MACROECONOMICS I

The Money Growth and Iflation

Lecture 7

March 25, 2022

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:

Prices rise when the government 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)

Money supply in the real world

- Determined by the Fed, the banking system, and consumers.

Money supply in this model

- We assume the Fed precisely controls MS and sets it at some fixed amount.

MONEY DEMAND (MD)

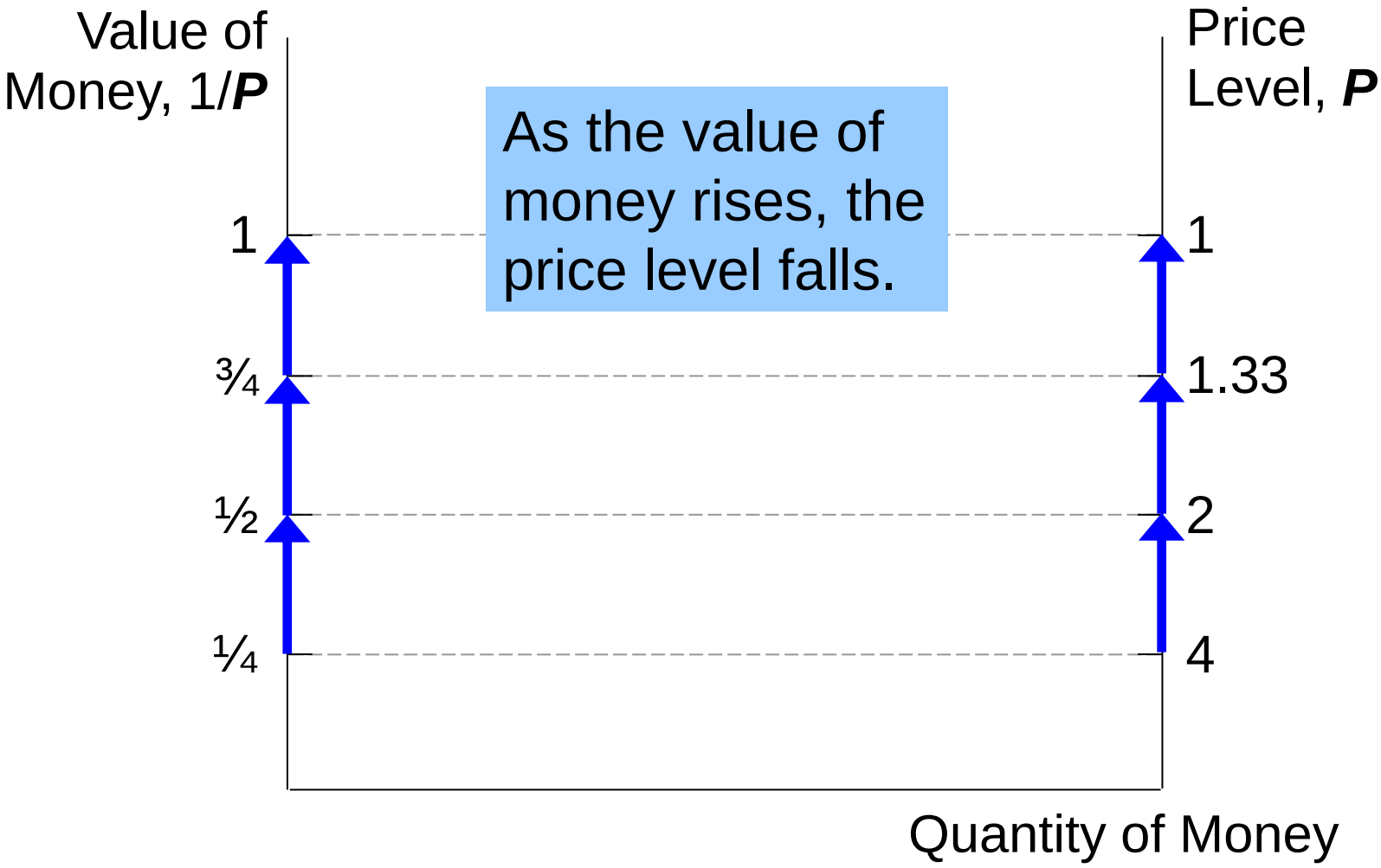
Money demand

- 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 goods and services.

Quantity of money demanded

- Is negatively related to the value of money
- And positively related to P, other things equal.

