

Chapter 4
Money and Inflation

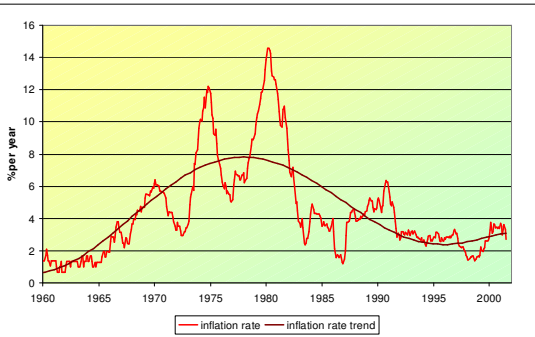
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Learning Objectives

- 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.

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



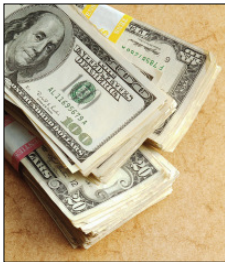
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Money

- **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.

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Money



1.1 Defining Money

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

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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

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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)

PxY = 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):

$$V = \bar{V}$$

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

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

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Causes of Inflation: Money

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

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
 $P = (\text{nominal GDP})/(\text{real GDP})$

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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

$$V \text{ is constant, so } \frac{\Delta V}{V} = 0.$$

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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 $r = 4$.

- Solve for i (the nominal interest rate).
- If the Fed increases the money growth rate by 2 percentage points per year, find Δi .
- 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** $\bar{Y} = F(\bar{K}, \bar{L})$
- 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. ³⁴

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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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