30 Money Growth and Inflation

PRINCIPLES OF

ECONOMICS

FOURTH EDITION

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PowerPoint® Slides
by Ron Cronovich

In this chapter, look for the answers to these questions:

- How does the money supply affect inflation and nominal interest rates?
- Does the money supply affect real variables like real GDP or the real interest rate?
- How is inflation like a tax?
- What are the costs of inflation? How serious are they?

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 long run behavior 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 drives down the value of money.

The Quantity Theory of Money

- Developed by 18th century philosopher David Hume, and the classical economists.
- Advocated more recently by Nobel Prize Laureate Milton Friedman.
- Asserts that the quantity of money determines the value of money.
- We study this theory using two approaches:
  1. a supply-demand diagram
  2. an equation

Money Supply (MS)

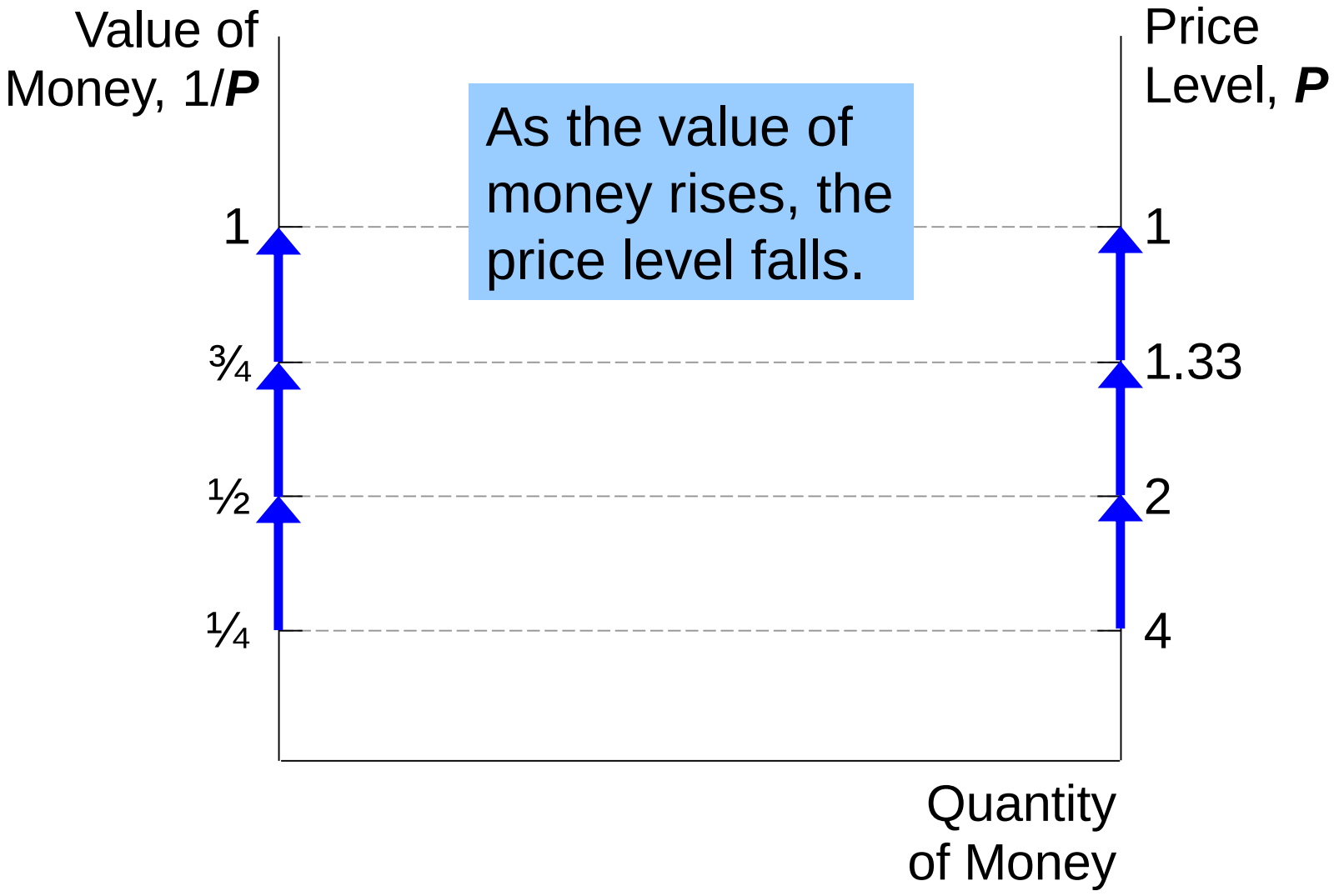
- In real world, determined by Federal Reserve, the banking system, consumers.
- In this model, we assume the Fed precisely controls MS and sets it at some fixed amount.

Money Demand (MD)

- Refers to how much wealth people want to hold in liquid form.
- Depends on ***P***:
  An increase in ***P*** reduces the value of money, 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.)

