University of Warwick

Macroeconomics 1 (EC108)

Lecture 1

Introduction to Macroeconomics: Some Definitions

Lecturer: Natalie Chen

Some Definitions

- The words
  - **Output**
  - **Unemployment**
  - **Inflation**

    appear daily in newspapers and in the news

- In this lecture, we define these concepts more precisely

Aggregate Output

- National income and product accounts were developed at the end of World War II as measures of aggregate output

- The measure of **aggregate output** is called **Gross Domestic Product** (**GDP**)

- How would you define aggregate output in the economy?

Aggregate Output: Example

Steel Company (Firm 1)			**Car Company (Firm 2)**		
Revenues from sales		$100	Revenues from sales		$200
Expenses		$80	Expenses		$170
Wages	$80		Wages	$70	
			Steel purchases	$100	
Profit		$20	Profit		$30

Source: Blanchard (2017)

- Consider an economy with two firms, Firm 1 and Firm 2
- Is aggregate output the sum of the values of all goods produced, i.e., $300? Or just the value of cars, i.e., $200?
- Steel is an **intermediate good**, which is a good used in the production of another good

Aggregate Output

There are three ways of defining GDP

1. GDP is the value of **final** goods and services produced in the economy during a given period

- We want to count only final goods, not intermediate goods
- If we merge the two firms in the previous example, the revenues of the new firm equal $200

Steel and Car Company	
Revenues from sales	$200
Expenses (wages)	$150
Profit	$50

Source: Blanchard (2017)

Aggregate Output

2. **GDP** is the sum of **value added** in the economy during a given period

- The **value added** by a firm is the value of its production minus the value of the intermediate goods used in production
- In the two-firm example, the value added equals $\$100 + \$100 = \$200$

Steel Company (Firm 1)			Car Company (Firm 2)		
Revenues from sales		\$100	Revenues from sales		\$200
Expenses		\$80	Expenses		\$170
Wages	\$80		Wages	\$70	
			Steel purchases	\$100	
Profit		\$20	Profit		\$30

Source: Blanchard (2017)

So far, we have looked at GDP from the production side

Aggregate Output

3. GDP is the sum of incomes in the economy during a given period

- Aggregate production and aggregate income are always equal
- From the **income side**, valued added in the two-firm example is equal to the sum of *labor income* ($150) and *capital* or *profit income* ($50), i.e., $200

Steel Company (Firm 1)			Car Company (Firm 2)		
Revenues from sales		$100	Revenues from sales		$200
Expenses		$80	Expenses		$170
Wages	$80		Wages	$70	
			Steel purchases	$100	
Profit		$20	Profit		$30

Source: Blanchard (2017)

Aggregate Output

- **Nominal GDP** is the sum of the quantities of final goods produced times their current price
- Nominal GDP increases for two reasons
  - The production of most goods increases
  - The price of most goods increases
- Our goal is to measure **production** and its change over time
- **Real GDP** is the sum of quantities of final goods times constant (not current) prices

Aggregate Output: Example

Year	Quantity of cars	Price of cars	Nominal GDP	Real GDP (in 2009 dollars)
2008	10	\$20,000	\$200,000	\$240,000
2009	12	\$24,000	\$288,000	\$288,000
2010	13	\$26,000	\$338,000	\$312,000

Source: Blanchard (2017)

- Real GDP in 2008 (in 2009 dollars) = 10 cars x \$24,000 per car = \$240,000
- Real GDP in 2009 (in 2009 dollars) = 12 cars x \$24,000 per car = \$288,000
- Real GDP in 2010 (in 2009 dollars) = 13 cars x \$24,000 per car = \$312,000

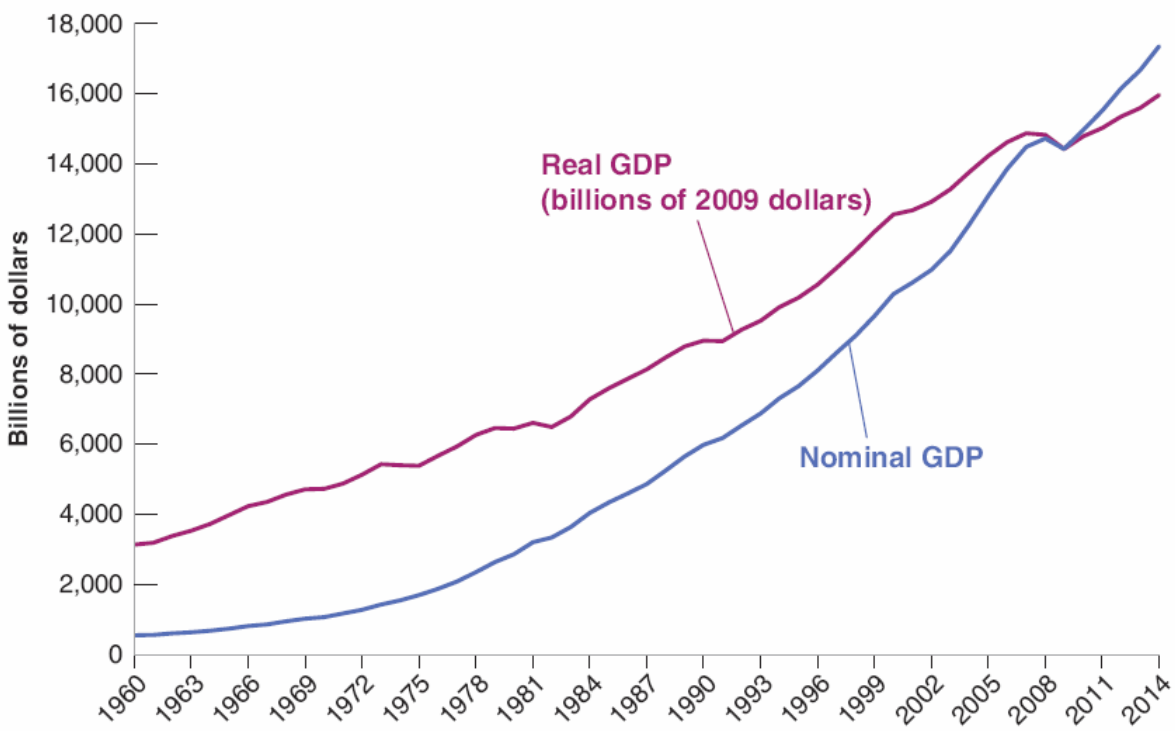
Aggregate Output

- For more than one good, relative prices of the goods are natural weights for construction of the weighted average of the output of all final goods

- **Real GDP in chained (2009) dollars** reflects relative prices that change over time

- The year used to construct prices is called the **base year**

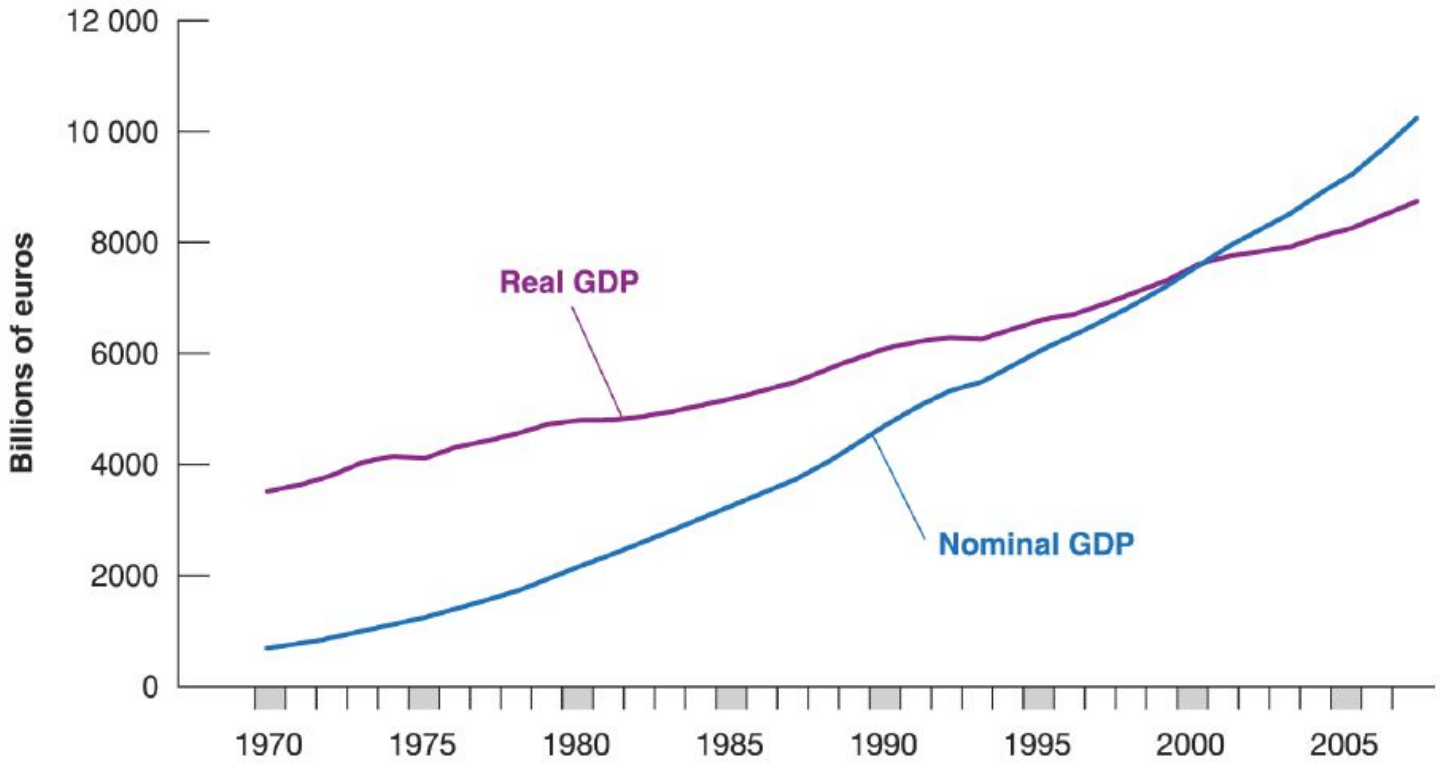
Aggregate Output



Nominal and Real US GDP, 1960–2014 (Blanchard, 2017)

From 1960 and 2014, nominal GDP increased by a factor of 32. Real GDP increased by a factor of about 5

Aggregate Output



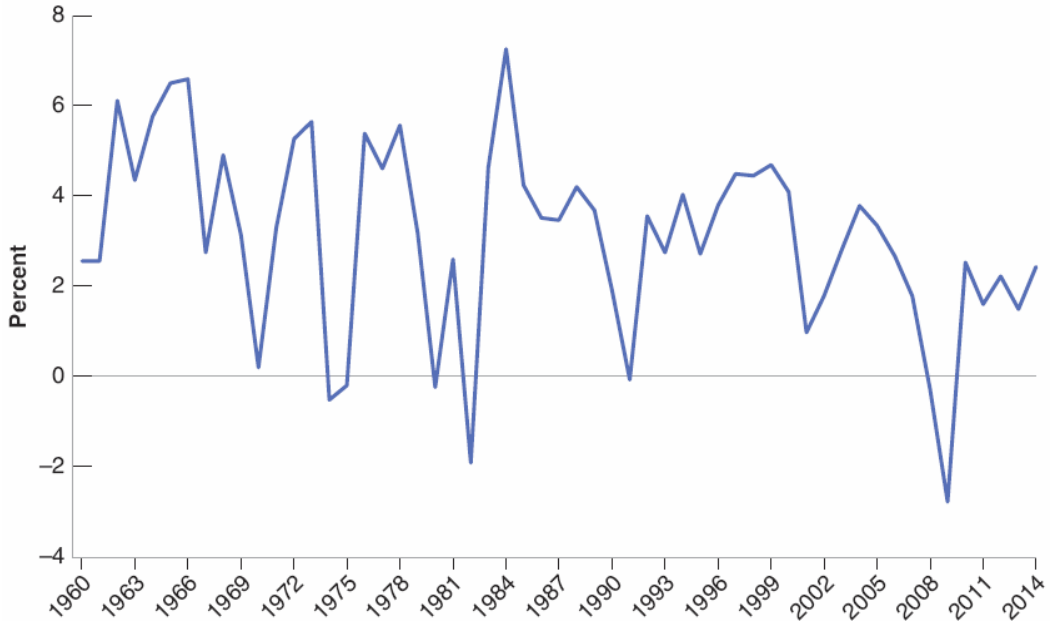
Nominal and real GDP in the EU15 since 1970 (Blanchard et al., 2013)

Since 1970, nominal GDP in the EU15 increased by a factor of 14. Real GDP increased by a factor of 2.5

Aggregate Output

- Nominal GDP is also called **dollar GDP**, or **GDP in current dollars**
- Real GDP is also called **GDP in terms of goods**, **GDP in constant dollars**, **GDP adjusted for inflation**, **GDP in chained (2009) dollars**, or **GDP in 2009 dollars**
- Y_t will denote real GDP in year t
- Nominal GDP and variables in current dollars will be denoted by a dollar sign in front of them, e.g., $\$Y_t$

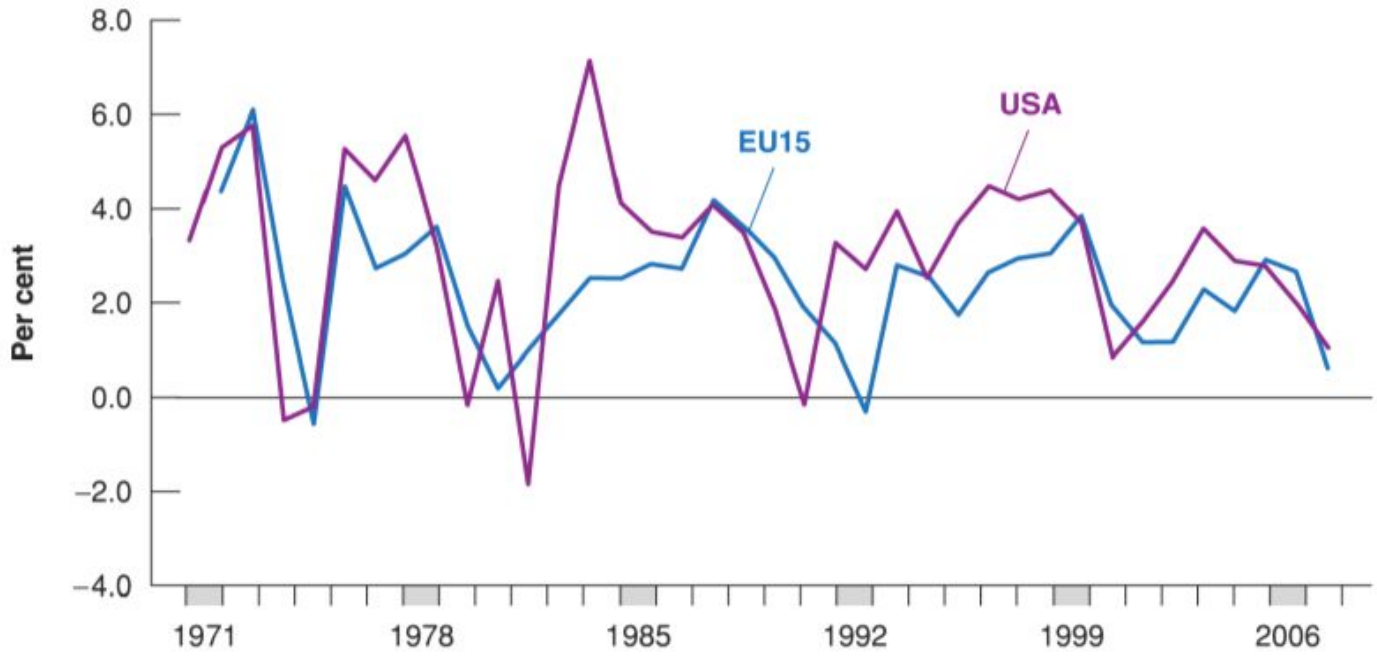
Aggregate Output



Growth Rate of US Real GDP, 1960–2014 (Blanchard, 2017)

- (Real) GDP growth in year t is $(Y_t - Y_{t-1})/Y_{t-1}$
- Since 1960, the US economy has gone through a series of expansions, interrupted by short recessions. The 2008–2009 recession was the most severe recession in the period from 1960 to 2014

Aggregate Output



Growth rates of GDP in the EU15 and the US since 1970 (Blanchard et al., 2013)

Since 1970, both the EU15 and the US economies have gone through a series of expansions, interrupted by short recessions

Measuring GDP is Difficult

1. The quality of products is changing over time

- A tough problem in computing real GDP is how to deal with changes in the quality of existing goods. One of the most difficult cases is computers
- The approach used to adjust for improvements is to look at how the market values computers with different characteristics in a given year
- This approach, which treats goods as providing a collection of characteristics – here speed, memory and so on – each with an implicit price, is called **hedonic pricing**
- The quality of new laptops has increased on average by 18% a year since 1995, while their dollar price has declined by about 7% a year

Measuring GDP is Difficult

2. **New products are a headache** (many new services are given for free)

   - The price for services from Facebook, YouTube, Wikipedia, Google is practically zero
   - Think about Skype. It makes long-distance phone calls free, but this implies a reduction in measured GDP

3. **Measuring illegal production is difficult**

   - Many activities may be legal in some countries but illegal in others (e.g., prostitution, drugs)

4. **Home production is normally excluded from GDP**

   - Only housing services are included

Other Macroeconomic Variables

Because it is a measure of aggregate activity, GDP is obviously the most important macroeconomic variable. But two other variables tell us about other important aspects of how an economy is performing

- Unemployment
- Inflation

The Unemployment Rate

- **Employment** is the number of people who have a job
- **Unemployment** is the number of people who do not have a job but are looking for one
- The **labor force** is the sum of employment and unemployment

$$\begin{aligned} L &= N + U \\ Labor\ force &= Employment + Unemployment \end{aligned}$$

- The **unemployment rate** is the ratio of the number of people who are unemployed to the number of people in the labor force

$$\begin{aligned} u &= \frac{U}{L} \\ Unemployment\ rate &= Unemployment/Labor\ force \end{aligned}$$

The Unemployment Rate

- Most rich countries rely on large surveys of households to compute the unemployment rate
- The **US Current Population Survey (CPS)** relies on interviews of 60,000 households every month
- A person is unemployed if he or she does not have a job and has been looking for a job in the last four weeks
- Those who do not have a job and are not looking for one are counted as **not in the labor force**

The Unemployment Rate

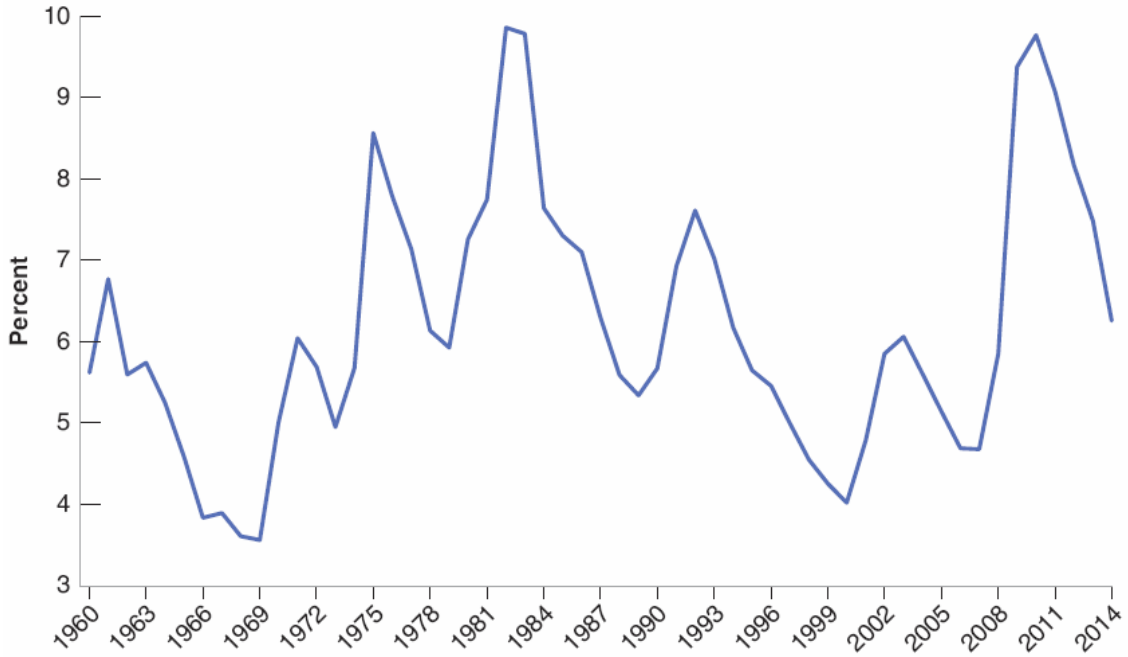
- **Discouraged workers** are those who give up looking for a job and so are no longer counted as unemployed

- The **participation rate** is the ratio of the labor force to the total population of working age

The Unemployment Rate

- Why Do Economists Care about Unemployment?
  - Direct effect on the welfare of the unemployed, especially those remaining unemployed for long periods of time
  - A signal that the economy is not using its human resources efficiently
- Very low unemployment can also be a problem as the economy runs into labor shortages

The Unemployment Rate

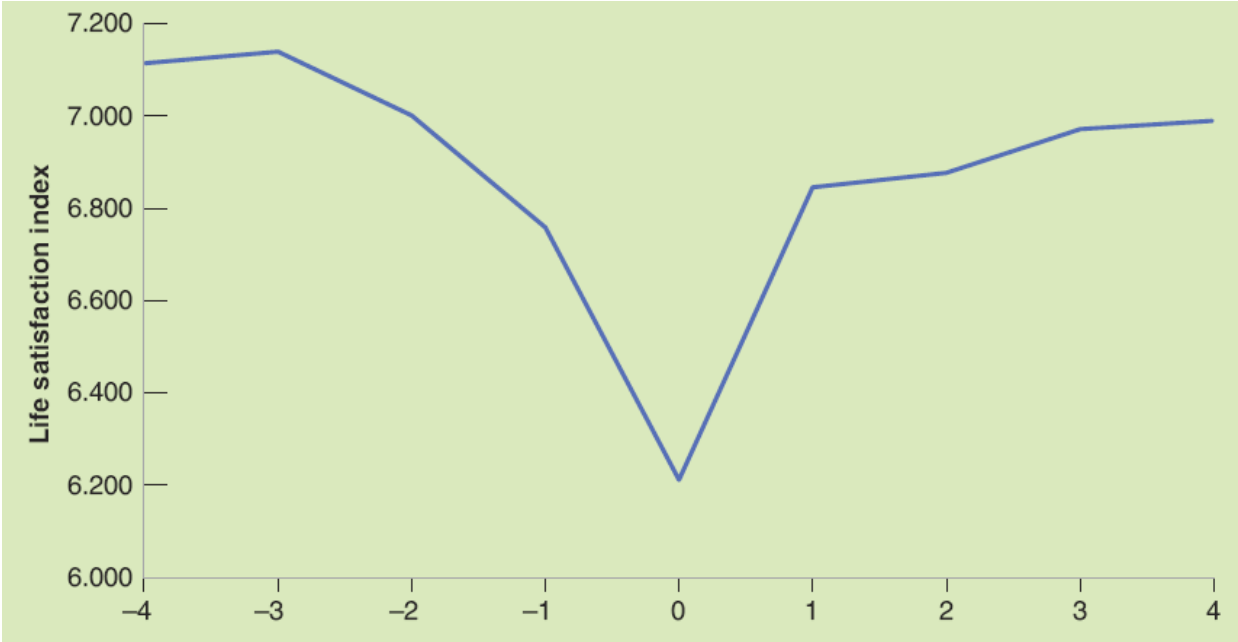


US Unemployment Rate, 1960-2014 (Blanchard, 2017)

- Since 1960, the US unemployment rate has fluctuated between 3 and 10%, going down during expansions and going up during recessions
- The effect of the recent crisis is highly visible, with the unemployment rate reaching close to 10% in 2010, the highest such rate since the early 1980s