THE MONEY SUPPLY-DEMAND DIAGRAM



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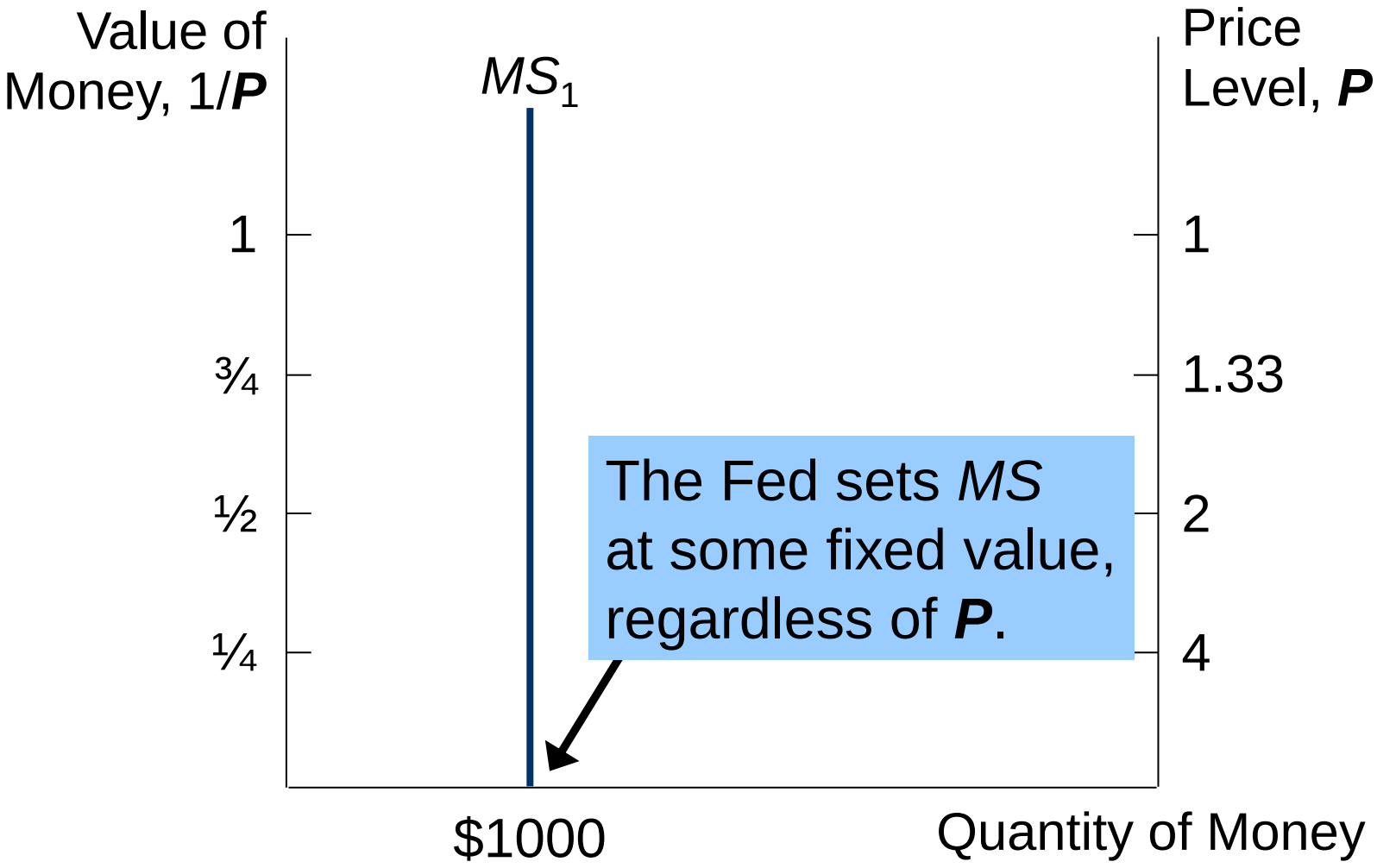

