Chapter 11
Money Growth and Inflation

The Price Level and the Value of Money

Remember one of the Ten Principles of Economics from Chapter 1:

> *Prices rise when the government prints too much money.*

In this chapter we will review the *quantity theory of money* to explain why that is true → **the quantity of money determines the value of money.**

The Price Level and the Value of Money

P = price level (e.g. the CPI or GDP deflator)

P = **price of a basket of G&S or $ per basket**

$1/P$ = the quantity of G&S that can be purchased with $1.

$1/P$ = **value of money (in terms of G&S)**

The price level and the value of money are *inversely related*.

Example: A basket contains 1 apple

- If P = $2, value of $1 is **1/2 apple**
- If P = $4, value of $1 is **1/4 apple**

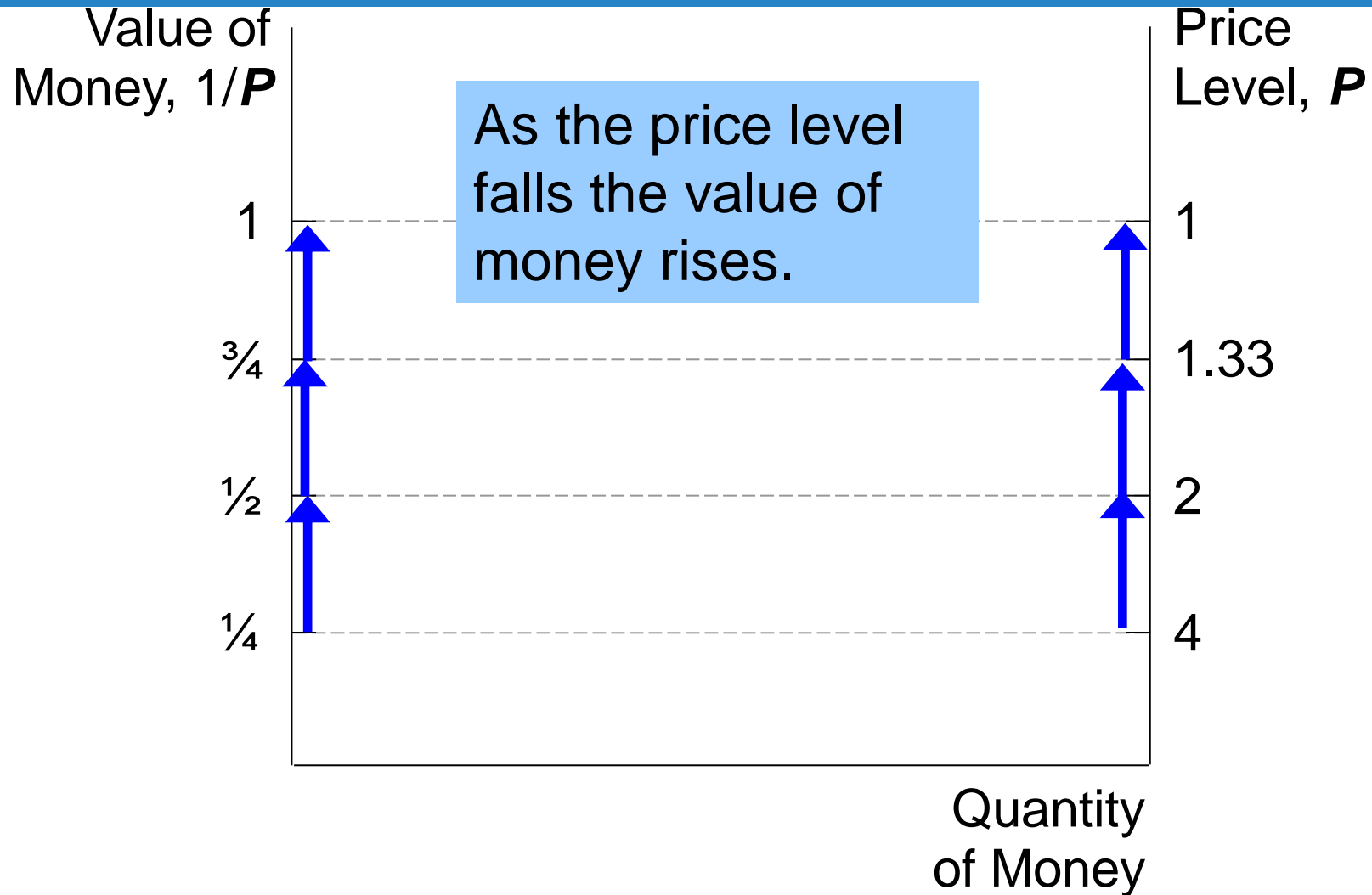# The Quantity Theory of Money: Supply and Demand