Unemployment and Happiness

Results of the German Socio-Economic Panel survey suggest that (1) becoming unemployed leads to a large decrease in happiness, (2) happiness declines before the actual unemployment spell, and (3) happiness does not fully recover even four years later



Effects of Unemployment on Happiness (Blanchard, 2017)

The Inflation Rate

- **Inflation** is a sustained rise in the general level of prices – the **price level**
- The **inflation rate** is the rate at which the price level increases
- **Deflation** is a sustained decline in the price level (negative inflation rate)

The Inflation Rate

- The **GDP deflator** in year t (P_t) is the ratio of nominal GDP to real GDP in year t

$$P_t = \frac{Nominal\ GDP_t}{Real\ GDP_t} = \frac{\$Y_t}{Y_t}$$

- It is called an **index number** (1 in 2009), which has no economic interpretation

- The rate of change has a clear interpretation: the rate of inflation

$$\pi_t = \frac{(P_t - P_{t-1})}{P_{t-1}}$$

The Inflation Rate

- Defining the price level as the GDP deflator implies a simple relation between nominal GDP, real GDP, and the GDP deflator

$$\$Y_t = P_t Y_t$$

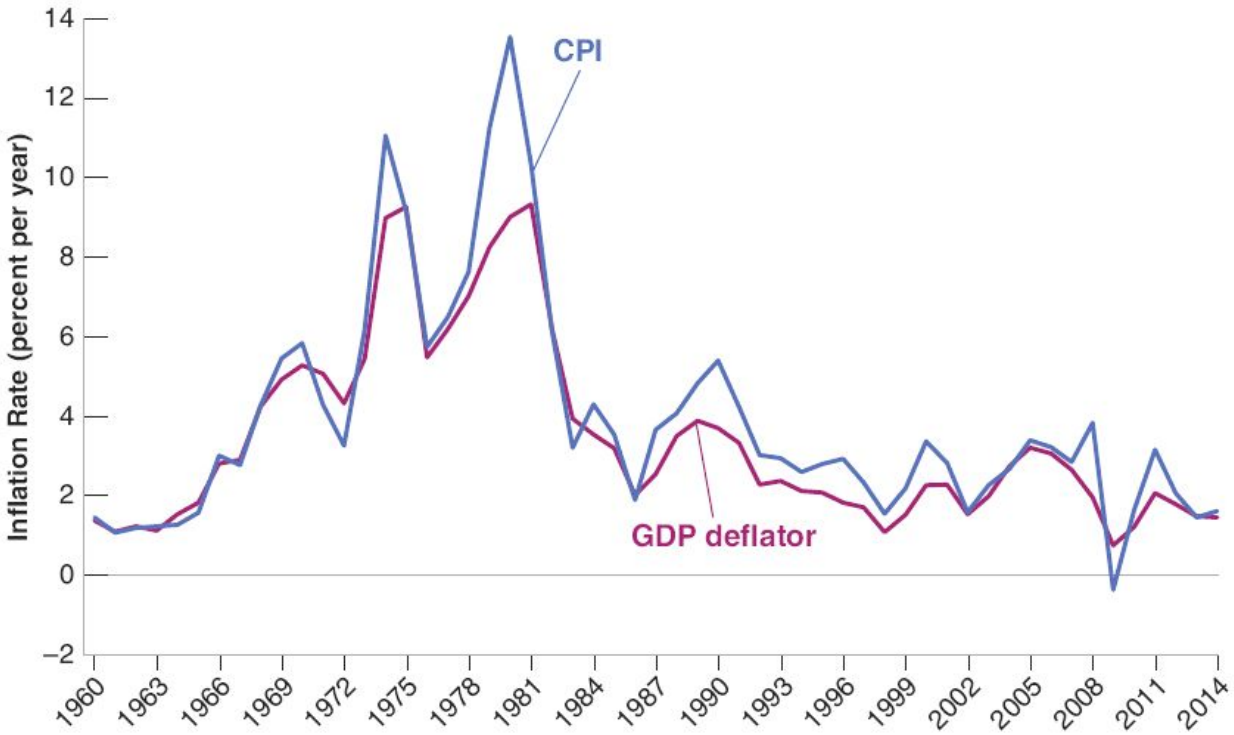
- *Nominal GDP is equal to the GDP deflator times real GDP*

- The rate of growth of nominal GDP is equal to the rate of inflation plus the rate of growth of real GDP

The Inflation Rate

- The set of goods produced in the economy is not the same as the set of goods purchased by consumers because
  - Some of the goods in GDP are sold not to consumers but to firms, to the government, or to foreigners
  - Some of the goods bought by consumers are not produced domestically but are imported from abroad
- The **Consumer Price Index (CPI)** is a measure of the **cost of living** (and of the cost of the **consumption basket** of a typical consumer)
- The CPI is published monthly by the Bureau of Labor Statistics (BLS), which collects price data for 211 items in 38 cities
- The CPI gives the cost in dollars of a specific list of goods and services over time

The Inflation Rate



Inflation Rate, based on the CPI and GDP Deflator (Blanchard, 2017)

The inflation rates, computed using either the CPI or the GDP deflator, are largely similar

The Inflation Rate

- The CPI and GDP deflator moved together most of the time

- Exception: in 1979 and 1980, the increase in the CPI was significantly larger than the increase in the GDP deflator due to the price of imported goods increasing relative to the price of domestically produced goods

The Inflation Rate

- Why Do Economists Care about Inflation?
  - Inflation affects income distribution when not all prices and wages rise proportionally
  - Inflation leads to distortions due to uncertainty, and because of its interaction with taxation (*bracket creep* in taxes)
- Most economists believe the "best" rate of inflation to be a low and stable rate of inflation between 1 and 4%

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Lecture 2

The Goods Market

Lecturer: Natalie Chen

The Goods Market: Outline

- The Composition of GDP
- The Demand for Goods
- The Determination of Equilibrium Output
- Investment Equals Saving

The Goods Market

When economists think about year-to-year movements in economic activity, they focus on the interactions among production, income, and demand

- Changes in the demand for goods lead to changes in production
- Changes in production lead to changes in income
- Changes in income lead to changes in the demand for goods

If we want to understand what determines the demand for goods it makes sense to decompose GDP from the point of view of the different buyers of these goods

The Composition of GDP

- **Consumption** (C): goods and services purchased by consumers
- **Investment** (I) or *fixed investment*: the sum of nonresidential investment and residential investment
- **Government spending** (G): purchases of goods and services by the federal, state, and local governments; excluding **government transfers**
- **Exports** (X): purchases of US goods and services by foreigners
- **Imports** (IM): purchases of foreign goods and services by US consumers, US firms and the US government
- **Net exports** or **trade balance**: $X - IM$
  - Exports $>$ Imports $\Longleftrightarrow$ trade surplus
  - Imports $>$ Exports $\Longleftrightarrow$ trade deficit
- Inventory investment: difference between production and sales

The Composition of GDP

		Billions of Dollars	Percent of GDP
	GDP (*Y*)	17,348	100.0
1	Consumption (*C*)	11,865	68.3
2	Investment (*I*)	2,782	16.0
	Nonresidential	2,233	12.9
	Residential	549	3.1
3	Government spending (*G*)	3,152	18.1
4	Net exports	–530	–3.1
	Exports (*X*)	2,341	13.5
	Imports (*IM*)	–2,871	–16.6
5	Inventory investment	77	0.4

Source: Survey of Current Business, July 2015, Table 1-1-5

The Composition of US GDP, 2014 (Blanchard, 2017)

The Demand for Goods

$$Z \equiv C + I + G + X - IM$$

The above identity defines the total demand for goods (Z) as consumption, plus investment, plus government spending, plus exports, minus imports

In a closed economy ($X = IM = 0$)

$$Z \equiv C + I + G$$

The symbol "$\equiv$" means that an equation is an **identity**, or definition

The Demand for Goods

- Consumption (C) is a function of disposable income (Y_D), which is the income that remains once consumers have received government transfers and paid their taxes

$$C = C(\underset{(+)}{Y_D}) \tag{1}$$

- $C(Y_D)$ is called the **consumption function**
- This is a **behavioral equation** that captures the behavior of consumers

The Demand for Goods

- Assume that the consumption function is a **linear relation** with two **parameters**, c_0 and c_1

$$C = c_0 + c_1 Y_D \tag{2}$$

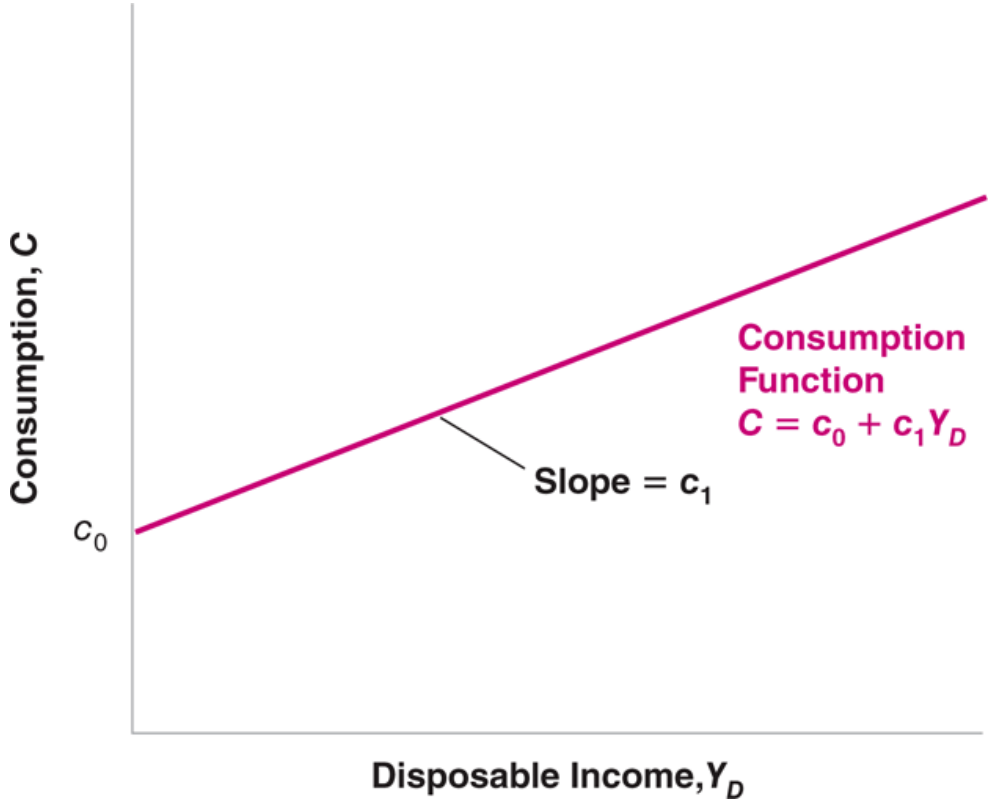
- c_1 is the **marginal propensity to consume,** or the effect of an additional dollar of disposable income on consumption with $0 < c_1 < 1$

- c_0 is what people would consume if their disposable income equals zero with $c_0 > 0$

- Changes in c_0 reflect changes in consumption for a given level of disposable income

- This is the Keynesian Consumption function (we will return to it later on)

The Demand for Goods



Consumption and Disposable Income (Blanchard, 2017)

Consumption increases with disposable income but less than one for one. A lower value of c_0 will shift the entire line down

The Demand for Goods

- Disposable income is

$$Y_D \equiv Y - T$$

where Y is income and T is taxes minus government transfers

- Replacing Y_D in equation (2) gives

$$C = c_0 + c_1 (Y - T) \tag{3}$$

The Demand for Goods

- **Endogenous variables**: variables depend on other variables in the model
- **Exogenous variables**: variables not explained within the model but are instead taken as given

$$I = \overline{I} \tag{4}$$

- A bar on investment means investment is taken as given (for now)
- G and T describe **fiscal policy** – the choice of spending and taxes by the government
- G and T are exogenous because
  - Governments do not behave with the same regularity as consumers or firms
  - We will typically treat G and T as variables chosen by the government and will not try to explain them within the model

The Determination of Equilibrium Output

- Assume $X = IM = 0$ (closed economy), so

$$Z \equiv C + I + G$$

- Replacing C and I from equations (3) and (4)

$$Z = c_0 + c_1 (Y - T) + \overline{I} + G \tag{5}$$

- **Equilibrium in the goods markets** requires

$$Y = Z \tag{6}$$

- This is an **equilibrium condition**

The Determination of Equilibrium Output

- Replacing Z in (6) by equation (5) gives

$$Y = c_0 + c_1 (Y - T) + \overline{I} + G \tag{7}$$

- *In equilibrium, production* (Y) *is equal to demand, which in turn depends on income* (Y)*, which is itself equal to production*

The Determination of Equilibrium Output

Macroeconomists always use three tools

1. Algebra to make sure that the logic is correct
2. Graphs to build the intuition
3. Words to explain the results

The Determination of Equilibrium Output

- Rewrite equation (7)

$$Y = c_0 + c_1 Y - c_1 T + \overline{I} + G$$

- Reorganize the equation

$$(1 - c_1)\, Y = c_0 + \overline{I} + G - c_1 T$$

- Divide both sides by $(1 - c_1)$

$$Y = \frac{1}{1 - c_1}\left[c_0 + \overline{I} + G - c_1 T\right] \tag{8}$$

  which characterizes equilibrium output in algebra

The Determination of Equilibrium Output

- **Autonomous spending** $\left[c_0 + \overline{I} + G - c_1 T\right]$ is the part of the demand for goods that does not depend on output

- Autonomous spending is positive because if $T = G$ **(balanced budget)** and c_1 is between 0 and 1, then $(G - c_1 T)$ is positive, and so is autonomous spending

- The term $1/(1 - c_1)$ is the **multiplier**, which is larger than 1 as $0 < c_1 < 1$. The multiplier is larger when c_1 is closer to 1.

- If c_1 equals 0.6, the multiplier equals $1/(1 - 0.6) = 2.5$, meaning that an increase of consumption c_0 by \$1 billion will increase output by 2.5 x \$1 billion = \$2.5 billion

The Determination of Equilibrium Output

Steps to characterize the equilibrium graphically

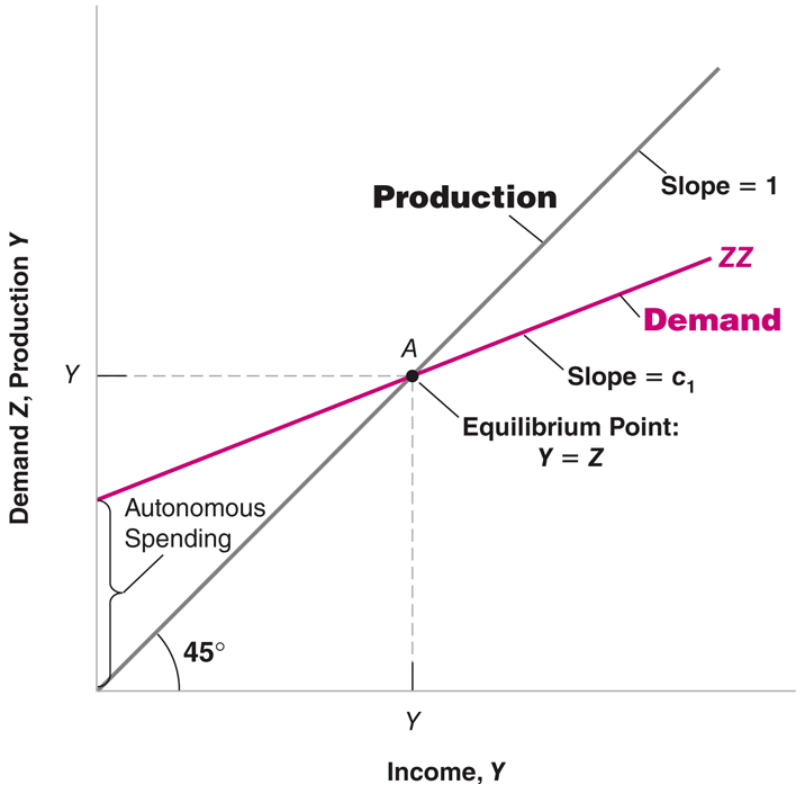
1. Plot production as a function of income. Because production equals income, their relation is the 45-degree line

2. Plot demand as a function of income

$$Z = \left(c_0 + \overline{I} + G - c_1 T\right) + c_1 Y \tag{9}$$

3. In equilibrium, production equals demand

The Determination of Equilibrium Output

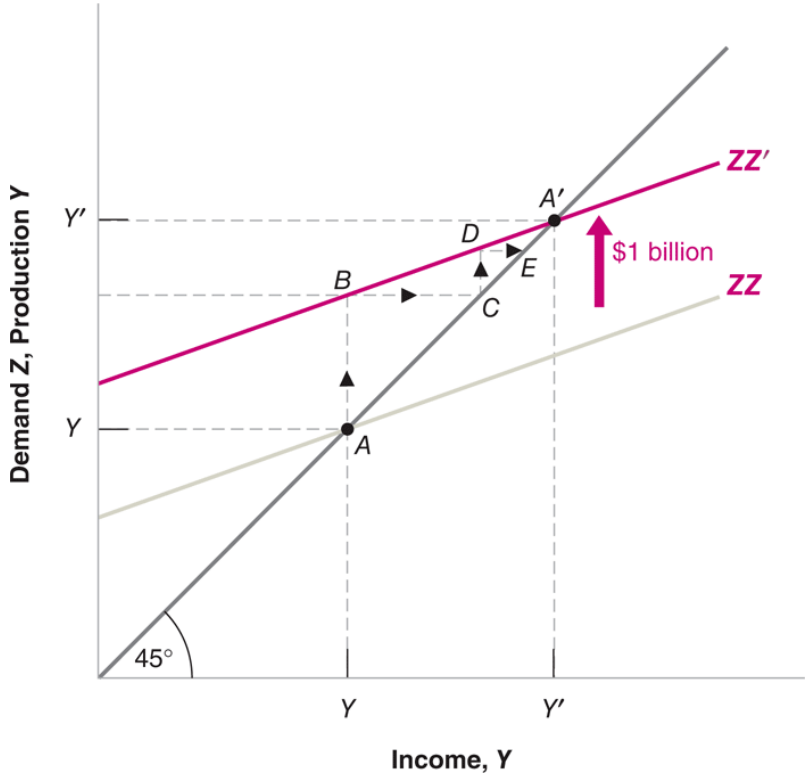


Equilibrium in the Goods Market (Blanchard, 2017)

Equilibrium output is determined by the condition that production is equal to demand

The Determination of Equilibrium Output

Suppose c_0 increases by \$1 billion



The effects of an increase in autonomous spending on output (Blanchard, 2017)

An increase in autonomous spending has a more than one-for-one effect on equilibrium output

The Determination of Equilibrium Output

- AB: first-round increase in demand
- BC: first-round increase in production
- CD: second-round increase in demand
- DE: second-round increase in production
- The total increase in production after $n+1$ rounds

$$1 + c_1 + c_1^2 + \ldots + c_1^n$$

which is a **geometric series** with a limit of $1/(1-c_1)$, i.e., the multiplier

The Determination of Equilibrium Output

To summarize our findings using words

- Production depends on demand, which depends on income, which is itself equal to production
- An increase in demand leads to an increase in production and income, which in turn leads to a future increase in demand
- The increase in output is larger than the initial shift in demand, by a factor equal to the multiplier
- The multiplier depends on the propensity to consume, which can be estimated using **econometrics** – the set of statistical methods used in economics

The Determination of Equilibrium Output

- The adjustment of output over time is called the **dynamics** of adjustment

- How long the adjustment takes depends on how and when firms revise their production schedule

Investment Equals Saving

- John Maynard Keynes articulated an alternative model that focuses instead on investment and saving in the General Theory of Employment, Interest and Money in 1936
- **Private saving** (S) is

$$\begin{aligned} S &\equiv Y_D - C \\ S &\equiv Y - T - C \end{aligned}$$

- By definition, **public saving** $= T - G$
  - Public saving $> 0 \iff$ **Budget surplus**
  - Public saving $< 0 \iff$ **Budget deficit**

Investment Equals Saving

- In equilibrium

$$Y = C + I + G$$

- Subtract T from both sides and move C to the left side

$$Y - T - C = I + G - T$$

- The left side of the equation is simply S, so

$$S = I + G - T$$

- Or equivalently

$$I = S + (T - G) \tag{10}$$

- This is the **IS relation**, which stands for "**I**nvestment equals **S**aving" (we will get back to this later on)

Investment Equals Saving

Two equivalent ways of stating the condition for equilibrium in the goods market

$$\text{Production} = \text{Demand}$$

$$\text{Investment} = \text{Saving}$$

Investment Equals Saving

- We can also derive equation (8) using equation (10)
- Because consumption behavior implies that

$$\begin{aligned} S &= Y - T - C \\ &= Y - T - c_0 - c_1(Y - T) \end{aligned}$$

  Rearranging terms, so

$$S = -c_0 + (1 - c_1)(Y - T) \tag{11}$$

- $(1 - c_1)$ is called the **marginal propensity to save**, which is between zero and one

Investment Equals Saving

- In equilibrium, $I = S$, so that equation (10) becomes

$$I = -c_0 + (1 - c_1)(Y - T) + (T - G)$$

- Solve for output

$$Y = \frac{1}{1 - c_1}\left[c_0 + \overline{I} + G - c_1 T\right] \tag{12}$$

- This is the same as equation (8)

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Lecture 3

Financial Markets

Lecturer: Natalie Chen

Financial Markets: Outline

- The Demand for Money
- Determining the Interest Rate I
- The Liquidity Trap
- Determining the Interest Rate II
- The Money Multiplier
- Nominal versus Real Interest Rates

Financial Markets

- Financial markets play an essential role in the economy
- In this lecture, we focus on the role of the central bank in affecting interest rates
- We learn how the interest rate on bonds is determined, and the role of the central bank (**Federal Reserve Bank**, or the **Fed**, in the US; the **Bank of England** in the UK; the **European Central Bank,** or the **ECB,** in the Eurozone) in this determination

The Demand for Money

- Suppose you only have a choice between two assets: money and bonds
- Money is used for transactions, but it pays no interest
- Two types of money: **currency** (coins and notes) and **checkable deposits** (the bank deposits on which you can write cheques)
- **Bonds** pay a positive interest rate, i (the rate of interest), but cannot be used for transaction (bonds are issued by governments and firms – government and corporate bonds)
- The holding of money and bonds depends on
  - Your level of transactions
  - The interest rate on bonds

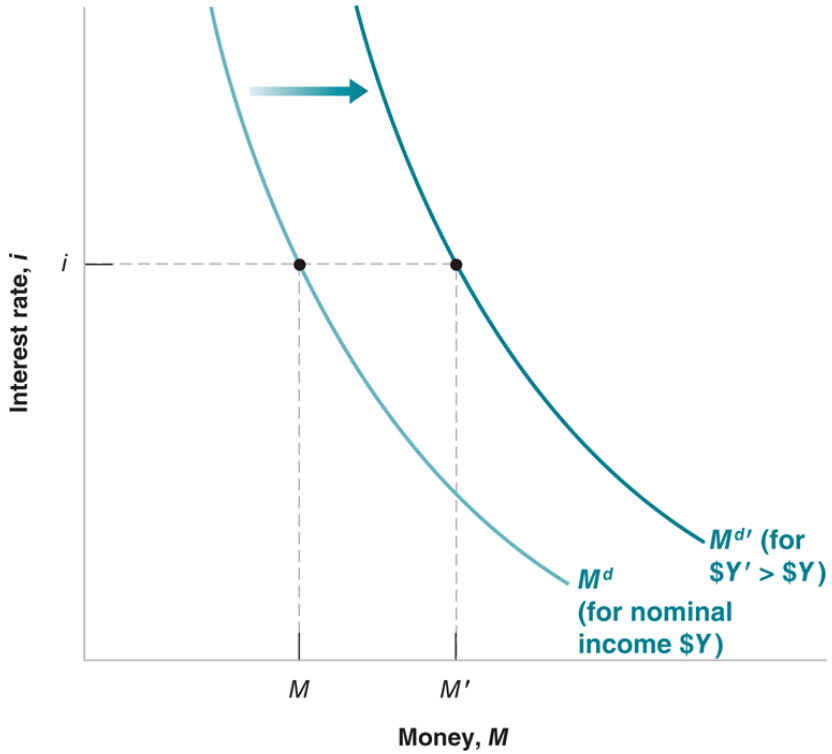
The Demand for Money

- The demand for money (M^d) is equal to nominal income $\$Y$ (a measure of the level of transactions in the economy) times a decreasing function $L(i)$ of the interest rate i

$$M^d = \$Y \underset{(-)}{L(i)} \tag{1}$$

- An increase in the interest rate decreases the demand for money as people put more of their wealth into bonds (**opportunity cost** of holding money)
- Equation (1) means that the demand for money
  - Increases in proportion to nominal income
  - Depends negatively on the interest rate
- The relation between the demand for money and the interest rate for a given level of income $\$Y$ is represented by the M^d curve