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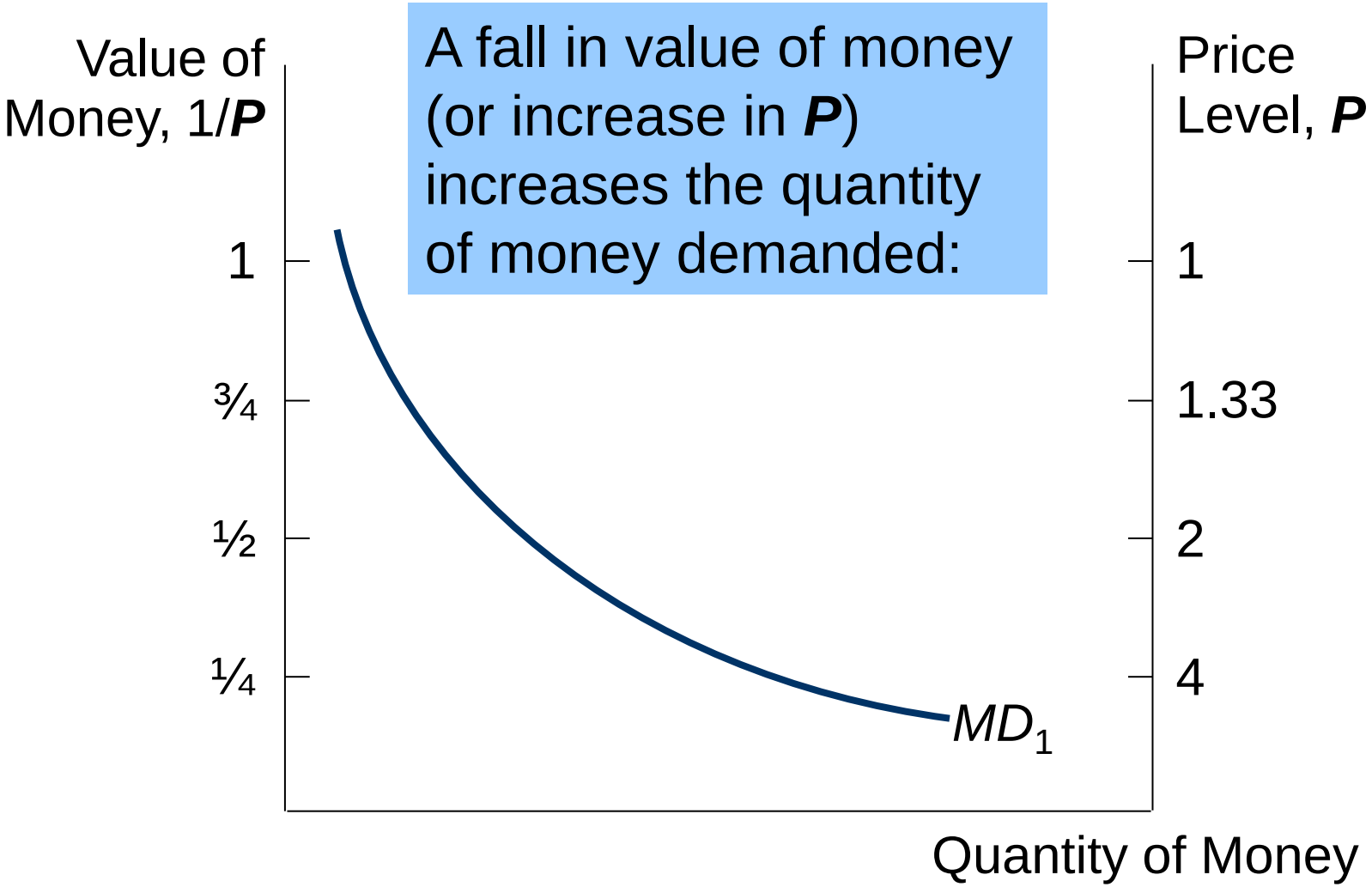