Supply of Money:

Assume for simplicity the central bank fixes the quantity of money available in the economy, so the supply of money is **perfectly inelastic.**
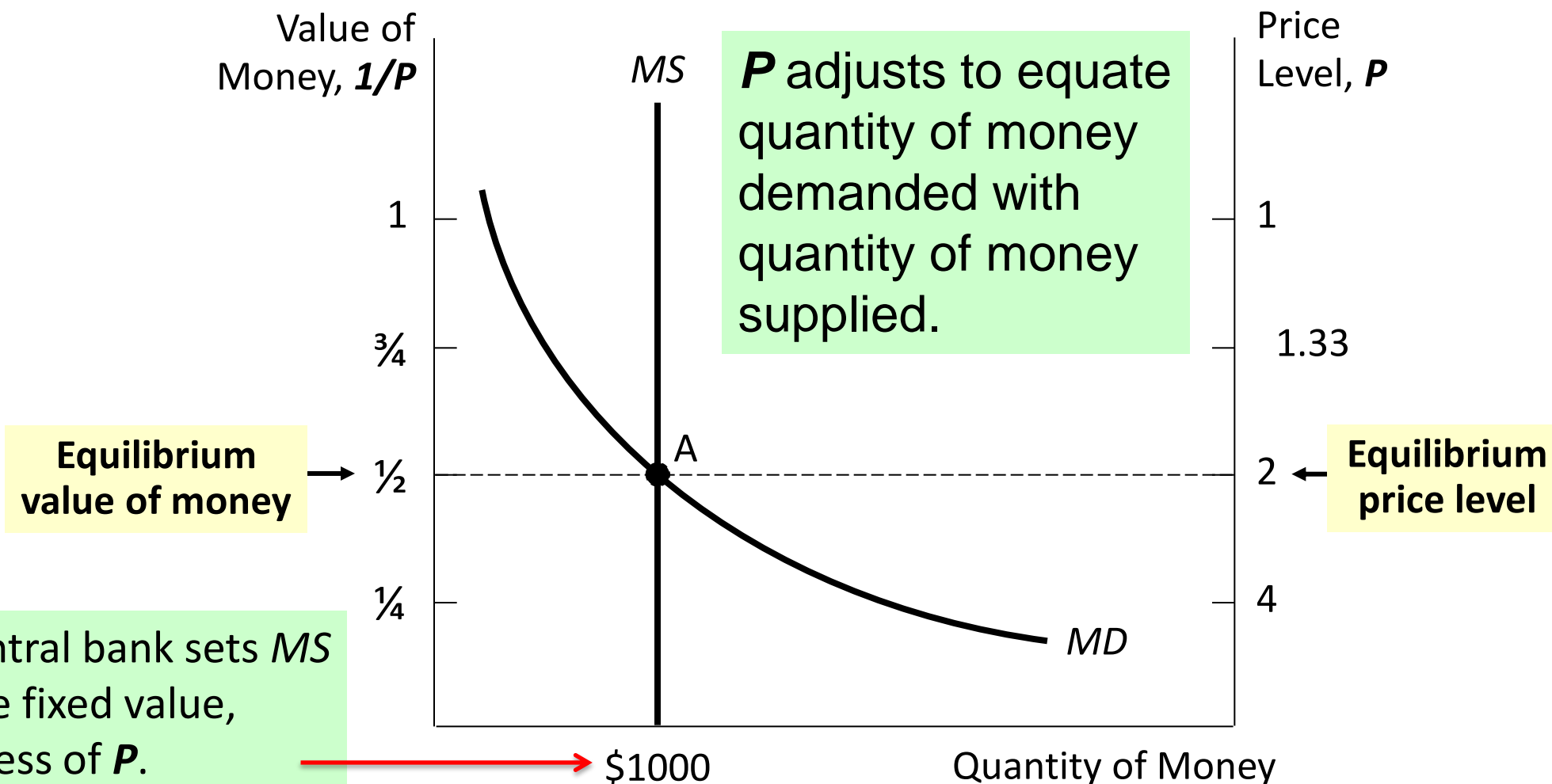
Demand for Money:

People hold money because it is the *medium of exchange* (to buy G&S). The higher prices are the more money the typical transaction requires. That means value of money decreases, therefore causes an **increase in the quantity of money demanded.**

The Money Supply-Demand Diagram

Value of Money, 1/P

Price Level, P

As the price level falls the value of money rises.

1

¾

½

¼

1

1.33

2

4

Quantity of Money

The Equilibrium Price Level

Value of Money, *1/P*

MS

P adjusts to equate quantity of money demanded with quantity of money supplied.

Price Level, **P**

1

¾

Equilibrium value of money → ½

A

Equilibrium price level

¼

MD

The central bank sets *MS* at some fixed value, regardless of **P**.

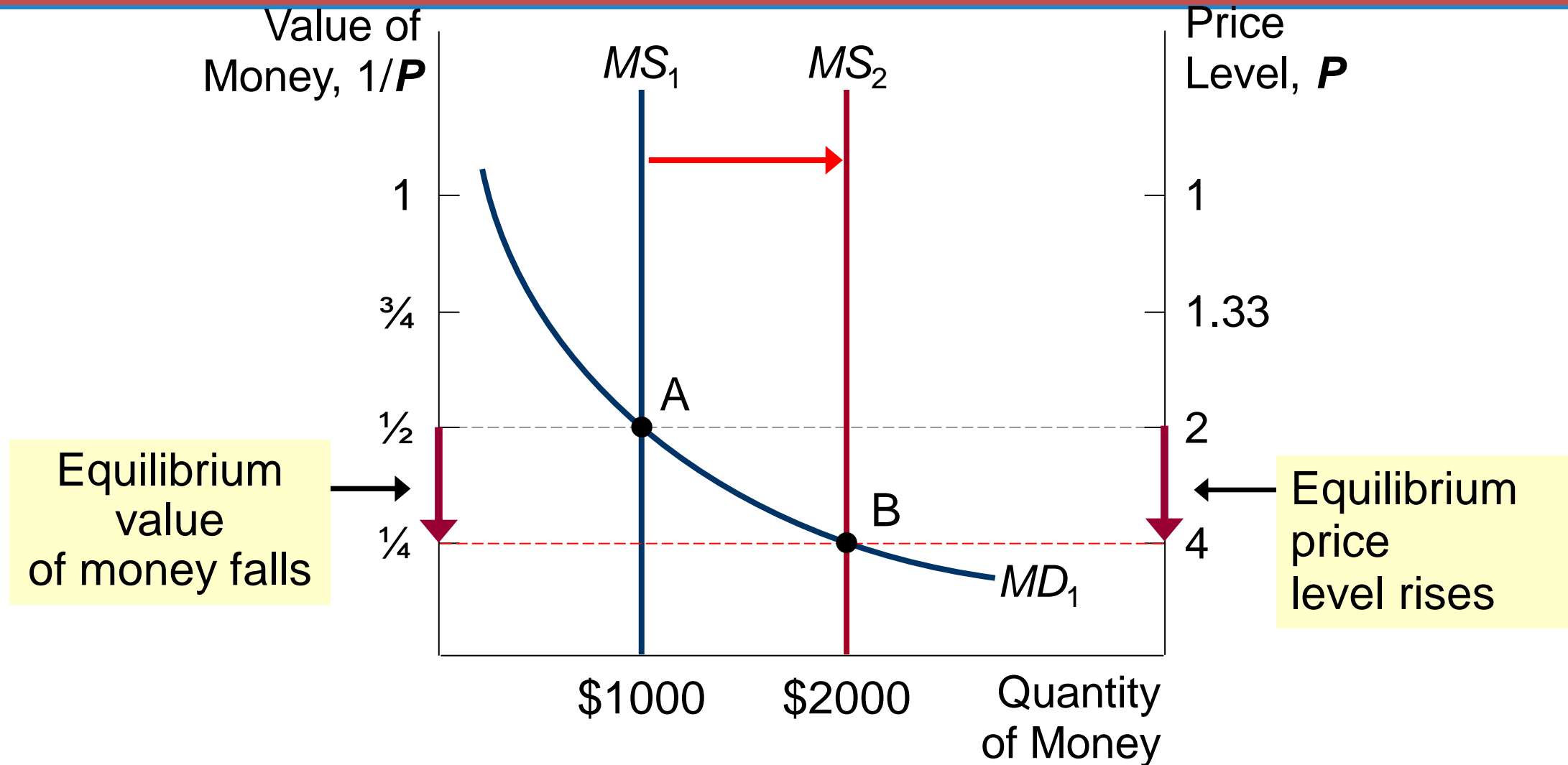$1000

Quantity of Money

1

1.33

2 ←

4

The Effects of a Monetary Injection

Monetary injection: **The central bank increases MS.**

The MS curve shifts **right.**

The equilibrium value of money **falls** and the price level **rises.**

The Effects of a Monetary Injection

Value of Money, 1/**P**

Price Level, **P**

MS_1 MS_2

1   1

¾   1.33

A

½   2

Equilibrium value of money falls

B

¼   4

Equilibrium price level rises

MD_1

$1000 $2000   Quantity of Money

The Adjustment Process: How MS affects the Price Level

Before the price level adjusts the *immediate effect* of an increase in money supply is to create **an excess supply of money.**

People use the excess supply of money to:

- Buy G&S
- Make loans to others, and these loans are then used to buy G&S.

As a result, the demand for G&S increases → **prices increase.**

If the Central Bank *decreased* MS there would be a *shortage* **of money, leading to less demand for G&S and a lower price level (or higher value of money).**

What Happens to the Price Level and the Value of Money When MS or MD Shifts?

	Price Level	Value of Money