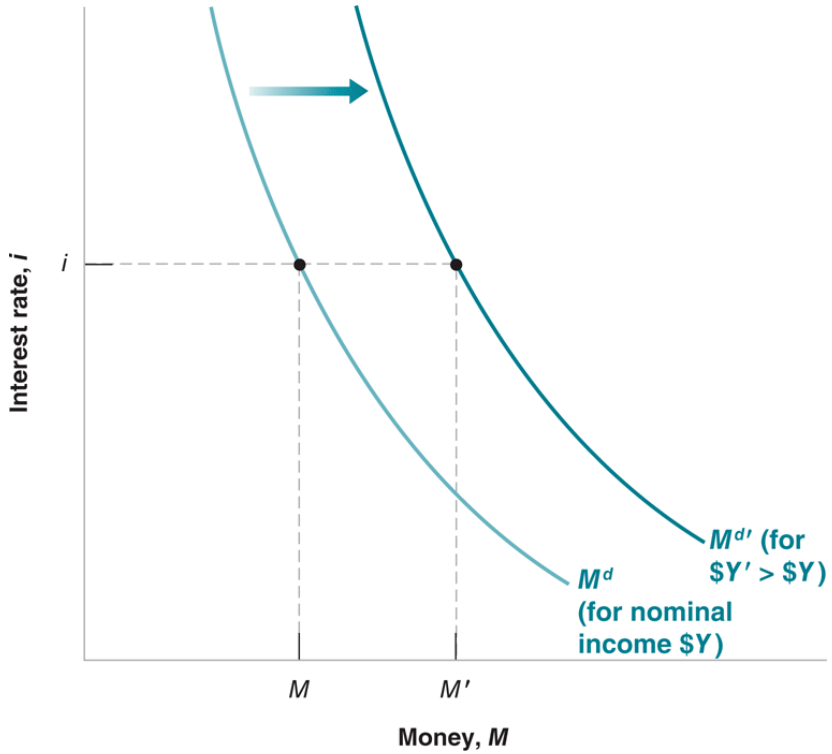
The Demand for Money



The Demand for Money (Blanchard, 2017)

For a given level of nominal income, a lower interest rate increases the demand for money

The Demand for Money



The Demand for Money (Blanchard, 2017)

At a given interest rate, an increase in nominal income shifts the demand for money to the right

Determining the Interest Rate I

- Suppose the central bank decides to supply an amount of money equal to M

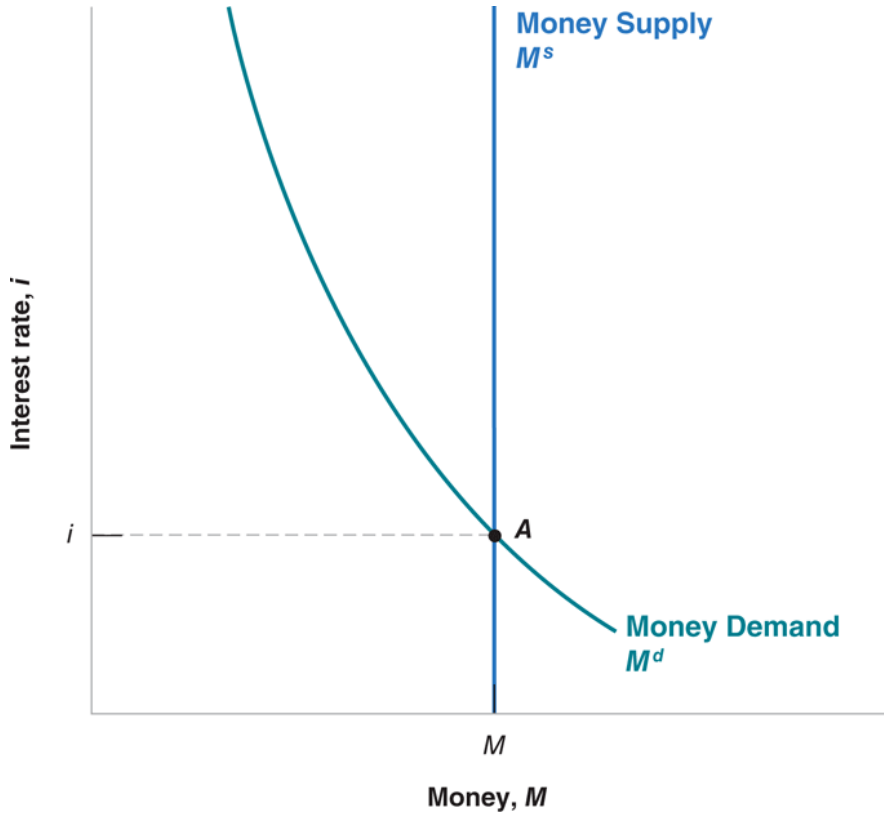
$$M^s = M$$

- Equilibrium in financial markets requires that $M^s = M^d = M$

$$\begin{aligned} \text{Money supply} &= \text{Money demand} \\ M &= \$YL(i) \end{aligned} \tag{2}$$

- This equilibrium relation is called the **LM relation** (we will return to this later on)

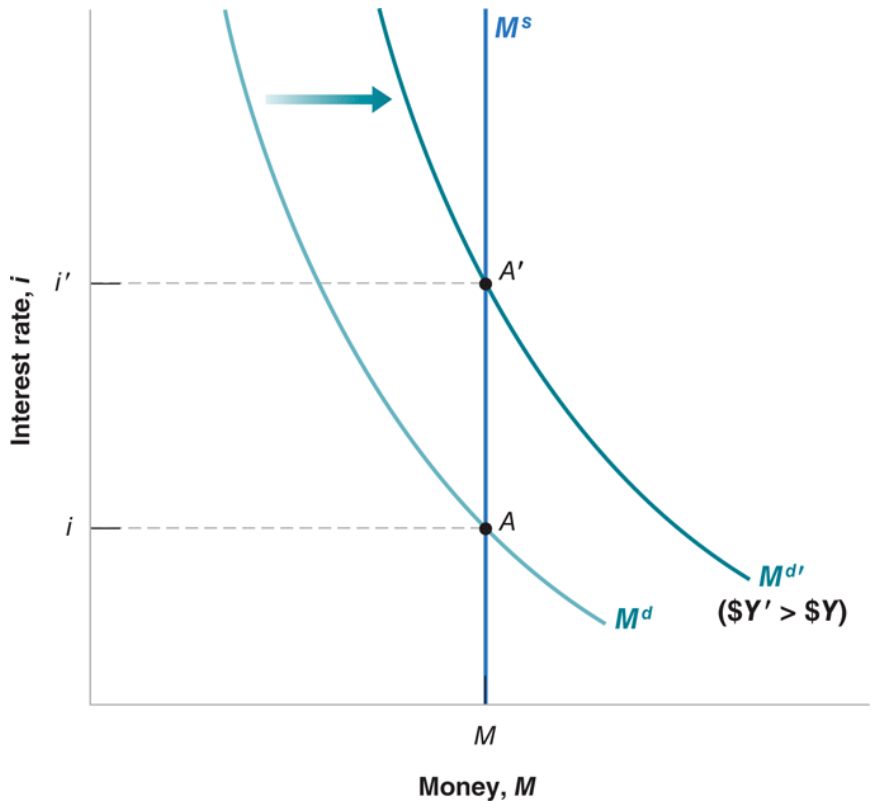
Determining the Interest Rate I



The Determination of the Interest Rate (Blanchard, 2017)

The interest rate is such that the supply of money (independent of the interest rate) is equal to the demand for money (depends on the interest rate)

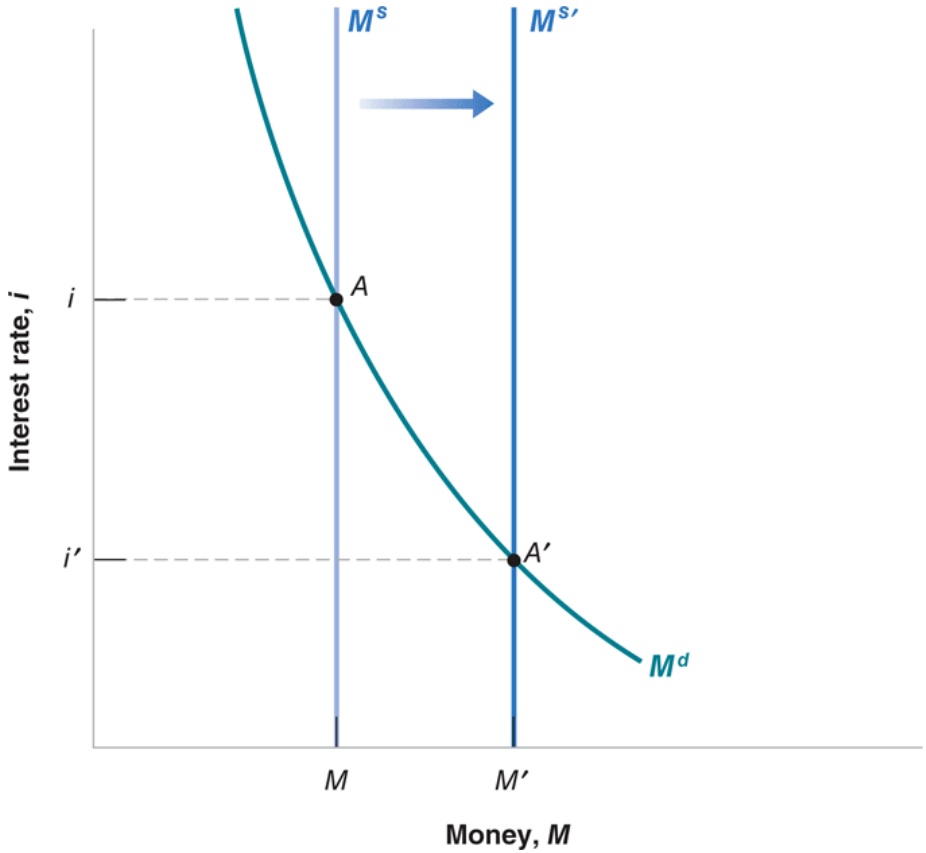
Determining the Interest Rate I



An Increase in Nominal Income on the Interest Rate (Blanchard, 2017)

Given money supply, an increase in nominal income increases the interest rate

Determining the Interest Rate I



An Increase in Money Supply on the Interest Rate (Blanchard, 2017)

An increase in the supply of money leads to a decrease in the interest rate

Determining the Interest Rate I

- Central banks typically change the supply of money by buying or selling bonds in the bond market (**open market operations**)

- **Expansionary open market operation**: the central bank expands the supply of money by buying bonds

- **Contractionary open market operation**: the central bank contracts the supply of money by selling bonds

Determining the Interest Rate I

Balance Sheet

Assets	Liabilities
Bonds	Money (currency)

The Effects of an Expansionary Open Market Operation

Assets	Liabilities
Change in bond holdings: +$1 million	Change in money stock: +$1 million

Central Bank Balance Sheet and Expansionary Open Market Operation (Blanchard, 2017)

- The assets of the central bank are the bonds it holds
- The liabilities are the stock of money in the economy
- An open market operation in which the central bank buys bonds and issues money increases both assets and liabilities by the same amount

Determining the Interest Rate I

- Suppose a bond such as a **Treasury bill**, or **T-bill**, promises to pay \$100 a year from now
- If the price of the bond today is $\$P_B$, the interest rate on the bond is

$$i = \frac{\$100 - \$P_B}{\$P_B} \Rightarrow \$P_B = \frac{\$100}{1+i}$$

- The higher the price of the bond, the lower the interest rate
- The higher the interest rate, the lower the price today

Determining the Interest Rate I

Summary

- Interest rate is determined by **supply of money = demand for money**
- The central bank can affect the interest rate by changing M^s
- The central bank changes M^s through open market operations: purchases or sales of bonds for money
- Expansionary open market operation
  - Central bank buys bonds and pays by creating money (M^s goes up)
  - The interest rate falls (i goes down) and the price of bonds increases
- Contractionary open market operation
  - Central bank sells bonds, in exchange for money (M^s goes down)
  - The interest rate increases (i goes up) and the price of bonds falls

Determining the Interest Rate I

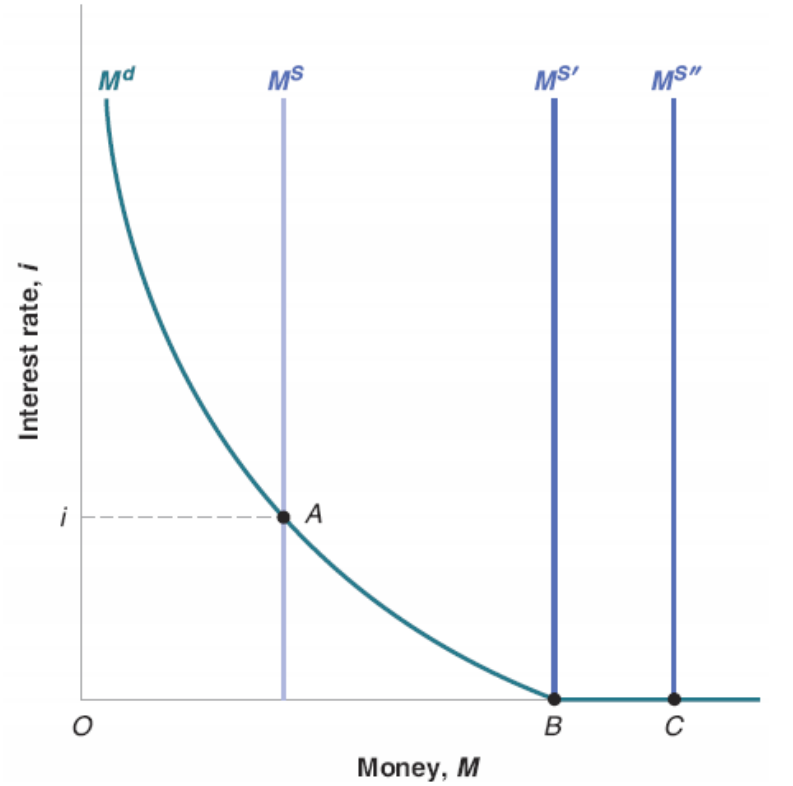
- Rather than the money supply, the central bank could have chosen the interest rate and then adjusted the money supply so as to achieve the interest rate it had chosen

- Choosing the interest rate, instead of the money supply, is what modern central banks, including the Fed, typically do

The Liquidity Trap

- As the interest rate decreases, people want to hold more money
- As the interest rate becomes equal to zero, people want to hold a certain amount they need for transactions, but they are willing to hold even more money (and fewer bonds) as they are indifferent between money and bonds
- **Zero lower bound**: the interest rate cannot go below zero
- **Liquidity trap**: people are willing to hold more money (more liquidity) at the same interest rate. Expansionary monetary policy is powerless

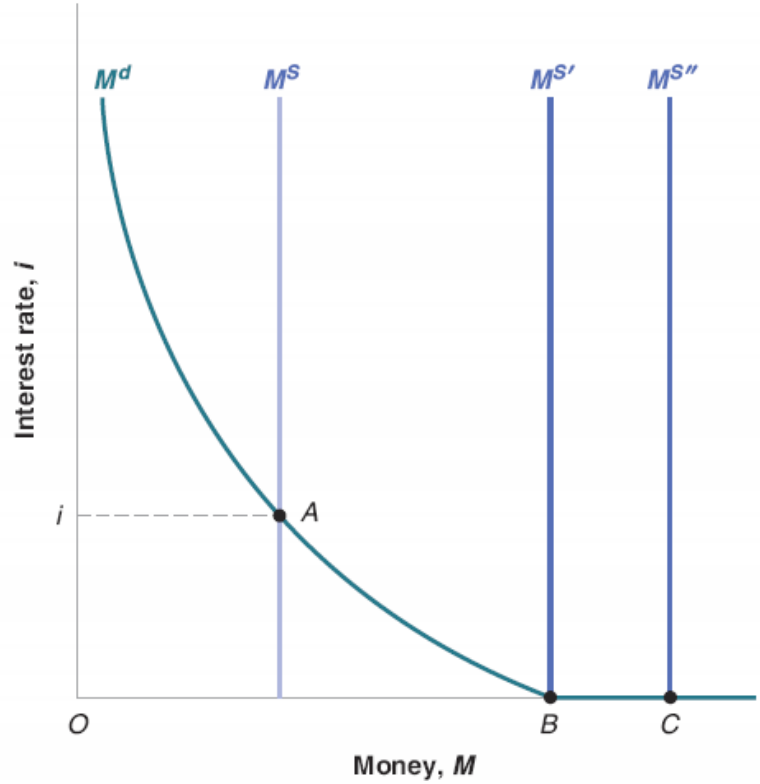
The Liquidity Trap



Money Demand, Money Supply, and the Liquidity Trap (Blanchard, 2017)

When the interest rate is equal to zero, and once people have enough money for transaction purposes, they become indifferent between holding money and holding bonds

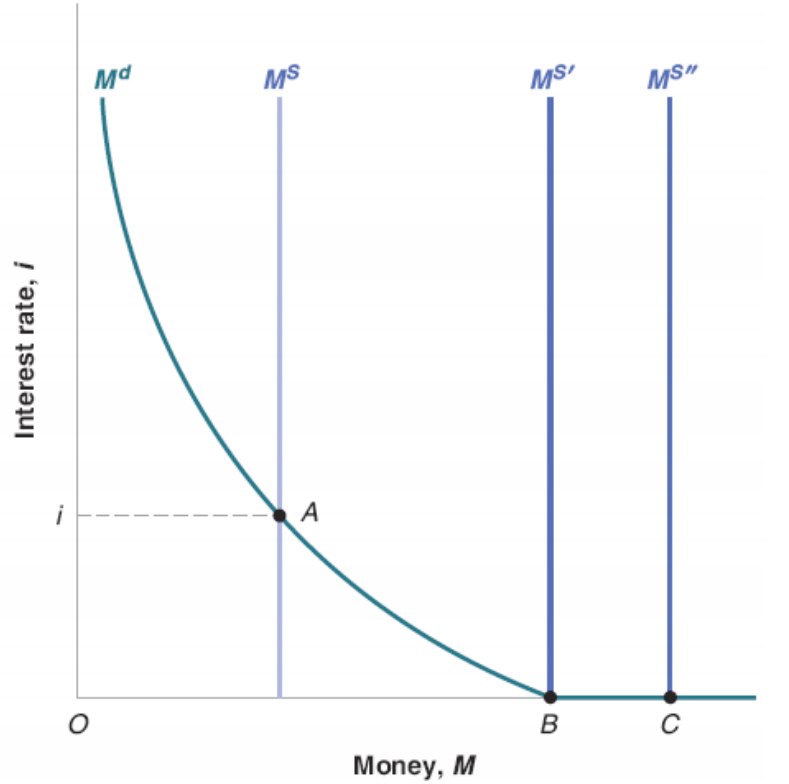
The Liquidity Trap



Money Demand, Money Supply, and the Liquidity Trap (Blanchard, 2017)

The demand for money becomes horizontal

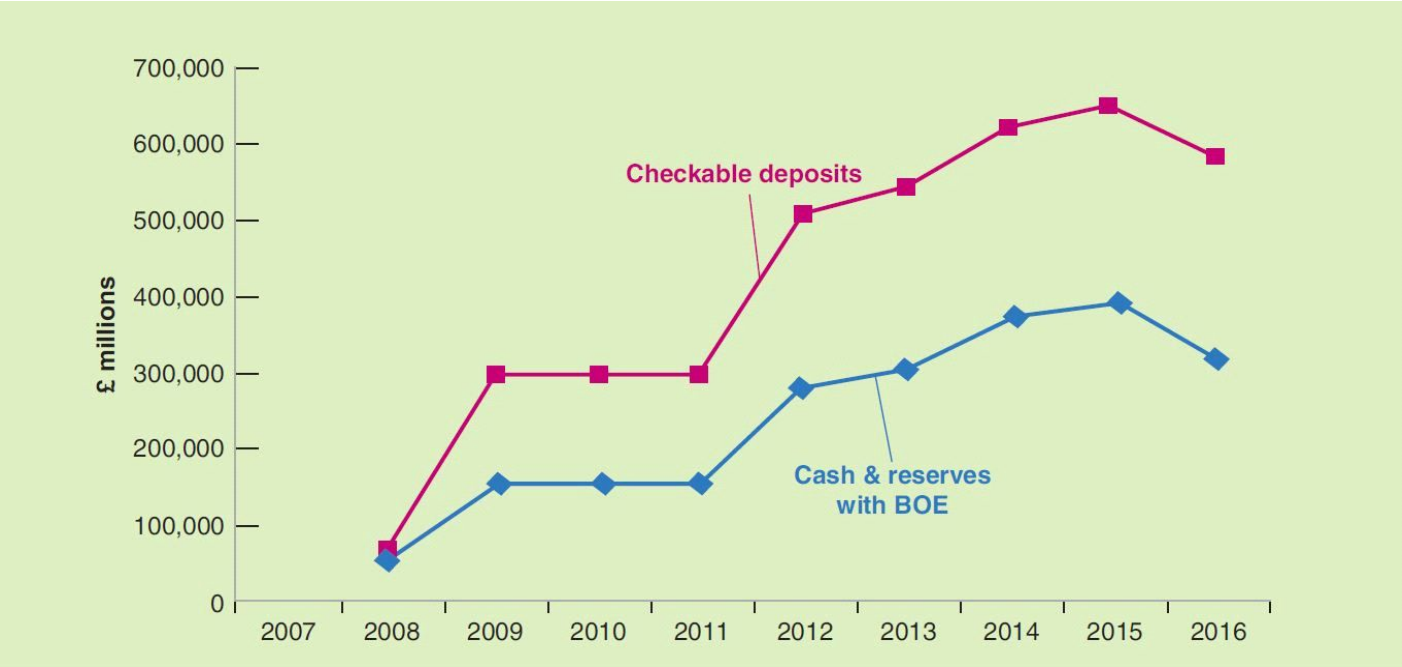
The Liquidity Trap



Money Demand, Money Supply, and the Liquidity Trap (Blanchard, 2017)

This implies that, when the interest rate is zero, further increases in the money supply have no effect on the interest rate, which remains equal to zero

