

Chapter 4: Money and Inflation*

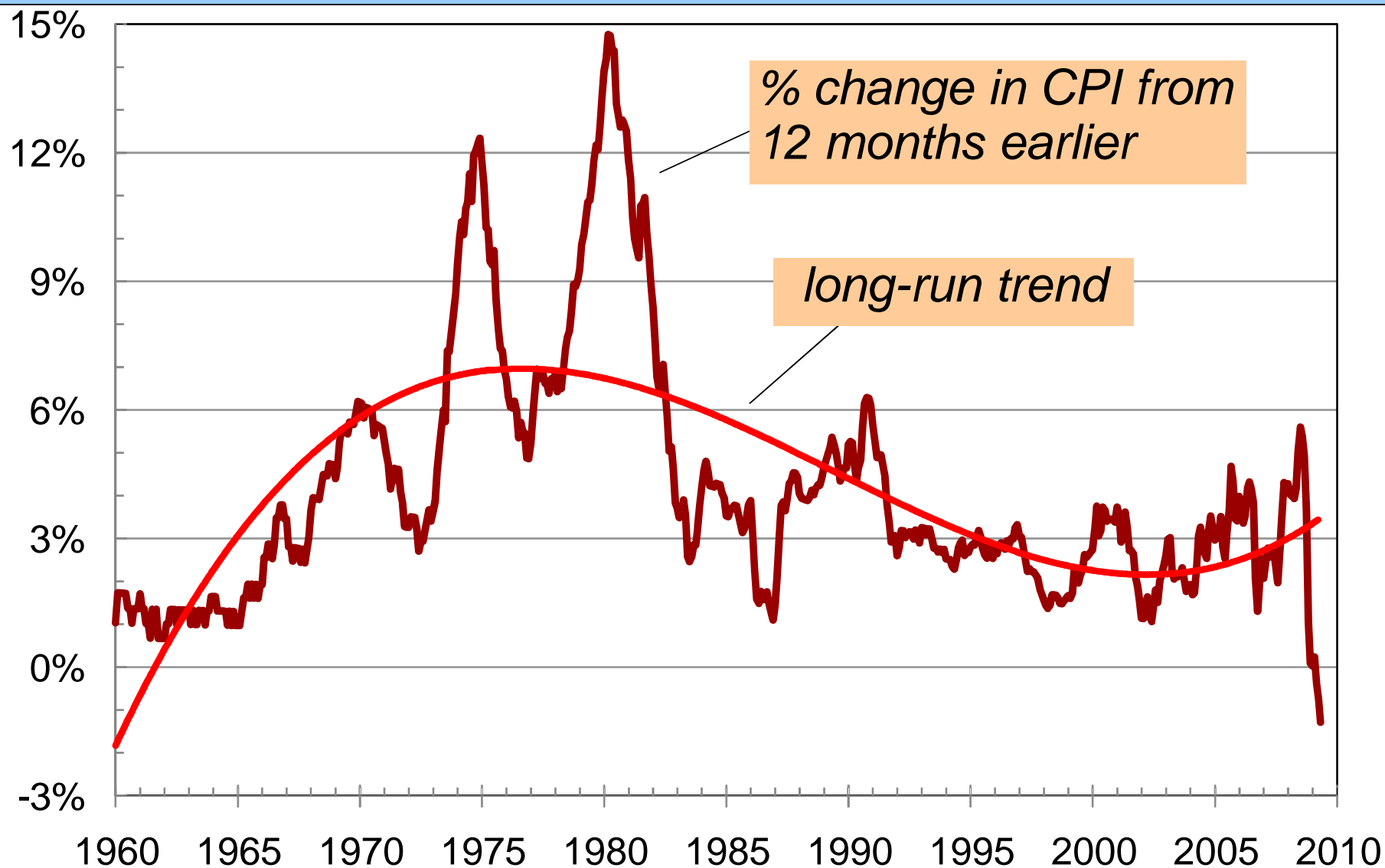
MACROECONOMICS

Seventh Edition

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*Slides based on Ron Cronovich's slides, adjusted for course in Macroeconomics at the Wang Yanan Institute for Studies in Economics at Xiamen University.

Introduction: U.S. Inflation and Its Trend, 1960-2009




Introduction:

Connection Between Money and Prices

- Inflation rate = the percentage increase in the average level of prices.
- Price = amount of money required to buy a good.
- Because prices are defined in terms of money, we need to consider the nature of money, the supply of money, and how it is controlled.

