CHAPTER 4

Money and Inflation

MACROECONOMICS SIXTH EDITION

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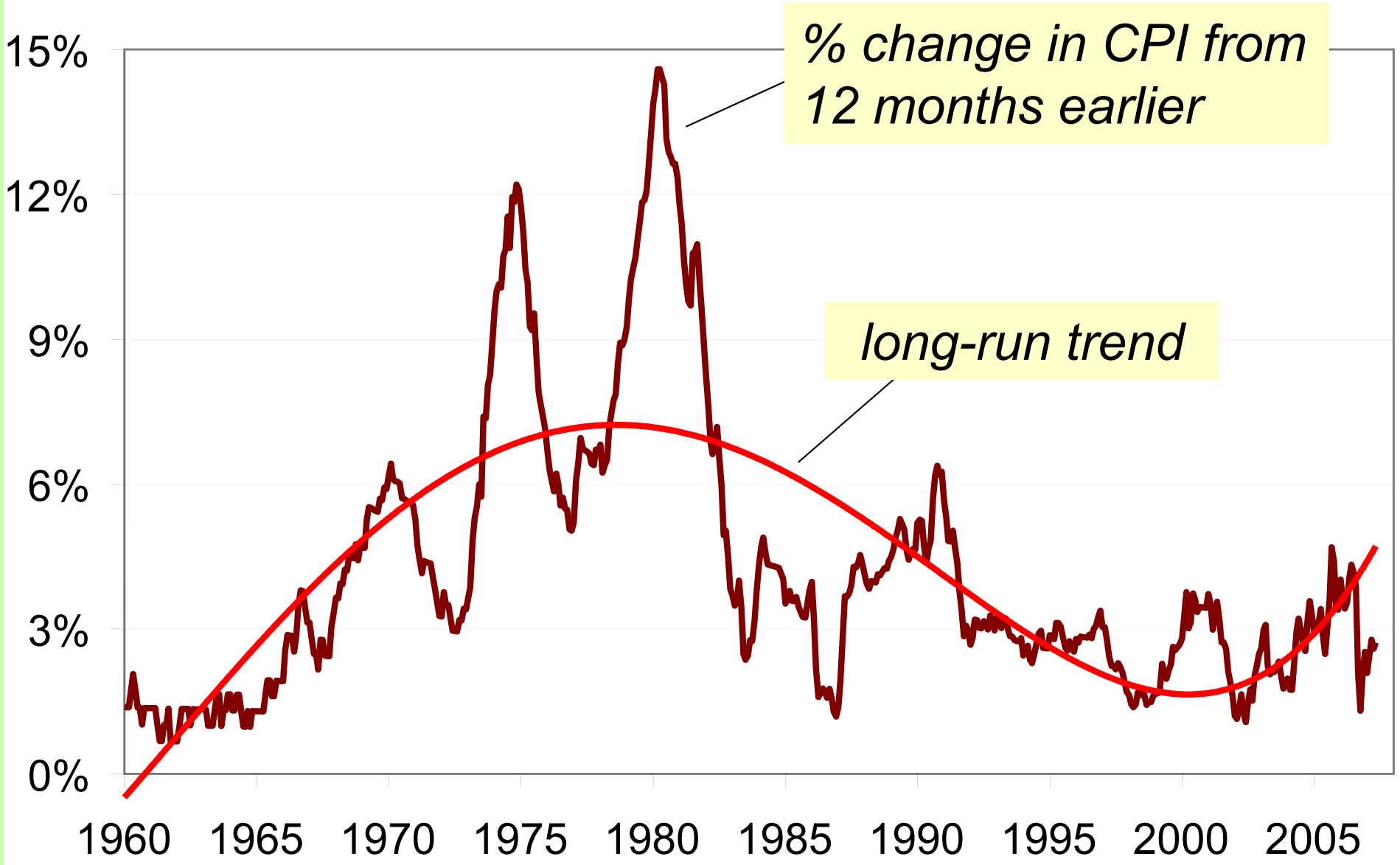
PowerPoint® Slides by Ron Cronovich

In this chapter, you will learn…

- The classical theory of inflation
  - causes
  - effects
  - social costs
- "Classical" – assumes prices are flexible & markets clear
- Applies to the long run

U.S. inflation and its trend, 1960-2007



The 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.

Money: Definition

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

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

Money: Types

1. fiat money
   - has no intrinsic value
   - example: the paper currency we use
2. commodity money
   - has intrinsic value
   - examples:
     gold coins,
     cigarettes in P.O.W. camps

Discussion Question

Which of these are money?

a. Currency
b. Debit cards
c. Deposits in checking accounts ("demand deposits")
d. Credit cards
e. Certificates of deposit ("time deposits")

The money supply and monetary policy definitions

- The **money supply** is the quantity of money available in the economy.
- **Monetary policy** is the control over the money supply.

The central bank

- Monetary policy is conducted by a country's **central bank**.
- In the U.S., the central bank is called the **Federal Reserve** ("the Fed").

The Federal Reserve Building
Washington, DC

Money supply measures, May 2007

symbol	assets included	amount ($ billions)
C	Currency	$755
M1	**C** + demand deposits, travelers' checks, other checkable deposits	$1377
M2	**M1** + small time deposits, savings deposits, money market mutual funds, money market deposit accounts	$7227

The Quantity Theory of Money

- A simple theory linking the inflation rate to the growth rate of the money supply.
- Begins with the concept of **velocity**…

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

Velocity, *cont.*

- This suggests the following definition:

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

where

V = velocity

T = value of all transactions

M = money supply

Velocity, *cont.*

- 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)

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.

Money demand and the quantity equation

- ***M*/*P*** = **real money balances**, the purchasing power of the money supply.
- A simple money demand function:

  $$(M/P)^d = kY$$

  where

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

  (***k*** is exogenous)

Money demand and the quantity equation

- money demand: $(M/P)^d = kY$
- 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).

Back to the quantity theory of money

- starts with quantity equation
- assumes V is constant & exogenous: $V = \overline{V}$
- With this assumption, the quantity equation can be written as

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

The quantity theory of money, *cont.*

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

How the price level is determined:

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

The quantity theory of money, *cont.*

- *Recall from Chapter 2:*
  The growth rate of a product equals the sum of the growth rates.
- The quantity equation in growth rates:

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

The quantity theory of money assumes

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

The quantity theory of money, *cont.*

π (Greek letter "pi") denotes the inflation rate:

$$\pi = \frac{\Delta P}{P}$$

The result from the preceding slide was:

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

Solve this result for π to get

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

The quantity theory of money, *cont.*

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

- Normal economic growth requires a certain amount of money supply growth to facilitate the growth in transactions.
- Money growth in excess of this amount leads to inflation.

The quantity theory of money, *cont.*

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

$\Delta Y/Y$ depends on growth in the factors of production and on technological progress (all of which we take as given, for now).

Hence, the Quantity Theory predicts a one-for-one relation between changes in the money growth rate and changes in the inflation rate.