Increase in MS	increases	decreases
Decrease in MS	decreases	increases
Increase in MD	decreases	increases
Decrease in MD	increases	decreases

Economic variables can be divided into two groups:

1) **Nominal variables**: **the effects of inflation have not been controlled for**
   E.g. nominal GDP, nominal wages, nominal interest rate
2) **Real variables**: **the effects of prices and/or inflation have been taken out, variables measured in physical units (G&S)**
   E.g. real GDP, real wages, real interest rate

Classical dichotomy: the theoretical separation of nominal and real variables.

Monetary neutrality: changes in MS affect nominal variables but not real variables in the long run.

Nominal and Real Variables

Prices are normally measured in terms of money, so they are **nominal variables**.

        Price of a novel: $15

        Price of a pizza: $10

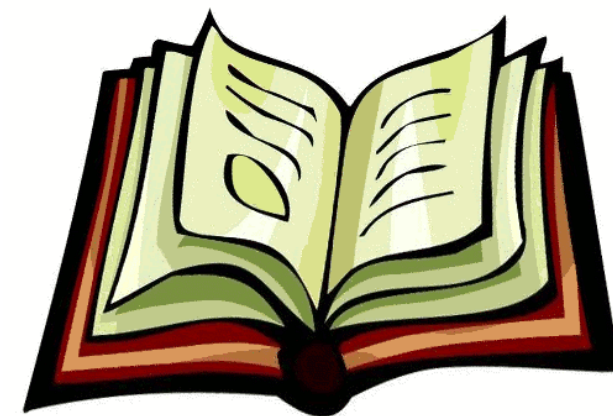A relative price is the price of one good relative to another.

Relative price of novels in terms of pizza =

        $15 /$10 = 1.5 pizzas/novel

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

If the price level doubles then the relative price of novels in terms of pizza =

        $30 /$20 = 1.5 pizzas/novel → unchanged → monetary neutrality

An important relative price is the *real wage*.

Real wage is the **price of labor relative to the price of output.**

W = nominal wage = price of labor = e.g. $20/hour

P = price level = price of goods and services = e.g. $10/pizza

w = **W/P = ($20/hour)/($10/pizza) = 2 pizzas per hour**

If the price level doubles then

w = **W/P = ($40/hour)/($20/pizza) = 2 pizzas per hour →**

unchanged → monetary neutrality

Word of Caution

If central bank doubles the money supply, then all nominal variables, including prices, will double, whereas all real variables, including relative prices, will remain unchanged.

