

CHAPTER 4

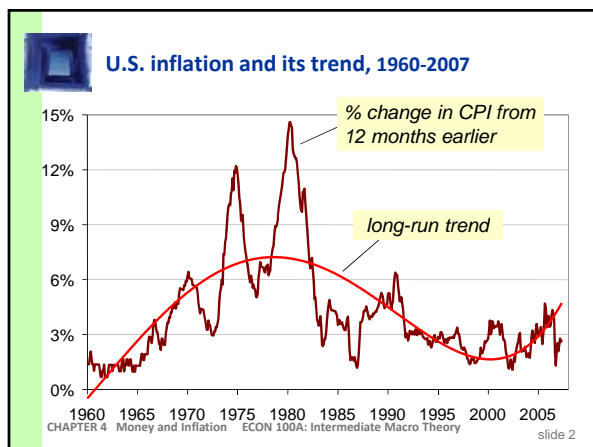
Money and Inflation

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

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The connection between money and prices

- 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: Definition

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

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Money: Functions

- medium of exchange
we use it to buy stuff
- 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: Types

1. fiat money
 - has no intrinsic value
 - example: the paper currency we use
2. commodity money
 - has intrinsic value
 - examples:
 - gold coins,
 - cigarettes in P.O.W. camps

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Discussion Question

Which of these are money?

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

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The money supply and monetary policy definitions

- 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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The central bank

- 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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The Quantity Theory of Money

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

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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 2007,
 - \$500 billion in transactions
 - money supply = \$100 billion
 - The average dollar is used in five transactions in 2007
 - So, velocity = 5

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Velocity, cont.

- This suggests the following definition:

$$V = \frac{T}{M}$$

where

V = velocity

T = value of all transactions

M = money supply

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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)

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The quantity equation

- The **quantity equation**

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

follows from the preceding definition of velocity.

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

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Money demand and the quantity equation

- M/P = **real money balances**, the purchasing power of the money supply.
- A simple money demand function:
 $(M/P)^d = kY$
where
 k = how much money people wish to hold for each dollar of income.
(k is exogenous)

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Money demand and the quantity equation

- money demand: $(M/P)^d = kY$
- quantity equation: $M \times V = P \times Y$
- 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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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

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

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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 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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The quantity theory of money, cont.

- Recall from Chapter 2:
The growth rate of a product equals the sum of the growth rates.
- 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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The quantity theory of money, cont.

π (Greek letter "pi") denotes 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 π to get

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

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The quantity theory of money, cont.

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

- 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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The quantity theory of money, cont.

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

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

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Confronting the quantity theory with data

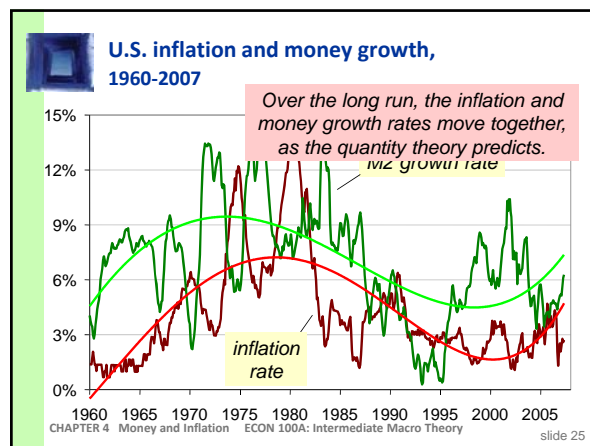
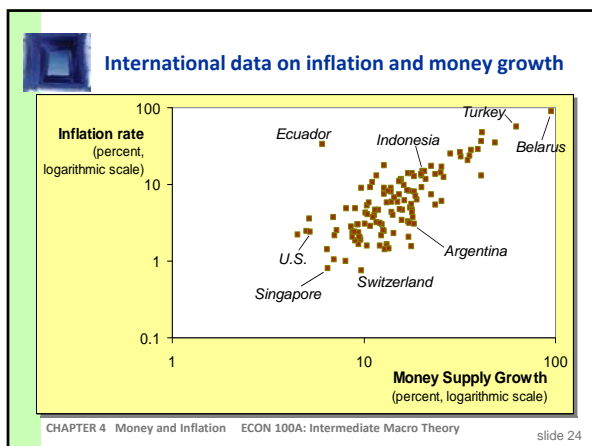
The quantity theory of money implies