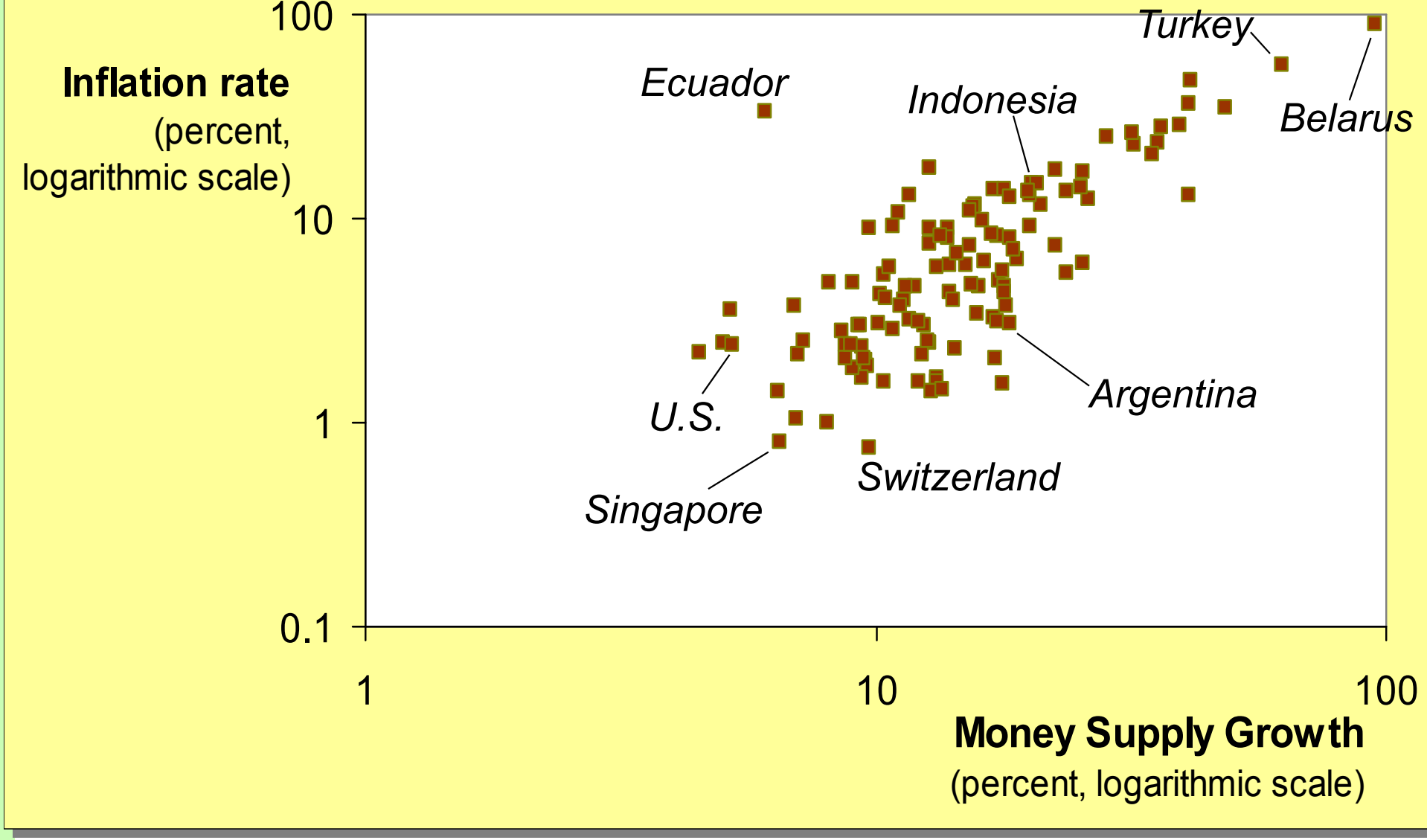
Confronting the quantity theory with data

The quantity theory of money implies

1. countries with higher money growth rates should have higher inflation rates.
2. the long-run trend behavior of a country's inflation should be similar to the long-run trend in the country's money growth rate.

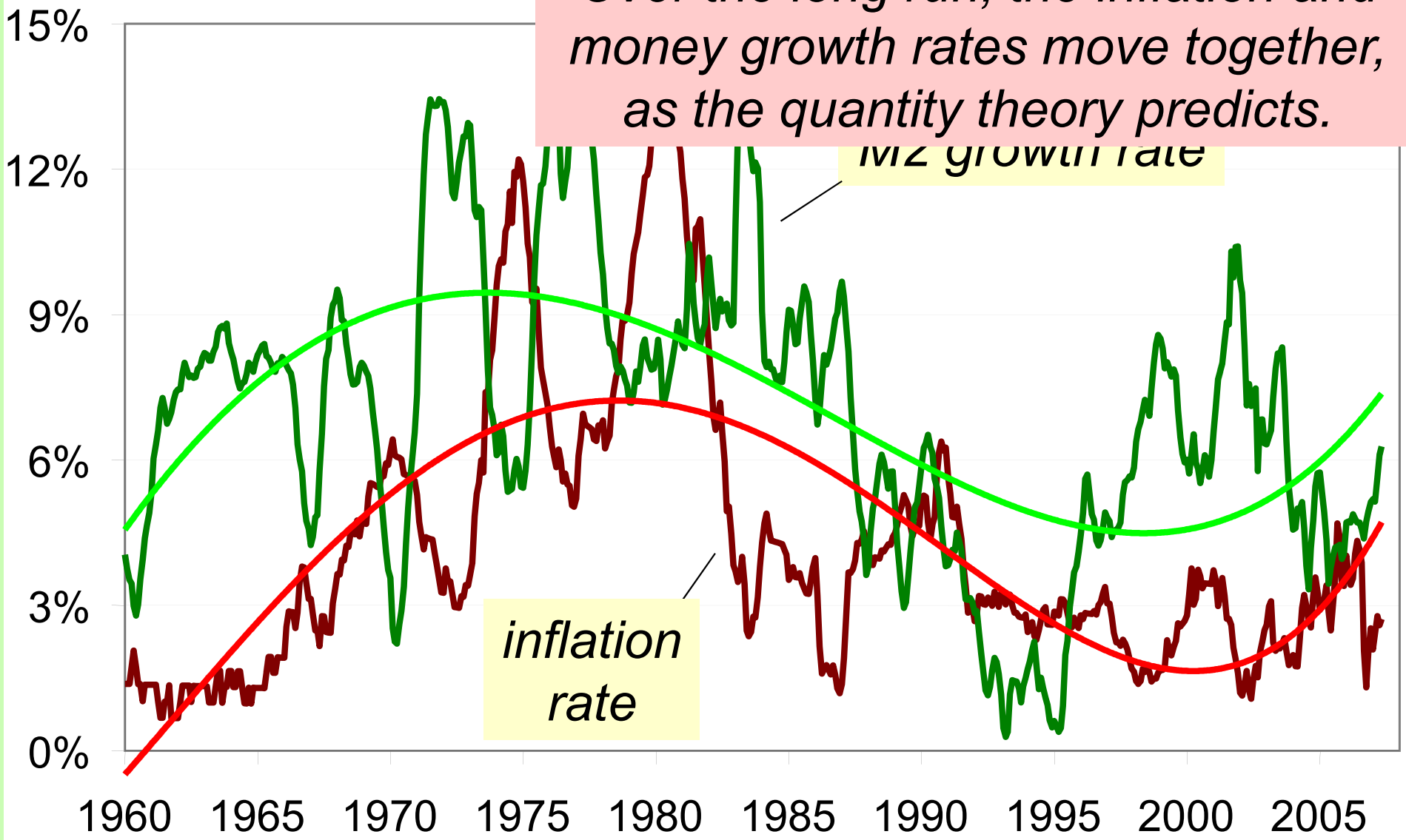
Are the data consistent with these implications?

International data on inflation and money growth



U.S. inflation and money growth, 1960-2007

Over the long run, the inflation and money growth rates move together, as the quantity theory predicts.