Learning Objectives

This chapter introduces you to understanding:

- What is money 
- The quantity theory of money
- Seigniorage: The revenue from printing money
- Inflation and interest rates
- The nominal interest rate and the demand for money
- The social costs of inflation
- Hyperinflation
- The classical dichotomy

4.1) What is Money?

→ Definition

Money is the stock of assets that can be readily used to make transactions.



4.1) What is Money?

→ Functions and Types of Money

Functions:

- Medium of exchange: *we use it to buy stuff*
- Store of value: *transfers purchasing power from the present to the future*
- Unit of account: *the common unit by which everyone measures prices and values*

Types:

- Fiat money: has no intrinsic value (paper money)
- Commodity money: has intrinsic value (gold coins)

4.1) What is Money?

→ Money Supply and Monetary Policy

- The **money supply** is the quantity of money available in the economy.
- **Monetary policy** is the control over the money supply. Monetary policy is conducted by a country's central bank.

4.1) What is Money?

→ Money Supply Measures, May 2009

Symbol	Assets included	Amount (\$ billions)
C	Currency	\$850
M1	C + demand deposits, travelers' checks, other checkable deposits	\$1596
M2	M1 + small time deposits, savings deposits, money market mutual funds, money market deposit accounts	\$8328

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4.2) The Quantity Theory of Money

- Provides the leading explanation of how money affects the economy in the long run.
- A simple theory linking the inflation rate to the growth rate of the money supply.
- Begins with the concept of **velocity**...

4.2) The Quantity Theory of Money

→ Velocity

- 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 2007,
 - \$500 billion in transactions
 - Money supply = \$100 billion
 - The average dollar is used in five transactions in 2007
 - So, velocity = 5

4.2) The Quantity Theory of Money

→ Velocity

This suggests the following definition:

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

where

V = velocity

T = value of all transactions

M = money supply

4.2) The Quantity Theory of Money

→ Velocity

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)

4.2) The Quantity Theory of Money

→ 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.

4.2) The Quantity Theory of Money

→ Money Demand and the Quantity Equation

- When analyzing how money affects the economy, it is useful to express the quantity of money in terms of G & S it can buy: $M/P = \text{real money balances}$

- Use money demand function to show how much real money balances people wish to hold:

$$(M/P)^d = k Y$$

where:

k = how much money people wish to hold for each dollar of income.

(k is exogenous)

4.2) The Quantity Theory of Money

→ Money demand and the Quantity Equation

- Money demand: $(M/P)^d = k Y$
- 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 high), money changes hands infrequently (V is low).

4.2) The Quantity Theory of Money

→ Deriving the Quantity Theory of Money

- If we assume V is constant and exogenous ($V = \bar{V}$), then the quantity equation becomes a useful theory about the effects of money.
- Given the assumption, the quantity equation can be written as
$$M \times \bar{V} = P \times Y$$
- A change in the quantity of money (M) must cause a proportionate change in nominal GDP (PY).
- If velocity is fixed, the quantity of money determines the dollar value of the economy's output.

4.2) The Quantity Theory of Money

→ Explaining an Economy's Overall Level of Prices

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

How the price level is determined:

- Real GDP is determined by the economy's supplies of K and L and the production function (Chap 3).
- With V constant, the money supply determines nominal GDP ($P \times Y$).
- The **price level** is
 $P = (\text{nominal GDP}) / (\text{real GDP})$.

4.2) The Quantity Theory of Money

→ Explaining an Economy's Overall Level of Prices

- The growth rate of a product equals the sum of the growth rates (See mankiw Ch. 2).
- The quantity equation in percentage change form:

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

Exogenous

Inflation

The quantity theory of money assumes

\mathbf{V} is constant, so $\frac{\Delta \mathbf{V}}{\mathbf{V}} = 0$.

