CHAPTER *30*

# Money Growth and Inflation

Economics

PRINCIPLES OF

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Premium PowerPoint Slides
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# Introduction

- This chapter introduces the **quantity theory of money** to explain one of the Ten Principles of Economics from Chapter 1:

    *Prices rise when the govt prints too much money.*

- Most economists believe the quantity theory is a good explanation of the

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  of inflation.

# The Value of Money

- **$P$** = the price level
  (*e.g.*, the CPI or GDP deflator)

  **$P$** is the price of a basket of goods, measured in money.

- $1/P$ is the value of \$1, measured in goods.

- Example:  basket contains one candy bar.
  - If **$P$** = \$2, value of \$1 is 1/2 candy bar
  - If **$P$** = \$3, value of \$1 is 1/3 candy bar

- Inflation drives up prices and

# Money Supply (MS)

- In real world, determined by Federal Reserve, the banking system, consumers.

- In this model, we assume the

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  and sets it at some fixed amount.

- [Should We End the Fed?-](#)video

# Money Demand (MD)

- Refers to how much wealth people want to hold in liquid form.

- Depends on **P**:
  An increase in **P** _____,
  so more money is required to buy g&s.

- Thus, quantity of money demanded
  is negatively related to the value of money
  and positively related to **P**, other things equal.

  (These "other things" include real income,
  interest rates, availability of ATMs.)