Seigniorage

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

Inflation and interest rates

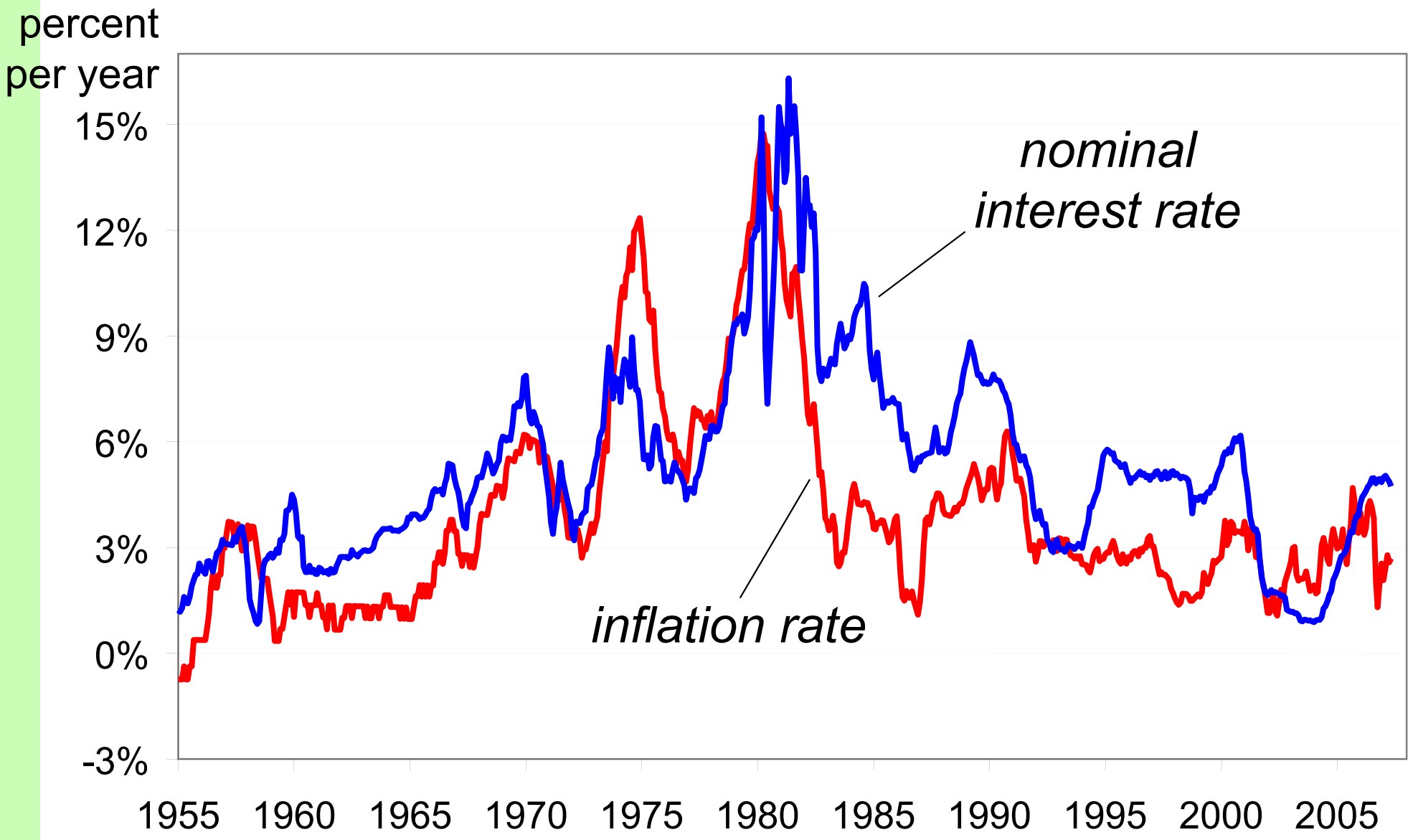
- Nominal interest rate, ***i***
  not adjusted for inflation
- Real interest rate, ***r***
  adjusted for inflation:

$$r = i - \pi$$

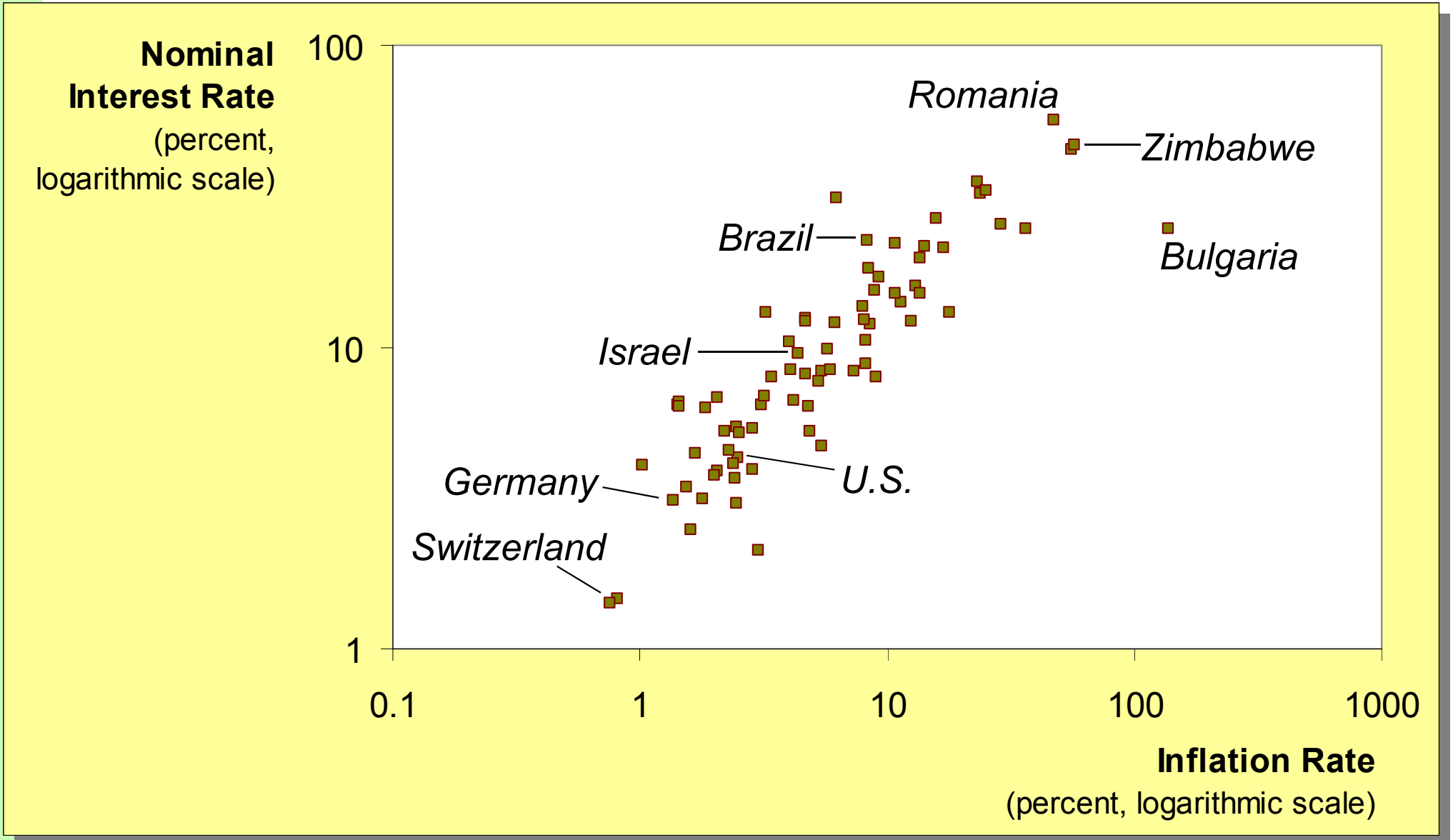
The Fisher effect

- 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**.