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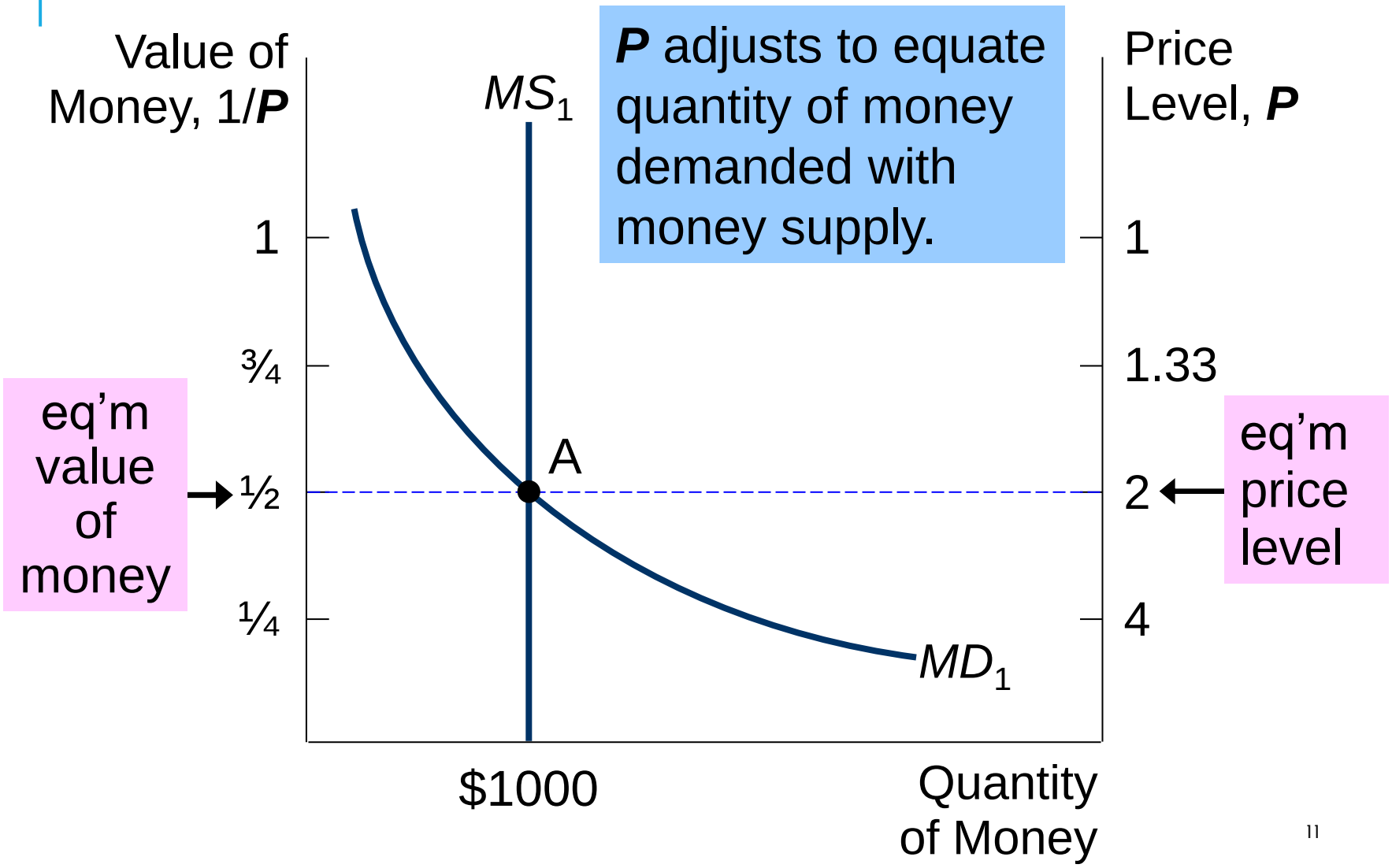
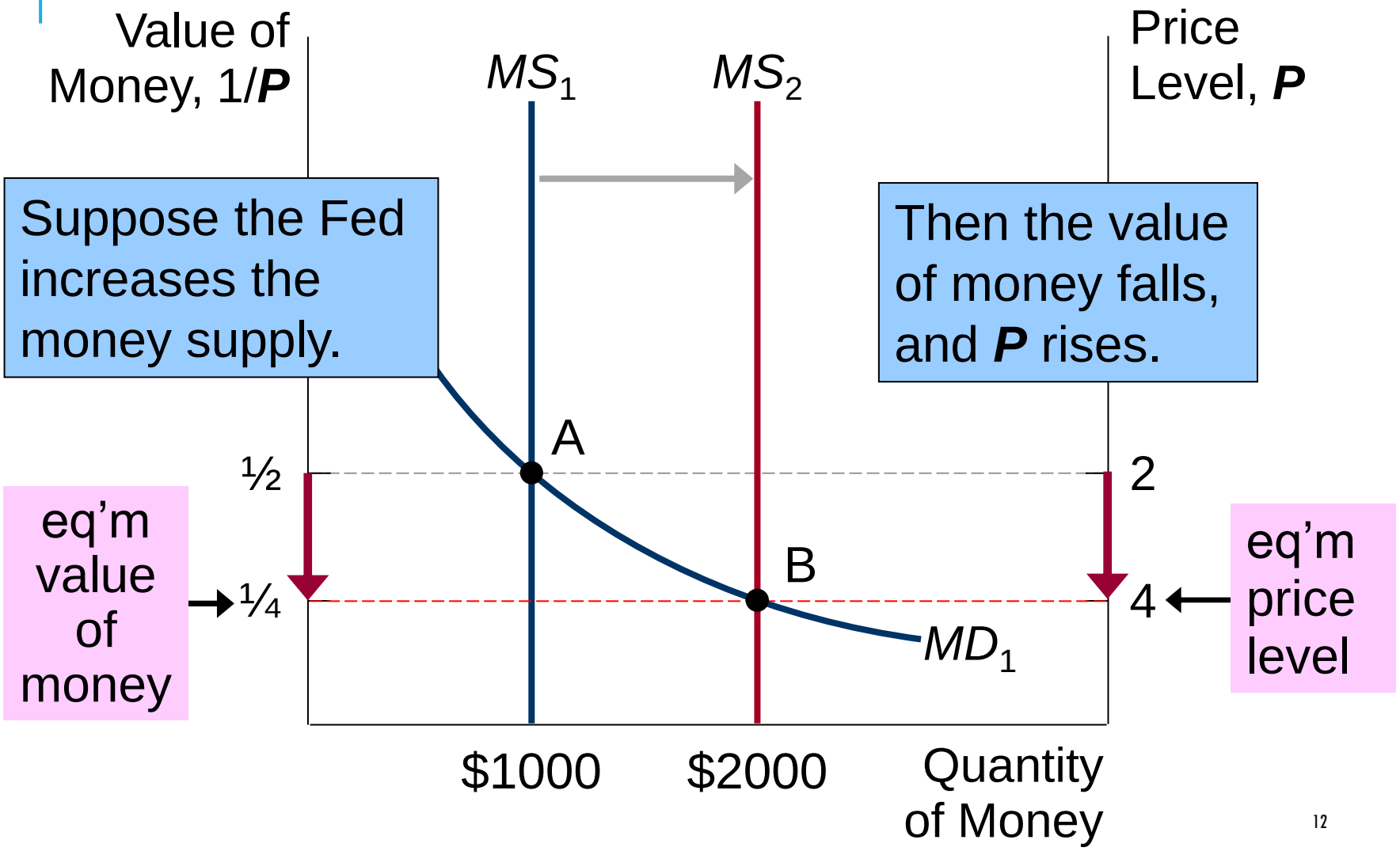