# How the supply and demand for money determine the equilibrium price level
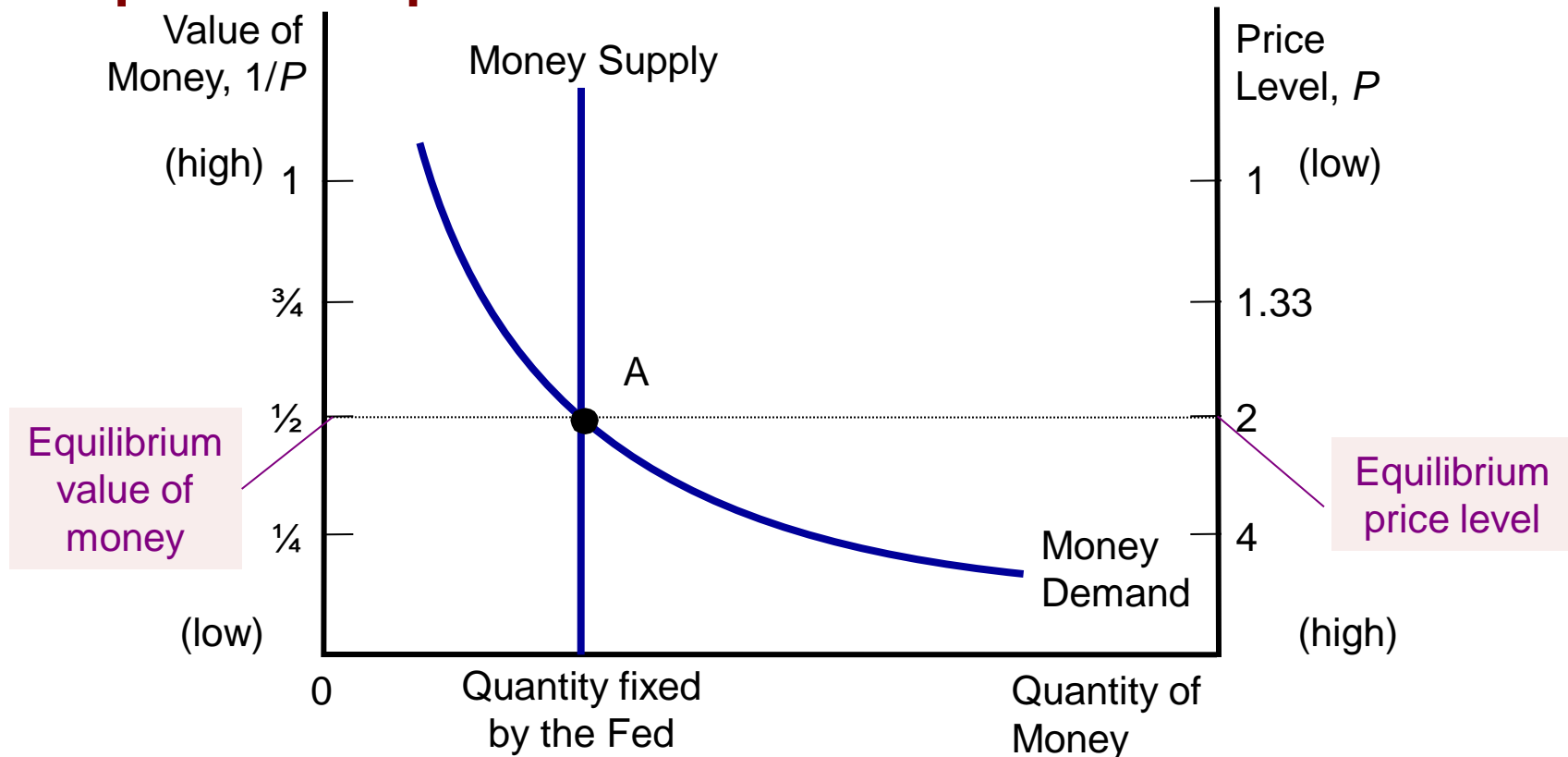


The horizontal axis shows the quantity of money. The left vertical axis shows the value of money, and the right vertical axis shows the price level. The supply curve for money is vertical because the quantity of money supplied is fixed by the Fed. The demand curve for money is downward sloping because people want to hold a larger quantity of money when each dollar buys less. At the equilibrium, point A, the value of money (on the left axis) and the price level (on the right axis) have adjusted to bring the quantity of money supplied and the quantity of money demanded into balance.

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# The Quantity Theory of Money-U.S.

- Evidence on the Quantity Theory of Money
  - U.S. evidence is consistent with the quantity theory of money.
  - The inflation rate fluctuates in line with money growth rate minus real GDP growth rate.



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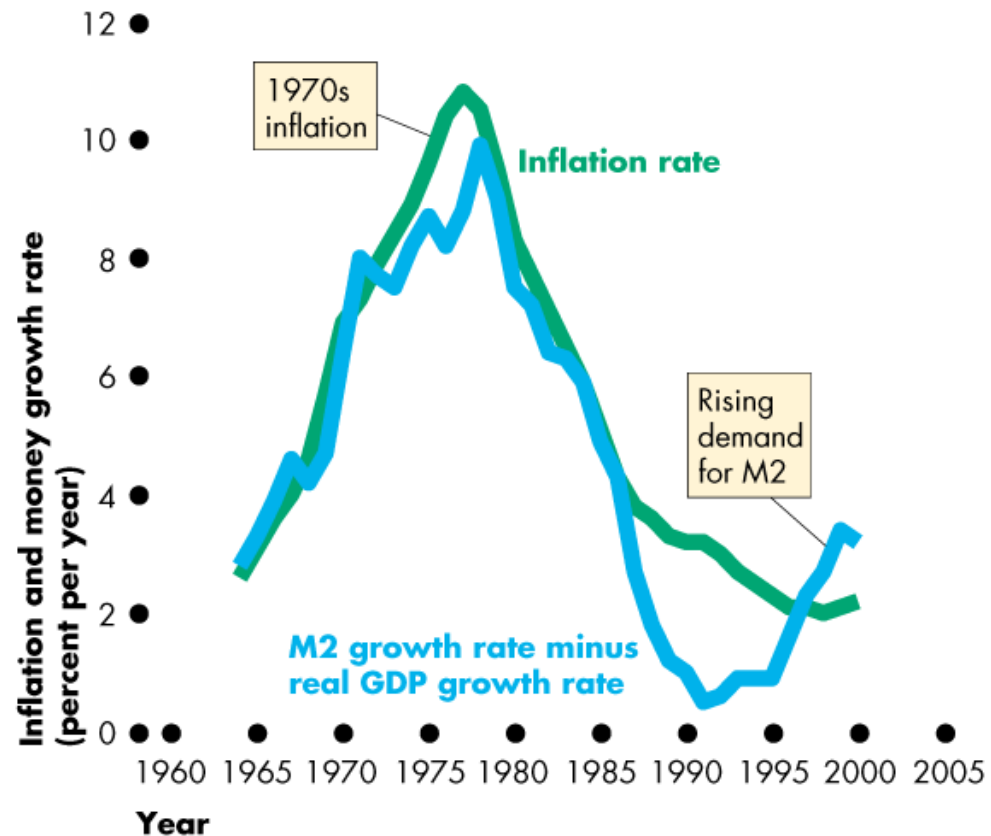
# The Quantity Theory of Money-Worldwide

Figure 9.11(b) shows the evidence for 104 countries from 1990 to 2005.