Inflation and nominal interest rates in the U.S., 1955-2007



Inflation and nominal interest rates across countries



Exercise:

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

a. Solve for ***i***.

b. If the Fed increases the money growth rate by 2 percentage points per year, find Δi.

c. 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?

Answers:

V is constant, ***M*** grows 5% per year,
Y grows 2% per year, ***r*** = 4.

a. First, find $\pi = 5 - 2 = 3$.

Then, find $i = r + \pi = 4 + 3 = 7$.

b. $\Delta i = 2$, same as the increase in the money growth rate.

c. If the Fed does nothing, $\Delta\pi = 1$.

To prevent inflation from rising,
Fed must reduce the money growth rate by
1 percentage point per year.

Two real interest rates

- π = actual inflation rate
  (not known until after it has occurred)
- π^e = expected inflation rate
- $i - \pi^e$ = ***ex ante*** real interest rate:
  the real interest rate people expect
  at the time they buy a bond or take out a loan
- $i - \pi$ = ***ex post*** real interest rate:
  the real interest rate actually realized

Money demand and the nominal interest rate

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

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.)

The money demand function

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

$$= L(r + \pi^e, Y)$$

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 $r + \pi^e$.

Equilibrium

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

The supply of real money balances

Real money demand

What determines what

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

variable	how determined *(in the long run)*
M	exogenous (the Fed)
r	adjusts to make $S = I$
Y	$\bar{Y} = F(\bar{K}, \bar{L})$
P	adjusts to make $\frac{M}{P} = L(i, Y)$

How *P* responds to ΔM

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

- For given values of ***r***, ***Y***, and π^e, a change in ***M*** causes ***P*** to change by the same percentage – just like in the quantity theory of money.

What about expected inflation?

- Over the long run, people don't consistently over- or under-forecast inflation,

  so $\pi^e = \pi$ on average.

- In the short run, π^e may change when people get new information.

- EX: Fed announces it will increase ***M*** next year. People will expect next year's ***P*** to be higher, so π^e rises.

- This affects ***P*** now, even though ***M*** hasn't changed yet….

How *P* responds to $\Delta\pi^e$

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

- For given values of *r*, *Y*, and *M* ,

$\uparrow \pi^e \Rightarrow \uparrow i$ (the Fisher effect)

$\Rightarrow \downarrow (M/P)^d$

$\Rightarrow \uparrow P$ to make (M/P) fall to re-establish eq'm

Discussion question

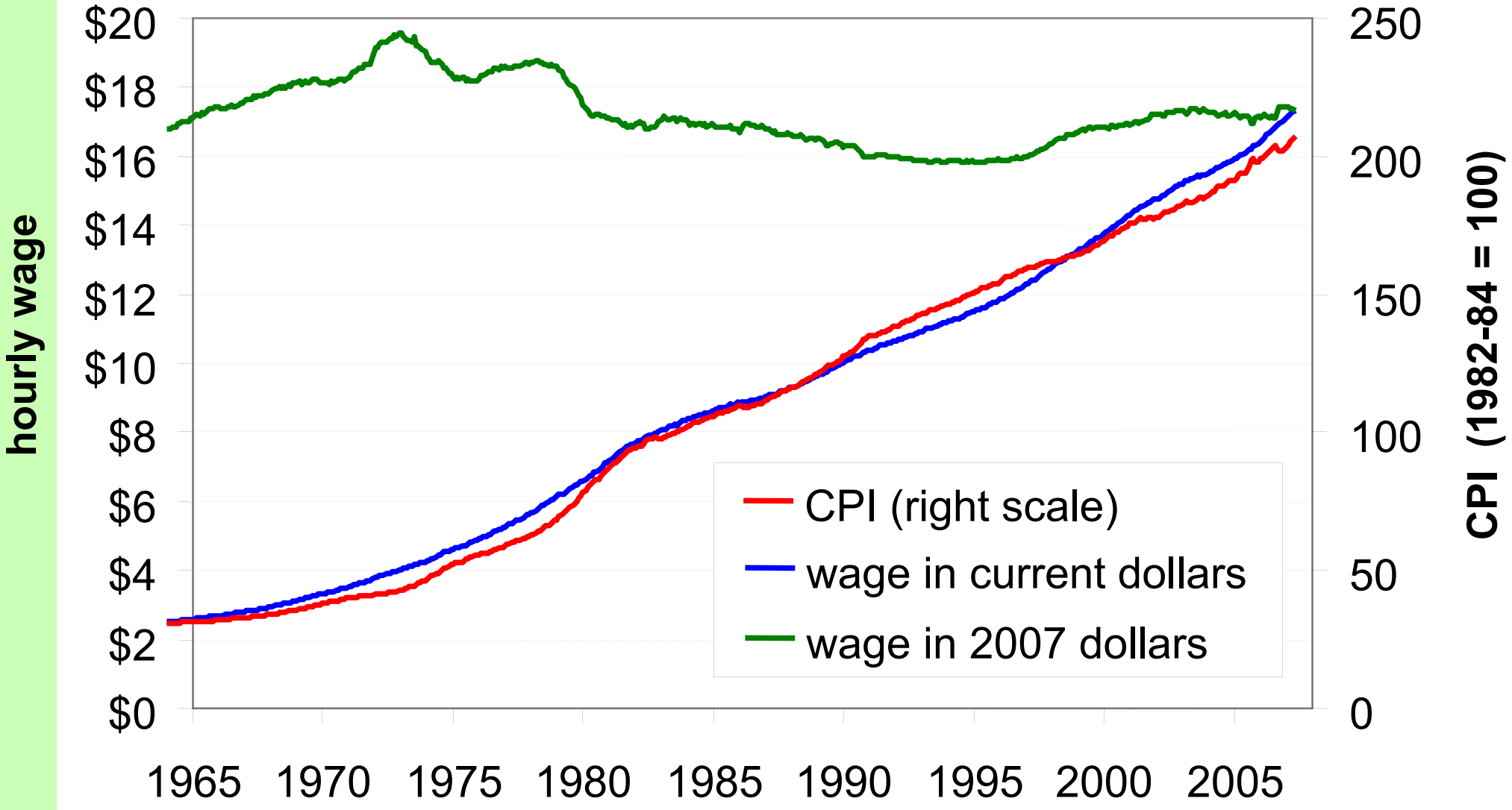
Why is inflation bad?

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

A common misperception

- Common misperception:
  inflation reduces real wages
- This is true only in the short run, when nominal wages are fixed by contracts.
- (Chap. 3) In the long run,
  the real wage is determined by
  labor supply and the marginal product of labor,
  not the price level or inflation rate.
- Consider the data…

Average hourly earnings and the CPI, 1964-2007



The classical view of inflation

- *The classical view:*
  A change in the price level is merely a change in the units of measurement.

So why, then, is inflation a social problem?

The social costs of inflation

…fall into two categories:

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

The costs of expected inflation:
1. Shoeleather cost

- def: the costs and inconveniences of reducing money balances to avoid the inflation tax.
- $\uparrow \pi \Rightarrow \uparrow i$

  $\Rightarrow \downarrow$ real money balances
- Remember: In long run, inflation does not affect real income or real spending.
- So, same monthly spending but lower average money holdings means more frequent trips to the bank to withdraw smaller amounts of cash.

The costs of expected inflation:
2. Menu costs

- def: The costs of changing prices.
- Examples:
  - cost of printing new menus
  - cost of printing & mailing new catalogs
- The higher is inflation, the more frequently firms must change their prices and incur these costs.

The costs of expected inflation: 3. Relative price distortions

- Firms facing menu costs change prices infrequently.
- Example:
  A firm issues new catalog each January.
  As the general price level rises throughout the year, the firm's relative price will fall.
- Different firms change their prices at different times, leading to relative price distortions…

  …causing microeconomic inefficiencies in the allocation of resources.