4.2) The Quantity Theory of Money

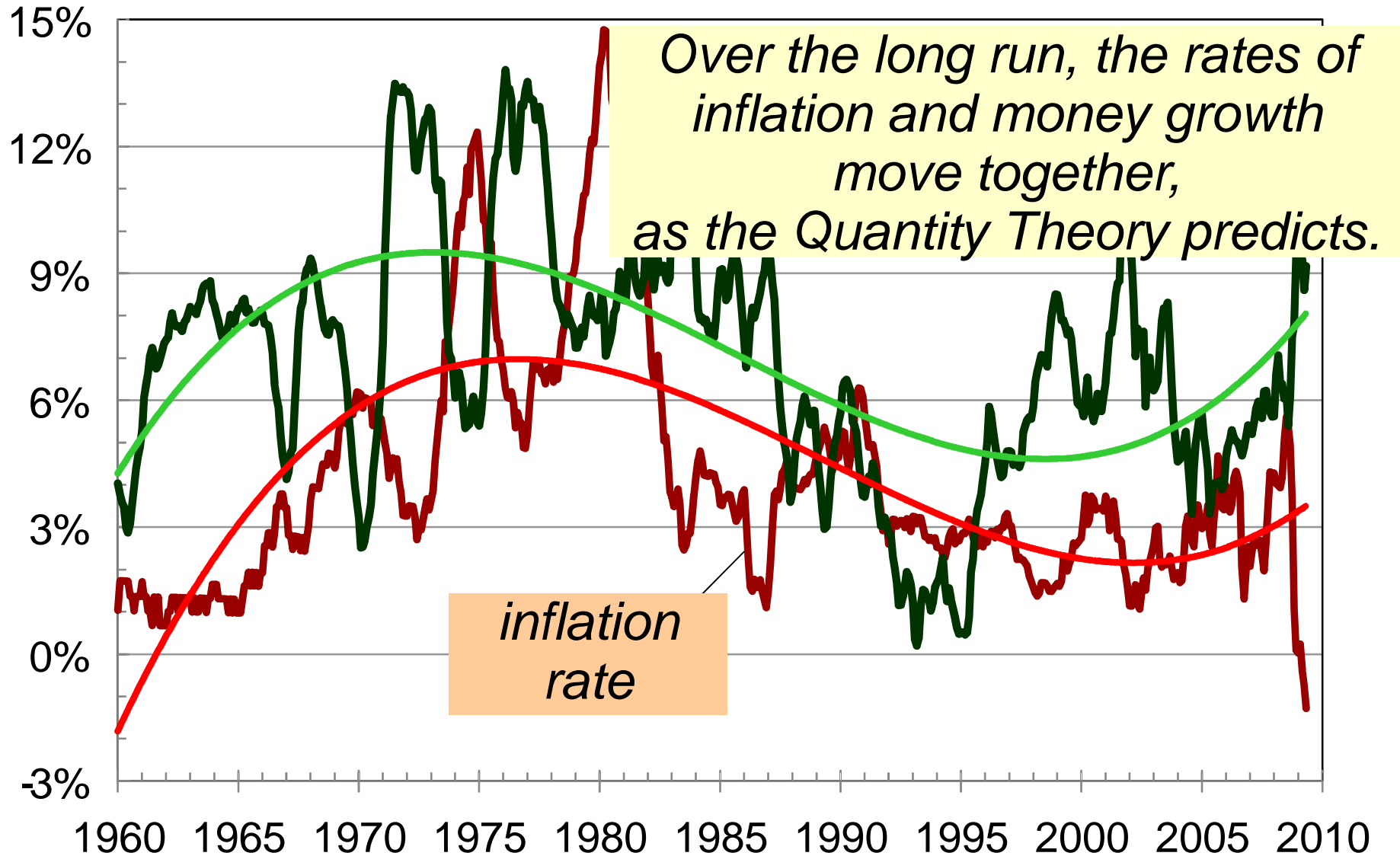
→ Explaining an Economy's Overall Level of Prices

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

- The quantity theory of money states that the central bank, which controls the money supply, has ultimate control over the rate of inflation.
 - If the central bank keeps the money supply stable, the price level will be stable.
 - If the central bank increases the money supply rapidly, the price level will rise rapidly.

4.2) The Quantity Theory of Money

→ U.S. Inflation and Money Growth, 1960 - 2009



BREAK 3

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4.4) Inflation and Interest Rates

- Interest rates are the market price at which resources are transferred between the present and the future
- In this subchapter we investigate the relation between interest and inflation
- **Nominal** interest rate, i , not adjusted for inflation
- **Real** interest rate, r , adjusted for inflation:
$$r = i + \pi$$