The Money Supply-Money Demand Diagram



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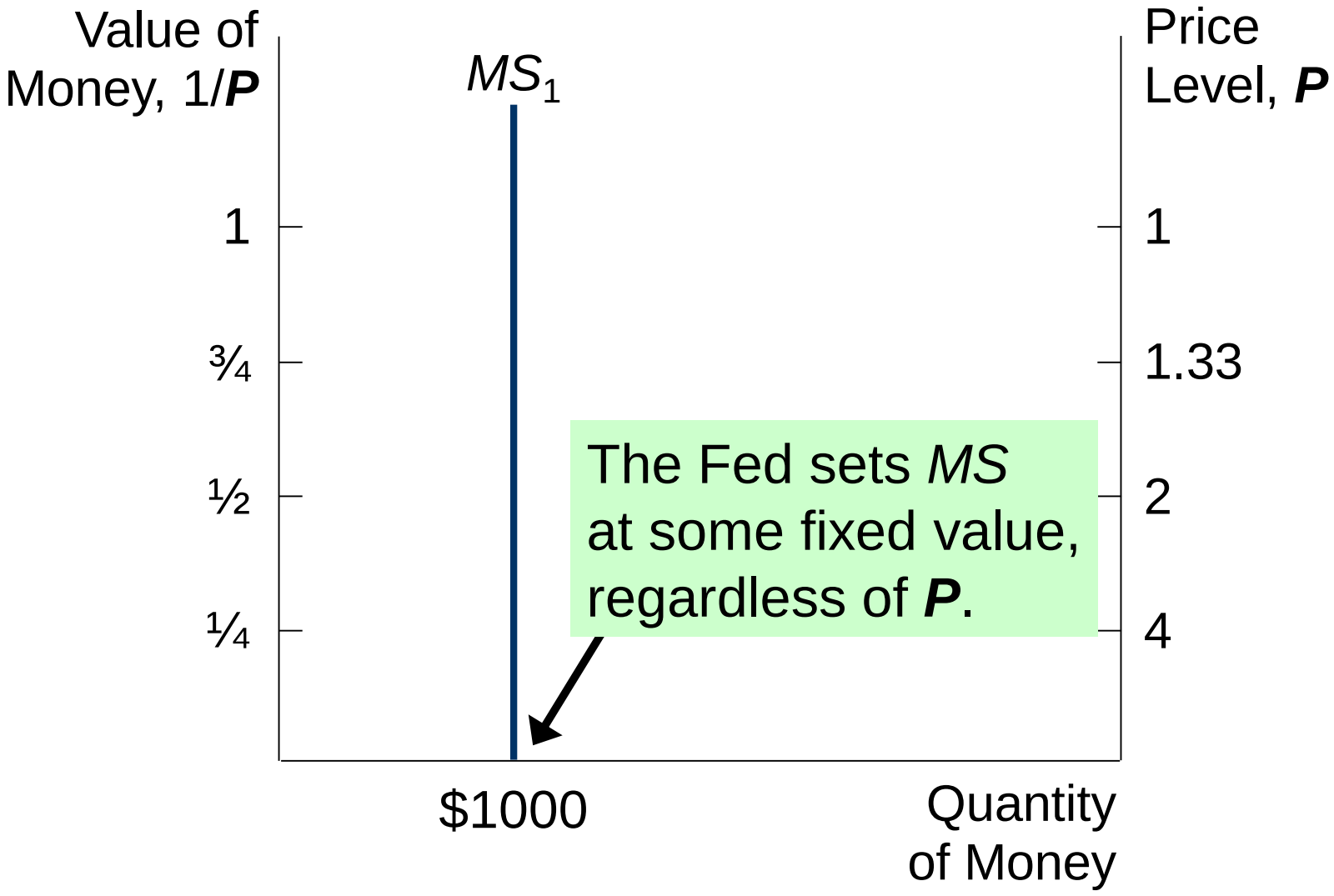