The costs of expected inflation:
4. Unfair tax treatment

Some taxes are not adjusted to account for inflation, such as the capital gains tax.

Example:

- Jan 1: you buy $10,000 worth of IBM stock
- Dec 31: you sell the stock for $11,000, so your nominal capital gain is $1000 (10%).
- Suppose π = 10% during the year. Your real capital gain is $0.
- But the govt requires you to pay taxes on your $1000 nominal gain!!

The costs of expected inflation:
5. General inconvenience

- Inflation makes it harder to compare nominal values from different time periods.
- This complicates long-range financial planning.

Additional cost of *unexpected* inflation: Arbitrary redistribution of purchasing power

- 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.

Additional cost of 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.

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.

Hyperinflation

- def: $\pi \geq 50\%$ 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.

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.

A few examples of hyperinflation

	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

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.

The Classical Dichotomy

Real variables: Measured in physical units – quantities and relative prices, *for example:*

- quantity of output produced
- real wage: output earned per hour of work
- real interest rate: output earned in the future by lending one unit of output today

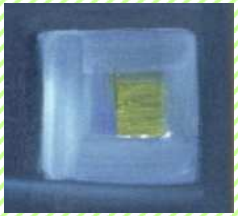
Nominal variables: Measured in money units, *e.g.,*

- nominal wage: Dollars per hour of work.
- nominal interest rate: Dollars earned in future by lending one dollar today.
- the price level: The amount of dollars needed to buy a representative basket of goods.

The Classical Dichotomy

- Note: Real variables were explained in Chap 3, nominal ones 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.

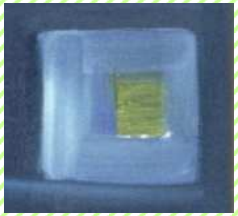


Chapter Summary

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.



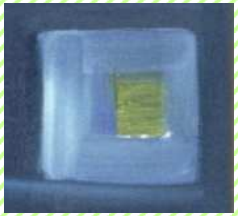
Chapter Summary

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

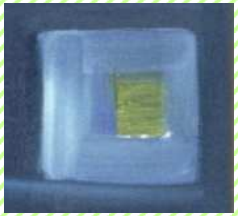
- depends only on income in the Quantity Theory
- also depends on the nominal interest rate
- if so, then changes in expected inflation affect the current price level.



Chapter Summary

Costs of inflation

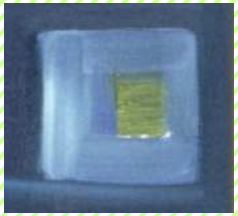
- *Expected inflation*
  shoeleather costs, menu costs,
  tax & relative price distortions,
  inconvenience of correcting figures for inflation
- *Unexpected inflation*
  all of the above plus arbitrary redistributions of wealth between debtors and creditors



Chapter Summary

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

Classical dichotomy

- In classical theory, money is neutral--does not affect real variables.
- So, we can study how real variables are determined w/o reference to nominal ones.
- Then, money market eq'm determines price level and all nominal variables.
- Most economists believe the economy works this way in the long run.

CHAPTER 18

Money Supply and Money Demand

MACROECONOMICS SIXTH EDITION

N. GREGORY MANKIW

PowerPoint® Slides by Ron Cronovich

In this chapter, you will learn…

- how the banking system "creates" money
- three ways the Fed can control the money supply, and why the Fed can't control it precisely
- Theories of money demand
  - a portfolio theory
  - a transactions theory: the Baumol-Tobin model

Banks' role in the money supply

- The money supply equals currency plus demand (checking account) deposits:

$$M = C + D$$

- Since the money supply includes demand deposits, the banking system plays an important role.

A few preliminaries

- **Reserves** (***R***): the portion of deposits that banks have not lent.
- A bank's liabilities include deposits, assets include reserves and outstanding loans.
- **100-percent-reserve banking**: a system in which banks hold all deposits as reserves.
- **Fractional-reserve banking**: a system in which banks hold a fraction of their deposits as reserves.

SCENARIO 1:
No banks

With no banks,

D = 0 and ***M*** = ***C*** = $1000.

SCENARIO 2: 100-percent reserve banking

- Initially C = \$1000, D = \$0, M = \$1,000.
- Now suppose households deposit the \$1,000 at "Firstbank."

FIRSTBANK'S balance sheet

Assets		Liabilities	
reserves	\$1,000	deposits	\$1,000

- After the deposit,
  C = \$0,
  D = \$1,000,
  M = \$1,000.
- 100%-reserve banking has no impact on size of money supply.

SCENARIO 3: Fractional-reserve banking

- Suppose banks hold 20% of deposits in reserve, making loans with the rest.
- Firstbank will make $800 in loans.

FIRSTBANK'S balance sheet

Assets	Liabilities
reserves $200	deposits $1,000
loans $800	

The money supply now equals $1,800:

- Depositor has $1,000 in demand deposits.
- Borrower holds $800 in currency.

SCENARIO 3: Fractional-reserve banking

Thus, in a fractional-reserve banking system, banks create money.

FIRSTBANK'S balance sheet

Assets	Liabilities
reserves $200	deposits $1,000
loans $800	

The money supply now equals $1,800:

- Depositor has $1,000 in demand deposits.
- Borrower holds $800 in currency.

SCENARIO 3: Fractional-reserve banking

- Suppose the borrower deposits the $800 in Secondbank.
- Initially, Secondbank's balance sheet is:

SECONDBANK'S balance sheet

Assets		Liabilities	
reserves	$160	deposits	$800
loans	$640		

- Secondbank will loan 80% of this deposit.

SCENARIO 3: Fractional-reserve banking

- If this $640 is eventually deposited in Thirdbank,
- then Thirdbank will keep 20% of it in reserve, and loan the rest out:

THIRDBANK'S balance sheet

Assets		Liabilities	
reserves	$128	deposits	$640
loans	$512		

Finding the total amount of money:

	Original deposit	= $1000
+	Firstbank lending	= $ 800
+	Secondbank lending	= $ 640
+	Thirdbank lending	= $ 512
+	other lending…	

Total money supply = $(1/rr) \times \$1{,}000$

where ***rr*** = ratio of reserves to deposits

In our example, ***rr*** = 0.2, so ***M*** = $5,000

Money creation in the banking system

A fractional reserve banking system creates money, but it doesn't create wealth:

Bank loans give borrowers some new money and an equal amount of new debt.

A model of the money supply

exogenous variables

- **Monetary base**, $B = C + R$

  controlled by the central bank

- **Reserve-deposit ratio**, $rr = R/D$

  depends on regulations & bank policies

- **Currency-deposit ratio**, $cr = C/D$

  depends on households' preferences

Solving for the money supply:

$$M = C + D = \frac{C + D}{B} \times B = m \times B$$

where

$$m = \frac{C + D}{B}$$

$$= \frac{C + D}{C + R} = \frac{(C/D) + (D/D)}{(C/D) + (R/D)} = \frac{cr + 1}{cr + rr}$$

The money multiplier

$$M = m \times B, \quad \text{where} \quad m = \frac{cr + 1}{cr + rr}$$

- If $rr < 1$, then $m > 1$
- If monetary base changes by ΔB, then $\Delta M = m \times \Delta B$
- m is the **money multiplier**, the increase in the money supply resulting from a one-dollar increase in the monetary base.

Exercise

$$M = m \times B, \quad \text{where} \quad m = \frac{cr + 1}{cr + rr}$$

Suppose households decide to hold more of their money as currency and less in the form of demand deposits.