THE EFFECTS OF A MONETARY INJECTION



A BRIEF LOOK AT THE ADJUSTMENT PROCESS

From graph: Increasing MS causes P to rise.

How does this work? Short version:

- At the initial P, an increase in MS causes an excess supply of money.
- People get rid of their excess money by spending it on goods and services 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.

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 CD: $15/cd
- Price of a 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:

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

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 goods and services, 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:

- Theoretical separation of nominal and real variables
- Hume and the classical economists: monetary developments affect nominal variables but not real variables:
  - If central bank doubles the money supply:
  - Then all nominal variables – including prices – will double
  - But 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?

THE NEUTRALITY OF MONEY

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

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 x Y= nominal GDP = (price level) x (real GDP)

M = money supply

V = velocity

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

THE VELOCITY OF MONEY

Velocity formula $V = P \times Y / M$

Example with one good: pizza. In 2020:

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.

ACTIVE LEARNING 1 VELOCITY OF MONEY

One good: corn.

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

V is constant.

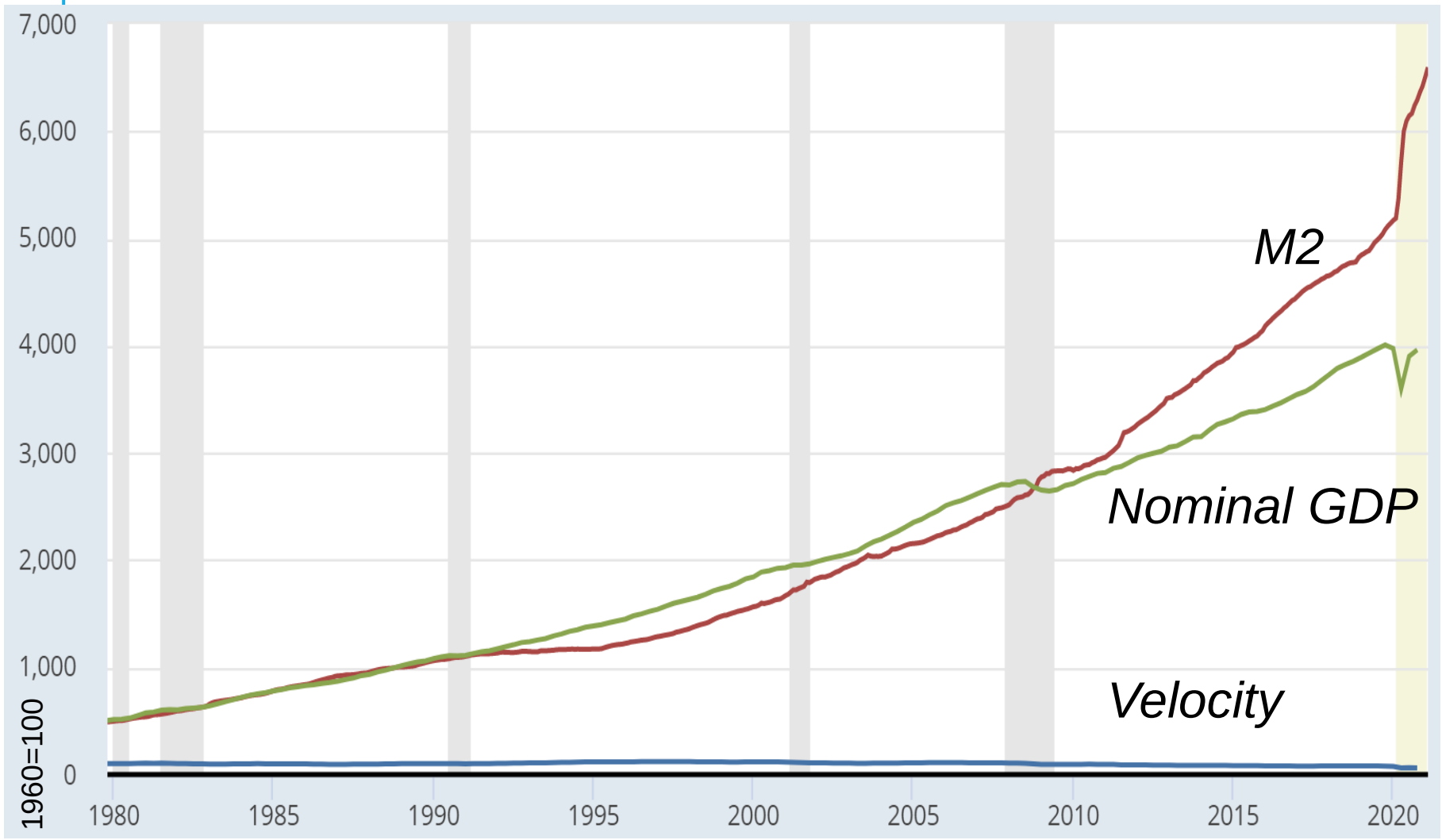
In 2019, MS = \$2000, P = \$5/bushel.

