# Inflation: Its Causes, Effects, and Social Costs

Chapter 6

Econ 313 – Intermediate Macroeconomics

University of Tennessee, Knoxville

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# In This Chapter, You Will Learn:

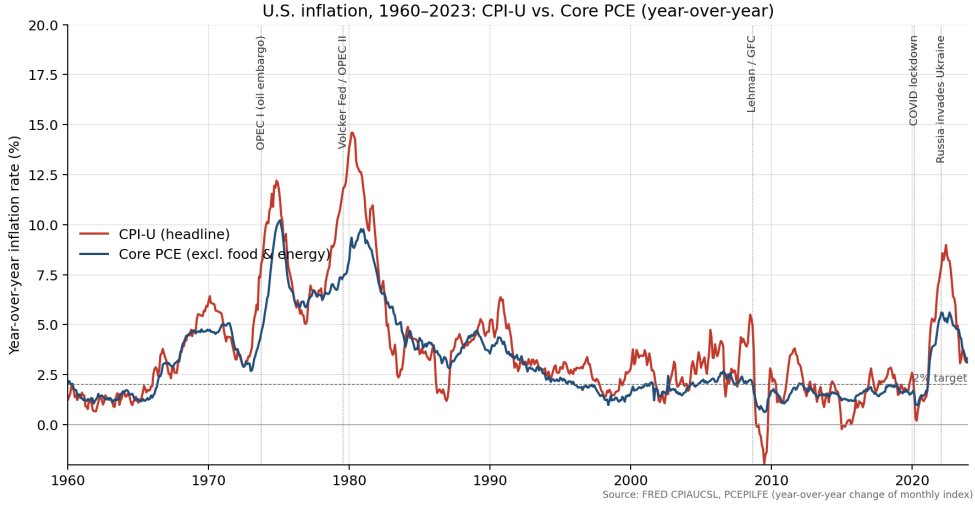
The classical theory of inflation

- Causes
- Effects
- Social costs

"Classical"—assumes prices are flexible and markets clear

Applies to the long run

# U.S. inflation, 1960–2023: CPI-U vs. Core PCE



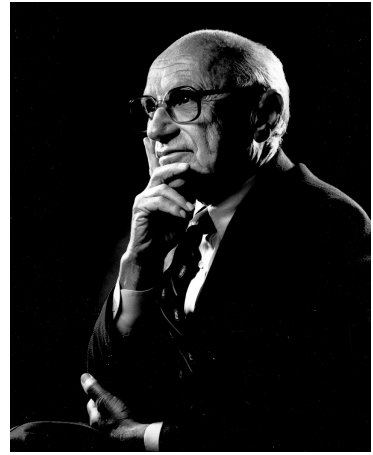

Sources: FRED `CPIAUCSL` and `PCEPILFE`; year-over-year change of the monthly index.

# 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**...

*"Inflation is always and everywhere a monetary phenomenon."*

— Milton Friedman



Milton Friedman (1912–2006)

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# Velocity, part 1

- 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 2023,
  - \$500 billion in transactions
  - money supply = \$100 billion
  - The average dollar is used in five transactions in 2023.
  - So, velocity = 5



The same dollars pass through many hands per year — that count is velocity.

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# Velocity, part 2

This suggests the following definition:

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

where

$V =$ velocity

$T =$ value of all transactions

$M =$ money supply

# Velocity, part 3

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**

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

follows from the preceding definition of velocity.

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

# Money demand and the quantity equation, part 1

- $M/P$ = **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.)

# Money demand and the quantity equation, part 2

- 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 large), money changes hands infrequently ($V$ is small).

# Back to the quantity theory of money

Starts with quantity equation

Assumes $V$ is constant and exogenous: $V = \bar{V}$

Then, the quantity equation becomes:

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

# The quantity theory of money, part 1

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

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 (Chapter 3).
- The price level is $P =$ (nominal GDP)/(real GDP).

# The quantity theory of money, part 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 $V$ is constant, so $\frac{\Delta V}{V} = 0$.

# The quantity theory of money, part 3

$\pi$ (Greek letter *pi*) denotes the inflation rate:

$$\pi = \frac{\Delta P}{P}$$

The result from the preceding slide:

$$\frac{\Delta M}{M} = \frac{\Delta P}{P} + \frac{\Delta Y}{Y}$$

Solve this result for $\pi$:

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

# The quantity theory of money, part 4

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

- 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.