- countries with higher money growth rates should have higher inflation rates.
- the long-run trend behavior of a country's inflation should be similar to the long-run trend in the country's money growth rate.

Are the data consistent with these implications?

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Seigniorage

- To spend more without raising taxes or selling bonds, the govt can print money.
- The “revenue” raised from printing money is called **seigniorage** (pronounced SEEN-your-idge).
- The **inflation tax**: Printing money to raise revenue causes inflation. Inflation is like a tax on people who hold money.

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Inflation and interest rates

- Nominal interest rate, i not adjusted for inflation
- Real interest rate, r adjusted for inflation:

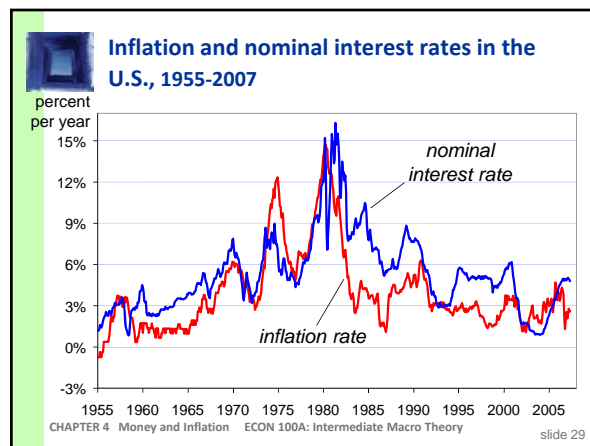
$$r = i - \pi$$

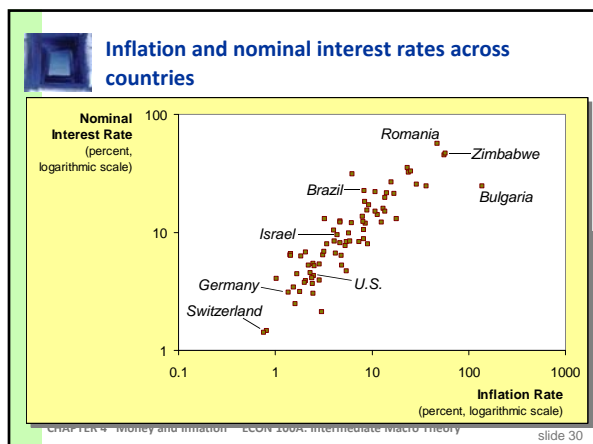
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The Fisher effect

- 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 .
- 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:

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

- First, find $\pi = 5 - 2 = 3$.
Then, find $i = r + \pi = 4 + 3 = 7$.
- $\Delta i = 2$, same as the increase in the money growth rate.
- 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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Two real interest rates

- π = actual inflation rate
(not known until after it has occurred)
- π^e = expected inflation rate
- $i - \pi^e$ = **ex ante** real interest rate:
the real interest rate people expect at the time they buy a bond or take out a loan
- $i - \pi$ = **ex post** real interest rate:
the real interest rate actually realized

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Money demand and the nominal interest rate

- In the quantity theory of money, the demand for real money balances depends only on real income Y .
- Another determinant of money demand: the nominal interest rate, i .
 - 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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The money demand function

$$(M/P)^d = L(i, Y)$$

$(M/P)^d$ = 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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The money demand function

$$\begin{aligned} (M/P)^d &= L(i, Y) \\ &= L(r + \pi^e, Y) \end{aligned}$$

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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Equilibrium

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

The supply of real money balances

Real money demand

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What determines what

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

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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How P responds to ΔM

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

- 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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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, π^e may change when people get new information.
- EX: Fed announces it will increase M next year. People will expect next year's P to be higher, so π^e rises.
- This affects P now, even though M hasn't changed yet....