There is a general tendency for money growth and inflation to be correlated, but the quantity theory does not predict inflation precisely.
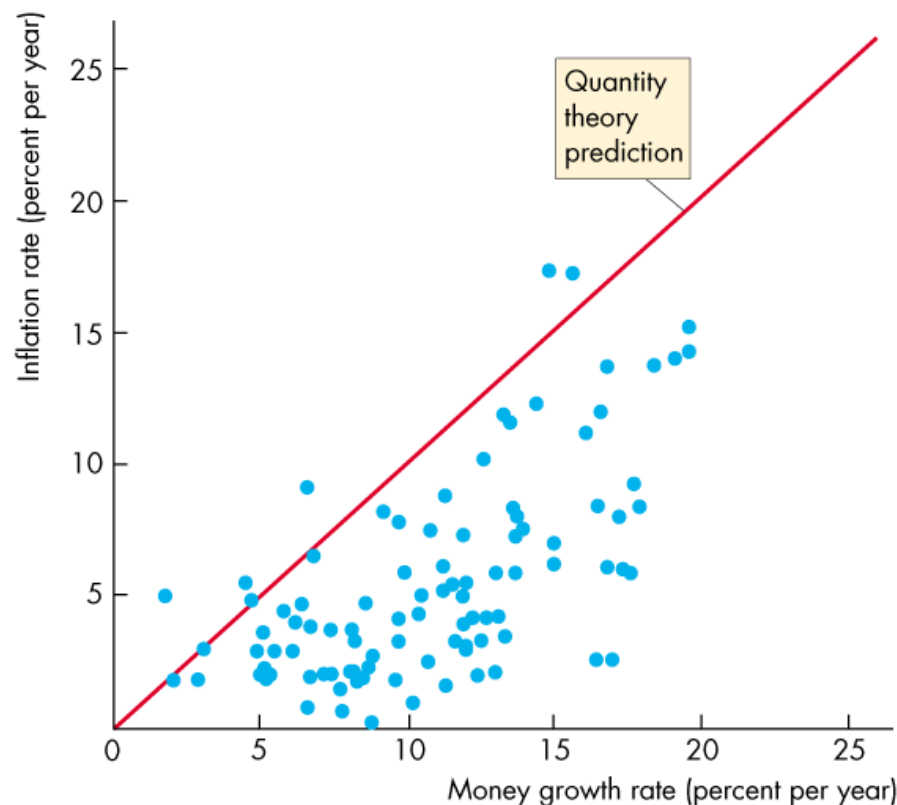


(b) **104 Lower-inflation countries: 1990–2005**

# A Brief Look at the Adjustment Process

Result from graph:  Increasing MS causes *P*  to rise.

How does this work?  Short version:

- At the initial *P*, an increase in MS causes

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- People get rid of their excess money by spending it on g&s or by loaning it to others, who spend it. Result:  increased demand for goods.
- But supply of goods does not increase, so prices must rise.

(Other things happen in the short run, which we will study in later chapters.)

# Real vs. Nominal Variables

- _____ are measured in monetary units.

   *Examples:*  nominal GDP,
   nominal interest rate (rate of return measured in $)
   nominal wage ($ per hour worked)

- _____ are measured in physical units.

   *Examples:*  real GDP,
   real interest rate (measured in output)
   real wage (measured in output)

# Real vs. Nominal Variables

Prices are normally measured in _____.

- ▪ Price of a compact disc:        $15/cd
- ▪ Price of a pepperoni pizza:     $10/pizza

A **relative price** is the price of one good relative to (divided by) another:

- ▪ Relative price of CDs in terms of pizza:

$$\frac{\text{price of cd}}{\text{price of pizza}} \ = \ \frac{\$15/cd}{\$10/pizza} \ = \ \boxed{1.5 \text{ pizzas per cd}}$$

Relative prices are measured in physical units, so they are **real variables**.

# Real vs. Nominal Wage

An important relative price is the real wage:

$W$ = nominal wage = price of labor,  *e.g.,* $15/hour

$P$ = price level = price of g&s,  *e.g.,* $5/unit of output

Real wage is the price of labor relative to the price of output:

$$\frac{W}{P} \ = \ \frac{\$15/\text{hour}}{\$5/\text{unit of output}} \ = \ 3 \text{ units output per hour}$$

# The Classical Dichotomy

- **Classical dichotomy**:  the theoretical separation of _____

- If central bank doubles the money supply, Hume & classical thinkers contend
  - all nominal variables – including prices – will double.
  - all real variables – including relative prices – will remain unchanged.

# The Neutrality of Money

- **Monetary neutrality**: the proposition that changes in the _____

- Doubling money supply causes all nominal prices to double; what happens to relative prices?

- Initially, relative price of cd in terms of pizza is

$$\frac{\text{price of cd}}{\text{price of pizza}} = \frac{\$15/cd}{\$10/pizza} = 1.5 \text{ pizzas per cd}$$

- After nominal prices double,

$$\frac{\text{price of cd}}{\text{price of pizza}} = \frac{\$30/cd}{\$20/pizza} = 1.5 \text{ pizzas per cd}$$

*The relative price is unchanged.*

# The Neutrality of Money

- Similarly, the real wage $W/P$ remains unchanged, so
    - quantity of labor supplied does not change
    - quantity of labor demanded does not change
    - total employment of labor does not change
- The same applies to employment of capital and other resources.
- Since employment of all resources is unchanged, total output is also unchanged by the money supply.