# The quantity theory of money, part 5

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

$\Delta Y/Y$ 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 relationship between changes in the money growth rate and changes in the inflation rate.*

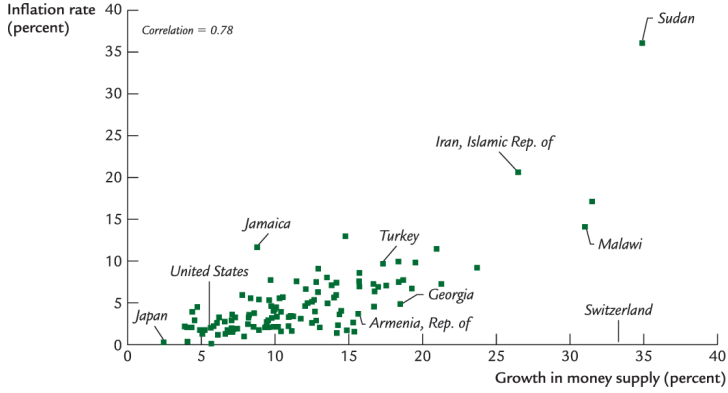
# Confronting the quantity theory with data

The quantity theory of money implies:

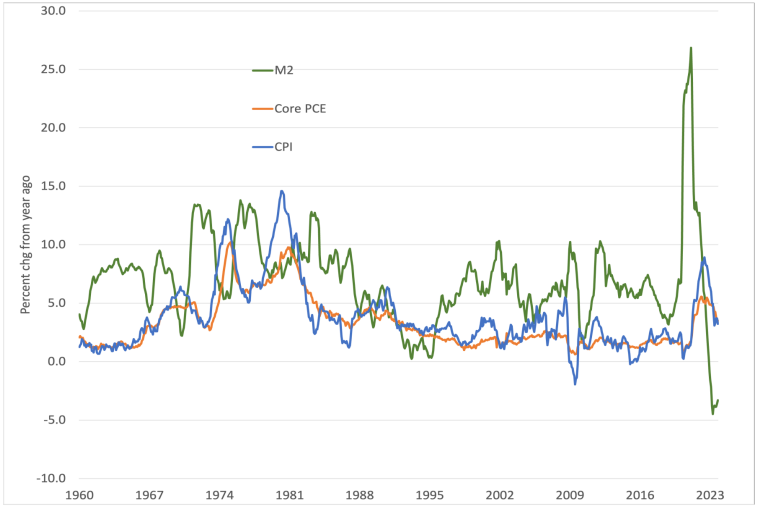
1. Countries with higher money growth rates should have higher inflation rates.
2. The long-run trend in a country's inflation rate should be similar to the long-run trend in the country's money growth rate.