Compute nominal GDP and velocity in 2019.

Answers

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

velocity V = P x Y / M = \$4000 / \$2000 = 2


7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
1960=100
1980
1985
1990
1995
2000
2005
2010
2015
2020
M2
Nominal GDP
Velocity

THE QUANTITY THEORY

The quantity equation: $M \times V = P \times Y$

1. V is stable.
2. A change in M causes nominal GDP (P x 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 x Y and M.
5. Rapid money supply growth causes rapid inflation.

ACTIVE LEARNING 2 QUANTITY THEORY OF MONEY

One good: corn. The economy has enough labor, capital, and land to produce Y = 800 bushels of corn. V is constant. In 2019, MS = \$2000, P = \$5/bushel.

For 2020, the Fed increases MS by 5%, to \$2100.

a. Compute the 2020 values of nominal GDP and P. Compute the inflation rate for 2019–2020.

b. Suppose tech. progress causes Y to increase to 824 in 2020. Compute 2019–2020 inflation rate.

ACTIVE LEARNING 2 ANSWERS

Y = 800, V is constant.

In 2019, MS = $2000, P = $5/bushel.

For 2020, the Fed increases MS by 5%, to $2100.

a. Compute the 2020 values of nominal GDP and P. Compute the inflation rate for 2019–2020.

- 2019: P x Y = M x V, so V= 2
- 2020: nominal GDP = P x Y = M x V = 2100 x 2 = $4200
- 2020: P = M x V / Y = 4200/800 = $5.25
- Inflation rate 2019-2020 = (5.25 – 5.00)/5.00 = 5% (same as MS!)

ACTIVE LEARNING 2 ANSWERS

Y = 800, V is constant.

In 2019, MS = \$2000, P = \$5/bushel.

For 2020, the Fed increases MS by 5%, to \$2100.

b. Suppose tech. progress causes Y to increase to 824 in 2020. Compute 2019–2020 inflation rate.

- 2020: P = M x V / Y = 4200/824 = \$5.10
- Inflation rate 2019-2020 =

= (5.10 – 5.00)/5.00 = 2%

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

Hyperinflation

- Inflation exceeding 50% per month.

Prices rise when the government prints too much money.

- Excessive growth in the money supply always causes hyperinflation.

THE INFLATION TAX

The inflation tax

- Revenue the government raises by creating (printing) money

- Like a tax on everyone who holds money
  - When the government prints money
  - The price level rises
  - And the dollars in your wallet are less valuable
- In the U.S., the inflation tax today accounts for less than 3% of total revenue

THE FISHER EFFECT

Principle of monetary neutrality

- An increase in the rate of money growth raises the rate of inflation but does not affect any real variable