# The Velocity of Money

- **Velocity of money**:

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- Notation:

  $P \times Y$ = nominal GDP

  = (price level) x (real GDP)

  $M$ = money supply

  $V$ = velocity

- Velocity formula: $V = \dfrac{P \times Y}{M}$

# The Velocity of Money

Velocity formula: $V = \dfrac{P \times Y}{M}$

Example with one good: pizza.

In 2008,

$Y$ = real GDP = 3000 pizzas

$P$ = price level = price of pizza = $10

$P \times Y$ = nominal GDP = value of pizzas = $30,000

$M$ = money supply = $10,000

$V$ = velocity = $30,000/$10,000 = 3

# Exercise

One good:  corn.

The economy has enough labor, capital, and land to produce $Y$ = 800 bushels of corn.

$V$ is constant.

In 2008, MS = $2000, $P$ = $5/bushel.

Compute nominal GDP and velocity in 2008.

# Answers

Given:   $Y$ = 800, $V$ is constant,
MS = $2000 and $P$ = $5 in 2005.

Compute nominal GDP and velocity in 2008.

Nominal GDP  =  $P$ x $Y$  =  $5 x 800  =  $4000

$$V = \frac{P \times Y}{M} = \frac{\$4000}{\$2000} = 2$$
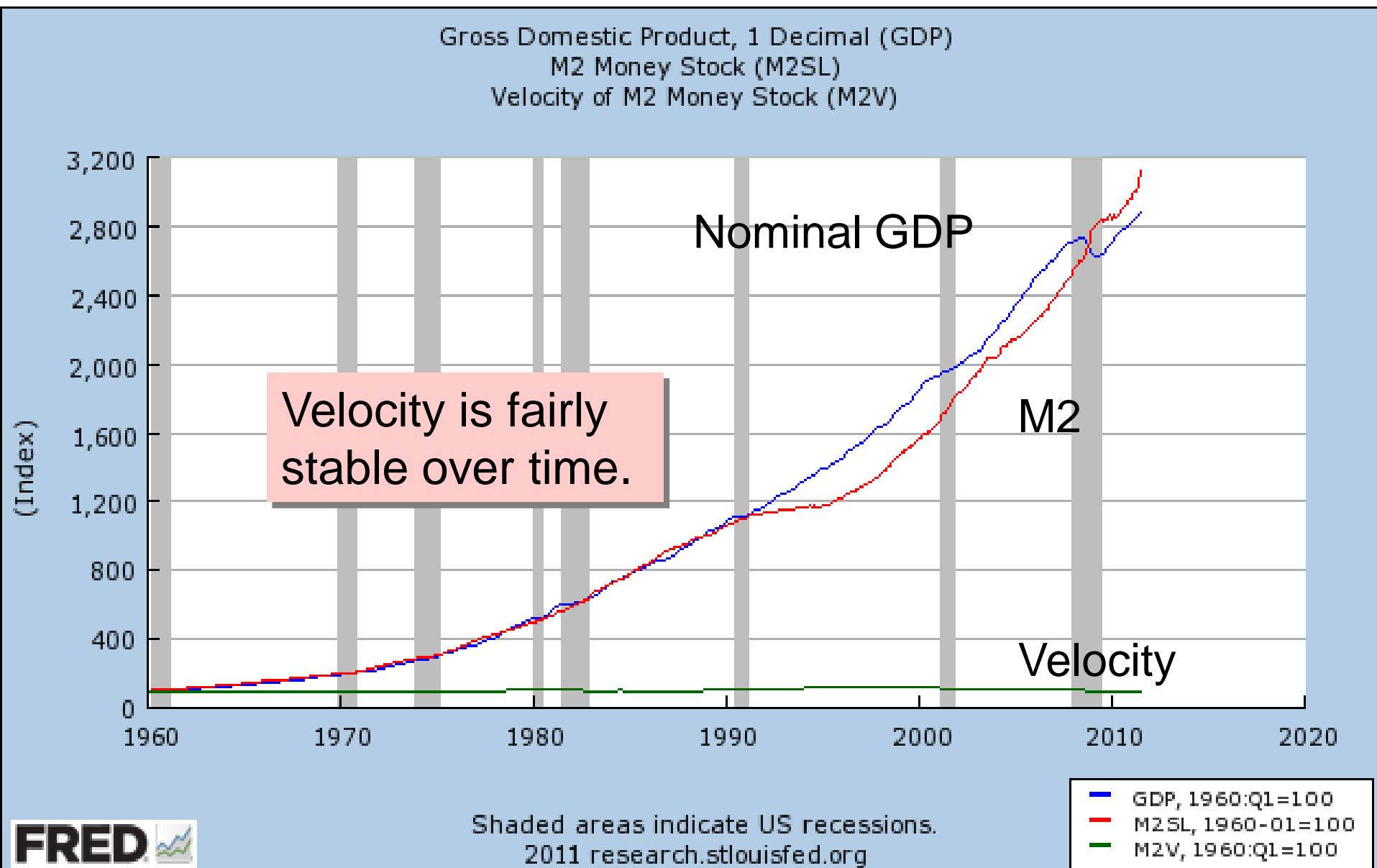
# The Quantity Equation