*Are the data consistent with these implications?*

# International data on inflation and money growth

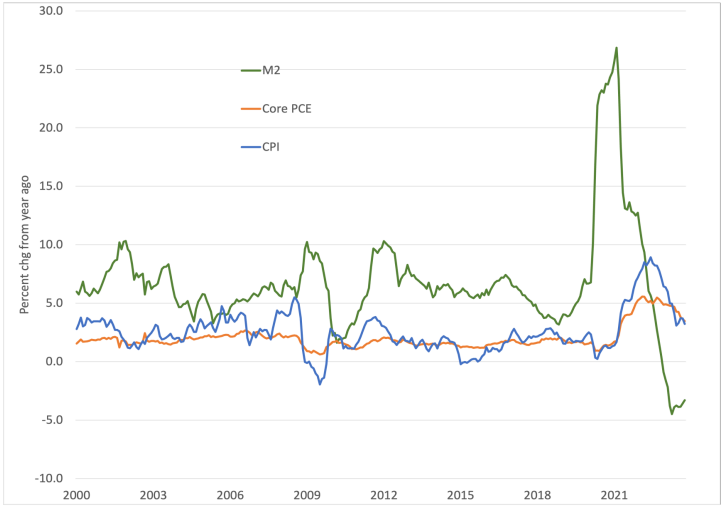


# U.S. inflation and money growth, 1960–2023




Source: Federal Reserve Bank of St. Louis

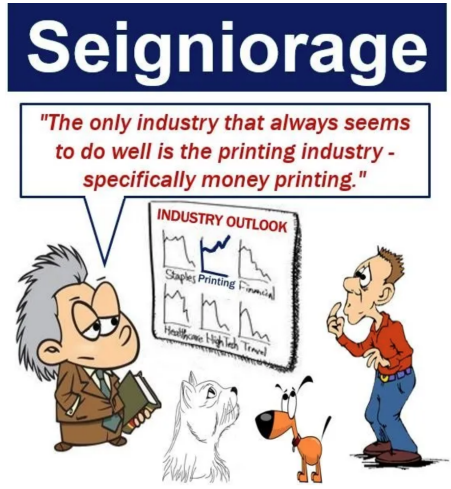
# U.S. inflation and money growth, 2000–2023




Source: Federal Reserve Bank of St. Louis

# Seigniorage

- To spend more without raising taxes or selling bonds, the government can create money.
- The "revenue" raised from money creation is called **seigniorage** (pronounced SEEN-your-idge).
- The **inflation tax**:
  Money creation to raise revenue can cause inflation, paid by holders of money and other nominal assets.



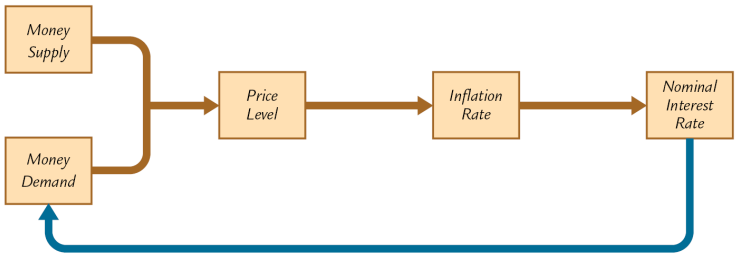
# Inflation and interest rates

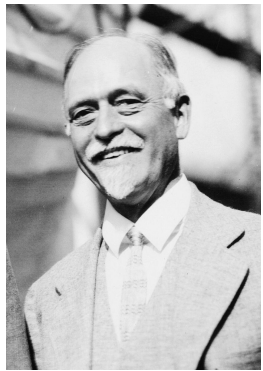
- Nominal interest rate, $i$ not adjusted for inflation
- Real interest rate, $r$ adjusted for inflation:

$$r = i - \pi$$

# The Fisher effect

The Fisher equation: $i = r + \pi$. Chapter 3: $S = I$ determines $r$. Hence, an increase in $\pi$ causes an equal increase in $i$ — the **Fisher effect**.

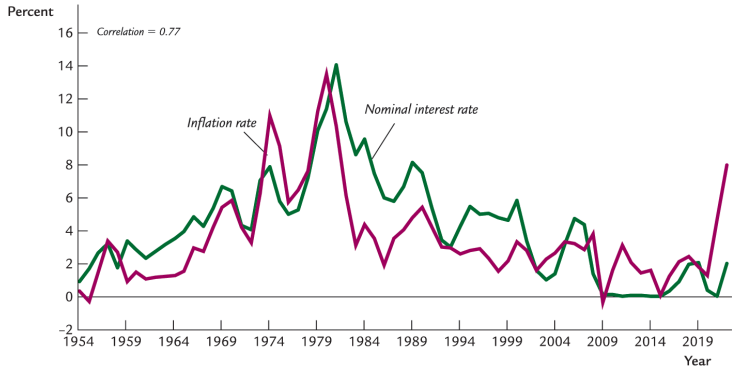


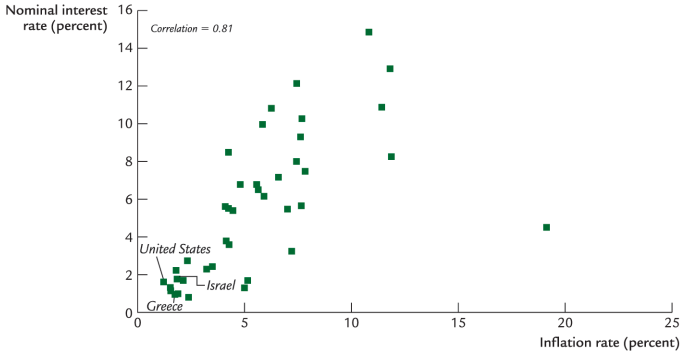
Irving Fisher
(1867–1947)

*LoC, PD*

# U.S. inflation and nominal interest rates, 1955–2022



# Inflation and nominal interest rates in 40 countries



# NOW YOU TRY: Applying the theory

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

(a) Solve for $i$.