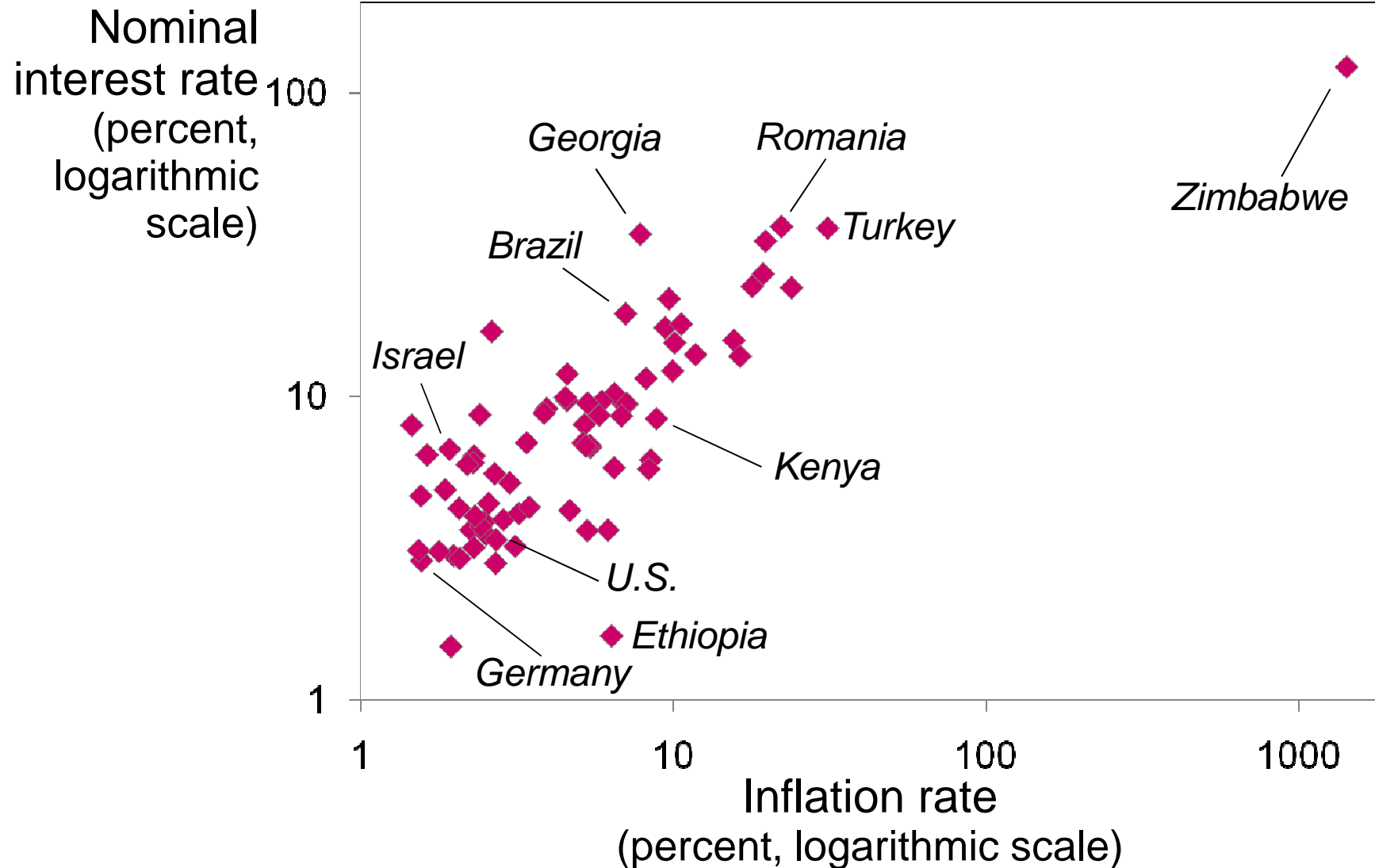
4.4) Inflation and Interest Rates

→ The Fisher Effect

- The Fisher equation: $i = r + \pi$
- Chap 3: $S = I$ determines r .
- Hence, an increase in π causes an equal increase in i .
- This one-for-one relationship is called the **Fisher effect**.

4.4) Inflation and Interest Rates

→ Inflation and Nom. Interest Rates Across Countries



4.4) Inflation and Interest Rates

→ Two Real Interest Rates

- π = actual inflation rate
(not known until after it has occurred)
- π^e = expected inflation rate
- $i - \pi^e = \text{ex ante}$ real interest rate:
the real interest rate people expect at the time they make a loan
- $i - \pi = \text{ex post}$ real interest rate:
the real interest rate actually realized

4.4) Inflation and Interest Rates

→ 该你们了

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

- Using the quantity theory of money and the Fisher equation, what is the nominal interest rate, i , given the above values?
- If the Fed increases the money growth rate by 2 percentage points per year, find Δi .
- Suppose the growth rate of Y falls to 1% per year.
 - What will happen to π ?
 - What must the Fed do if it wishes to keep π constant?

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4.5) Money Demand and Nominal Interest

- 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 .
- It is the opportunity cost of holding money (instead of bonds or other interest-earning assets).
- Hence, $\uparrow i \Rightarrow \downarrow$ in money demand.

