V constant, the money supply determines nominal GDP ($P \times Y$)
- Real GDP is determined by the economy's supplies of K and L and the production function (chap 3)
- The price level is P = (nominal GDP)/(real GDP)

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Causes of Inflation: Money

- 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 $\frac{\Delta V}{V} = 0$.

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Causes of Inflation: Money

$$\pi = \frac{\Delta M}{M} - \frac{\Delta Y}{Y}$$

- Normal economic growth requires a certain amount of money supply growth to facilitate the growth in transactions.
- Money growth in excess of this amount leads to inflation.

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Causes of Inflation: Money

$$\pi = \frac{\Delta M}{M} - \frac{\Delta Y}{Y}$$

$\Delta Y/Y$ 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 one-for-one relation between changes in the money growth rate and changes in the inflation rate.

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Causes of Inflation: Expectations

A. Fisher Equations

- Nominal interest rate, i not adjusted for inflation
- Real interest rate, r adjusted for inflation: $r = i - \pi$
- The Fisher equation: $i = r + \pi$
- Chap 3: $S = I$ determines r.
- Hence, an increase in π causes an equal increase in i.
- This one-for-one relationship is called the **Fisher effect**.

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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 Δi.

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

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Answers

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

a. First, find $\pi = 5 - 2 = 3$.
   Then, find $i = r + \pi = 4 + 3 = 7$.

b. $\Delta i = 2$, same as the increase in the money growth rate.

c. If the Fed does nothing, $\Delta\pi = 1$.
   To prevent inflation from rising, Fed must reduce the money growth rate by 1 percentage point per year.

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Causes of Inflation: Expectations

- π = actual inflation rate
  (not known until after it has occurred)
- π^e = expected inflation rate
- $i - \pi^e$ = ***ex ante*** real interest rate:
  what people expect at the time they buy a bond or take out a loan
- $i - \pi$ = ***ex post*** real interest rate:
  what people actually end up earning on their bond or paying on their loan
- $i = r + \pi^e$ **Fischer Equation**

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Causes of Inflation: Expectations

A. Money Supply; as described before

B. Money Demand; a new definition

- 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 opportunity cost of holding money (instead of bonds or other interest-earning assets).
- Hence, $\uparrow i \Rightarrow \downarrow$ in money demand.

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Causes of Inflation: Expectations

$(M/P)^d$ = real money demand, depends

- negatively on ***i***
  i is the opp. cost of holding money
- positively on ***Y***
  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.)

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Causes of Inflation: Expectations

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

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 $r + \pi^e$.

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Causes of Inflation: Expectations

D. Money Market Equilibrium

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

The supply of real money balances

Real money demand

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Causes of Inflation: Expectations

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

variable	how determined *(in the long run)*
M	exogenous (the Fed)
r	adjusts to make $S = I$
Y	$\overline{Y} = F(\overline{K}, \overline{L})$
P	adjusts to make $\frac{M}{P} = L(i, Y)$

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Causes of Inflation: Expectations

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

- For given values of r, Y, and π^e, a change in M causes P to change by the same percentage --- just like in the Quantity Theory of Money.

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Causes of Inflation: Expectations

- Over the long run, people don't consistently over- or under-forecast inflation, so $\pi^e = \pi$ on average.
- In the short run, π^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 π^e rises.
- This will affect P now, even though M hasn't changed yet.

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Causes of Inflation: Expectations

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

- For given values of r, Y, and M,

  $\uparrow \pi^e \Rightarrow \uparrow i$ (the Fisher effect)

  $\Rightarrow \downarrow (M/P)^d$

  $\Rightarrow \uparrow P$ to make (M/P) fall to re-establish eq'm

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Costs of Inflation

A. Costs of Expected Inflation

1. Shoe-leather cost

- def: the costs and inconveniences of reducing money balances to avoid the inflation tax.
- $\uparrow\pi \Rightarrow \uparrow i$

  $\Rightarrow \downarrow$ 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.

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Costs of Inflation

2. Menu Costs

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

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Costs of Inflation

3. Relative Price Distortions

- Firms facing menu costs change prices infrequently.
- Example:
  Suppose a firm issues 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.

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Costs of Inflation

4. Unfair Tax Treatment

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!!

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Costs of Inflation

5. General Inconvenience

- Inflation makes it harder to compare nominal values from different time periods.
- This complicates long-range financial planning.

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Costs of Inflation

B. Additional Costs of Unexpected Inflation

1. Arbitrary Redistributions of Purchasing Power

- Many long-term contracts not indexed, but based on π^e.
- If π turns out different from π^e, then some gain at others' expense.

  Example: borrowers & lenders
  - If $\pi > \pi^e$, then $(i - \pi) < (i - \pi^e)$ and purchasing power is transferred from lenders to borrowers.
  - If $\pi < \pi^e$, then purchasing power is transferred from borrowers to lenders.

  Exercise: Think about what the implications of having asymmetric information regarding next period's π could have on net returns.

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Costs of Inflation

2. Increased Uncertainty

- When inflation is high, it's more variable and unpredictable:
  π turns out different from π^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.

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Benefit(s) 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.

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The Classical Dichotomy

Real variables are measured in physical units: quantities and relative prices, e.g.
- quantity of output produced
- real wage: output earned per hour of work
- real interest rate: output earned in the future by lending one unit of output today

Nominal variables: measured in money units, e.g.
- nominal wage: dollars per hour of work
- nominal interest rate: dollars earned in future by lending one dollar today
- the price level: the amount of dollars needed to buy a representative basket of goods

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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 nominal variables do not affect real variables.
- **Neutrality of Money**: Changes in the money supply do not affect real variables.
  In the real world, money is approximately neutral in the long run.

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Chapter Summary

1. Money
   - the stock of assets used for transactions
   - serves as a medium of exchange, store of value, and unit of account.
   - Commodity money has intrinsic value, fiat money does not.
   - Central bank controls money supply.
2. Quantity theory of money
   - assumption: velocity is stable
   - conclusion: the money growth rate determines the inflation rate.

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Chapter Summary

3. Nominal interest rate
   - equals real interest rate + inflation rate.
   - Fisher effect: nominal interest rate moves one-for-one w/ expected inflation.
   - is the opp. cost of holding money
4. Money demand
   - depends on income in the Quantity Theory
   - more generally, it also depends on the nominal interest rate;
     if so, then changes in expected inflation affect the current price level.

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Chapter Summary

5. Costs of inflation
   - *Expected inflation*
     shoeleather costs, menu costs, tax & relative price distortions, inconvenience of correcting figures for inflation
   - *Unexpected inflation*
     all of the above plus arbitrary redistributions of wealth between debtors and creditors

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Chapter Summary

7. 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.
   - Most economists believe the economy works this way in the long run.

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