(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?

# NOW YOU TRY: Applying the theory, answers

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

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

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

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

# Two real interest rates

Notation:

- $\pi$ = actual inflation rate
  (not known until after it has occurred)
- $E\pi$ = expected inflation rate

Two real interest rates:

- $i - E\pi$ = **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

# 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).
- So, money demand depends negatively on $i$.

# The money demand function, part 1

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

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

- negatively on $i$
  $i$ is the opportunity cost of holding money.
- positively on $Y$
  higher $Y$ increases spending on g&s
  so increases the need for money.

($L$ is used for the money demand function because money is the most liquid asset.)

# The money demand function, part 2

$$\left(\frac{M}{P}\right)^d = L(i, Y) = L(r + E\pi, Y)$$

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 $r + E\pi$.

# Equilibrium

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

The supply of real money balances

Real money demand

# What determines what?

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

| **Variable** | **How determined** (*in the long run*) |
|---|---|
| $M$ | Exogenous (the Fed) |
| $r$ | Adjusts to ensure $S = I$ |
| $Y$ | $\bar{Y} = F(\bar{K}, \bar{L})$ |

$P$ adjusts to ensure $\frac{M}{P} = L(i, Y)$

$i$ is solved for by $i = r + E\pi$

# How $P$ responds to $\Delta M$

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

- For given values of $r$, $Y$, and $E\pi$, a change in $M$ causes $P$ to change by the same percentage—just like in the quantity theory of money.
- Yet in real life, changes in $M$ can change $E\pi$. Therefore, the effect of money on prices is more complicated than the simple quantity theory of money suggests.

# What about expected inflation?

- Over the long run, people don't consistently over- or under-forecast inflation, so $E\pi = \pi$ on average.
- In the short run, $E\pi$ may change when people get new information.
- *Example*: The Fed announces it will increase $M$ next year. People will expect next year's $P$ to be higher, so $E\pi$ rises.
- This affects $P$ now, even though $M$ hasn't changed yet...

# How $P$ responds to $\Delta E\pi$

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

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

$$\begin{aligned} \uparrow E\pi \;&\Rightarrow \uparrow i \quad \text{(the Fisher effect)} \\ &\Rightarrow \downarrow (M/P)^d \\ &\Rightarrow \uparrow P \text{ to make } (M/P) \text{ fall} \\ &\quad \text{to reestablish eq'm} \end{aligned}$$

# The classical view of inflation

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

*Then, why is inflation a social problem?*

# NOW YOU TRY: Discussion question

***Why is inflation good?***

What are the benefits of inflation?

- List all the benefits you can think of.

***Why is inflation bad?***

What costs does inflation impose on society?

- List all the costs you can think of.
- Think like an economist.

***Based on our previous slides, what is the larger current issue: too-low inflation or too-high inflation?***

# A common misperception

- Common misperception:
  *inflation reduces real wages*
- This is true only in the short run, when nominal wages are fixed by contracts.
- (Chapter 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.

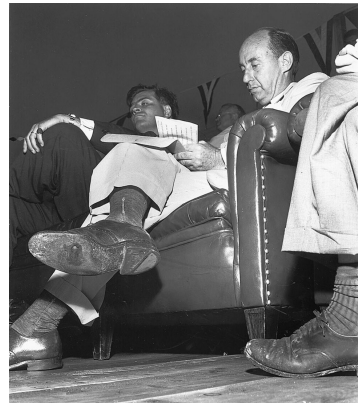
# The social costs of inflation

...fall into two categories:

1. costs when inflation is **expected**.
2. costs when inflation is different from what people had **expected**.

# The costs of expected inflation: 1. Shoeleather cost

- Definition: the costs and inconveniences of reducing money balances to avoid the inflation tax.
- If $\pi$ increases, $i$ increases (why?), so people reduce their real money balances.
- Remember: In the long run, inflation does not affect real income or real spending.
- The same monthly spending but lower average money holdings means more frequent trips to the bank to withdraw smaller amounts of cash.



A literal "shoeleather cost": Adlai Stevenson's worn-through sole, 1952 campaign trail.