The Liquidity Trap in the United Kingdom

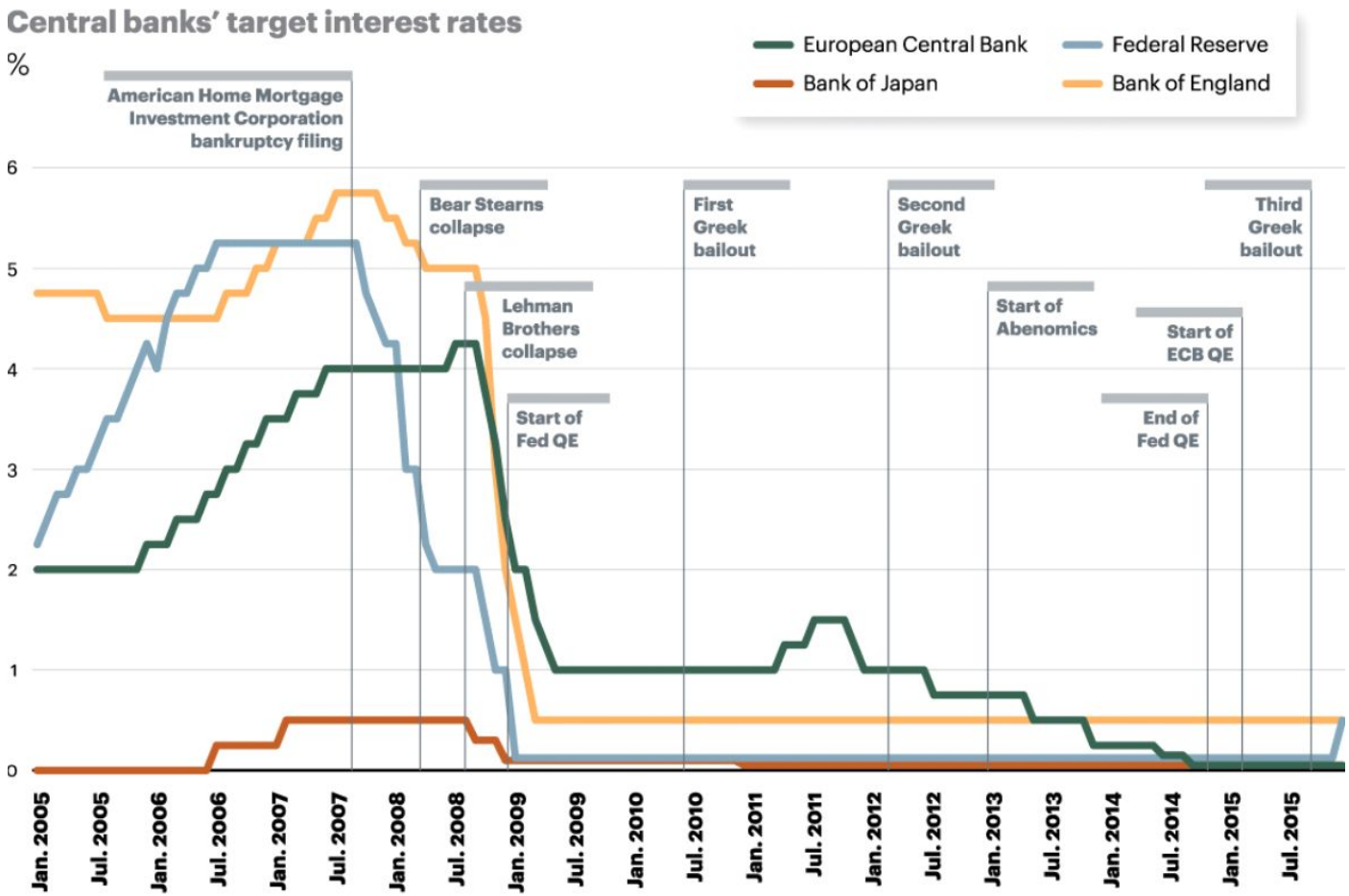


Checkable Deposits and Reserves with BoE, 2007–2016 (Blanchard, 2017)

The large increase in the supply of central bank money between 2007 and 2014 was absorbed by households and banks

Figure 4

Interest rates are near zero in all major economies



Liquidity Trap in Major Economies

Determining the Interest Rate II

- We have been looking at an economy with only two assets: money and bonds. This is obviously a much simplified version of actual economies, with their many financial assets and markets

- There is one dimension, however, to which our model must be extended. We have assumed that all money in the economy consists of currency supplied by the central bank. In the real world, money includes not only currency but also checkable deposits

Determining the Interest Rate II

Financial intermediaries are institutions that receive funds from people and firms, and use these funds to buy bonds or stocks, or to make loans to other people and firms

- Banks receive deposits from people and firms. The *liabilities* of the banks are equal to the value of these *checkable deposits*
- Banks use these deposits for
  - Loans/Bonds
  - Reserves
- The assets of the banks are therefore equal to the sum of bonds, loans and total reserves

Determining the Interest Rate II

Banks hold **reserves** for three reasons

1. On any given day, some depositors withdraw cash from their checking accounts, while others deposit cash into their accounts
2. In the same way, on any given day, people with accounts at the bank write cheques to people with accounts at other banks, and people with accounts at other banks write cheques to people with accounts at the bank
3. Banks are subject to reserve requirements. The actual **reserve ratio** – the ratio of bank reserves to bank checkable deposits – is about 10% in the US today

Determining the Interest Rate II

The assets of the central bank are the bonds it holds. The liabilities of the central bank are the money it has issued, **central bank money**. The new feature is that not all of central bank money is held as currency by the public. Some of it is held as reserves by banks

(a) **Central Bank**

Assets	**Liabilities**
Bonds	Central Bank Money = Reserves + Currency

(b) **Banks**

Assets	**Liabilities**
Reserves Loans Bonds	Checkable deposits

Balance Sheet of Banks and of the Central Bank Revisited (Blanchard, 2017)

Determining the Interest Rate II

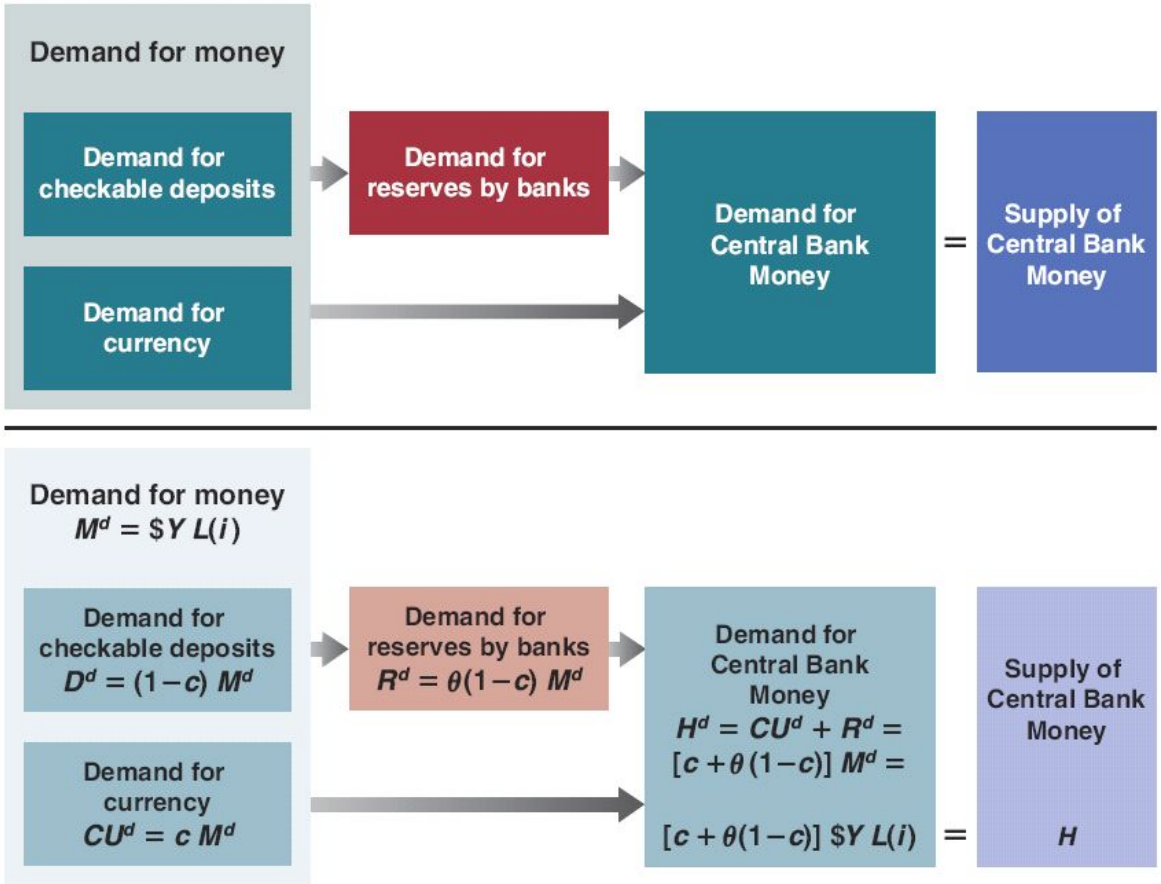
Let's think in terms of the supply and the demand for **central bank money**

- The demand for central bank money is equal to the demand for currency by people plus the demand for reserves by banks

- The supply of central bank money is under the direct control of the central bank

- The equilibrium interest rate is such that the demand and the supply for central bank money are equal

Determining the Interest Rate II



Determinants of the demand and supply of central bank money

Determining the Interest Rate II

The Demand for Money

- When people can hold both currency and checkable deposits, the demand for money involves two decisions
- First, people must decide how much money to hold. Second, they must decide how much of this money to hold in currency and how much to hold in checkable deposits
- We can assume that overall money demand is given by equation (2) as before $M^d = \$YL(i)$
- The demands for currency and checkable deposits are given by

$$\begin{aligned} CU^d &= cM^d \\ D^d &= (1-c)\,M^d \end{aligned} \tag{3}$$

Determining the Interest Rate II

The Demand for Reserves

- The larger the amount of checkable deposits, the larger the amount of reserves the banks must hold, for both precautionary and regulatory reasons
- The relation between reserves (R) and deposits (D)

$$R = \theta D$$

  where θ is the **reserve ratio**

- The demand for reserves by banks is given by

$$R^d = \theta \left(1 - c\right) M^d$$

Determining the Interest Rate II

The Demand for Central Bank Money

- The demand for central bank money H^d is equal to the sum of the demand for currency and the demand for reserves

$$H^d = CU^d + R^d$$

- Replace CU^d and R^d with their expressions to get

$$H^d = cM^d + \theta\left(1 - c\right)M^d = \left[c + \theta\left(1 - c\right)\right]M^d$$

- Finally, replace the overall demand for money $M^d = \$YL\left(i\right)$ to get

$$H^d = \left[c + \theta\left(1 - c\right)\right]\$YL\left(i\right)$$

Determining the Interest Rate II

The Determination of the interest rate

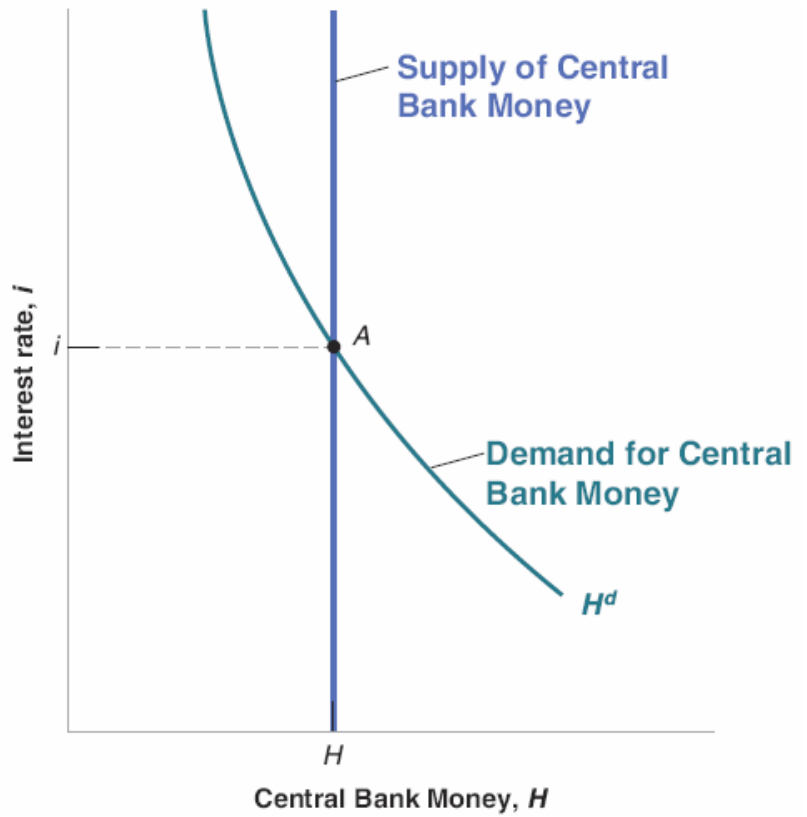
In equilibrium, the supply of central bank money (H) is equal to the demand for central bank money (H^d)

$$H = H^d$$

or

$$H = [c + \theta (1 - c)] \$YL(i)$$

Determining the Interest Rate II



Equilibrium in the Market for Central Bank Money and the Interest Rate (Blanchard, 2017)

The equilibrium interest rate is such that the supply of central bank money is equal to the demand for central bank money

Another Way of Looking at the Equilibrium

Demand for money equals supply of money

$$\frac{1}{[c+\theta(1-c)]}H = \$YL(i)$$

$$\text{Supply of money} = \text{Demand for money}$$

- Money supply is equal to central bank money times the **money multiplier**

$$\frac{1}{[c+\theta(1-c)]}$$

- H is the **monetary base**, also referred to as **high-powered money**

- The ultimate increase in money supply results from successive rounds of bond purchases – first by the Fed, then by the banks

The Money Multiplier

Assume

- People hold only deposits, $c = 0$ and multiplier $= 1/\theta$
- Let $\theta = 0.1$ so the multiplier $= 1/0.1 = 10$
- To simplify, assume only two commercial banks, A and B
- The central bank buys \$100 bonds in an open market operation
- The central bank creates \$100 to pay the seller – Charles
- If there are no banks, the increase in money supply is \$100
- With banks, this is the beginning of the story...

The Money Multiplier

Balance of commercial bank A

Assets		**Liabilities**	
Reserves	10	100	Deposit Charles
Bonds	90		

- Bank A buys \$90 bonds to Anne
- Anne now has \$90 currency (money) instead of bonds (no money)
- $M = CU + D = 90 + 100 = 190$ – Bank A has created money
- $R/D = 10/100 = 0.1$

The Money Multiplier

Balance of commercial bank A

Assets		Liabilities	
Reserves	10	100	Deposit Charles
Bonds	90		

Balance of commercial bank B

Assets		Liabilities	
Reserves	9	90	Deposit Anne
Bonds	81		

- Bank B keeps reserves $= 0.1 \times 90 =$ \$9
- Bank B buys bonds for $0.9 \times 90 =$ \$81 from Jane
- Jane now has 81 in currency (money) instead of bonds (no money)
- $M = CU + D = 81 + 100 + 90 = 271$ – Bank B has created money
- $R/D = (10 + 9)/190 = 0.1$

The Money Multiplier

Balance of commercial bank A

Assets		Liabilities	
Reserves	10	100	Deposit Charles
	8.1	81	Deposit Jane
Bonds	90		
	72.9		

Balance of commercial bank B

Assets		Liabilities	
Reserves	9	90	Deposit Anne
Bonds	81		

- Jane deposits 81 in Bank A
- Jane has 81 in deposits (money)
- $M = CU + D = 72.9 + 81 + 100 + 90 = 343.9$
- $R/D = (10 + 8.1 + 9)/271 = 0.1$

The Money Multiplier

Increases in Money Supply

Central bank high power money	100	$\$100 \times 1$
Bank A buying bonds	90	$\$100 \times 0.9$
Bank B buying bonds	81	$\$100 \times 0.9^2$
Bank A buying bonds again	72.9	$\$100 \times 0.9^3$
Bank X buying bonds	65.6	$\$100 \times 0.9^4$

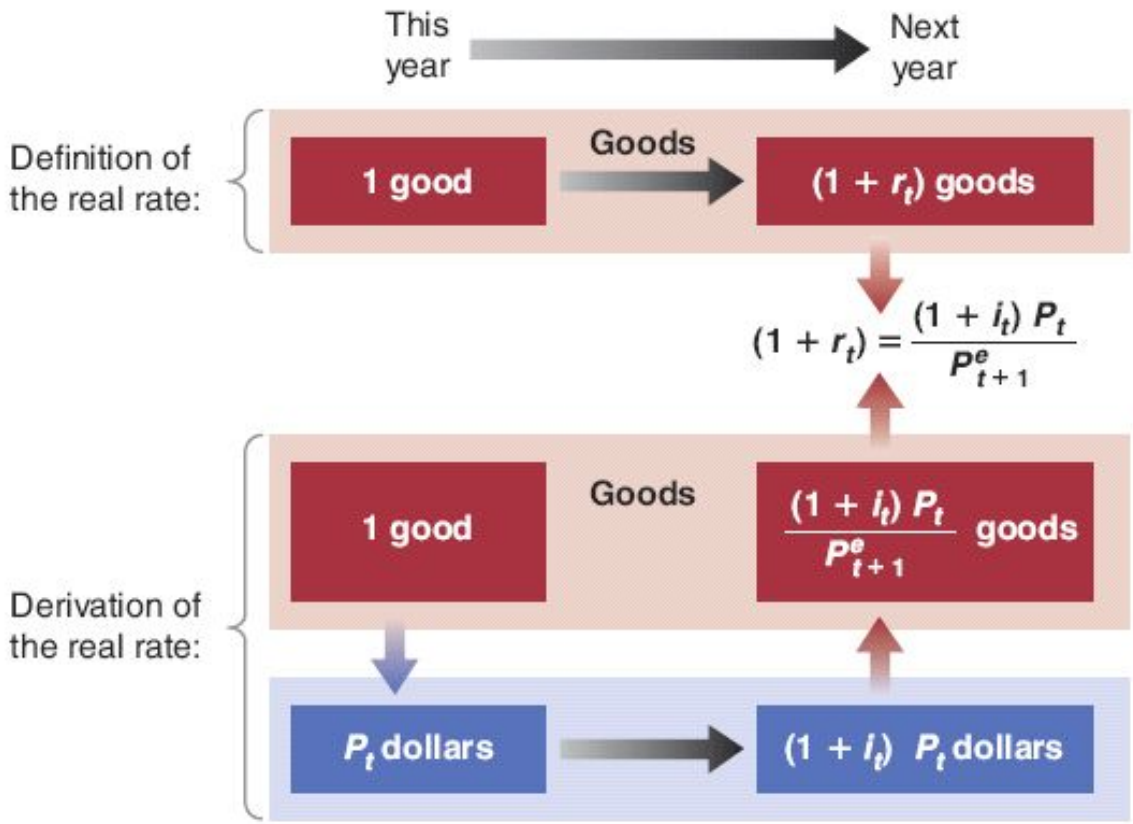
$$\$100(1 + 0.9 + 0.9^2 + 0.9^3 + 0.9^4 ...) = 1/(1 - 0.9) = 1/0.1 = 1/\theta$$

$$\frac{1}{\theta}H = \frac{1}{0.1}100 = 10 \times 100 = 1,000$$

Nominal versus Real Interest Rates

- Until now, we assumed that there was only one interest rate (the rate on bonds) determined by monetary policy
- **Nominal interest rate** i is the interest rate in terms of dollars (it is the one we looked at so far in this lecture)
- **Real interest rate** r is the interest rate in terms of a basket of goods
- We must adjust the nominal interest rate to take into account expected inflation

Nominal versus Real Interest Rates



Definition and Derivation of the Real Interest Rate (Blanchard, 2017)

P_t is the price level this year, P^e_{t+1} is expected price level next year

Nominal versus Real Interest Rates

- One-year real interest rate r_t

$$1 + r_t = (1 + i_t)\frac{P_t}{P^e_{t+1}} \tag{4}$$

- Denote expected inflation between t and $t+1$ by

$$\pi^e_{t+1} = \frac{\left(P^e_{t+1} - P_t\right)}{P_t} \tag{5}$$

so that equation (4) becomes

$$\begin{aligned} (1 + r_t) &= \frac{1 + i_t}{1 + \pi^e_{t+1}} \qquad (6) \\ (1 + r_t)\left(1 + \pi^e_{t+1}\right) &= 1 + i_t \\ 1 + r_t + \pi^e_{t+1} + r_t\pi^e_{t+1} &= 1 + i_t \\ r_t &= i_t - \pi^e_{t+1} - r_t\pi^e_{t+1} \end{aligned}$$

Nominal versus Real Interest Rates

- If the nominal interest rate and expected inflation are not too large $\left(\text{i.e., } r_t \pi^e_{t+1} \approx 0\right)$, a close approximately to equation (6) is

$$r_t \approx i_t - \pi^e_{t+1} \tag{7}$$

- This is the **Fisher rule**
- When expected inflation equals zero, the nominal interest rate and the real interest rate are equal
- Because expected inflation is in general positive, the real interest rate is typically lower than the nominal interest rate
- For a given nominal interest rate, the higher expected inflation, the lower the real interest rate

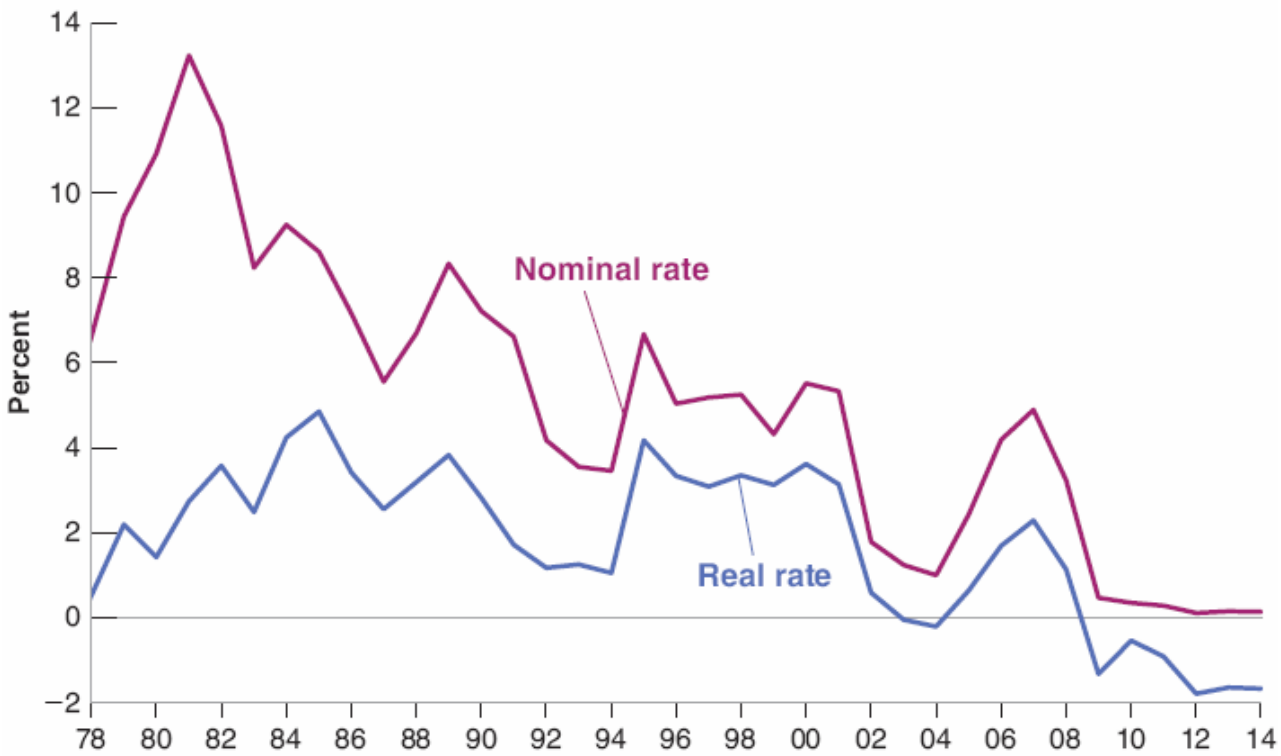
Nominal versus Real Interest Rates

- The real interest rate $(i - \pi^e)$ is based on expected inflation, so it is sometimes called the **ex-ante** ("before the fact") real interest rate

- The realized real interest rate $(i - \pi)$ is called the **ex-post** ("after the fact") interest rate

- The zero lower bound of the nominal interest rate implies that the real interest rate cannot be lower than the negative of inflation

Nominal versus Real Interest Rates



Nominal and Real One-Year T-Bill Rates in the US since 1978 (Blanchard, 2017)

The nominal interest rate has declined considerably since the early 1980s, but because expected inflation has declined as well, the real rate has declined much less than the nominal rate

University of Warwick

Macroeconomics 1 (EC108)