Velocity formula:    $V = \dfrac{P \times Y}{M}$

- Multiply both sides of formula by **M** to get the

  _____:

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- If we take the percentage change of each variable, we get the following:

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# U.S. Nominal GDP, M2, and Velocity (1960=100)
## 1960-2011



Gross Domestic Product, 1 Decimal (GDP)
M2 Money Stock (M2SL)
Velocity of M2 Money Stock (M2V)

Nominal GDP

Velocity is fairly stable over time.

M2

Velocity

Shaded areas indicate US recessions.
2011 research.stlouisfed.org

— GDP, 1960:Q1=100
— M2SL, 1960-01=100
— M2V, 1960:Q1=100

# The Quantity Theory in 5 Steps

Start with quantity equation:   $M \times V = P \times Y$

1.  $V$ is stable.

2.  So, a change in $M$ causes nominal GDP ($P \times Y$) to change by the same percentage.

3.  A change in $M$ does not affect $Y$: money is neutral,

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4.  So, $P$ changes by same percentage as $P \times Y$ and $M$.

5.  Rapid money supply growth causes

# Exercise

One good:  corn.  The economy has enough labor, capital, and land to produce $Y$ = 800 bushels of corn. $V$ is constant.  In 2008, MS = $2000, $P$ = $5/bushel.

For 2009, the Fed increases MS by 5%, to $2100.

a.  Compute the 2009 values of nominal GDP and $P$. Compute the inflation rate for 2008-2009.

b.  Suppose tech. progress causes $Y$ to increase to 824 in 2009.  Compute 2008-2009 inflation rate.

# Answers

Given:  $Y$ = 800, $V$ is constant,

         MS = $2000 and $P$ = $5 in 2008.

For 2009, the Fed increases MS by 5%, to $2100.

a.  Compute the 2009 values of nominal GDP and $P$.
    Compute the inflation rate for 2008-2009.

Nominal GDP $= P \times Y = M \times V$  (Quantity Eq'n)

$$= \$2100 \times 2 = \boxed{\$4200}$$

$$P = \frac{P \times Y}{Y} = \frac{\$4200}{800} = \boxed{\$5.25}$$

$$\text{Inflation rate} = \frac{\$5.25 - 5.00}{5.00} = \boxed{5\%} \text{ (same as MS!)}$$

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# A C T I V E   L E A R N I N G   *2*
## Answers

Given:   $Y = 800$, $V$ is constant,
            MS = $2000 and $P = $5 in 2005.