Because

Real interest rate = Nominal interest rate – Inflation rate

We get

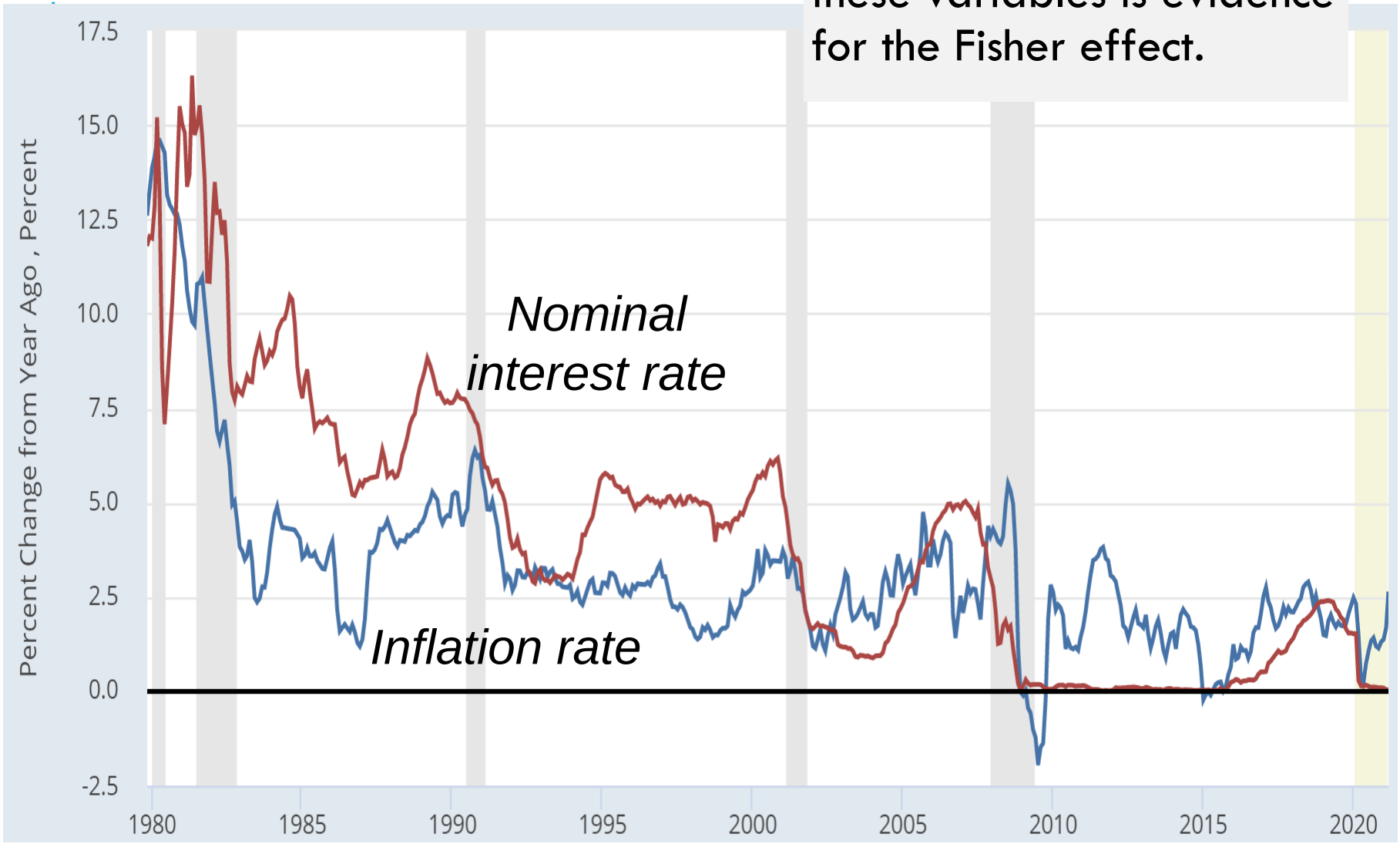
Nominal interest rate = Real interest rate + Inflation rate

THE FISHER EFFECT

Fisher effect

- One-for-one adjustment of nominal interest rate to inflation rate
- When the Fed increases the rate of money growth
- Long-run result
  - Higher inflation rate
  - Higher nominal interest rate