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How P responds to $\Delta \pi^e$

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

- For given values of r , Y , and M ,
 - $\uparrow \pi^e \Rightarrow \uparrow i$ (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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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.

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A common misperception

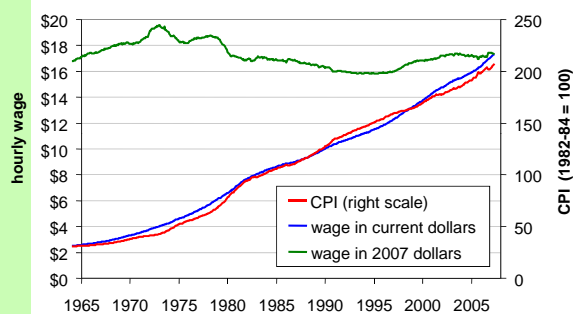
- Common misperception:
inflation reduces real wages
- This is true only in the short run, when nominal wages are fixed by contracts.
- (Chap. 3) In the long run, the real wage is determined by labor supply and the marginal product of labor, not the price level or inflation rate.
- Consider the data...

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Average hourly earnings and the CPI, 1964-2007



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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?

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The social costs of inflation

...fall into two categories:

1. costs when inflation is expected
2. costs when inflation is different than people had expected

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The costs of expected inflation:

1. Shoeleather 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 does not 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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The costs of expected inflation: 2. Menu costs

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

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The costs of expected inflation: 3. Relative price distortions

- Firms facing menu costs change prices infrequently.
- Example:
 - 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...
 - ...causing microeconomic inefficiencies in the allocation of resources.

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The costs of expected inflation: 4. Unfair tax treatment

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

Example:

- Jan 1: you buy \$10,000 worth of IBM stock
- Dec 31: you sell the stock for \$11,000, so your nominal capital gain is \$1000 (10%).
- Suppose $\pi = 10\%$ during the year. Your real capital gain is \$0.
- But the govt requires you to pay taxes on your \$1000 nominal gain!!

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The costs of expected 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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Additional cost of *unexpected* inflation: Arbitrary redistribution 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.

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Additional cost of high inflation: 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, making risk averse people worse off.

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One benefit of inflation

- Nominal wages are rarely reduced, even when the equilibrium real wage falls.
This hinders labor market clearing.
- 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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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.

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What causes hyperinflation?

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

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A few examples of hyperinflation

	money growth (%)	inflation (%)
Israel, 1983-85	295	275
Poland, 1989-90	344	400
Brazil, 1987-94	1350	1323
Argentina, 1988-90	1264	1912
Peru, 1988-90	2974	3849
Nicaragua, 1987-91	4991	5261
Bolivia, 1984-85	4208	6515

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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: stop printing money.
- In the real world, this requires drastic and painful fiscal restraint.

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The Classical Dichotomy

Real variables: Measured in physical units – quantities and relative prices, *for example:*

Normal variables: Measured in money units, e.g.,

- quantity of output produced
- real wage: output earned per hour of work
- nominal wage: Dollars per hour of work
- real interest rate: output earned in the future by lending one dollar today
- nominal interest rate: Dollars earned in the 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 Chapter 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

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 the money supply.

Quantity theory of money assumes velocity is stable, concludes that the money growth rate determines the inflation rate.

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Chapter Summary

Nominal interest rate

- equals real interest rate + inflation rate
- the opp. cost of holding money
- Fisher effect: Nominal interest rate moves one-for-one w/ expected inflation.

Money demand

- depends only on income in the Quantity Theory
- 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

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

Hyperinflation

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

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Chapter Summary

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, money market eq'm determines price level and all nominal variables.
- Most economists believe the economy works this way in the long run.

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