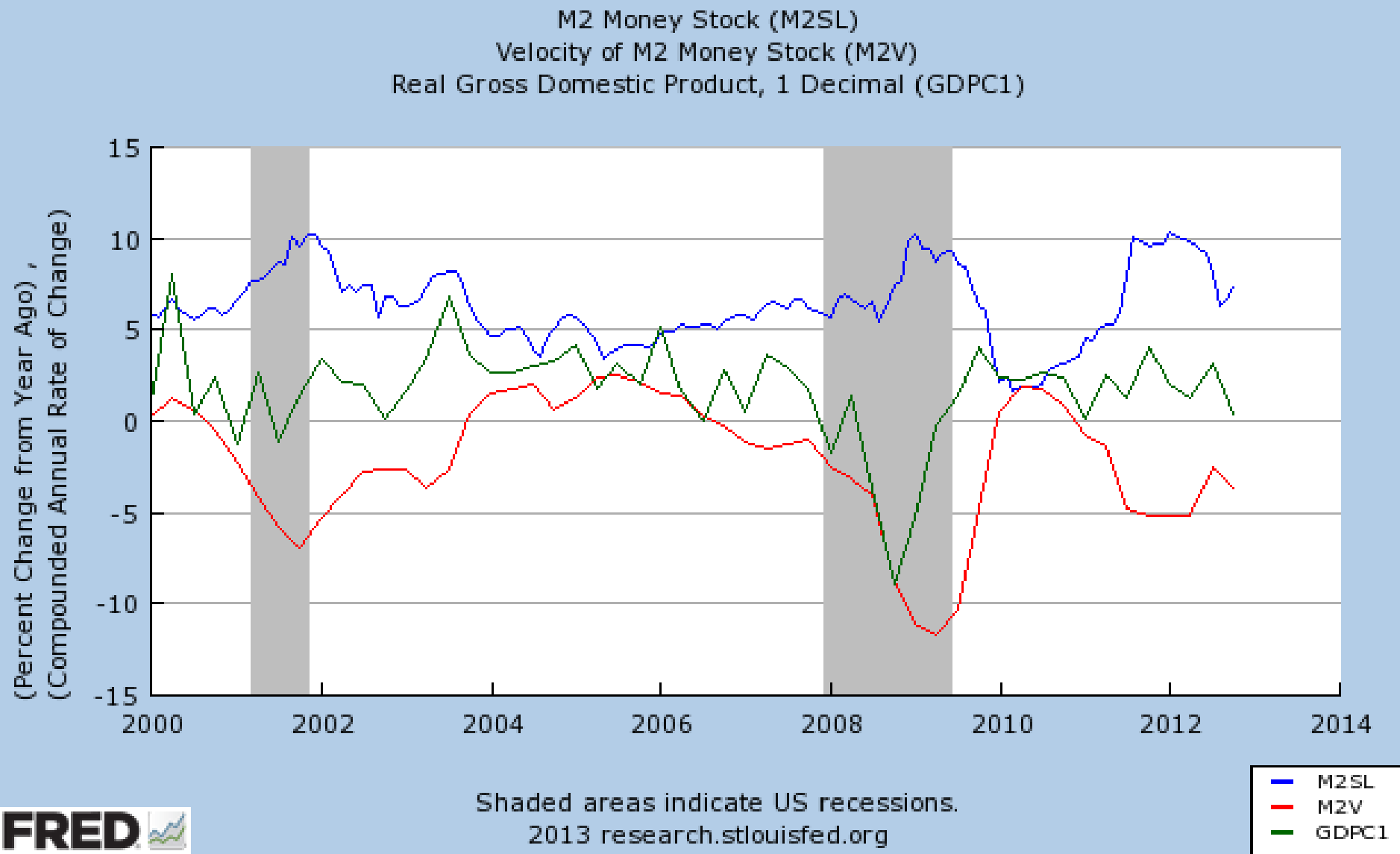For 2009, the Fed increases MS by 5%, to $2100.

**b.**  Suppose tech. progress causes $Y$ to increase 3% in 2009, to 824.  Compute 2008-2009 inflation rate.

First, use Quantity Eq'n to compute $P$:

$$P = \frac{M \times V}{Y} = \frac{\$4200}{824} = \$5.10$$

$$\text{Inflation rate} = \frac{\$5.10 - 5.00}{5.00} = \boxed{2\%}$$

# What is Left? Inflation



M2 Money Stock (M2SL)
Velocity of M2 Money Stock (M2V)
Real Gross Domestic Product, 1 Decimal (GDPC1)

Shaded areas indicate US recessions.
2013 research.stlouisfed.org

Legend:
- M2SL
- M2V
- GDPC1

# Summary and Lessons about the Quantity Theory of Money

- If real GDP is constant, then
  inflation rate = money growth rate.

- If real GDP is growing, then
  inflation rate < money growth rate.

- The bottom line:
  - Economic growth increases # of transactions.
  - Some money growth is needed for these extra transactions.
  - Excessive money growth causes inflation.

# Hyperinflation

- [Why Not Print More Money?](#)-video

- Hyperinflation is generally defined as inflation exceeding 50% per month.

- Recall one of the Ten Principles from Chapter 1:
    *Prices rise when the government prints too much money.*

- Excessive growth in the money supply always causes hyperinflation.

# The Inflation Tax

- When tax revenue is inadequate and ability to borrow is limited, govt may print money to pay for its spending.

- Almost all hyperinflations start this way.

- The revenue from printing money is the **inflation tax**: printing money causes inflation, which is like a tax on everyone who holds money.

- In the U.S., the inflation tax today accounts for less than 3% of total revenue.

# The Fisher Effect

- Rearrange the definition of the real interest rate:

$$\text{Nominal interest rate} = \text{Inflation rate} + \text{Real interest rate}$$

- The real interest rate is determined by saving & investment in the loanable funds market.

- Money supply growth determines inflation rate.

- So, this equation shows how the nominal interest rate is determined.

# The Fisher Effect

$$\text{Nominal interest rate} = \text{Inflation rate} + \text{Real interest rate}$$

- In the long run, money is neutral, so a change in the money growth rate affects the inflation rate but not the real interest rate.

- So, the nominal interest rate adjusts one-for-one with changes in the inflation rate.