*W. M. Gallagher / Wikimedia, PD-US*

# The costs of expected inflation: 2. Menu costs

- Definition: the costs of changing prices
- Examples:
  - cost of printing new menus and mailing out catalogs
  - time spent trying to decide on what the new prices should be
- The higher is inflation, the more frequently firms must change their prices and incur these costs.




Every price on this chalkboard must be erased and rewritten whenever the restaurant re-prices — a literal menu cost.

*Infrogmation / Wikimedia, CC BY-SA 4.0*

# 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.

# The costs of expected inflation: 4. Tax treatment

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

Example:

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

# 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.

# The costs of *unexpected* inflation: Arbitrary redistribution of purchasing power

- Many long-term contracts are not indexed but are based on $E\pi$.
- If $\pi$ turns out to be different from $E\pi$, then some gain at others' expense.
- Example: borrowers and lenders
  - If $\pi > E\pi$, then $(i - \pi) < (i - E\pi)$ and purchasing power is transferred from lenders to borrowers.
  - If $\pi < E\pi$, then purchasing power is transferred from borrowers to lenders.

# Additional cost of high inflation: Increased uncertainty

- When inflation is high, it's more variable and unpredictable: $\pi$ turns out different from $E\pi$ more often, and the differences tend to be larger, *though not systematically positive or negative*.
- So, arbitrary redistributions of wealth are more likely.
- This increases uncertainty, making risk-averse people worse off.

# 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.

# Hyperinflation

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



Germany, 1923: pasting 1-Mark notes as **wallpaper** — cheaper than actual wallpaper.

*Bundesarchiv, CC BY-SA 3.0 DE*

# What causes hyperinflation?

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

# A few examples of hyperinflation

| Country | Period | CPI % /yr | $M2$ % /yr |
|---|---|---|---|
| Israel | 1983–1985 | 338 | 305 |
| Brazil | 1987–1994 | 1,256 | 1,451 |
| Bolivia | 1983–1986 | 1,818 | 1,727 |
| Ukraine | 1992–1994 | 2,089 | 1,029 |
| Argentina | 1988–1990 | 2,671 | 1,583 |
| Dem. Rep. Congo/Zaire | 1990–1996 | 3,039 | 2,373 |
| Angola | 1995–1996 | 4,145 | 4,106 |
| Peru | 1988–1990 | 5,050 | 3,517 |
| Zimbabwe | 2005–2007 | 5,316 | 9,914 |




**Zimbabwe, 2008**: a \$100 trillion note — the highest denomination ever printed.

*Reserve Bank of Zimbabwe / Wikimedia, PD*

# Why governments create hyperinflation

- When a government cannot raise taxes or sell bonds, it must finance spending increases via money creation.
- In theory, the solution to hyperinflation is simple: Stop money creation.
- In the real world, this requires drastic and painful fiscal restraint.

# The classical dichotomy, part 1

**Real variables**: measured in physical units—quantities and relative prices, *for example:*

- 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

# The classical dichotomy, part 2

**Nominal variables**: measured in money units—*for example:*

- nominal wage: dollars per hour of work
- nominal interest rate: dollars earned in the future by lending one dollar today
- price level: number of dollars needed to buy a representative basket of goods

# The classical dichotomy, part 3

- Recall: Real variables were explained in Chapter 3, nominal ones in Chapter 5.
- **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**: idea that changes in the money supply do not affect real variables.
- In the real world, money is approximately neutral in the long run.

# Chapter Summary, Part 1

- Velocity: the ratio of nominal expenditure to money supply, the rate at which money changes hands
- Quantity theory of money
  - assumes velocity is constant
  - concludes that the money growth rate determines the inflation rate
  - applies in the long run
  - consistent with cross-country and time-series data

# Chapter Summary, Part 2

- Nominal interest rate
  - equals real interest rate + inflation rate
  - the opportunity cost of holding money
- Fisher effect: Nominal interest rate moves one-for-one with 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

# Chapter Summary, Part 3

**Benefits of inflation**

- Allows nominal wages to adjust

**Costs of inflation**

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

# Chapter Summary, Part 4

- Hyperinflation
  - caused by rapid money supply growth when money is created to finance government budget deficits
  - stopping it requires fiscal reforms to eliminate the government's need for money creation

# Chapter Summary, Part 5

- Classical dichotomy
  - In classical theory, money is neutral—does not affect real variables.
  - So, we can study how real variables are determined without 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.