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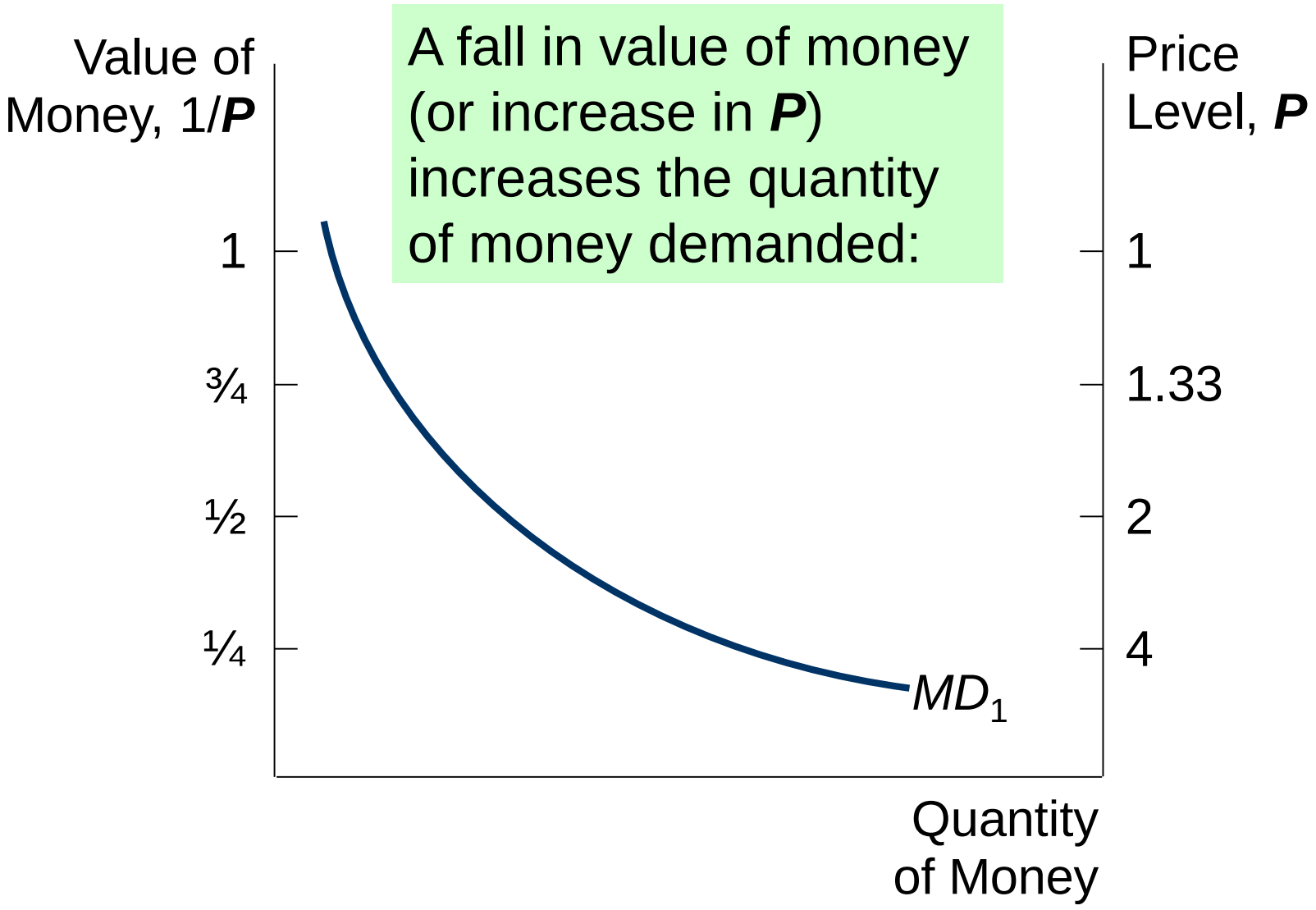