- This relationship is called the **Fisher effect** after Irving Fisher, who studied it.
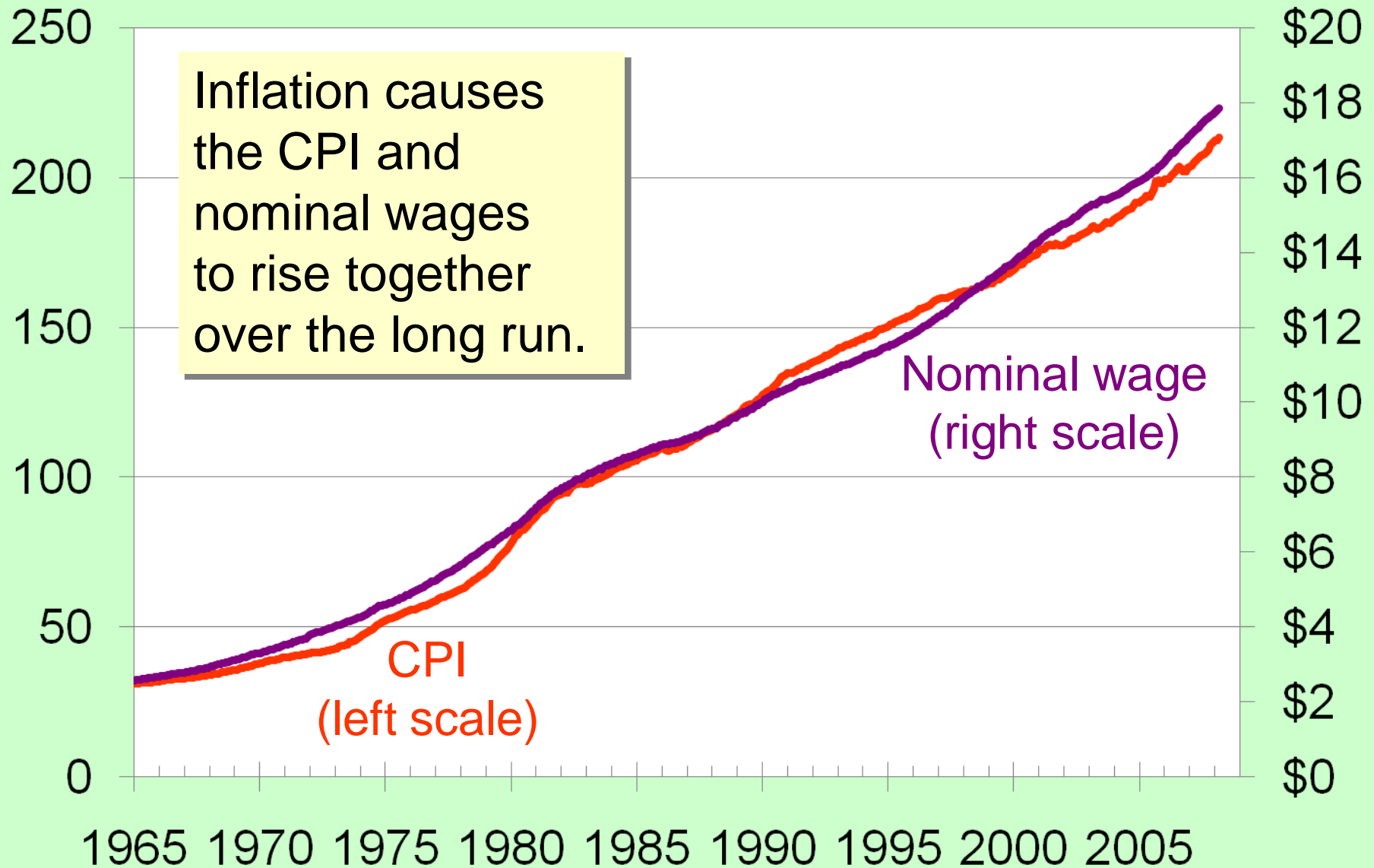
# U.S. Nominal Interest & Inflation Rates, 1960-2007



The close relation between these variables is evidence for the Fisher effect.