1. Determine impact on money supply.
2. Explain the intuition for your result.

Solution to exercise

Impact of an increase in the currency-deposit ratio $\Delta cr > 0$.

1. An increase in ***cr*** increases the denominator of ***m*** proportionally more than the numerator. So ***m*** falls, causing ***M*** to fall.

2. If households deposit less of their money, then banks can't make as many loans, so the banking system won't be able to "create" as much money.

Three instruments of monetary policy

1. Open-market operations
2. Reserve requirements
3. The discount rate

Open-market operations

- *definition:*
  The purchase or sale of government bonds by the Federal Reserve.
- *how it works:*
  If Fed buys bonds from the public,
  it pays with new dollars, increasing ***B*** and therefore ***M***.

Reserve requirements

- *definition:*
  Fed regulations that require banks to hold a minimum reserve-deposit ratio.
- *how it works:*
  Reserve requirements affect ***rr*** and ***m***:
  If Fed reduces reserve requirements,
  then banks can make more loans and
  "create" more money from each deposit.

The discount rate

- *definition:*
  The interest rate that the Fed charges on loans it makes to banks.
- *how it works:*
  When banks borrow from the Fed, their reserves increase, allowing them to make more loans and "create" more money.

  The Fed can increase ***B*** by lowering the discount rate to induce banks to borrow more reserves from the Fed.

Which instrument is used most often?

- Open-market operations:
  most frequently used.
- Changes in reserve requirements:
  least frequently used.
- Changes in the discount rate:
  largely symbolic.
  The Fed is a "lender of last resort,"
  does not usually make loans to banks
  on demand.

Why the Fed can't precisely control *M*

$$M = m \times B, \quad \text{where} \quad m = \frac{cr + 1}{cr + rr}$$

- Households can change ***cr***, causing ***m*** and ***M*** to change.
- Banks often hold **excess reserves** (reserves above the reserve requirement). If banks change their excess reserves, then ***rr***, ***m***, and ***M*** change.

CASE STUDY:
Bank failures in the 1930s

- From 1929 to 1933,
  - Over 9,000 banks closed.
  - Money supply fell 28%.
- This drop in the money supply may have caused the Great Depression.

  It certainly contributed to the severity of the Depression.

CASE STUDY:
Bank failures in the 1930s

$$M = m \times B, \quad \text{where} \quad m = \frac{cr + 1}{cr + rr}$$

- Loss of confidence in banks
  $\Rightarrow \uparrow cr \Rightarrow \downarrow m$
- Banks became more cautious
  $\Rightarrow \uparrow rr \Rightarrow \downarrow m$

CASE STUDY:
Bank failures in the 1930s

	August 1929	*March 1933*	*% change*
M	26.5	19.0	–28.3%
C	3.9	5.5	41.0
D	22.6	13.5	–40.3
B	7.1	8.4	18.3
C	3.9	5.5	41.0
R	3.2	2.9	–9.4
m	3.7	2.3	–37.8
rr	0.14	0.21	50.0
cr	0.17	0.41	141.2

Could this happen again?

- Many policies have been implemented since the 1930s to prevent such widespread bank failures.
- *E.g.*, Federal Deposit Insurance,
  to prevent bank runs and large swings in the currency-deposit ratio.

Money Demand

Two types of theories

- Portfolio theories
  - emphasize "store of value" function
  - relevant for *M*2, *M*3
  - not relevant for *M*1. (As a store of value, *M*1 is dominated by other assets.)
- Transactions theories
  - emphasize "medium of exchange" function
  - also relevant for *M*1

A simple portfolio theory

$$(M/P)^d = L(r_s, r_b, \pi^e, W),$$

(signs: r_s −, r_b −, π^e −, W +)

where

r_s = expected real return on stocks

r_b = expected real return on bonds

π^e = expected inflation rate

W = real wealth

The Baumol-Tobin Model

- a transactions theory of money demand
- notation:

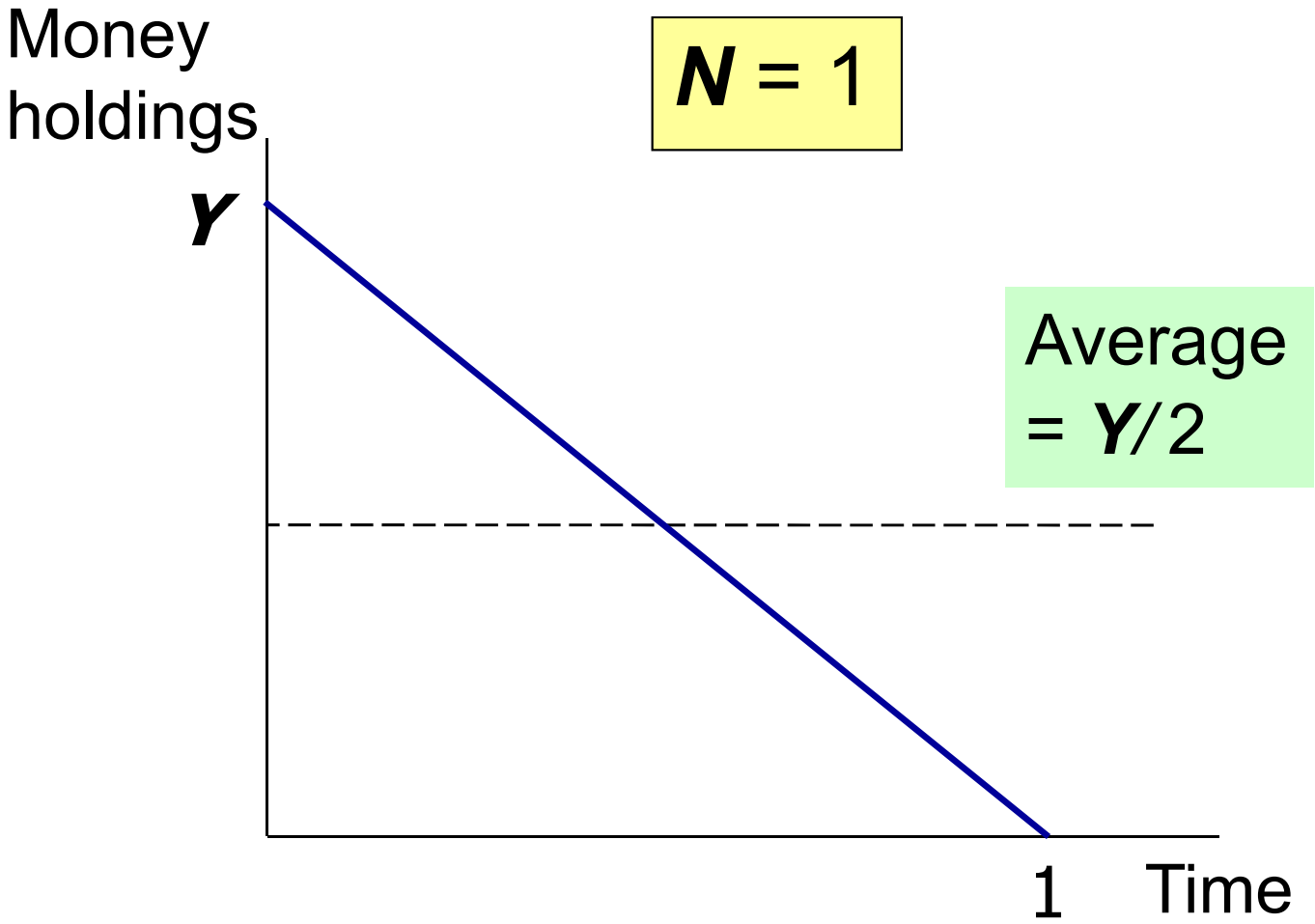
  Y = total spending, done gradually over the year