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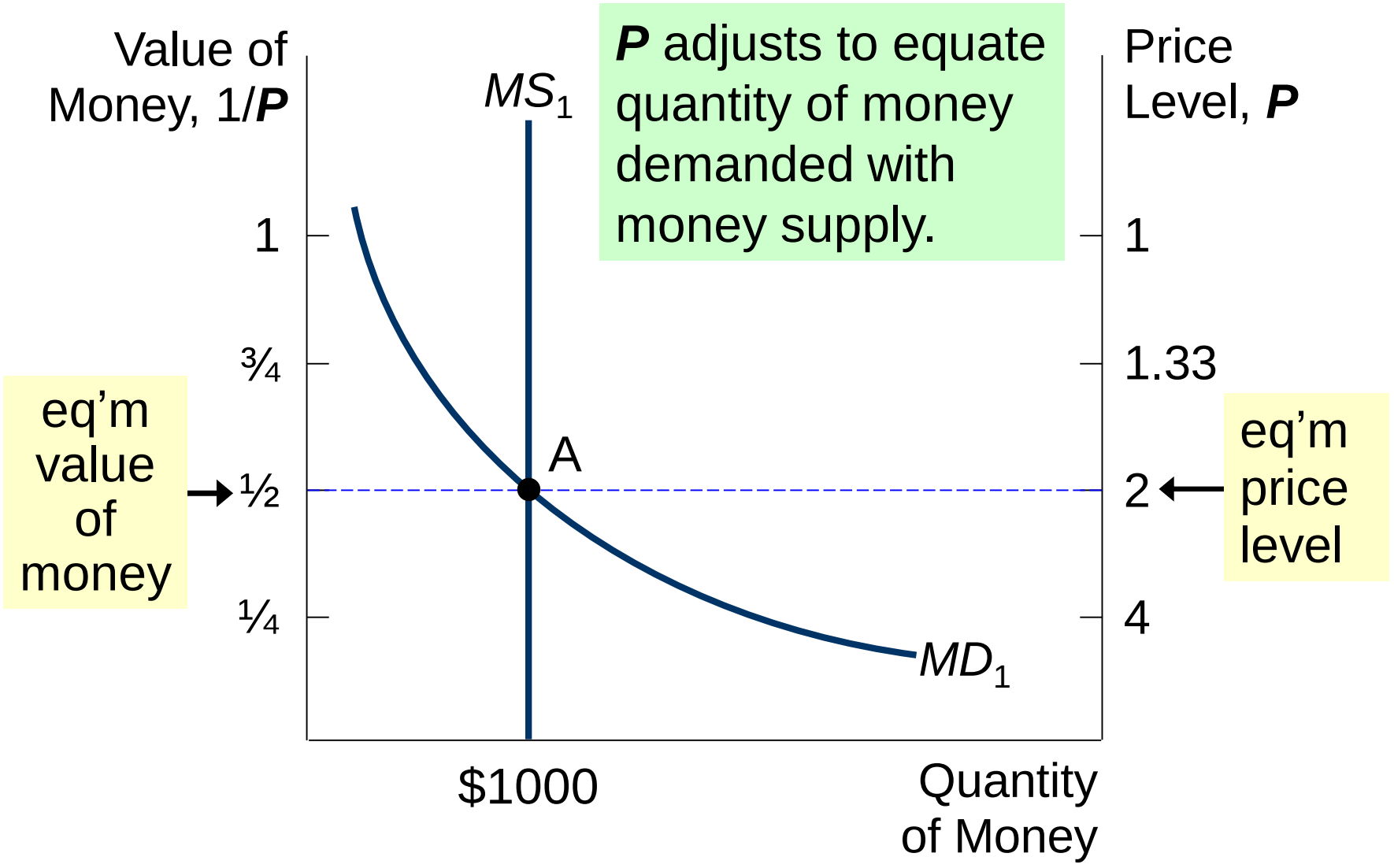
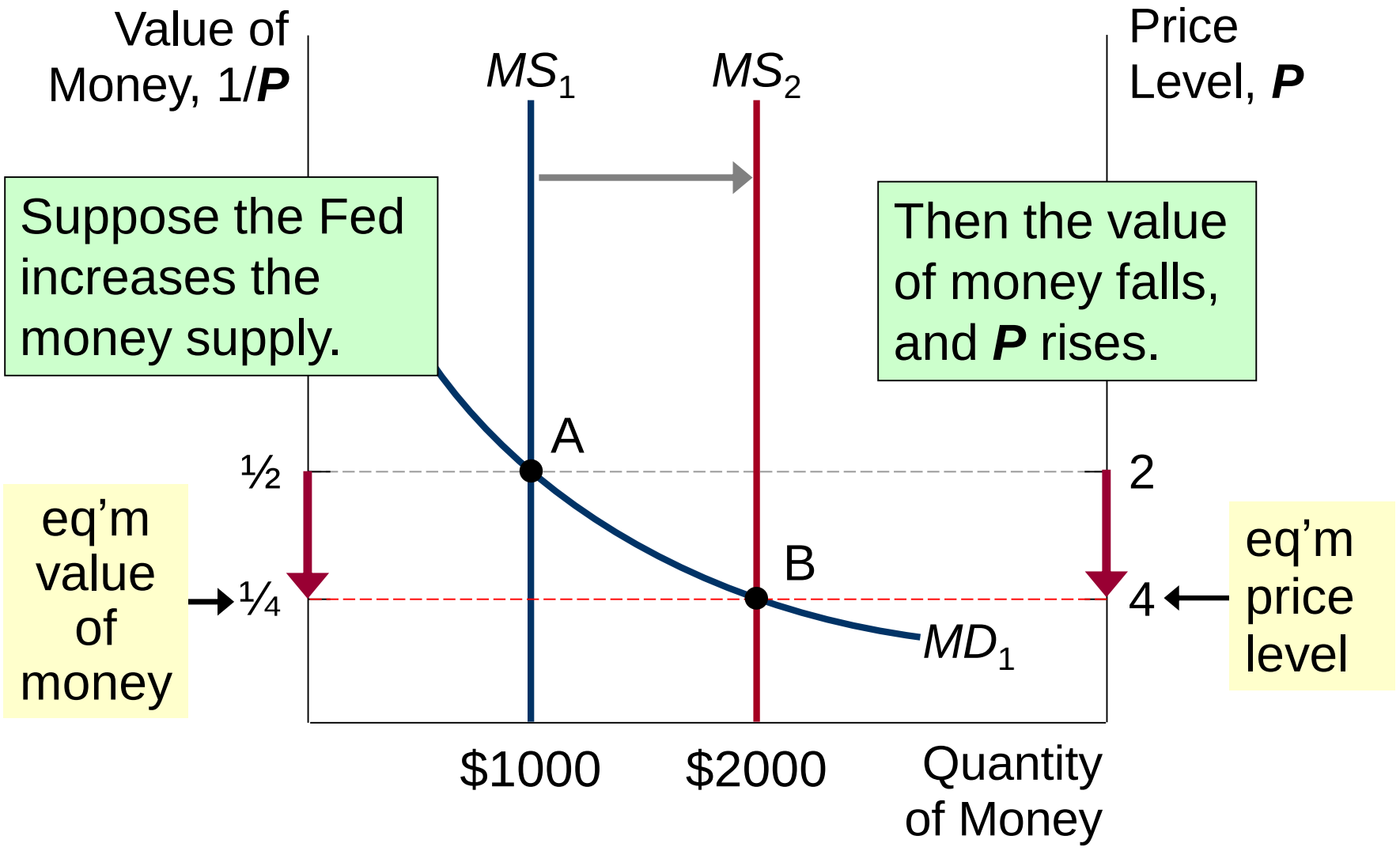