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



THE COSTS OF INFLATION

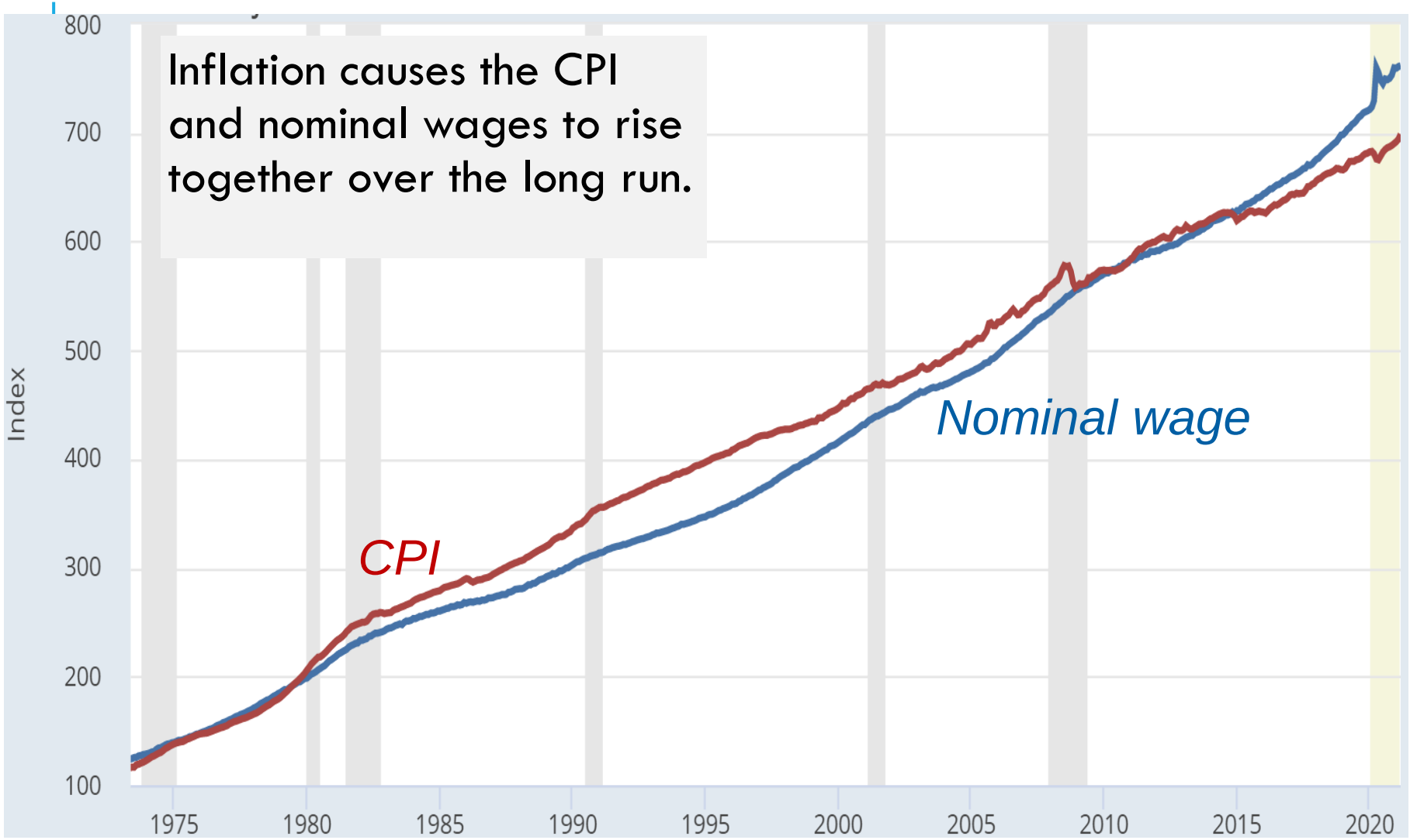
Inflation fallacy

- "Inflation robs people of the purchasing power of his hard-earned dollars"

When prices rise

- Buyers pay more
- Sellers get more

Inflation does not in itself reduce people's real purchasing power


Inflation causes the CPI and nominal wages to rise together over the long run.
Index
800
700
600
500
400
300
200
100
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020
CPI
Nominal wage

THE COSTS OF INFLATION

Shoeleather costs

- Resources wasted when inflation encourages people to reduce their money holdings
- Time and transaction cost of more frequent bank withdrawals

Menu costs

- Costs of changing prices
- Inflation – increases menu costs that firms must bear
- Take time and resources from productive activity

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
  - Distorts the allocation of resources

Confusion and 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.
- After-tax real interest rate falls, making saving less attractive

ACTIVE LEARNING 3 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 inflation to get the after-tax real interest rate for both cases.

ACTIVE LEARNING 3 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 3 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 3 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 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 3 SUMMARY AND 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

↑ Inflation - ↓ the incentive to save – ↓ future productivity

ARBITRARY REDISTRIBUTIONS OF WEALTH

Unexpected inflation

- Redistributes wealth among the population
  - Not by merit
  - Not by need
- Redistribute wealth among debtors and creditors

Inflation: volatile and uncertain

- When the average rate of inflation is high

THE COSTS OF INFLATION

All these costs

- Are quite high for economies experiencing hyperinflation.

For economies with low inflation (< 10% per year),

- These costs are probably much smaller, though their exact size is open to debate.

CONCLUSION

Prices rise when the government prints too much money.

- We saw that money is neutral in the long run, affecting only nominal variables

In later chapters

- Money has important effects in the short run on real variables like output and employment

SUMMARY

- To explain inflation in the long run, economists use the quantity theory of money.
  - 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 and nominal.
- The neutrality of money is the idea that changes in the money supply affect nominal variables but not real ones (in the long-run).

SUMMARY

- The inflation tax is the loss in the real value of people's money holdings 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.