  i = interest rate on savings account

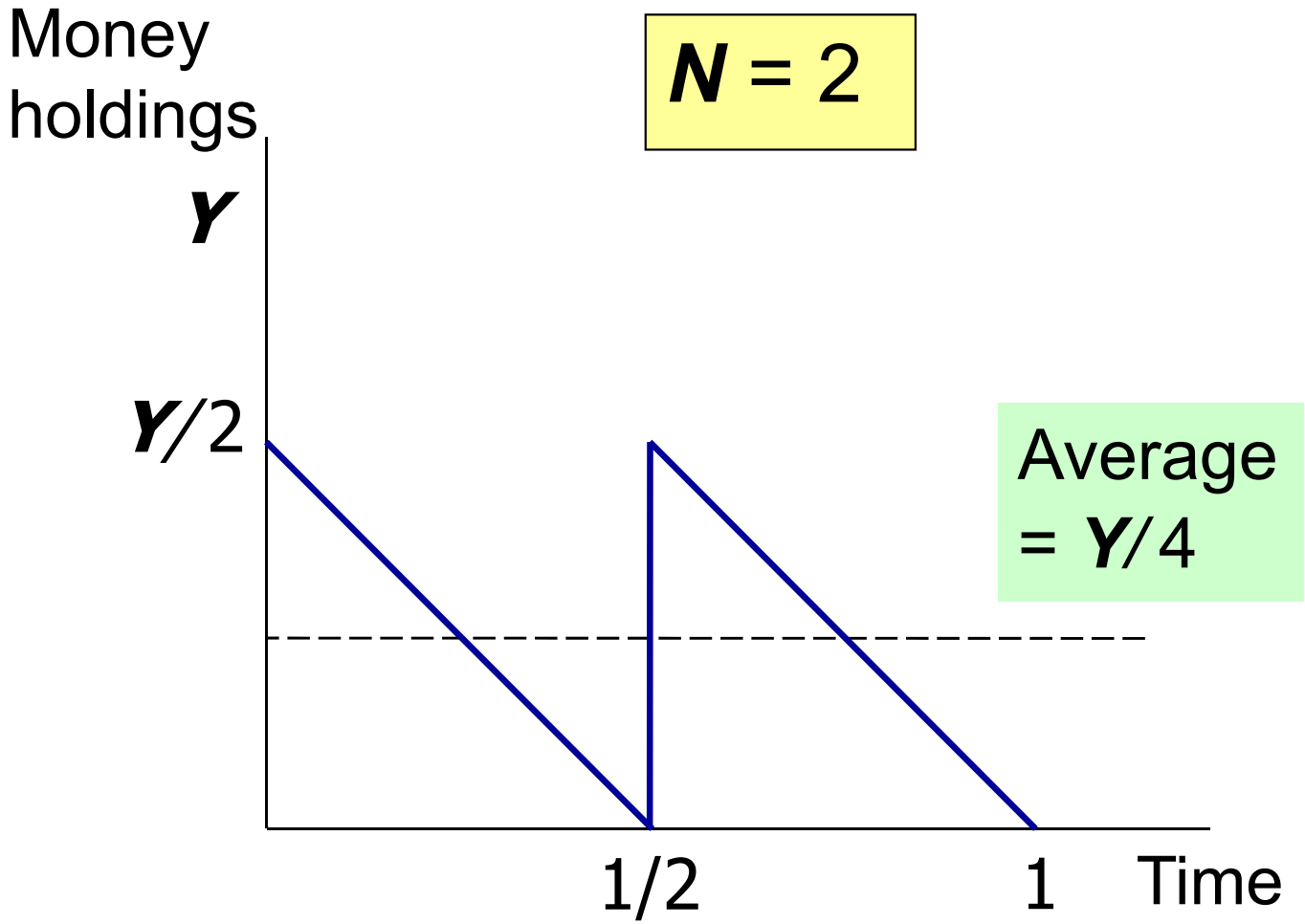
  N = number of trips consumer makes to the bank to withdraw money from savings account

  F = cost of a trip to the bank
  (*e.g.*, if a trip takes 15 minutes and consumer's wage = \$12/hour, then ***F*** = \$3)