The Effects of a Monetary Injection



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 excess supply of money.
- 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

- **Nominal variables** are measured in monetary units.

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

- **Real variables** 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 terms of money.

- 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:

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

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 nominal and real variables
- Hume and the classical economists suggested that monetary developments affect nominal variables, but not real variables.
- 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 money supply do not affect real variables
- Doubling money supply causes all nominal prices to double; what happens to relative prices?
- Initially, relative price of cd in terms of pizza is

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

- After nominal prices double,

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

The relative price is unchanged.

The Neutrality of Money

- **Monetary neutrality**: the proposition that changes in the money supply do not affect real variables
- 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 Neutrality of Money

- Most economists believe the classical dichotomy and neutrality of money describe the economy in the long run.
- In later chapters, we will see that monetary changes can have important *short-run* effects on real variables.

The Velocity of Money

- **Velocity of money**: the rate at which money changes hands
- 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: $V = \frac{P \times Y}{M}$

Example with one good: pizza.
In 2006,

Y = real GDP = 3000 pizzas

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

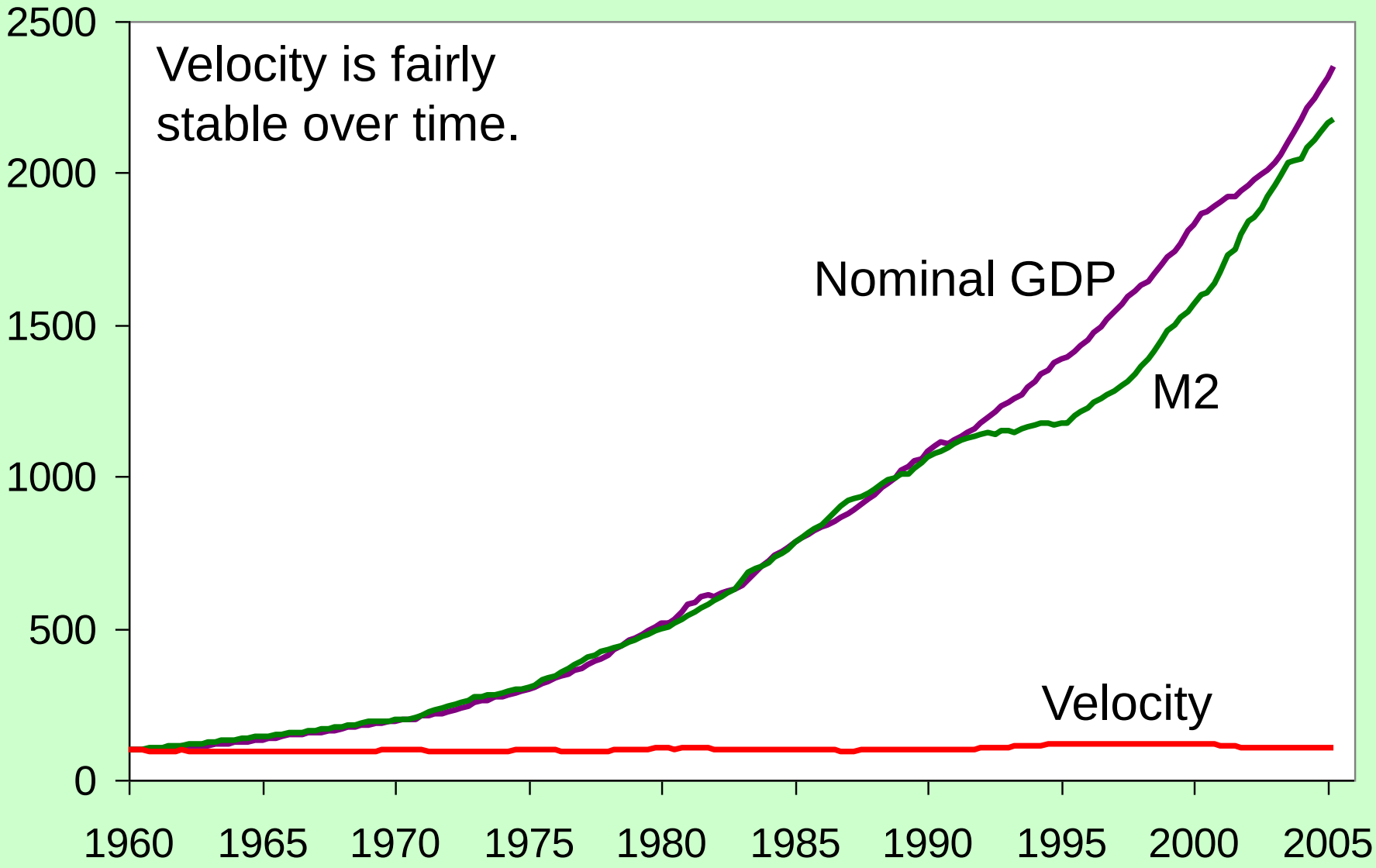
$P \times Y$ = nominal GDP = value of pizzas = \$30,000