Lecture 4

Openness in Goods and Financial Markets

Lecturer: Natalie Chen

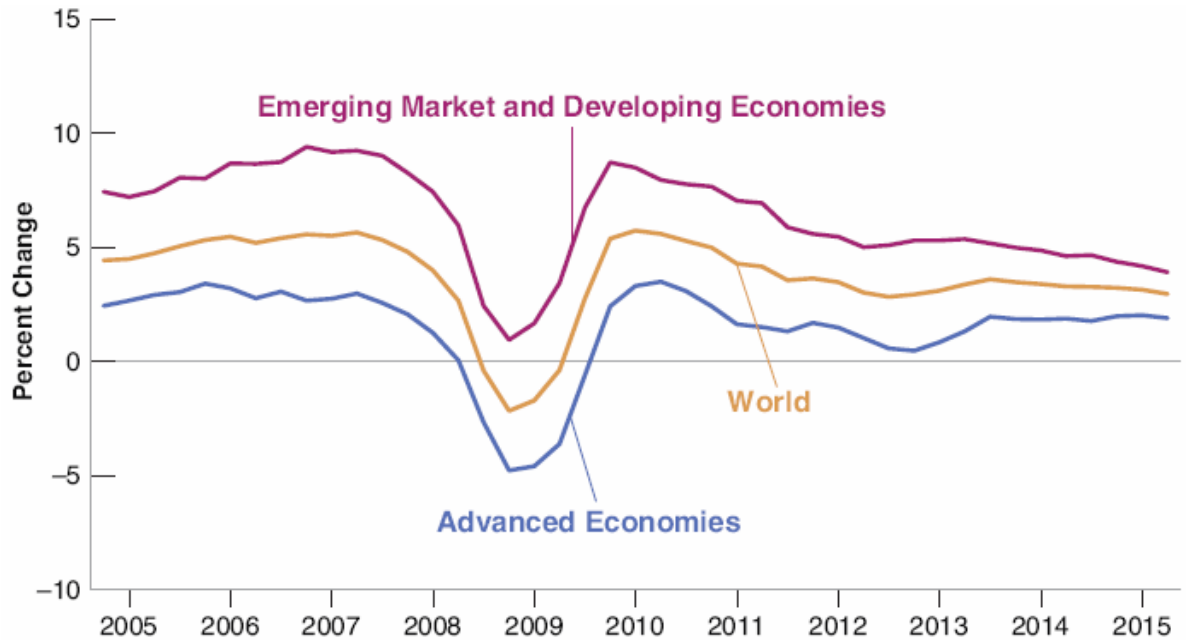
Openness in Goods and Financial Markets

Three dimensions to openness

- **Openness in goods markets**: the ability of consumers and firms to choose between domestic goods and foreign goods. Even countries most committed to free trade have **tariffs** (taxes on imported goods) and **quotas** (restrictions on the quantity of goods that can be imported)

- **Openness in financial markets**: the ability of financial investors to choose between domestic assets and foreign assets. Until recently, even some rich countries had **capital controls** (restrictions on the foreign assets their domestic residents could hold)

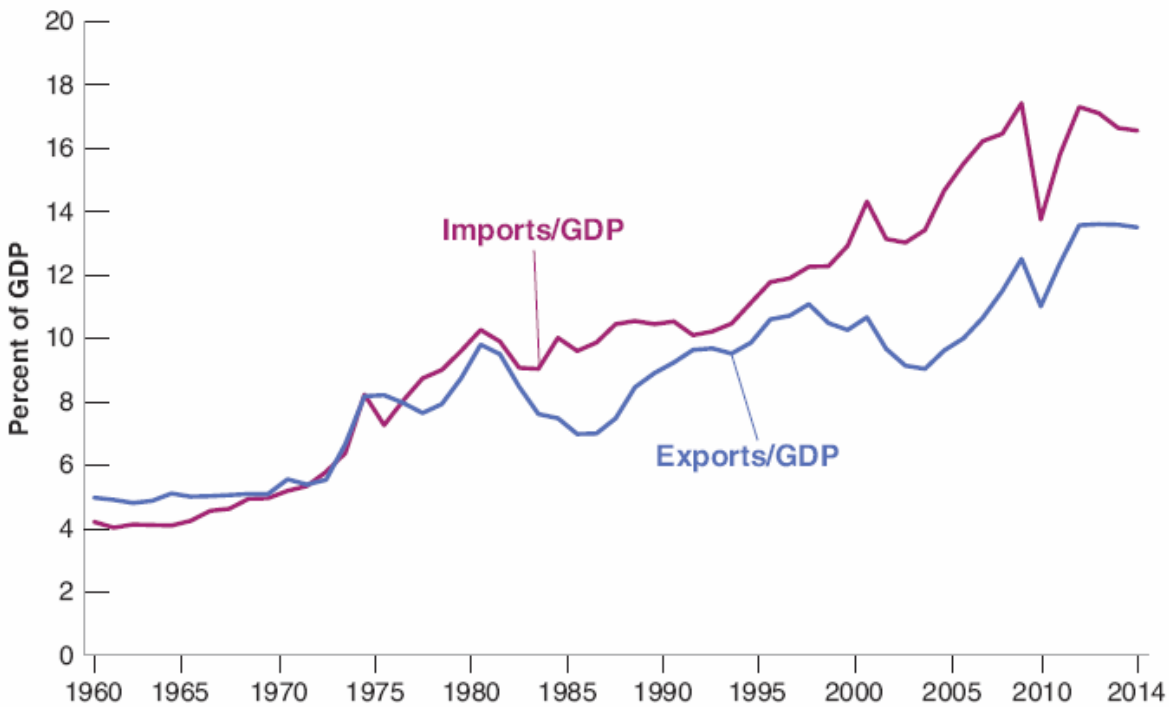
- **Openness in factor markets**: the ability of firms to choose where to locate production, and of workers to choose where to work, e.g., the North American Free Trade Agreement (NAFTA) signed in 1993 by the US, Canada, and Mexico affected the relocation of US firms to Mexico



Growth in Advanced and Emerging Economies since 2005 (Blanchard, 2017)

The crisis started in the US, but it affected nearly every country in the world

Openness in Goods Markets



US Exports and Imports as Ratios of GDP since 1960 (Blanchard, 2017)

Since 1960, exports and imports have more than tripled in relation to GDP. The US has become a much more open economy

Openness in Goods Markets

- The volume of trade is not necessarily a good measure of openness (it depends on geography, and does not capture the pressure from international competition)
- **Tradable goods**: goods that compete with foreign goods in either domestic markets or foreign markets
- A good index of openness is the proportion of aggregate output composed of tradable goods (goods that compete with foreign goods in either domestic or foreign markets)
- Tradable goods represent about 60% of aggregate output in the US today

Openness in Goods Markets

Country	Export Ratio	Country	Export Ratio
United States	13.5%	Germany	45.7%
Japan	17.7%	Austria	53.2%
United Kingdom	28.3%	Switzerland	64.1%
Chile	33.8%	Netherlands	82.9%
Source: IMF, *World Economic Outlook.*			

Ratios of Exports to GDP for Selected OECD Countries, 2014 (Blanchard, 2017)

The US is at the low end of the range of export ratios. The main factors behind differences in export ratios are geography, country size, and distance from other markets. Size matters: the smaller the country, the more it must specialize in producing and exporting only a few products and rely on imports for other products

Can Exports Exceed GDP?

- Since a country cannot export more than it produces, is the export ratio less than one?

- No, exports may be larger than GDP because exports and imports may include exports and imports of intermediate goods

- In 2014, the ratio of exports to GDP in Singapore was 188%!

Openness in Goods Markets

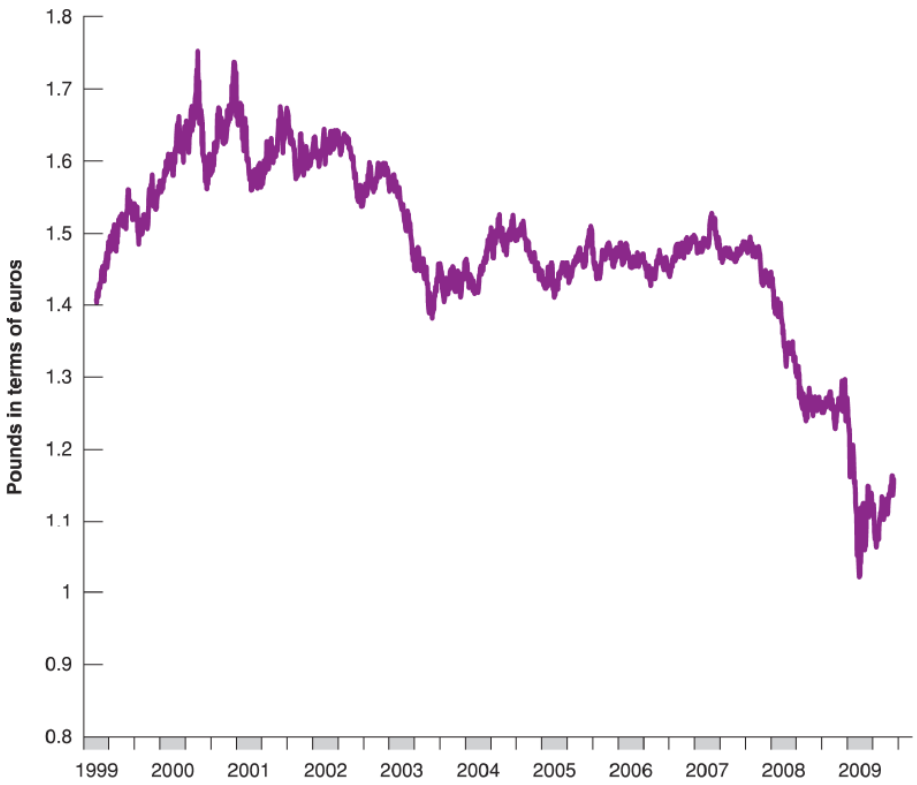
- When goods markets are open, domestic consumers must decide not only how much to consume and save but also whether to buy domestic goods or foreign goods

- Central to the second decision is the price of domestic goods relative to foreign goods, or the real exchange rate (computed using the nominal exchange rate)

Openness in Goods Markets

- **Nominal exchange rate**: the price of domestic currency in terms of foreign currency (could also be quoted as the price of foreign currency in terms of domestic)
  - (Nominal) **appreciation**: an increase in the price of domestic currency in terms of a foreign currency, i.e., an increase in the exchange rate
  - (Nominal) **depreciation**: a decrease in the price of domestic currency in terms of a foreign currency, i.e., a decrease in the exchange rate
- **Fixed exchange rates**: a system in which two or more countries maintain a constant exchange rate between their currencies
- In the fixed exchange rate system, **revaluations** are increases in the exchange rate, and **devaluations** are decreases in the exchange rate

Openness in Goods Markets

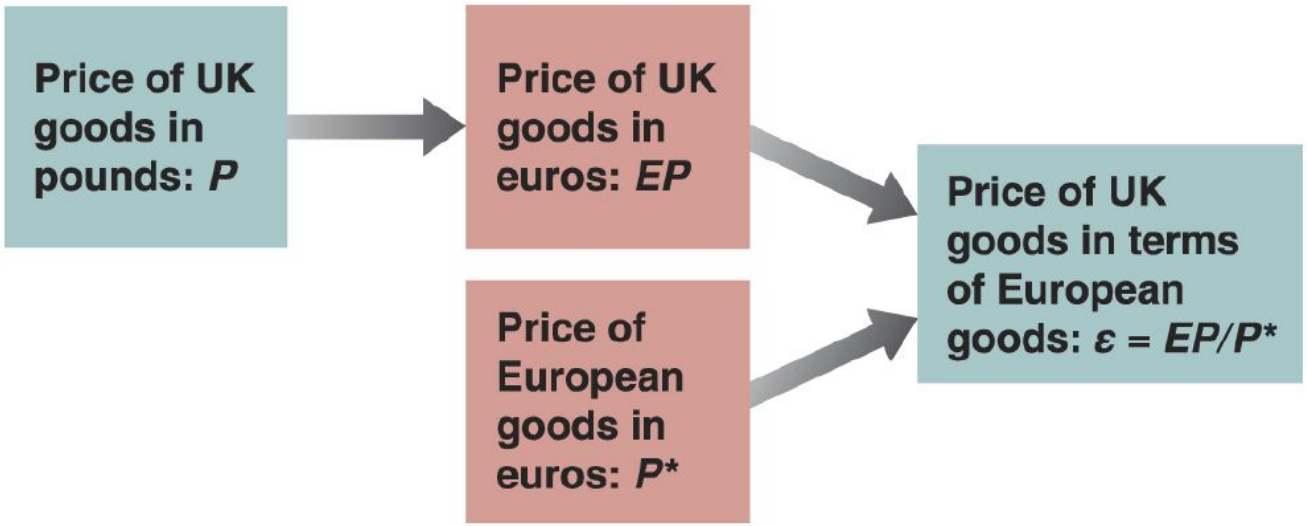


The nominal exchange rate between the British pound and the euro since 1999 (Blanchard, Amighini, Giavazzi, 2017)

Openness in Goods Markets

The real exchange rate, the price of British goods in terms of European goods, is (P is the price of domestic goods in domestic currency, P^* is the price of foreign goods in foreign currency, E is the nominal exchange rate)

$$\varepsilon = \frac{EP}{P^*}$$



The Construction of the Real Exchange Rate (Blanchard, Amighini, Giavazzi, 2017)

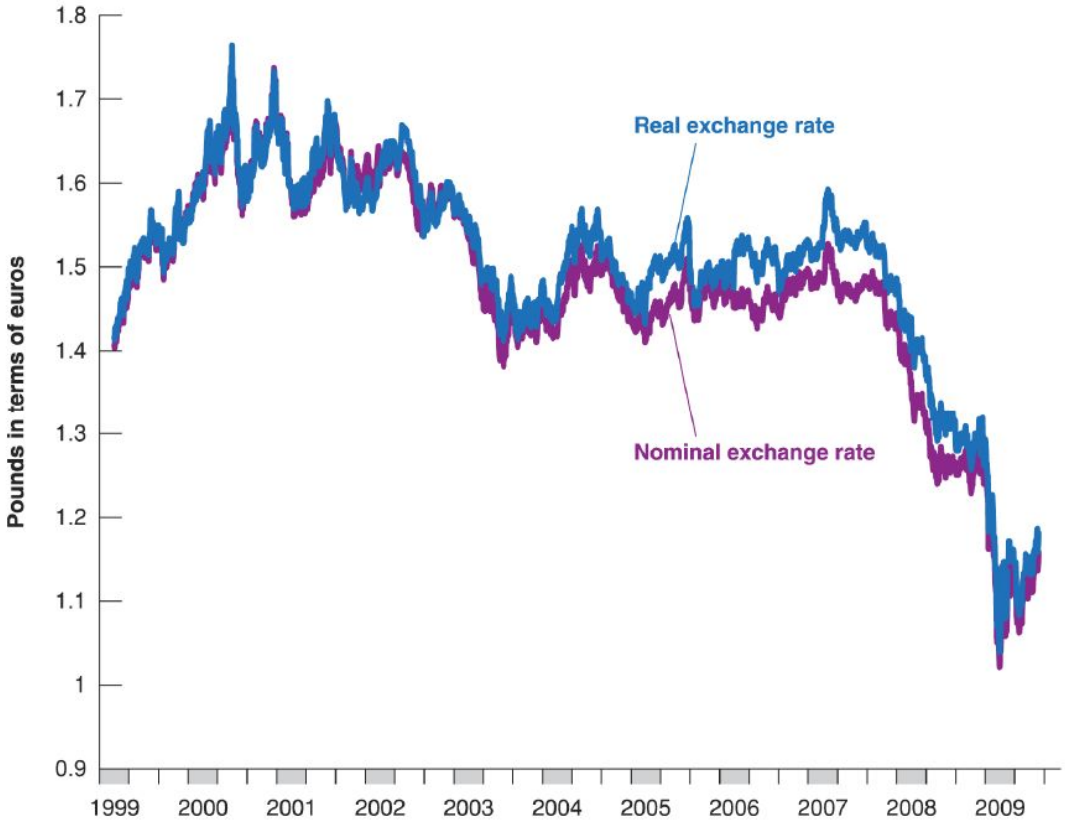
Openness in Goods Markets

Real exchange rate: the price of domestic goods relative to foreign goods

- **Real appreciation**: an increase in the real exchange rate, i.e., an increase in the relative price of domestic goods in terms of foreign goods

- **Real depreciation**: a decrease in the real exchange rate, i.e., a decrease in the relative price of domestic goods in terms of foreign goods

Openness in Goods Markets



Real and nominal exchange rates in the UK since 1999 (Blanchard, Amighini, Giavazzi, 2017)

The nominal and the real exchange rates in the UK have moved largely together since 1999

Openness in Goods Markets

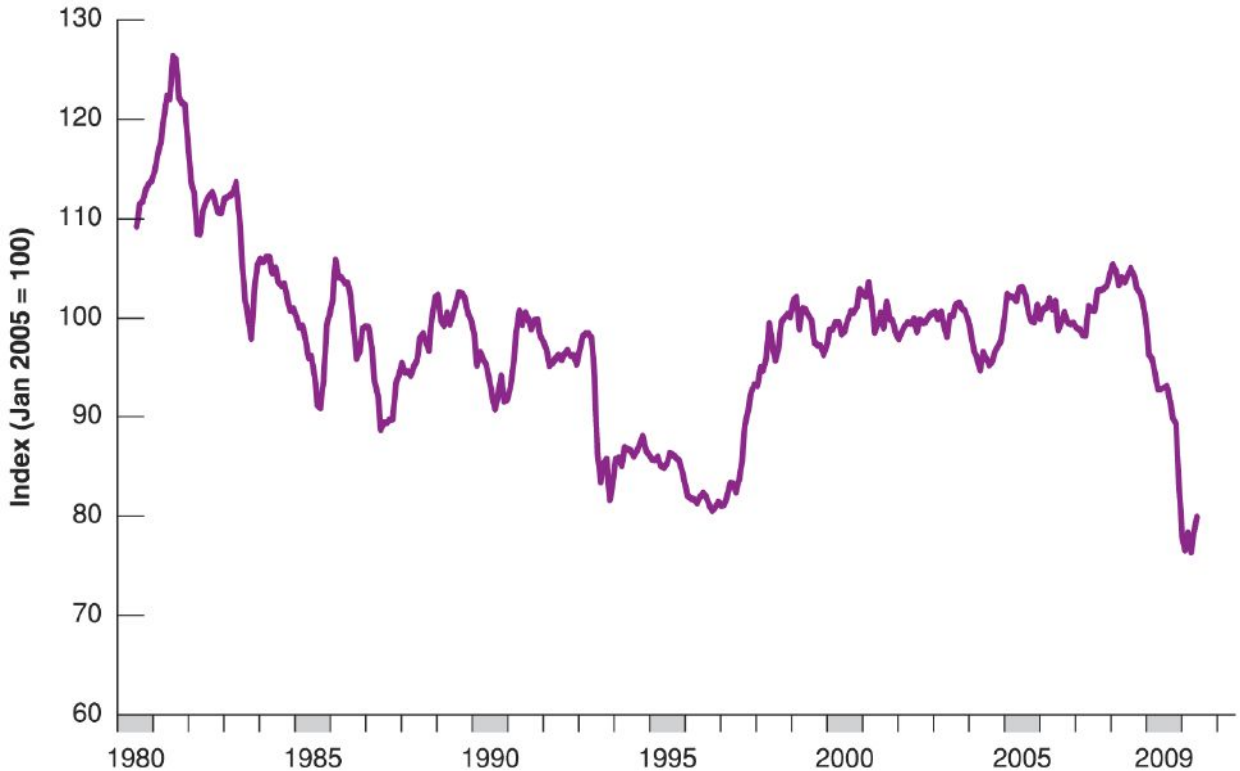
Example of going from bilateral exchange rates (between two countries) to multilateral exchange rates (between several countries): the multilateral real US exchange rate requires data on the geographic composition of US trade for both exports and imports

	Percent of Exports to	Percent of Imports from
Canada	16	15
Mexico	12	13
European Union	15	18
China	7	20
Japan	4	6
Rest of Asia and Pacific	11	10
Others	35	18

Source: US Census, Related Party Trade, May 2015.

The Country Composition of US Exports and Imports, 2014 (Blanchard, 2017)

Openness in Goods Markets



The UK Multilateral Real Exchange Rate since 1980 (Blanchard, Amighini, Giavazzi, 2017)

The 1980s and 1990s were characterised by large swings in the real exchange rate. The real exchange rate was much more stable since the end of the 1990s, until the large real depreciation in 2009

Openness in Financial Markets

- **Balance of payments**: a set of accounts that summarize a country's transactions with the rest of the world

- Transactions above the line are **current account** transactions. Transactions below the line are **capital account** transactions

- The current account balance and the capital account balance should be equal, but because of data gathering errors they are not. For this reason, the account shows a statistical discrepancy

Openness in Financial Markets

Current Account		
Exports	2343	
Imports	2851	
Trade balance (deficit = −)(1)		−508
Income received	823	
Income paid	585	
Net income (2)		238
Net transfers received (3)		−119
Current account balance (deficit = −)(1) + (2) + (3)		−389
Capital Account		
Increase in foreign holdings of U.S. assets (4) (*)	1031	
Increase in U.S. holdings of foreign assets (5)	792	
Capital account balance (7) = (4) − (5)		239
Statistical discrepancy (= capital account balance − current account balance)		150

*including an increase in foreign holdings of U.S. assets of $54 billion from net transactions in financial derivatives

Source: US Bureau of Economic Analysis, September 17, 2015.