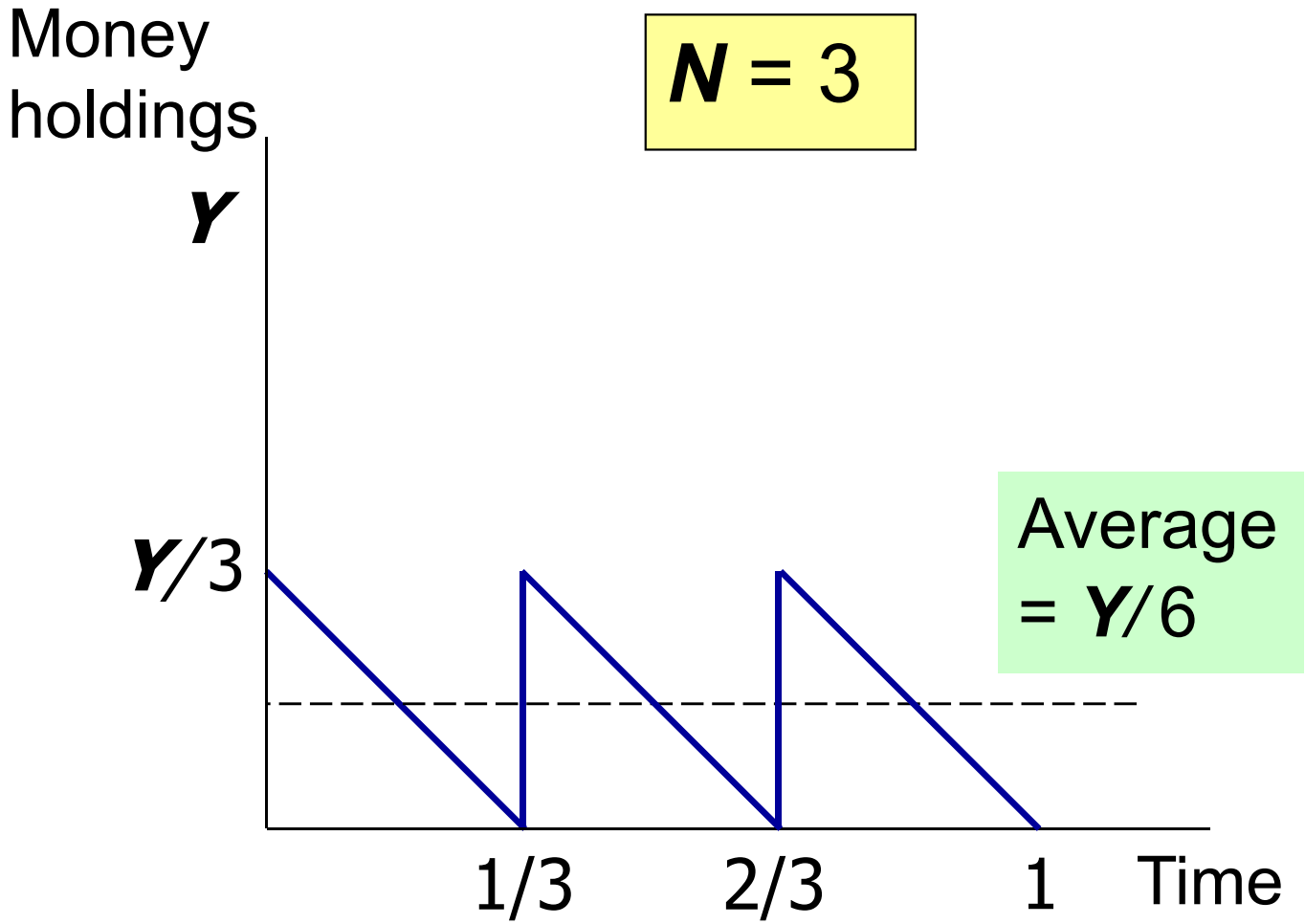
Money holdings over the year



Money holdings over the year



Money holdings over the year



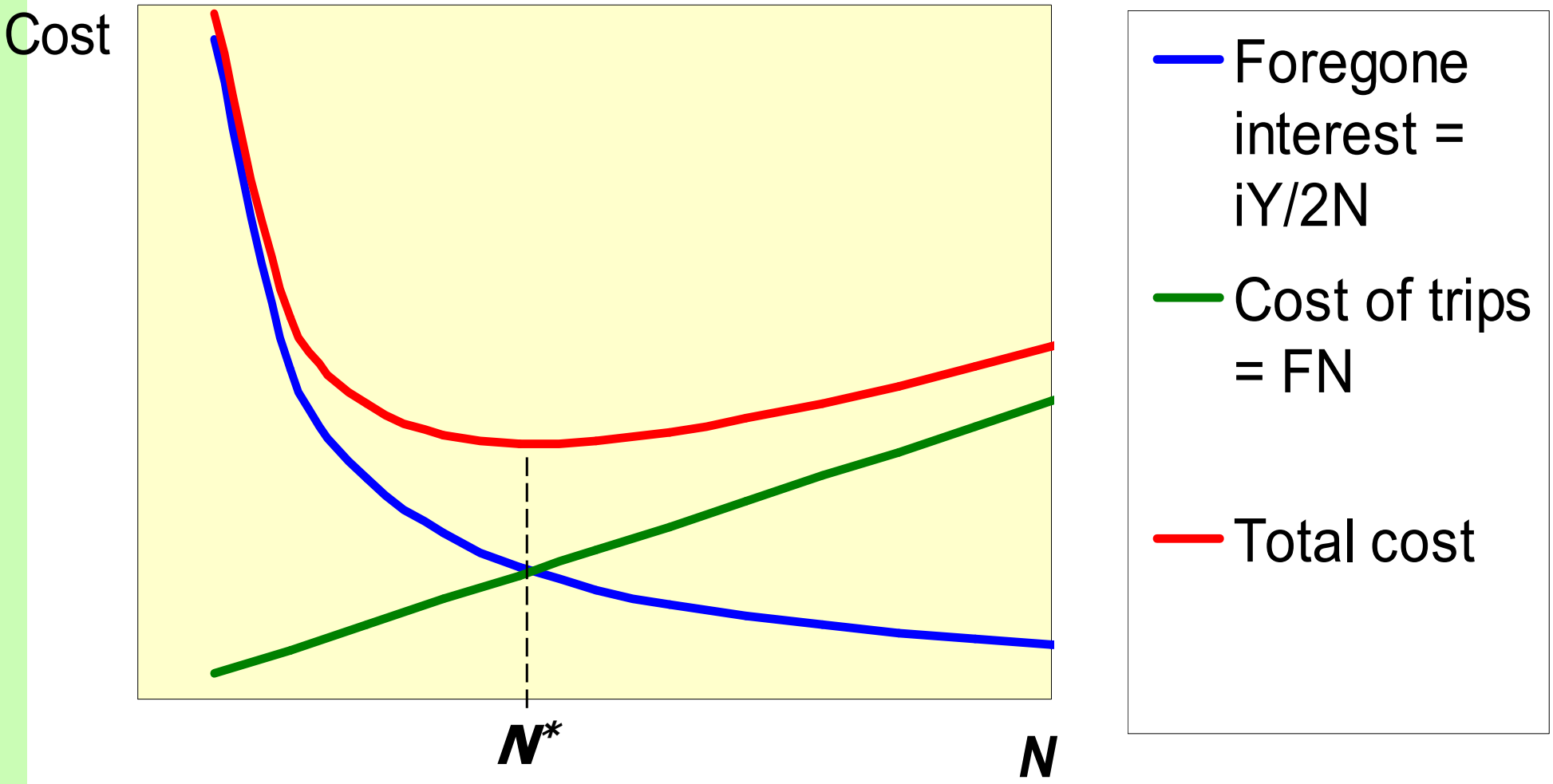
The cost of holding money

- In general, average money holdings = $Y/2N$
- Foregone interest = $i \times (Y/2N)$
- Cost of N trips to bank = $F \times N$
- Thus,

$$\text{total cost} = i \times \frac{Y}{2N} + F \times N$$

- Given Y, i, and F,
  consumer chooses N to minimize total cost

Finding the cost-minimizing *N*



Finding the cost-minimizing *N*

$$\text{total cost} = i \times \frac{Y}{2N} + F \times N$$

- Take the derivative of total cost with respect to ***N***, set it equal to zero:

$$-\frac{iY}{2N^2} + F = 0$$

- Solve for the cost-minimizing ***N****

$$N^* = \sqrt{\frac{iY}{2F}}$$

The money demand function

- The cost-minimizing value of N : $N^* = \sqrt{\frac{iY}{2F}}$
- To obtain the money demand function, plug N^* into the expression for average money holdings:

$$\text{average money holding} = \sqrt{\frac{YF}{2i}}$$

- Money demand depends positively on Y and F, and negatively on i.

The money demand function

- The Baumol-Tobin money demand function:

$$(M/P)^d = \sqrt{\frac{YF}{2i}} = L(i, Y, F)$$

How this money demand function differs from previous chapters:

- B-T shows how F affects money demand.
- B-T implies:
  income elasticity of money demand = 0.5,
  interest rate elasticity of money demand = –0.5

EXERCISE:
The impact of ATMs on money demand

During the 1980s, automatic teller machines became widely available.

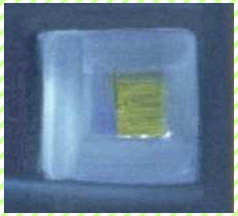
How do you think this affected ***N**** and money demand? Explain.

Financial Innovation, Near Money, and the Demise of the Monetary Aggregates

- Examples of financial innovation:
  - many checking accounts now pay interest
  - very easy to buy and sell assets
  - mutual funds are baskets of stocks that are easy to redeem - just write a check
- Non-monetary assets having some of the liquidity of money are called near money.
- Money & near money are close substitutes, and switching from one to the other is easy.

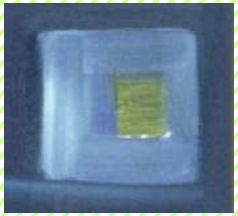
Financial Innovation, Near Money, and the Demise of the Monetary Aggregates

- The rise of near money makes money demand less stable and complicates monetary policy.
- 1993: the Fed switched from targeting monetary aggregates to targeting the Federal Funds rate.
- This change may help explain why the U.S. economy was so stable during the rest of the 1990s.



Chapter Summary

1. Fractional reserve banking creates money because each dollar of reserves generates many dollars of demand deposits.
2. The money supply depends on the
   - monetary base
   - currency-deposit ratio
   - reserve ratio
3. The Fed can control the money supply with
   - open market operations
   - the reserve requirement
   - the discount rate



Chapter Summary

4. Portfolio theories of money demand
   - stress the store of value function
   - posit that money demand depends on risk/return of money & alternative assets
5. The Baumol-Tobin model
   - a transactions theory of money demand, stresses “medium of exchange” function
   - money demand depends positively on spending, negatively on the interest rate, and positively on the cost of converting non-monetary assets to money