M = money supply = \$10,000

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

The average dollar was used in 3 transactions.

U.S. Nominal GDP, M2, and Velocity (1960=100)
1960-2005



The Quantity Equation

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

- Multiply both sides of formula by M:

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

- Called the **quantity equation**

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,
   Y is determined by technology & resources
4. So, P changes by same percentage as $P \times Y$ and M.
5. Rapid money supply growth causes rapid inflation.

ACTIVE LEARNING 1:
Exercise

One good: corn. The economy has enough labor, capital, and land to produce ***Y*** = 800 bushels of corn. ***V*** is constant. In 2005, MS = \$2000, ***P*** = \$5/bushel.

a. Compute nominal GDP and velocity in 2005.

For 2006, the Fed increases MS by 5%, to \$2100.

b. Compute the 2006 values of nominal GDP and ***P***. Compute the inflation rate for 2005-2006.

c. Suppose tech. progress causes ***Y*** to increase to 824 in 2006. Compute 2005-2006 inflation rate.

ACTIVE LEARNING 1:
Answers

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

a. Compute nominal GDP and velocity in 2005.

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

$$V = \frac{P \times Y}{M} = \frac{\$4000}{\$2000} = 2$$

ACTIVE LEARNING 1:
Answers

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

For 2006, the Fed increases MS by 5%, to \$2100.

b. Compute the 2006 values of nominal GDP and P.
Compute the inflation rate for 2005-2006.

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

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

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

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

ACTIVE LEARNING 1:
Answers

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

For 2006, the Fed increases MS by 5%, to \$2100.

c. Suppose tech. progress causes Y to increase 3% in 2006, to 824. Compute 2005-2006 inflation rate.

First, use Quantity Eq'n to compute P:

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

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

Hyperinflation

- 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:

nominal interest rate	=	inflation rate	+	real interest rate

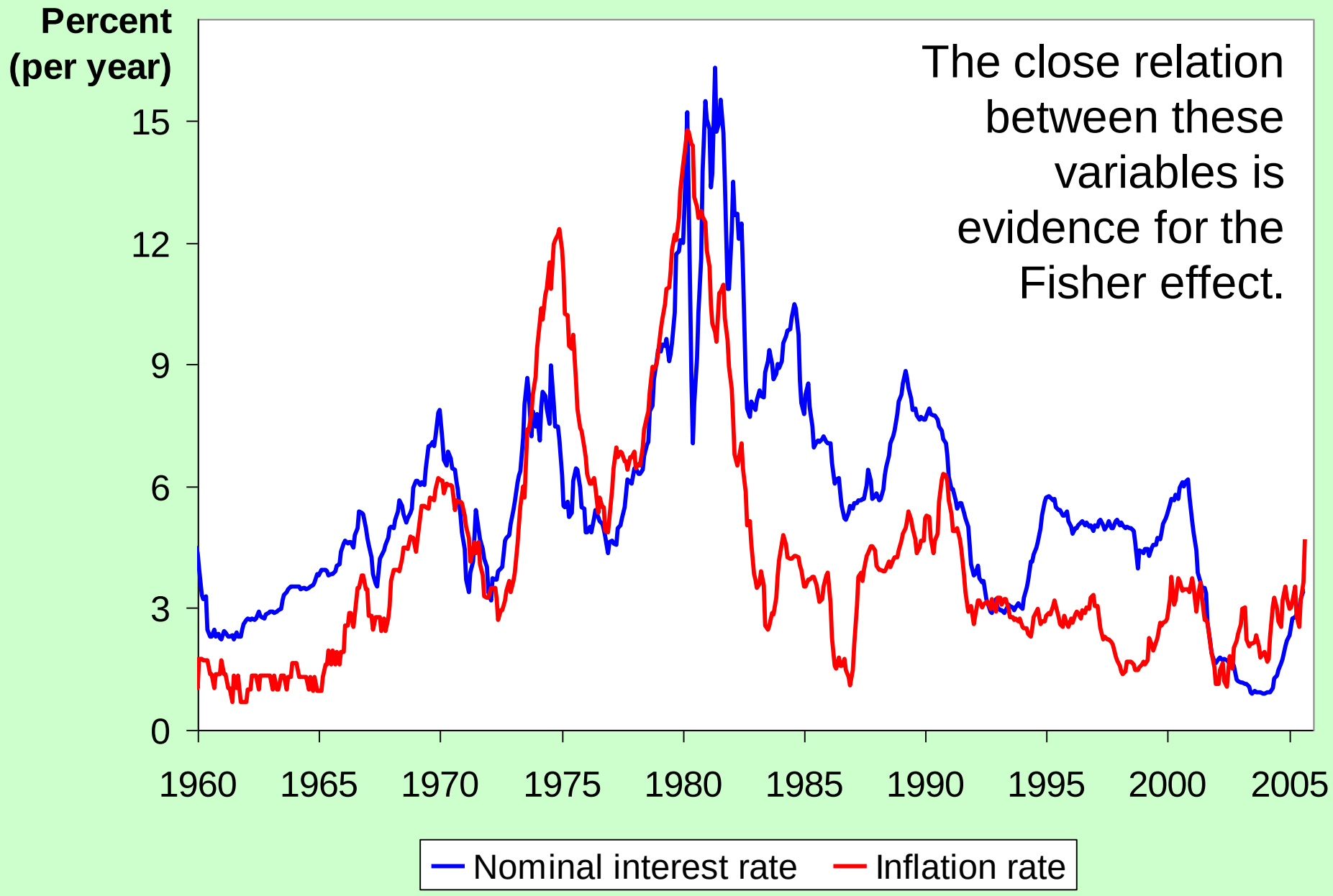
- The real interest rate is determined by saving & investment in the loanable funds market.
- Money supply growth determines inflation rate.
- So, this equation shows how the nominal interest rate is determined.

The Fisher Effect

nominal interest rate	=	inflation rate	+	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



The Fisher Effect & the Inflation Tax

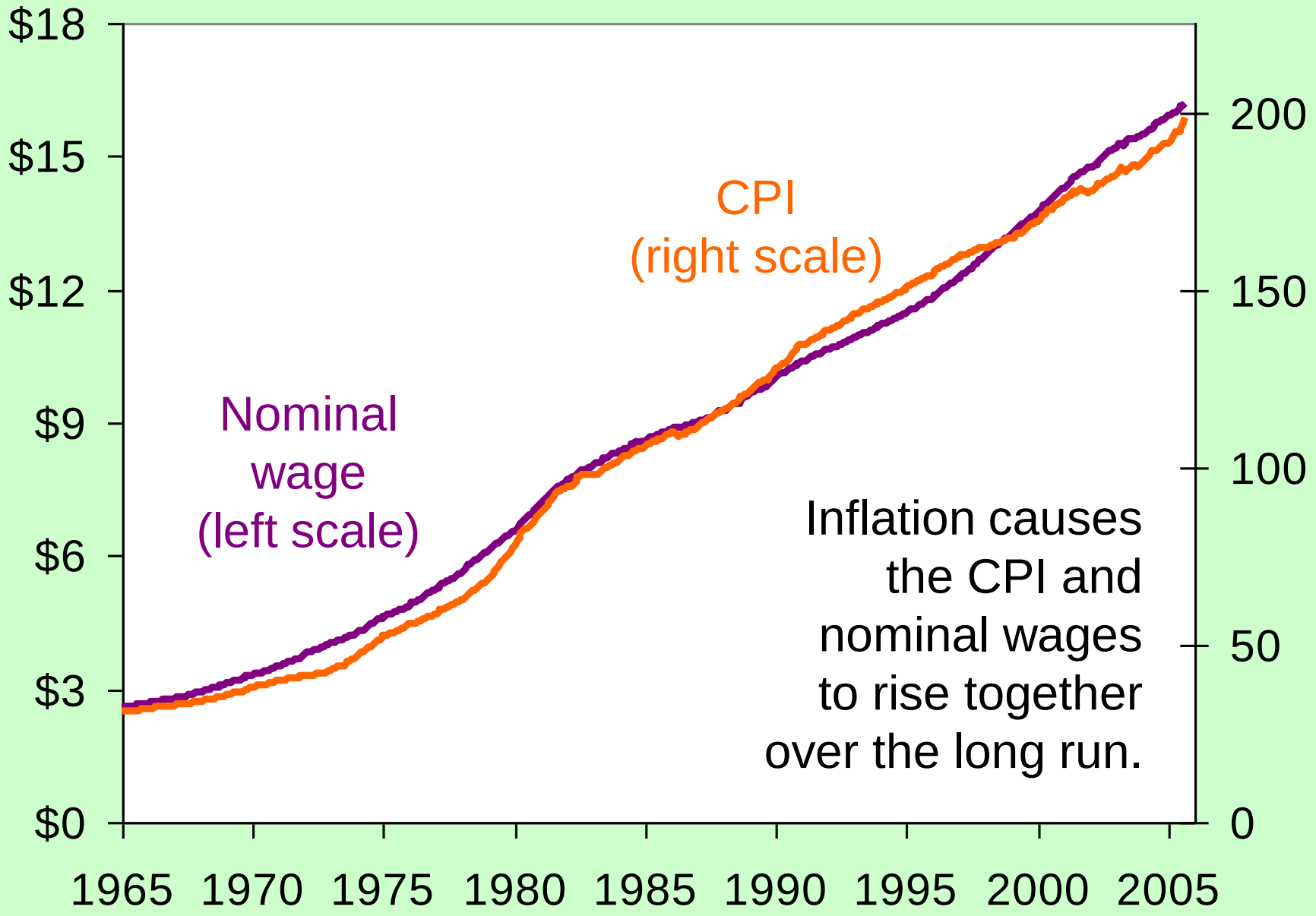
nominal interest rate	=	inflation rate	+	real interest rate