The US Balance of Payments, 2014, in Billions of US Dollars (Blanchard, 2017)

Openness in Financial Markets

Current account: payments to and from the rest of the world

- Exports and imports of goods and services (**trade balance**)
- **Net income balance** between income received from the rest of the world and income paid to foreigners
- **Net transfer received** (difference in foreign aid given and received)

Current account balance: sum of net payments to/from rest of the world

- **Current account surplus**: positive net payments from rest of the world
- **Current account deficit**: negative net payments from rest of the world

Openness in Financial Markets

Capital account: transactions record net foreign holdings of domestic assets

Net capital flows or **capital account balance**: an increase in net foreign indebtedness (holdings of domestic assets minus the increase in domestic holdings of foreign assets)

- **Capital account surplus**: positive net capital flows
- **Capital account deficit**: negative net capital flows

Openness in Financial Markets

- GDP measures value added domestically

- **Gross national product (GNP)** measures the value added by domestic factors of production

$$GNP = GDP + NI$$

where NI denotes net income payments received from the rest of the world less income paid to the rest of the world

University of Warwick

Macroeconomics 1 (EC108)

Lecture 5

Consumption

Lecturer: Natalie Chen

Consumption

An introduction to the most prominent work on consumption, including

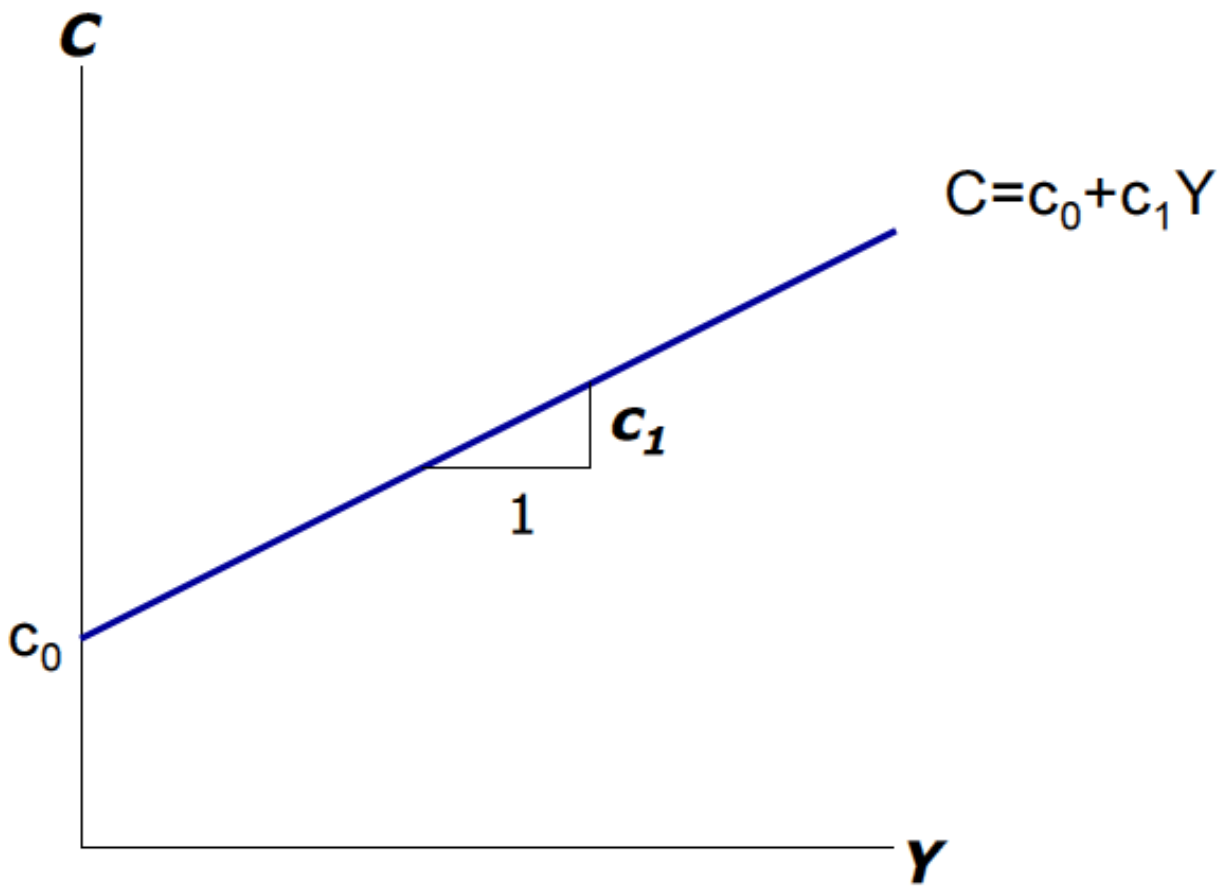
- John Maynard Keynes: consumption and current income
- Irving Fisher and intertemporal choice
- Franco Modigliani: the life-cycle hypothesis
- Milton Friedman: the permanent income hypothesis
- Expectations

Keynes's Conjectures

Recall the Keynesian Consumption Function that we saw in lecture 2. For simplicity, assume here that income Y is the same as disposable income Y_D

1. $0 < MPC < 1$
2. Average propensity to consume (APC) falls as income rises ($APC = C/Y$)
3. Income is the main determinant of consumption

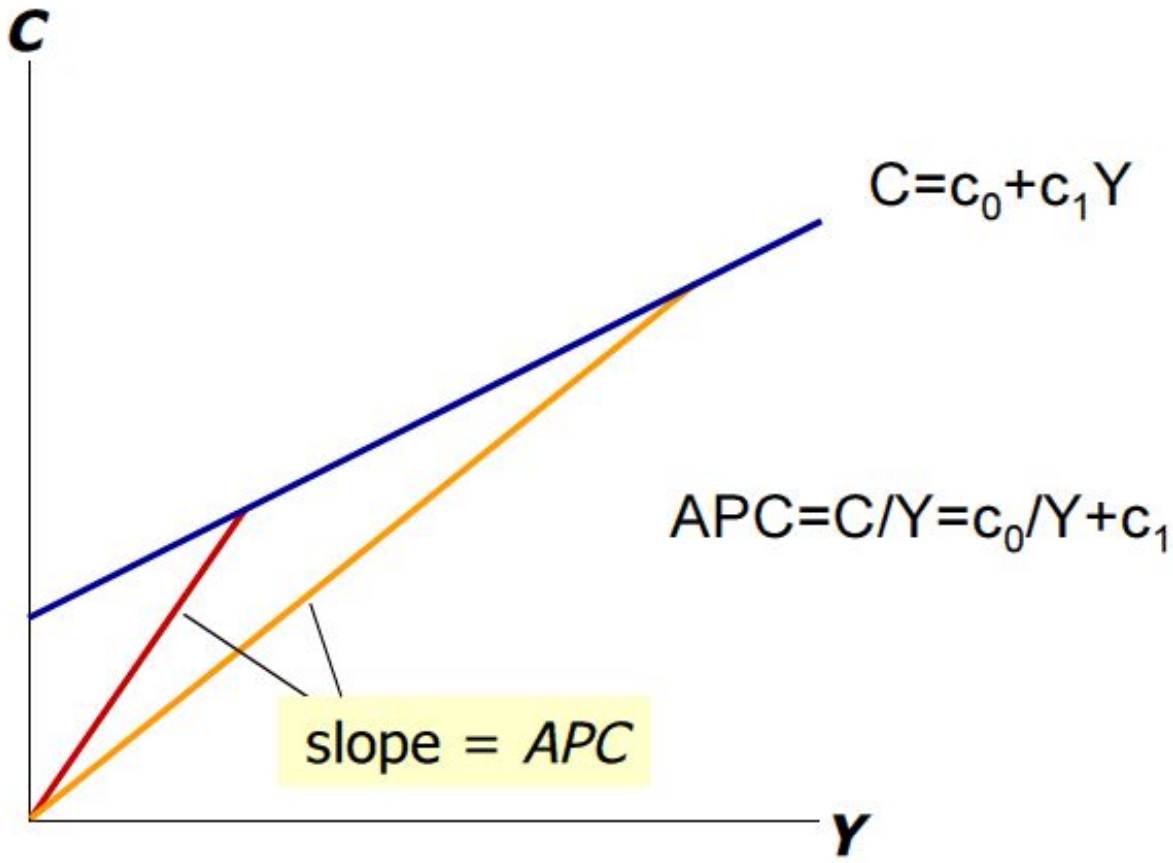
The Keynesian Consumption Function



Source: Mankiw (2015)

The Keynesian Consumption Function

As income rises, consumers save a bigger fraction of their income, so APC falls



Source: Mankiw (2015)

The Keynesian Consumption Function

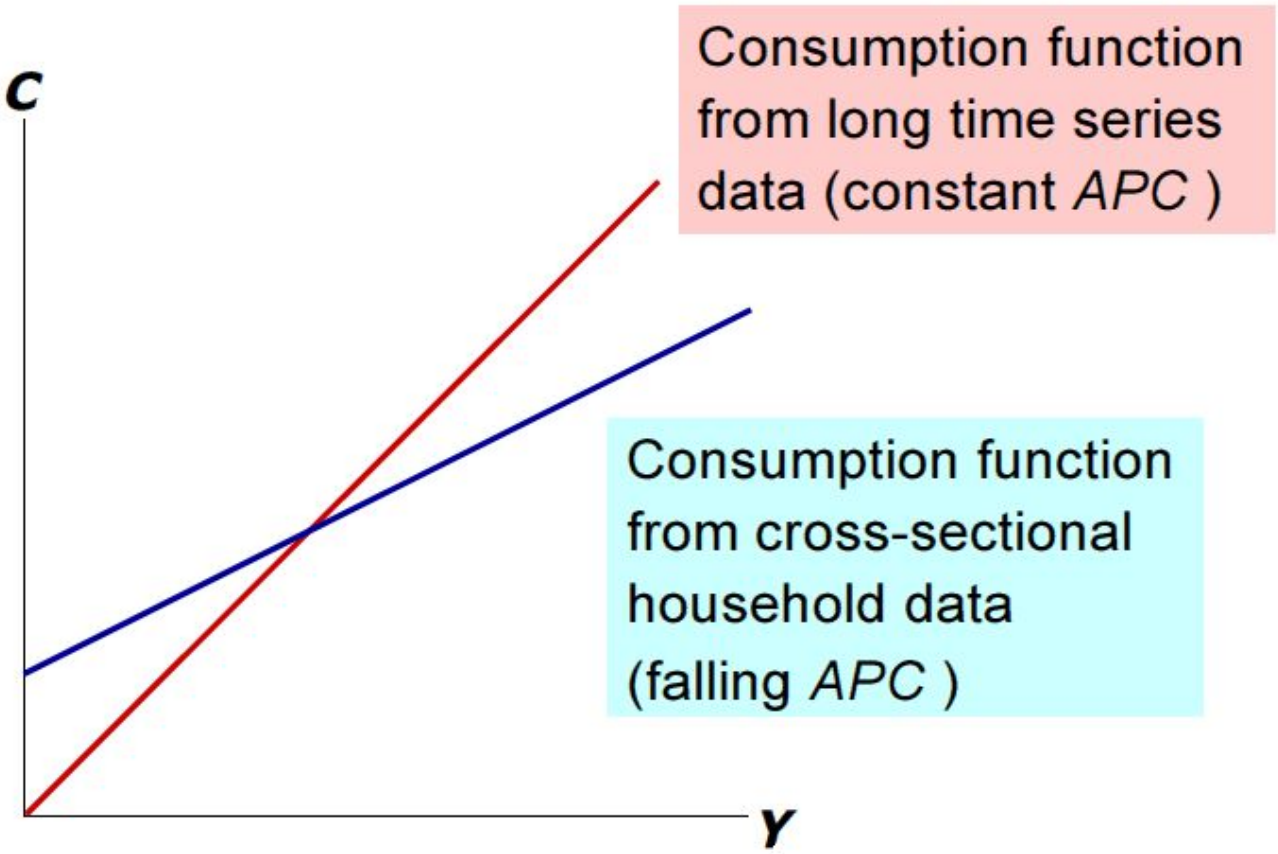
- Households with higher incomes
  - Consume more so $MPC > 0$
  - Save more so $MPC < 1$
  - Save a larger fraction of their income, so the APC falls as Y increases
- Very strong correlation between income and consumption: income seemed to be the main determinant of consumption

Keynesian Consumption Function: Problems

- Based on the Keynesian consumption function, economists predicted that C would grow more slowly than Y over time (APC falls)

- This prediction did not come true. Evidence showed that C/Y was very stable in long time series data (i.e., APC did not fall, and C grew at the same rate as income)

The Consumption Puzzle



Source: Mankiw (2015)

Irving Fisher and Intertemporal Choice

- The basis for much subsequent work on consumption
- Assumes consumer is forward-looking and chooses consumption for the present and future to maximize lifetime satisfaction
- Consumer's choices are subject to an **intertemporal budget constraint**, a measure of the total resources available for present and future consumption

The Basic Two-Period Model

- Period 1: the present
- Period 2: the future
- Notation
  - $Y_1, Y_2 =$ income in period 1, 2
  - $C_1, C_2 =$ consumption in period 1, 2
  - $S = Y_1 - C_1 =$ saving in period 1
  - ($S < 0$ if the consumer borrows in period 1)

Deriving the Intertemporal Budget Constraint

- Period 2 budget constraint

$$\begin{aligned} C_2 &= Y_2 + (1+r)\,S \\ &= Y_2 + (1+r)\,(Y_1 - C_1) \end{aligned}$$

- Rearrange terms

$$(1+r)\,C_1 + C_2 = Y_2 + (1+r)\,Y_1$$

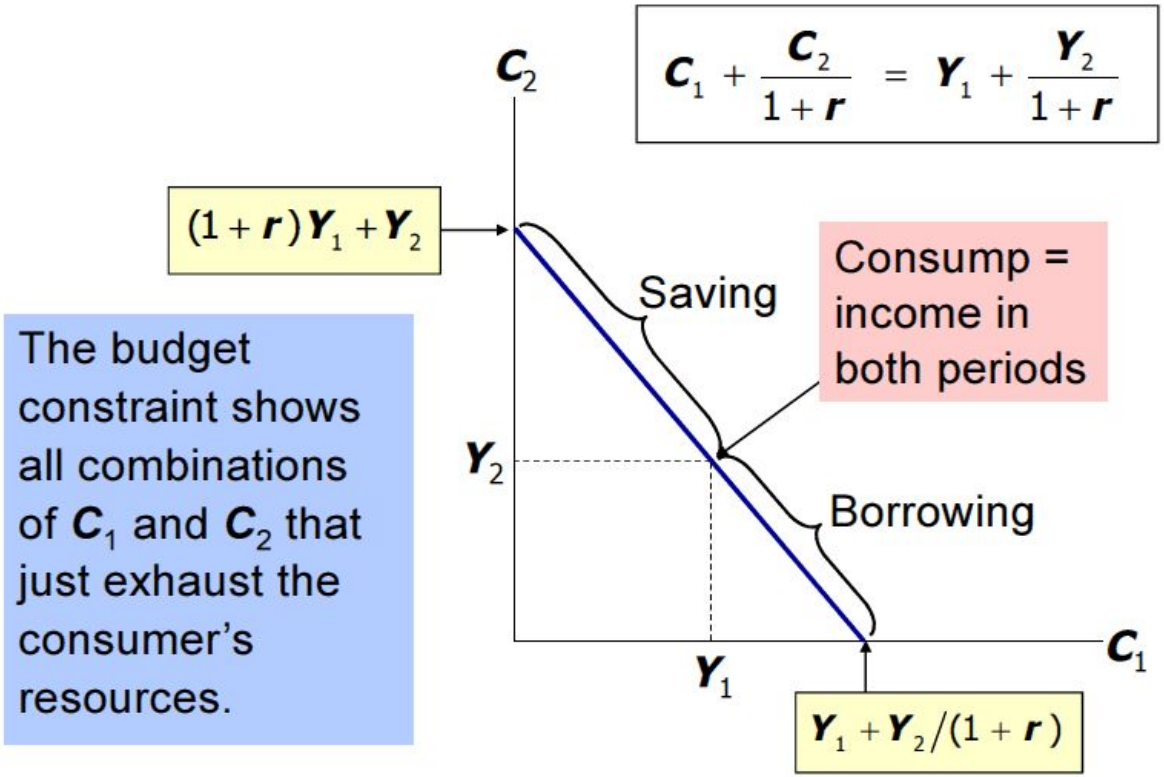
- Divide through by $(1+r)$ to get the intertemporal budget constraint

The Intertemporal Budget Constraint

$$C_1 + \frac{C_2}{1+r} = Y_1 + \frac{Y_2}{1+r}$$

- Present value of lifetime consumption $C_1 + \frac{C_2}{1+r}$
- Present value of lifetime income $Y_1 + \frac{Y_2}{1+r}$

The Intertemporal Budget Constraint

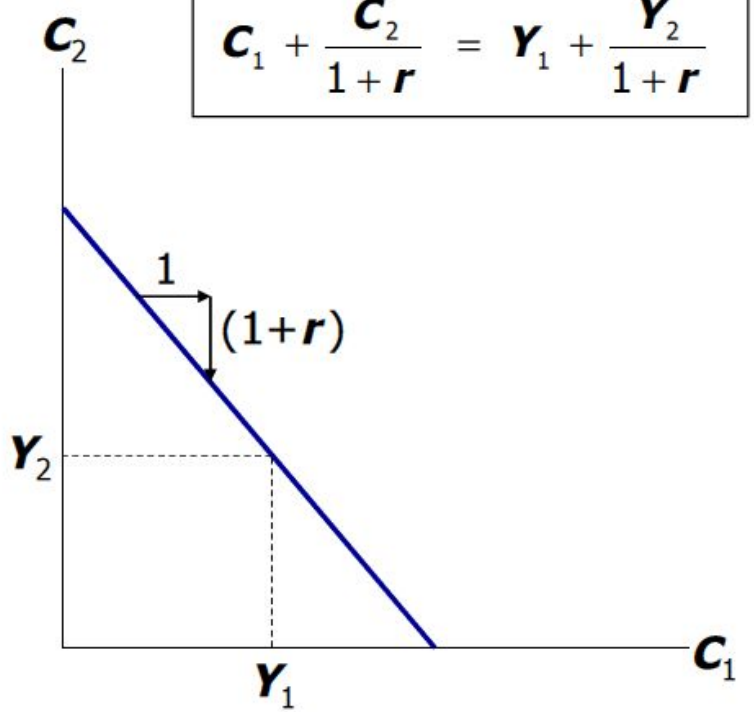


Source: Mankiw (2015)

The Intertemporal Budget Constraint

The slope of the budget line equals $-(1+r)$

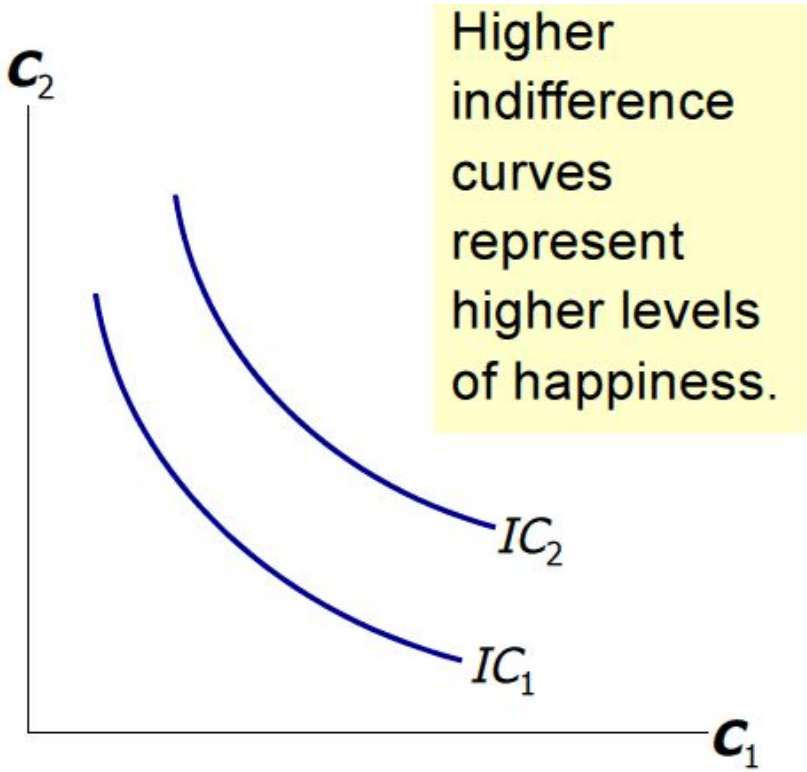
$$C_1 + \frac{C_2}{1+r} = Y_1 + \frac{Y_2}{1+r}$$



Source: Mankiw (2015)

Consumer Preferences

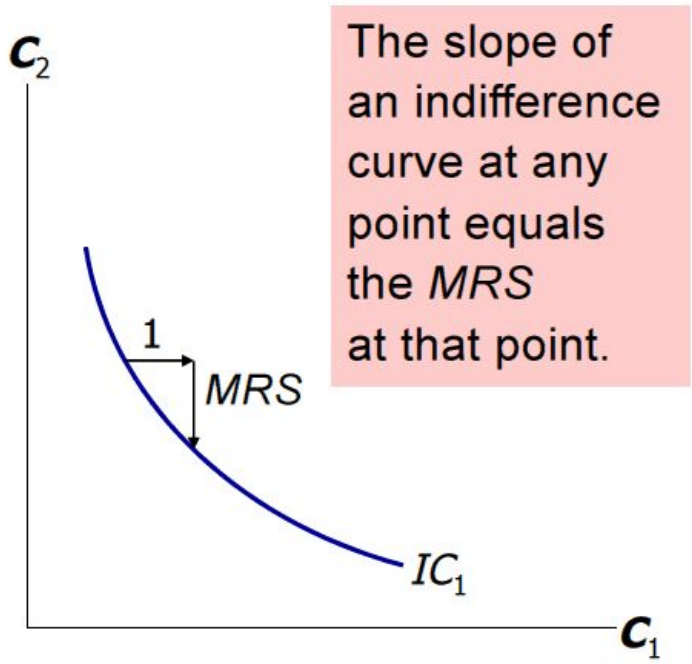
An **indifference curve** shows all combinations of C_1 and C_2 that make the consumer equally happy



Source: Mankiw (2015)

Consumer Preferences

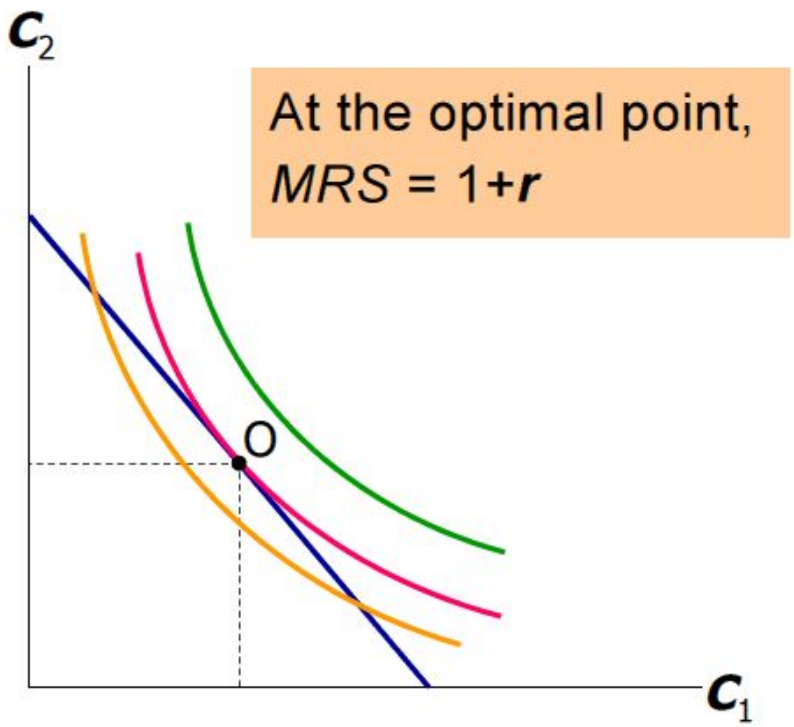
Marginal rate of substitution (MRS): the amount of C_2 the consumer would be willing to substitute for one unit of C_1



Source: Mankiw (2015)

Optimization

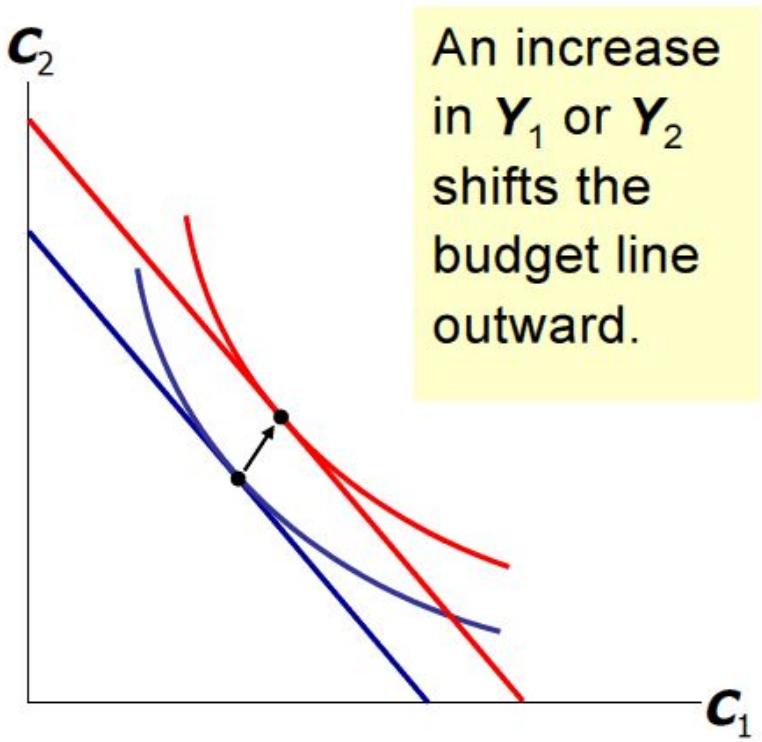
The optimal (C_1, C_2) is where the budget line just touches the highest indifference curve



Source: Mankiw (2015)

How C Responds to Changes in Y

Provided they are both normal goods, C_1 and C_2 both increase, regardless of whether the income increase occurs in period 1 or period 2



Source: Mankiw (2015)

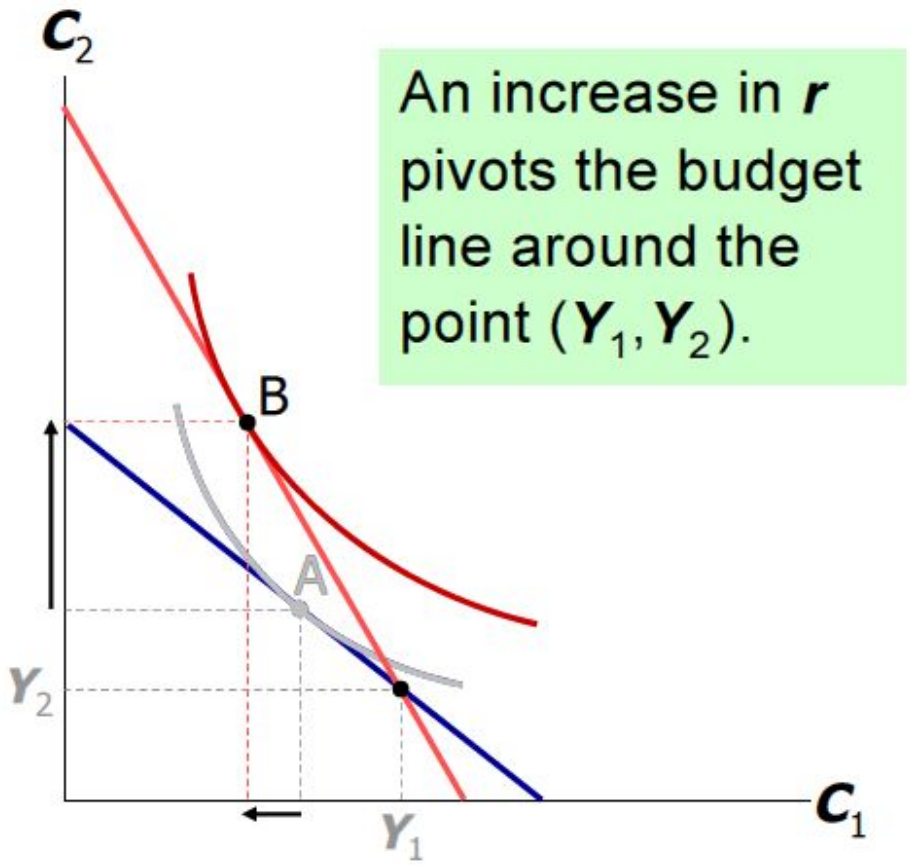
Keynes versus Fisher

- Keynes: current consumption depends only on current income

- Fisher: current consumption depends only on the present value of lifetime income. The timing of income is irrelevant because the consumer can borrow or lend between periods

How C Responds to Changes in r

As depicted here, C_1 falls and C_2 rises. But it could turn out differently...