Most economists believe the classical dichotomy and money neutrality describe the economy in the long run.

In later chapters (Ch. 14, Ch. 15, and Ch. 16), we will learn that monetary changes can have important short-run effects on real variables.

Velocity of Money and the Quantity Equation

Example economy with one good: pizza.

Y = real GDP in year t = 300 pizzas

P = price level = price of pizza = $10

$P \times Y$ = nominal GDP = value of pizzas = $3000

M = money supply = $500

In order for $3000 worth of pizza to be purchased with $500 of cash the money must change hands 6 times.

V = velocity of money = **(P x Y)/M = $3000/$500 = 6**

The average dollar was used in 6 transactions.

Velocity of Money and the Quantity Equation

Velocity of money: **the rate at which money changes hands**

Velocity of money = $\dfrac{\text{nominal GDP}}{\text{money supply}}$ = $\dfrac{PY}{M}$

Or **MV = PY** → **The quantity equation**

The velocity is relatively stable over time.

When the central bank changes the quantity of money (M), it will proportionately change the nominal value of output (PY) because P increases (but Y does not – see Ch 7).

Exercise

Assume there is only one good in the economy, corn.
The economy has enough labour, capital, and land to produce Y = 800 bushels of corn.
V is constant.
In 2015 MS = $2000 and P = $5/bushel.

1) Compute nominal GDP and velocity in 2015.

Exercise

2).   Assume that the output remains unchanged in 2016, and the central bank increases the money supply by 5%, to $2100. Compute the 2016 values of nominal GDP and P and compute the inflation rate for 2015-2016.

Exercise

3).   Now suppose that technological progress causes Y to increase by 3% to 824 in 2016, and the central bank increases the money supply by 5%, to $2100. Compute inflation rate for 2015-2016.

Aside: A Useful Equation

If Z = XY, then for small changes in X and Y, we have the following relationship:

$$\%\Delta\, Z = \%\Delta\, X + \%\Delta\, Y$$

Quantity theory of money: **1) the quantity of money available determines the price level; 2) the growth rate in the quantity of money available determines the inflation rate.**
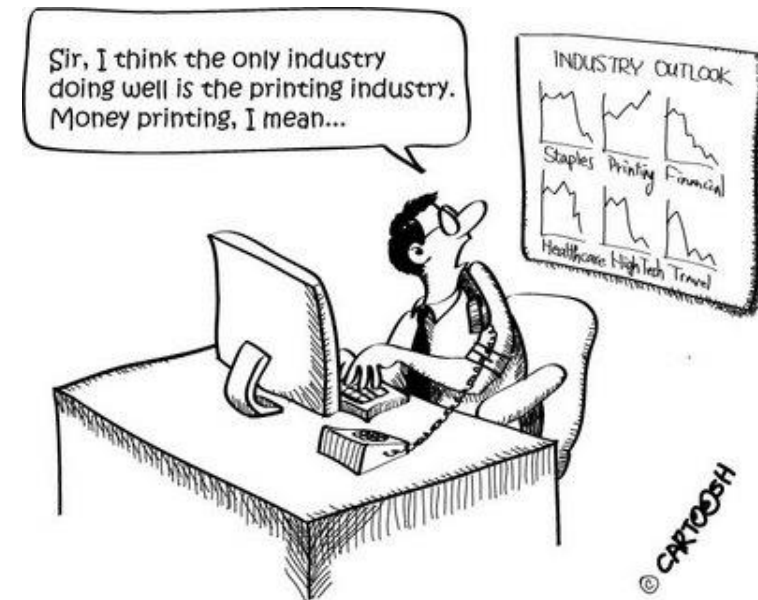
The Inflation Tax

When tax revenue is inadequate and the ability to borrow is limited, a government may print money to pay for its spending.

When the government causes inflation by printing money, the **real value of people's money holdings decreases.**

Inflation "tax" = **the revenue the government raises by creating money.**

The inflation is like a "tax" on everyone who holds money.