- The inflation tax applies to people's holdings of money, not their holdings of wealth.
- The Fisher effect: an increase in inflation causes an equal increase in the nominal interest rate, so the real interest rate (on wealth) is unchanged.

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 and 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



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.

ACTIVE LEARNING 2:
Tax distortions

You deposit $1000 in the bank for one year.

CASE 1: inflation = 0%, nom. interest rate = 10%

CASE 2: inflation = 10%, nom. interest rate = 20%

a. In which case does the real value of your deposit grow the most?

Assume the tax rate is 25%.

b. In which case do you pay the most taxes?

c. Compute the after-tax nominal interest rate, then subtract off inflation to get the after-tax real interest rate for both cases.

ACTIVE LEARNING 2:
Answers

Deposit = $1000.

CASE 1: inflation = 0%, nom. interest rate = 10%

CASE 2: inflation = 10%, nom. interest rate = 20%

a. In which case does the real value of your deposit grow the most?

In both cases, the real interest rate is 10%, so the real value of the deposit grows 10% (before taxes).

ACTIVE LEARNING 2:
Answers

Deposit = $1000. Tax rate = 25%.

CASE 1: inflation = 0%, nom. interest rate = 10%

CASE 2: inflation = 10%, nom. interest rate = 20%

b. In which case do you pay the most taxes?

CASE 1: interest income = $100,
so you pay $25 in taxes.

CASE 2: interest income = $200,
so you pay $50 in taxes.

ACTIVE LEARNING 2:
Answers

Deposit = $1000. Tax rate = 25%.

CASE 1: inflation = 0%, nom. interest rate = 10%

CASE 2: inflation = 10%, nom. interest rate = 20%

c. Compute the after-tax nominal interest rate, then subtract off inflation to get the after-tax real interest rate for both cases.

CASE 1:	nominal	=	0.75 x 10%	= 7.5%
	real	=	7.5% – 0%	= 7.5%
CASE 2:	nominal	=	0.75 x 20%	= 15%
	real	=	15% – 10%	= 5%

ACTIVE LEARNING 2:
Summary & lessons

Deposit = $1000. Tax rate = 25%.

CASE 1: inflation = 0%, nom. interest rate = 10%

CASE 2: inflation = 10%, nom. interest rate = 20%

Inflation…

- raises nominal interest rates (Fisher effect) but not real interest rates
- increases savers' tax burdens
- lowers the after-tax real interest rate

CONCLUSION

- This chapter explains one of the Ten Principles of economics:

  Prices rise when the govt prints too much money.

- We saw that money is neutral in the long run, affecting only nominal variables.
- In later chapters, we will see that money has important effects in the short run on real variables like output and employment.

CHAPTER SUMMARY

- To explain inflation in the long run, economists use the quantity theory of money. According to this theory, the price level depends on the quantity of money, and the inflation rate depends on the money growth rate.
- The classical dichotomy is the division of variables into real & nominal. The neutrality of money is the idea that changes in the money supply affect nominal variables, but not real ones. Most economists believe these ideas describe the economy in the long run.

CHAPTER SUMMARY

- The inflation tax is the loss in the real value of people's money when the government causes inflation by printing money.
- The Fisher effect is the one-for-one relation between changes in the inflation rate and changes in the nominal interest rate.
- The costs of inflation include menu costs, shoeleather costs, confusion and inconvenience, distortions in relative prices and the allocation of resources, tax distortions, and arbitrary redistributions of wealth.