Source: Mankiw (2015)

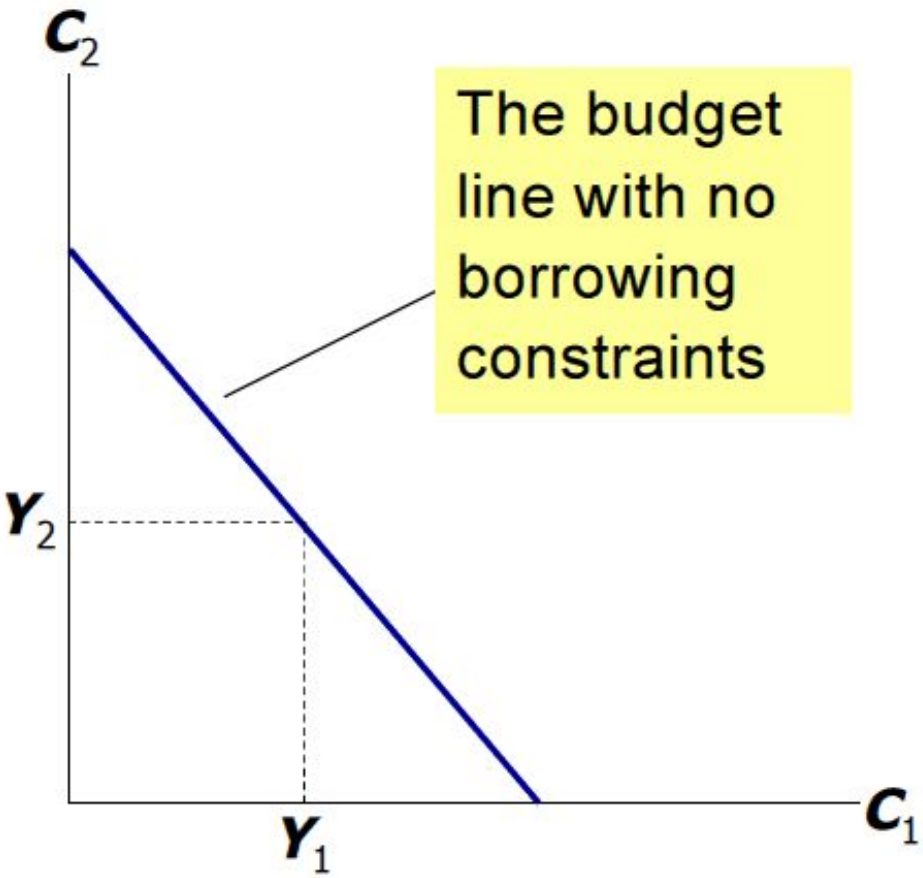
How C Responds to Changes in r

- **Income effect**: if the consumer is a saver, the rise in r makes him better off, which tends to increase consumption in both periods
- **Substitution effect**: the rise in r increases the opportunity cost of current consumption, which tends to reduce C_1 and increase C_2
- Both effects imply that C_2 rises
- Whether C_1 rises or falls depends on the relative size of the income and substitution effects

Constraints on Borrowing

- In Fisher's theory, the timing of income is irrelevant: consumers can borrow and lend across periods
- Example: if the consumer learns that his future income will increase, he can spread the extra consumption over both periods by borrowing in the current period
- However, if the consumer faces borrowing constraints (i.e., "liquidity constraints"), then he may not be able to increase current consumption
- ...and his consumption may behave as in the Keynesian theory even though he is rational and forward-looking

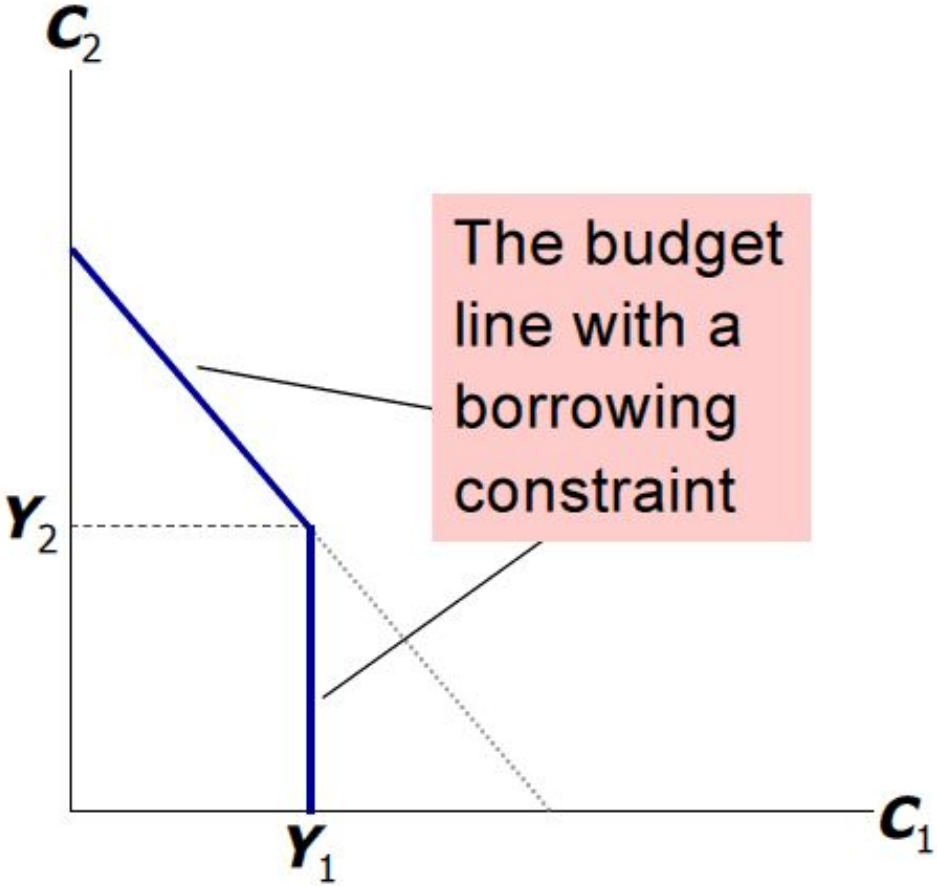
Constraints on Borrowing



Source: Mankiw (2015)

Constraints on Borrowing

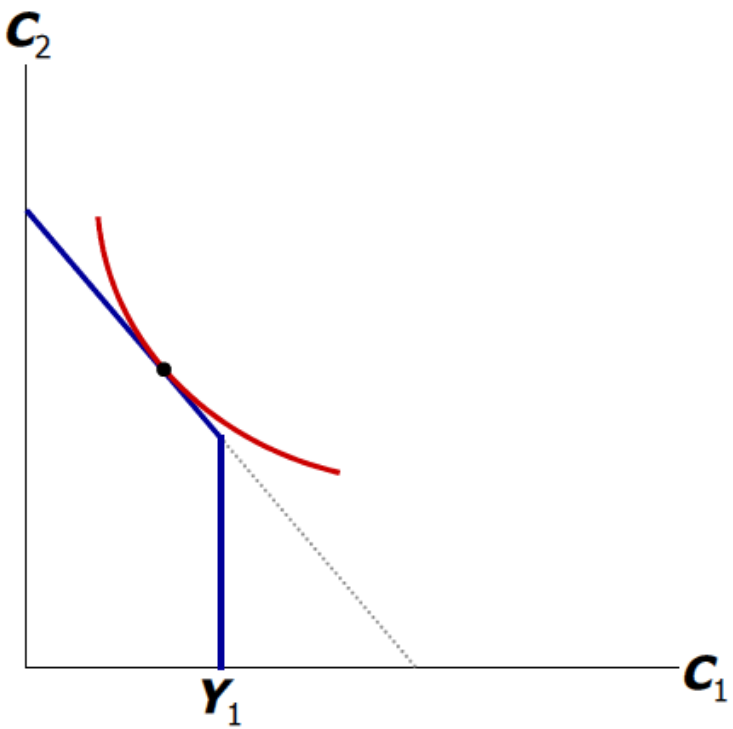
The borrowing constraint takes the form $C_1 \leq Y_1$



Source: Mankiw (2015)

Borrowing Constraint is not Binding

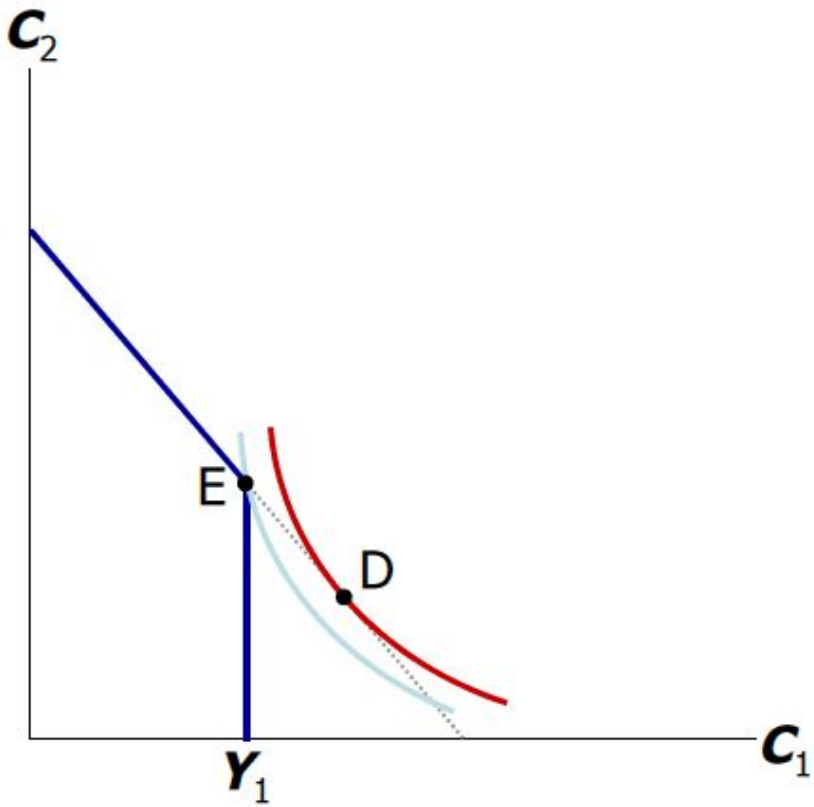
The borrowing constraint is not binding if the consumer's optimal C_1 is less than Y_1



Source: Mankiw (2015)

Borrowing Constraint is Binding

The optimal choice is at point D. But since the consumer cannot borrow, the best he can do is point E



Source: Mankiw (2015)

The Life-Cycle Hypothesis

- Due to Franco Modigliani (1950s)
- Fisher's model says that consumption depends on lifetime income, and people try to smooth consumption
- The LCH says that income varies systematically over the phases of the consumer's "life cycle"
- And, saving allows the consumer to achieve smooth consumption

The Life-Cycle Hypothesis

- The basic model
  - $W =$ initial wealth
  - $Y =$ annual income until retirement (assumed constant)
  - $R =$ number of years until retirement
  - $T =$ lifetime in years
- Assumptions
  - Zero real interest rate (for simplicity)
  - Consumption-smoothing is optimal

The Life-Cycle Hypothesis

- Lifetime resources $= W + RY$
- To achieve smooth consumption, consumer divides his resources equally over time

$$\begin{aligned} C &= (W + RY)/T, \ or \\ C &= \alpha W + \beta Y \end{aligned}$$

where

- $\alpha = (1/T)$ is the marginal propensity to consume out of wealth
- $\beta = (R/T)$ is the marginal propensity to consume out of income

Implications of the Life-Cycle Hypothesis

The LCH can explain the consumption puzzle

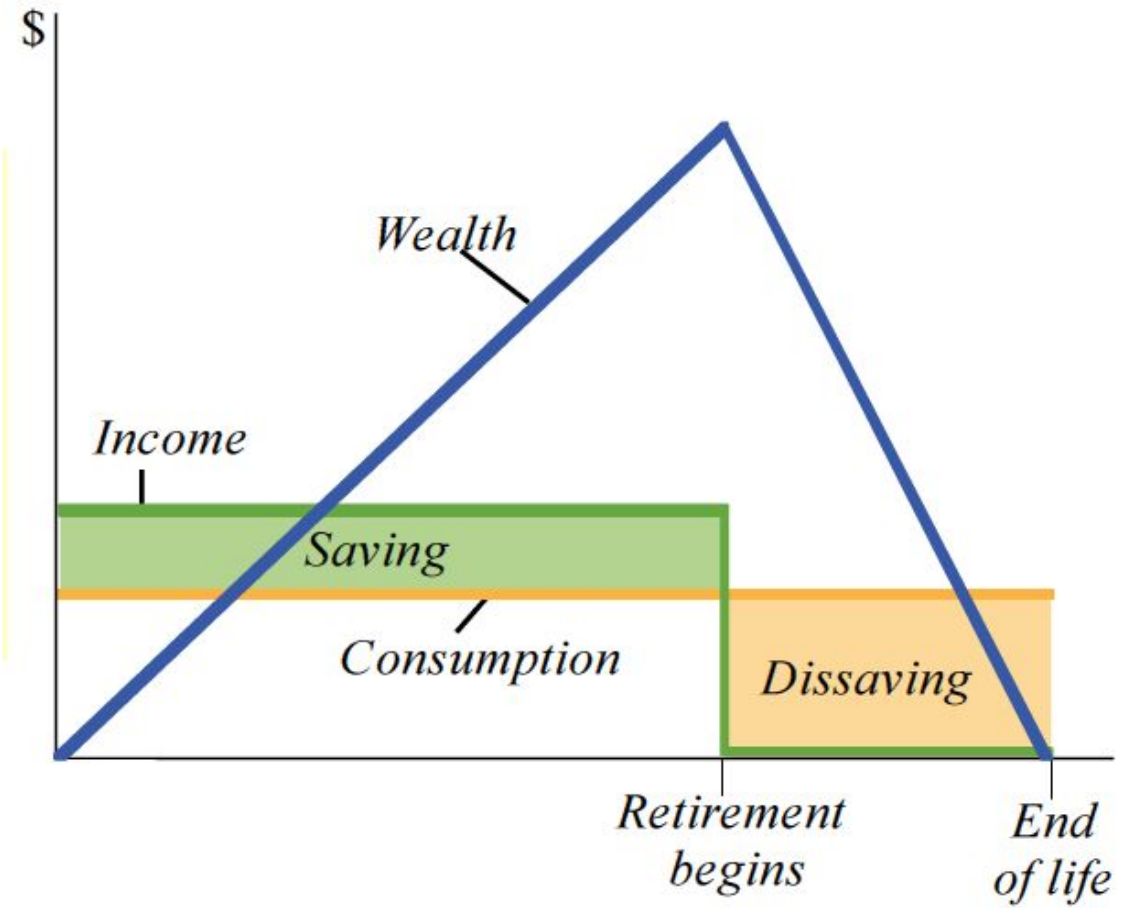
- The life-cycle consumption function implies

$$APC = C/Y = \alpha(W/Y) + \beta$$

- Across households, income varies more than wealth, so high-income households should have a lower APC than low-income households
- Over time, aggregate wealth and income grow together, causing APC to remain stable

Implications of the Life-Cycle Hypothesis

The LCH implies that saving varies systematically over a person's lifetime



Source: Mankiw (2015)

The Permanent Income Hypothesis

- Due to Milton Friedman (1957)
- $Y = Y^P + Y^T$ where
  - $Y =$ current income
  - $Y^P =$ **permanent income** (average income, which people expect to persist into the future)
  - $Y^T =$ **transitory income** (temporary deviations from average income)

The Permanent Income Hypothesis

- Consumers use saving and borrowing to smooth consumption in response to transitory changes in income
- The PIH consumption function

$$C = \alpha Y^P$$

where α is the fraction of permanent income that people consume per year

The Permanent Income Hypothesis

The PIH can explain the consumption puzzle

- The PIH implies

$$APC = C/Y = \alpha Y^P/Y$$

- If high-income households have higher transitory income than low-income households, APC is lower in high-income households
- Over the long run, income variation is due mainly (if not solely) to variation in permanent income, which implies a stable APC

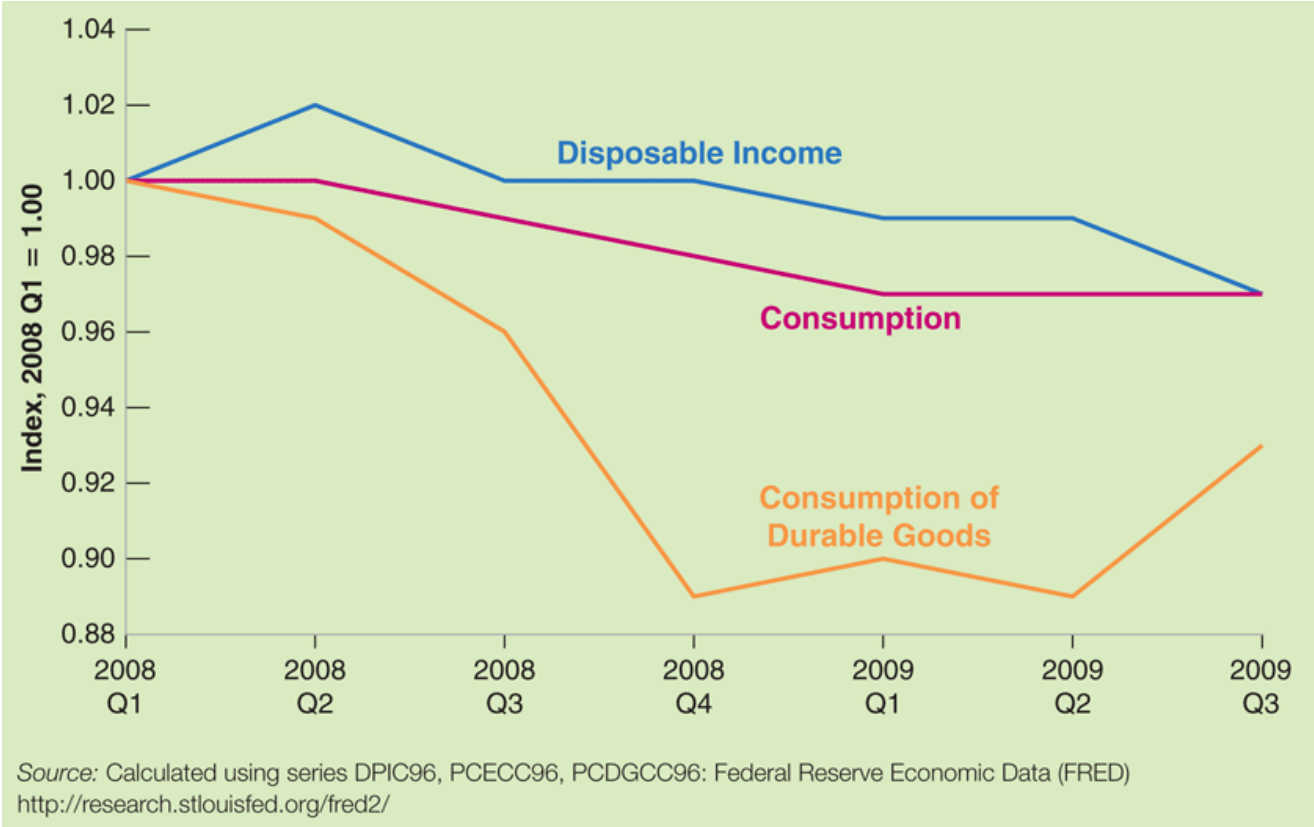
The PIH versus LCH

- Both: people try to smooth their consumption in the face of changing current income
- LCH: current income changes systematically as people move through their life cycle
- PIH: current income is subject to random, transitory fluctuations
- Both can explain the consumption puzzle

Expectations

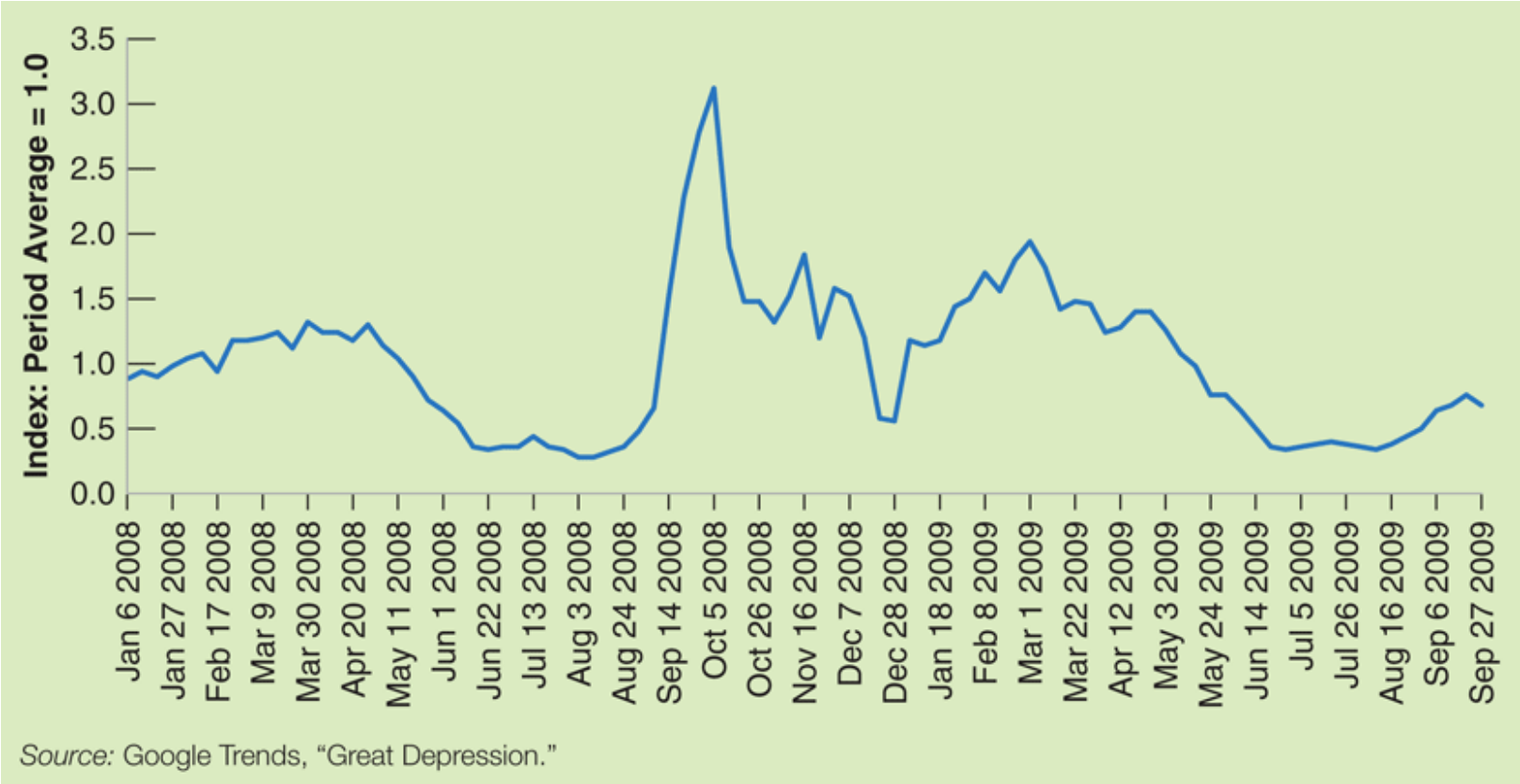
- When people start worrying about the future, they decide to save more even if their current income has not changed
- News about Lehman Brothers going bankrupt in September 2008 reminded people of the Great Depression, as confirmed by the number of searches for "Great Depression" in Google
- Consumption fell even if disposable income had not yet changed