Sir, I think the only industry doing well is the printing industry. Money printing, I mean...

INDUSTRY OUTLOOK

Staples Printing Financial

Healthcare High Tech Travel

The Fisher Effect

Fisher Equation: Nominal interest rate = real interest rate + inflation rate

- The real interest rate is determined by **saving & investment in the loanable funds market.**
- The inflation rate is determined by **money supply growth.**
- 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.
- Therefore, the nominal interest rate adjusts one-for-one with changes in the inflation rate.

Fisher effect: **Δ inflation rate = Δ nominal interest rate**

So when the central bank increases the growth rate of MS, the inflation rate rises and the nominal interest rate rises by the same amount.

As long as your wages rise at the same rate as inflation, your real income should remain unchanged → not a cost.

But there are other costs:

Shoe leather Costs = the resources wasted when inflation encourages people to reduce their money holdings quickly.
Includes the time and transactions costs of more frequent bank withdrawals. This is significant in countries experiencing *hyperinflation* where people rush to cash pay cheques and buy things before the price increase further.

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

The Costs of Inflation

Relative-Price Variability and Misallocation of Resources

Firms do not all raise prices at the same time, so **relative prices vary.**

When inflation distorts relative prices, consumer decisions are distorted and markets are **less likely to allocate resources efficiently.**

Confusion and Inconvenience

Money is the unit used to measure economic transactions.

With high inflation, the value of money falls. This alters the unit that we use to measure important variable like income and profits.

Inflation-Induced Tax Distortions

The nominal values of interest income are taxed.

E.g. Interest income = principal X nominal interest rate

As inflation increases, nominal interest rate **increases.**

As a result, savers receive more interest income and they will pay more taxes.

→ **The after-tax real interest rate falls.**

High inflation tends to discourage people from saving.

How Inflation Raises the Tax Burden on Saving

	Economy A (price stability)	Economy B (inflation)
Real interest rate	4%	4%
Inflation rate	0	8
Nominal interest rate (real interest rate + inflation rate)	4	12
Reduced interest due to 25 percent tax (.25 × nominal interest rate)	1	3
After-tax nominal interest rate (.75 × nominal interest rate)	3	9
After-tax real interest rate (after-tax nominal interest rate − inflation rate)	3	1

Exercise

You deposit $1000 in the bank for one year.
Case 1: inflation = 0%, nominal interest rate = 5%
Case 2: inflation = 5%, nominal interest rate = 10%

1) In which case does the real value of your deposit grow the most?

2) Assume the tax rate is 25%. In which case do you pay the most taxes?

3) In which case does the real value of your deposit grow the most?

The Costs of Inflation

Arbitrary Redistribution of Wealth (for *Unexpected* Inflation)

1. If actual inflation is higher than the expected inflation, borrowers are better off and savers are worse off because **borrowers get to repay their debt with dollars that are not worth as much.**

2. If actual inflation is lower than expected, borrower are worse off and savers are better off because **borrowers repay their debt with dollars that are worth more.**

High inflation is more variable and less predictable than low inflation. So, these arbitrary redistributions are frequent when inflation is high.

Example

Assume that savers expected a real interest rate of 4%, and the expected inflation rate is 3%.

Then the nominal interest rate =

If the actual inflation = 5%, then the actual real interest rate

Savers are worse off and borrowers are better off.

If the actual inflation = 1%, then the actual real interest rate

Savers are better off and borrowers are worse off.

Comments

1. **Are there any benefits of inflation?**

Yes.

The first benefit of inflation is to help the adjustment of real wages.

A second benefit is about the trade-off between inflation and unemployment (we'll learn this in Chapter 16). Inflation is usually associated with a booming economy, and is by-product of strong consumer demand. In the choice between the two evils – inflation and unemployment, inflation is the lesser of the two evils.

Also inflation is a lot better than *deflation*.

Comments

2. Hyperinflation

Hyperinflation is the extraordinarily high rate of inflation.

Hyperinflation is almost always caused by the excessive increase in money supply. The government has high spending, inadequate tax revenue, and limited ability to borrow. As a result, the government turns to the printing of money to pay for its spending.

Hyperinflation can destroy a monetary system and countries may have to abandon their currency.