Legend: — Nominal interest rate   — Inflation rate
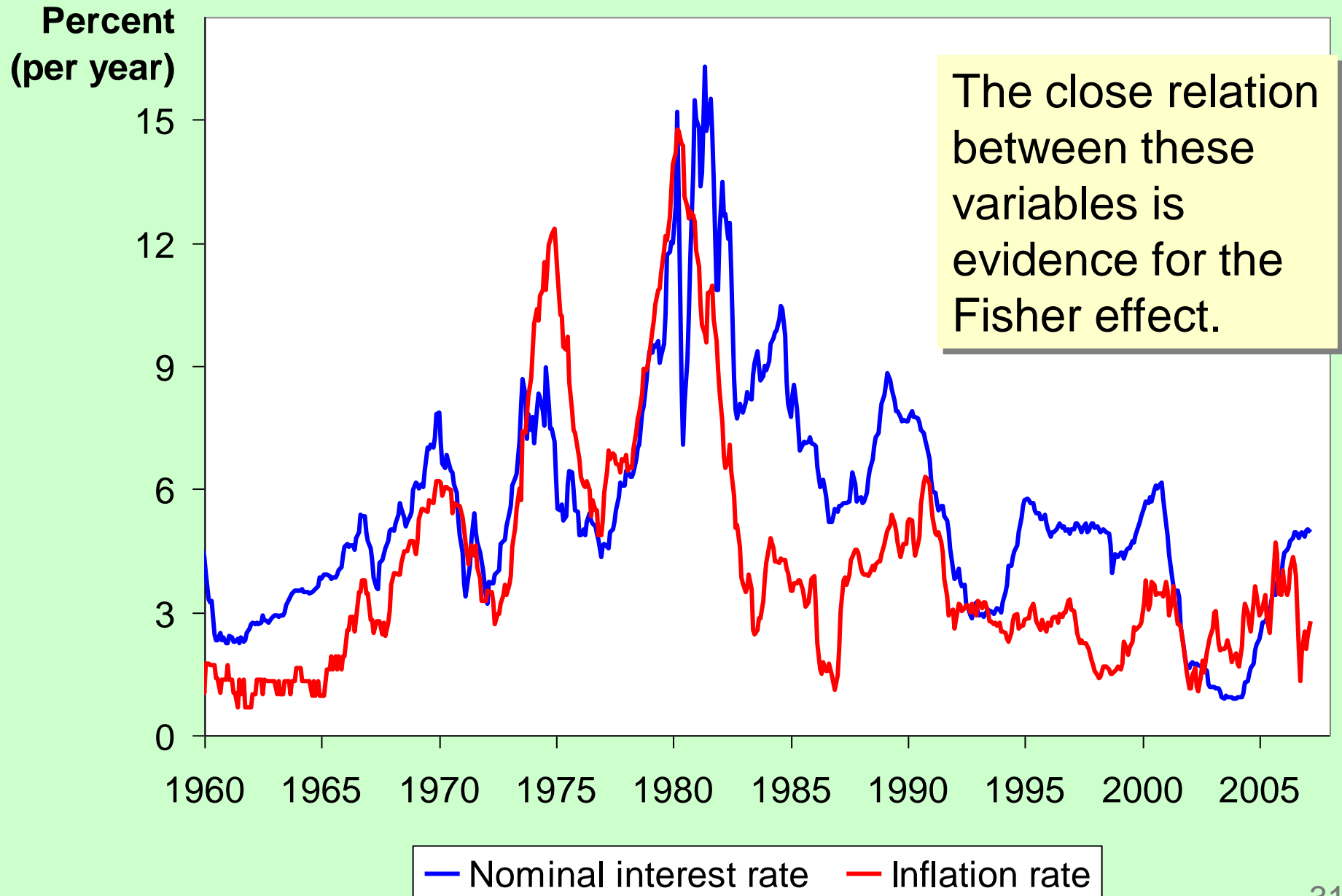
# The Costs of Inflation

- The inflation fallacy:  most people think inflation erodes real incomes.

- But inflation is a general increase in prices of the things people buy <u>and</u> the things they sell (*e.g.,* their labor).

- In the long run, real incomes are determined by real variables, not the inflation rate.

# U.S. Average Hourly Earnings & the CPI

Inflation causes the CPI and nominal wages to rise together over the long run.

Nominal wage (right scale)

CPI (left scale)

# The Costs of Inflation

- **Shoeleather costs**:  the resources wasted when inflation encourages people to reduce their money holdings
  - Includes the time and transactions costs of more frequent bank withdrawals

- **Menu costs**:  the costs of changing prices
  - Printing new menus, mailing new catalogs, *etc*.

# The Costs of Inflation

- **Misallocation of resources from relative-price variability**:  Firms don't all raise prices at the same time, so relative prices can vary…
  which distorts the allocation of resources.

- **Confusion & inconvenience**:  Inflation changes the yardstick we use to measure transactions.
  Complicates long-range planning and the comparison of dollar amounts over time.

# The Costs of Inflation

- **Tax distortions**:

  Inflation makes nominal income grow faster than real income.

  Taxes are based on nominal income,
  and some are not adjusted for inflation.

  So, inflation causes people to pay more taxes even when their real incomes don't increase.

**Arbitrary redistributions of wealth**
Higher-than-expected inflation transfers purchasing power from creditors to debtors: Debtors get to repay their debt with dollars that aren't worth as much.