4.5) Money Demand and Nominal Interest

→ The Money Demand Function

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

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

- negatively on i .
 i is the opp. cost of holding money
- positively on Y
higher $Y \Rightarrow$ more spending
 \Rightarrow so, need more money

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

4.5) Money Demand and Nominal Interest

→ The Money Demand Function

$$\begin{aligned}(\mathbf{M/P})^d &= \mathbf{L}(i, Y) \\ &= \mathbf{L}(r + \pi^e, Y)\end{aligned}$$

- 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 $r + \pi^e$.

4.5) Money Demand and Nominal Interest

→ Equilibrium: Money Supply=Money Demand

The supply of real money balances

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

Real money demand

- The level of real money balances depends on the expected rate of inflation.
- Today's price level does not only depend on today's money supply but also on the money supply expected in the future

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4.8) The Classical Dichotomy

→ The Separation of Real and Nominal Variables

- Note: Real variables were explained in Chap 3 (output, wage etc.), nominal ones (price level, output) in Chapter 4.
- **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:** Changes in the money supply do not affect real variables.
- In the real world, money is approximately neutral in the long run.

Chapter Summary

Money:

- the stock of assets used for transactions
- serves as a medium of exchange, store of value, and unit of account.
- Commodity money has intrinsic value, fiat money does not.
- Central bank controls the money supply.

Quantity theory of money assumes velocity is stable, concludes that the money growth rate determines the inflation rate.

Chapter Summary (ctd.)

Nominal interest rate

- equals real interest rate + inflation rate
- the opp. cost of holding money
- Fisher effect: Nominal interest rate moves one-for-one w/ 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 (ctd.)

Costs of inflation

- Expected inflation
shoeleather costs, menu costs, tax & 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 (ctd.)

Hyperinflation

- caused by rapid money supply growth when money printed to finance govt budget deficits
- stopping it requires fiscal reforms to eliminate govt's need for printing money

Chapter Summary (ctd.)

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 equilibrium determines price level and all nominal variables.
- Most economists believe the economy works this way in the long run.

Appendix: Sub-Chapters for Self-Study

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4.3) Seigniorage

- To spend more without raising taxes or selling bonds, the govt can print money.
- The “revenue” raised from printing money is called **seigniorage**.
- The **inflation tax**: Printing money to raise revenue causes inflation. Inflation is like a tax on people who hold money.

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4.6) The Social Costs of Inflation

→ 该你们了: Why is Inflation Bad?

- What costs does inflation impose on society
List all the ones you can think of.
- Focus on the long run.
- Think like an economist.

4.6) The Social Costs of Inflation

→ The Classical View of Inflation

A change in the price level is merely a change in the units of measurement.

→ So why, then, is inflation a social problem?

Social costs of inflation fall into two categories:

1. Costs when inflation is expected
2. Costs when inflation is different than people had expected

4.6) The Social Costs of Inflation

→ Costs When Inflation is Unexpected

- Shoeleather costs: $\uparrow \pi \Rightarrow \uparrow i \Rightarrow \downarrow$ real money balances
People have to run more often to the bank to withdraw smaller amounts of cash
- Menu costs: cost of printing new menus
- Relative price distortions: Different firms change their prices at different times, leading to relative price distortions causing microeconomic inefficiencies in resource allocation
- Unfair tax treatment (e.g. capital gain tax on inflated stocks)
- General inconvenience: long range financial planning is complicated

4.6) The Social Costs of Inflation

→ Costs When Inflation is Expected

Arbitrary redistribution:

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

4.6) The Social Costs of Inflation

→ High Inflation: Increased Uncertainty

- When inflation is high, it's more variable and unpredictable: π turns out different from π^e more often, and the differences tend to be larger (though not systematically positive or negative)
- Arbitrary redistributions of wealth become more likely.
- This creates higher uncertainty, making risk averse people worse off.

4.6) The Social Costs of Inflation

→ 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.

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4.7) Hyperinflation

- 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 may not serve its other functions (unit of account, medium of exchange).
- People may conduct transactions with barter or a stable foreign currency.

4.7) Hyperinflation

→ What Causes Hyperinflation

Hyperinflation is caused by excessive money supply growth:

- When the central bank prints money, the price level rises.
- If it prints money rapidly enough, the result is hyperinflation.

4.7) Hyperinflation

→ A Few Examples

	Money growth (%)	Inflation (%)
Israel, 1983-85	295	275
Poland, 1989-90	344	400
Brazil, 1987-94	1350	1323
Argentina, 1988-90	1264	1912
Peru, 1988-90	2974	3849
Nicaragua, 1987-91	4991	5261
Bolivia, 1984-85	4208	6515

4.7) Hyperinflation

→ Why Governments Create Hyperinflation

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