The Lehman Bankruptcy and Consumption



Disposable Income, Consumption, and Consumption Of Durables in the US, 2008:1 to 2009:3 (Blanchard, 2017)

The Lehman Bankruptcy and Consumption



Google Search Volume for "Great Depression," Jan 2008 to Sept 2009 (Blanchard, 2017)

University of Warwick

Macroeconomics 1 (EC108)

Lecture 6

Investment

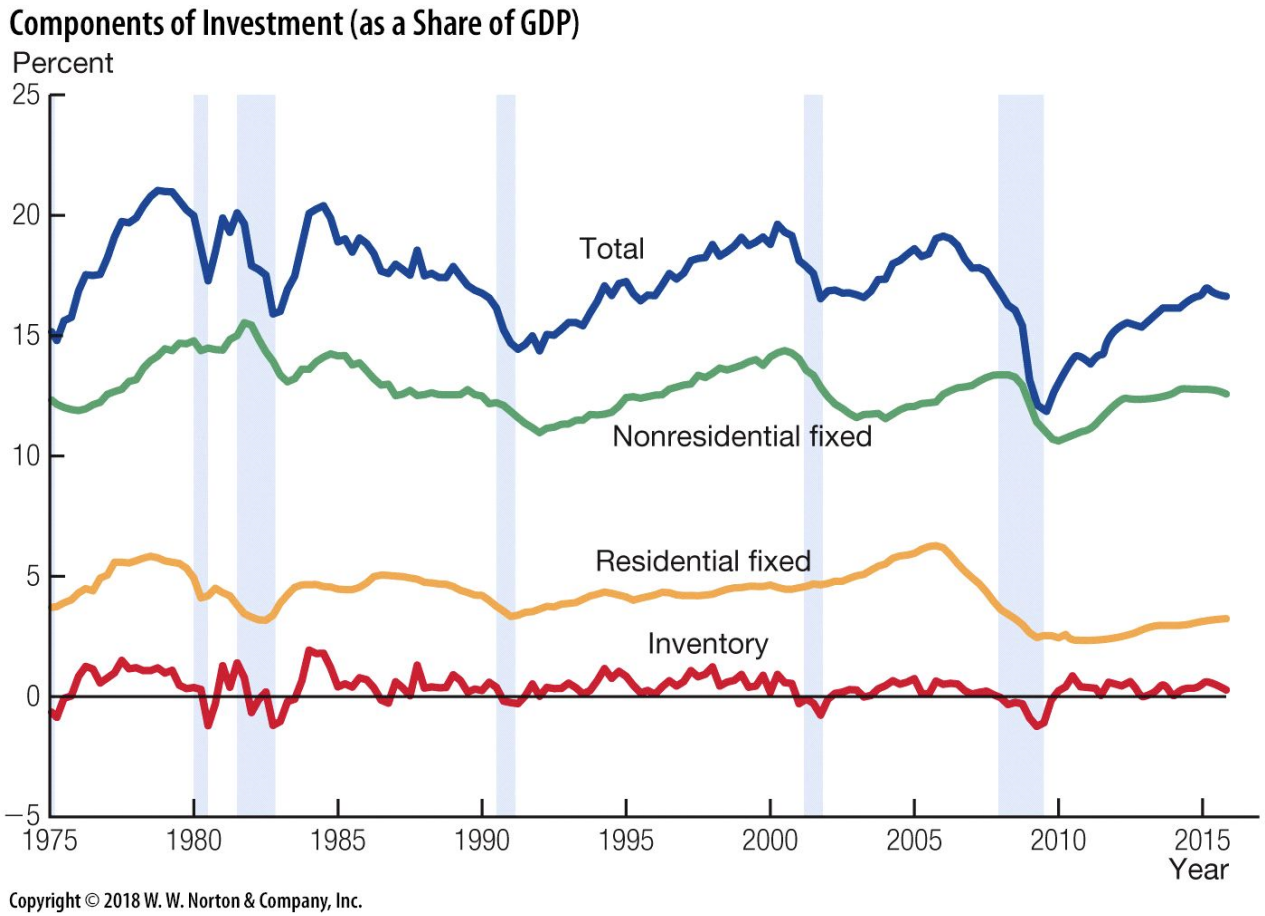
Lecturer: Natalie Chen

Investment

- Investment is the accumulation of physical capital – tangible assets used in the production process (e.g., houses, computers, machine tools, as well as increases in inventories of goods to be sold at a future date)
- Three types of investment
  - **Business fixed investment**: businesses' spending on equipment and structures for use in production
  - **Residential investment**: purchases of new housing units (either by occupants or landlords)
  - **Inventory investment**: the value of the change in inventories of finished goods, materials and supplies, and work in progress

Investment

Different types of investment, US 1975–2015



Source: Jones (2017)

Investment

How do firms make investment decisions?

- Examples: should Amazon build a new distribution centre? Should Morrisons open another store in Coventry?
- Investment occurs
  - To bring the capital stock to its desired level
  - To make up for capital lost through depreciation
- Investment decisions by firms depend on
  - Current sales
  - Real interest rate
  - Expectations about the future
- Firms need to decide what is the **optimal capital stock**

Investment: Outline

- The optimal stock of capital
- Forward looking behavior (present value calculations)
- Tobin's q theory of investment

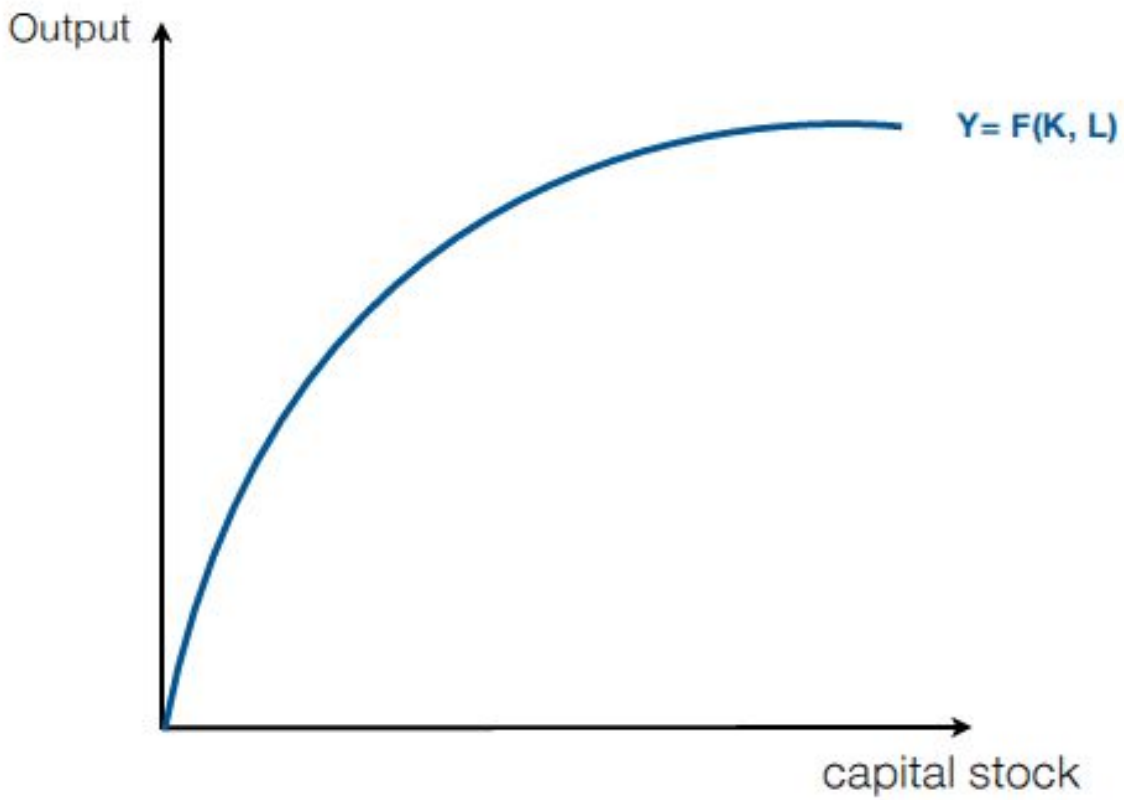
The Optimal Stock of Capital

Marginal productivity of capital (MPK)

- Amount of extra output that can be obtained when an additional unit of capital is installed (return from an additional unit of capital)
- Slope of the production function
- Principle of declining marginal productivity
- Assume labor input is constant (focus on capital only)

The Optimal Stock of Capital

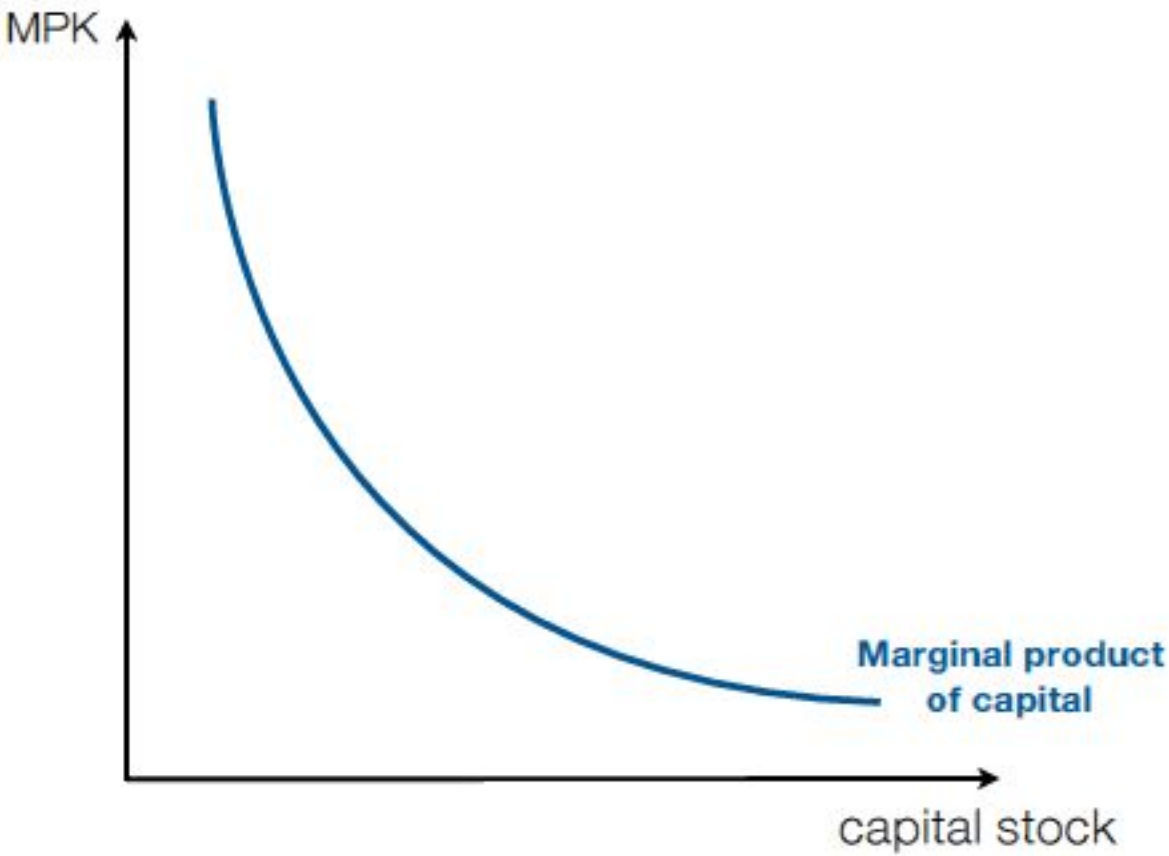
Marginal productivity of capital (MPK)



K is capital, L is labor, $Y = F(K, L)$ is the production function

The Optimal Stock of Capital

Marginal productivity (or product) of capital $MPK = \frac{\partial F(K,L)}{\partial K}$



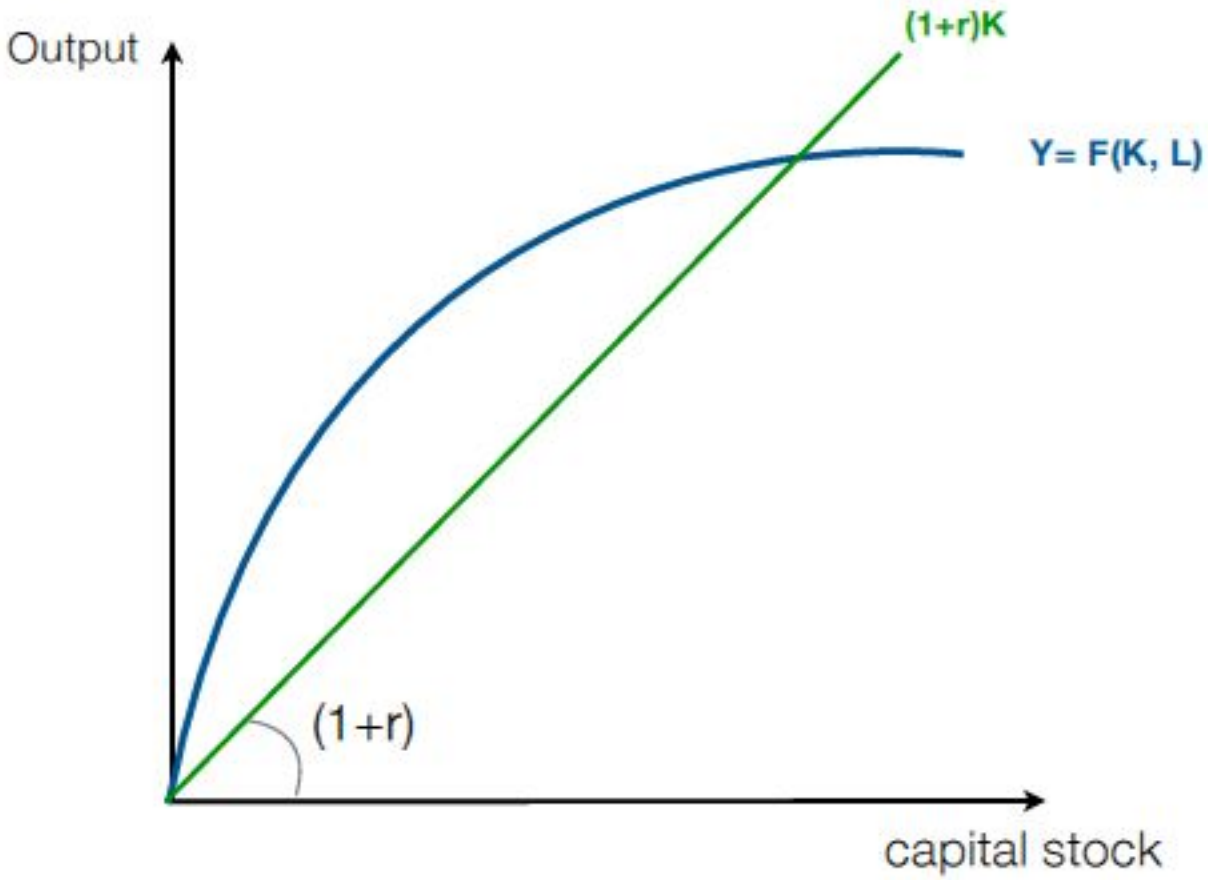
The Optimal Stock of Capital

Investment is funded

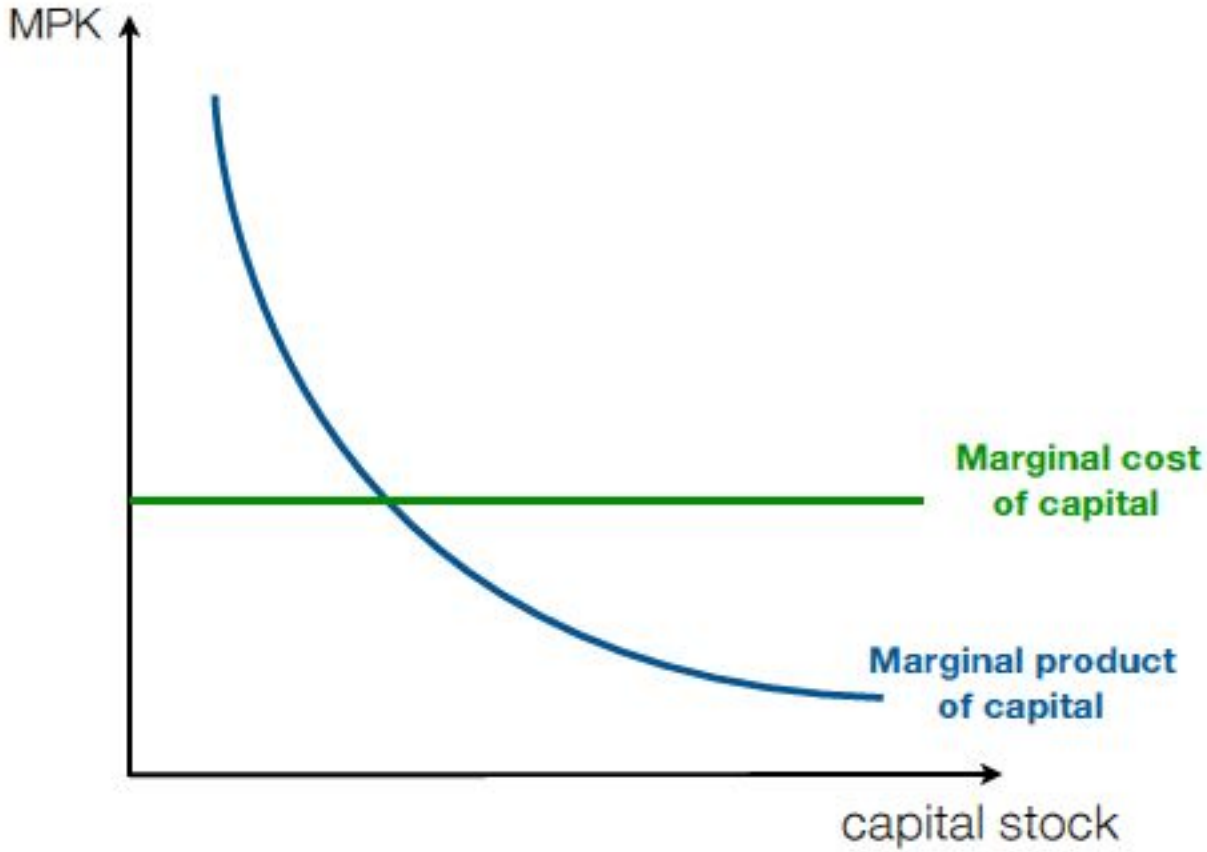
- With resources that could instead be invested in financial assets – opportunity cost of the investment $(1 + r)$

- By borrowing – marginal cost of investment $(1 + r)$

The Optimal Stock of Capital



The Optimal Stock of Capital



The Optimal Stock of Capital

- The firm's profits after making the investment is

$$\text{profit} = F(K, L) - (1 + r) K$$

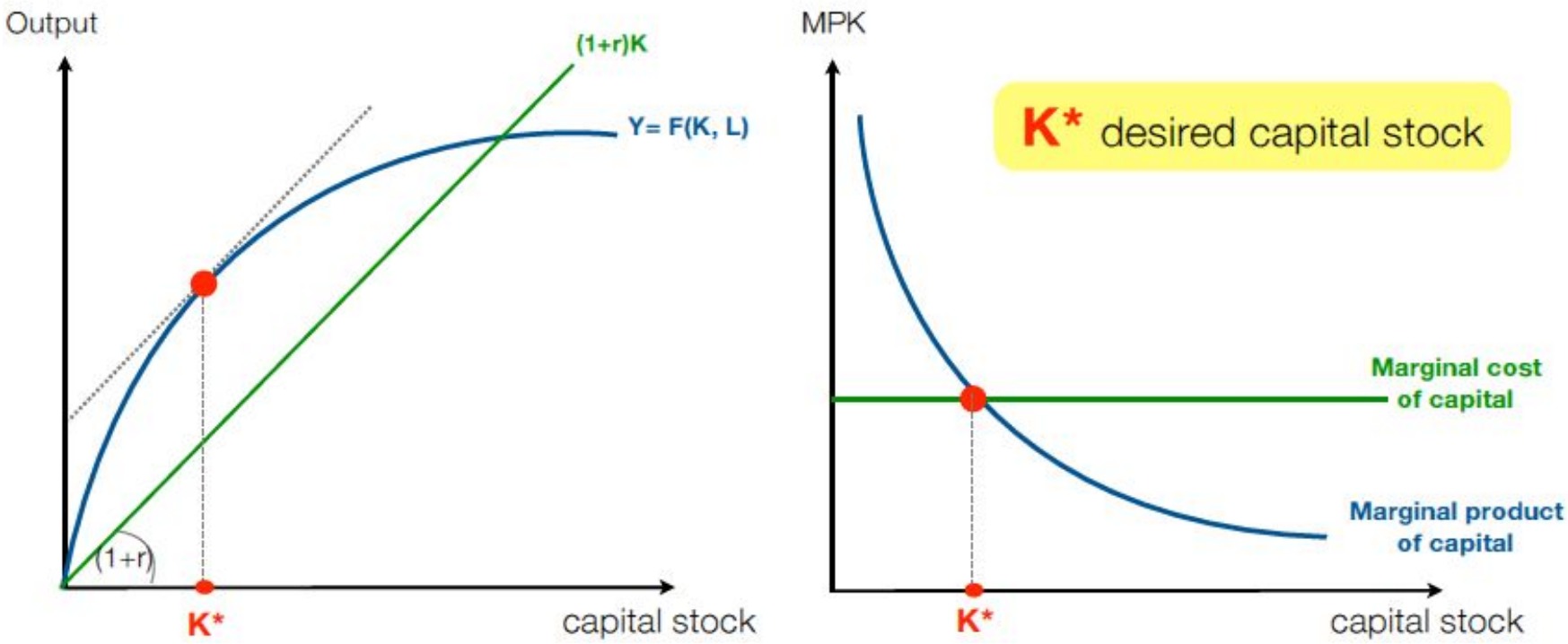
  which is captured by the vertical distance between the production function $Y = F(K, L)$ and total cost $(1 + r) K$

- To maximize profits, the firm chooses the optimal capital stock that maximizes this vertical distance

- This happens where the slope of the production function is equal to the slope of the total cost of capital, i.e.

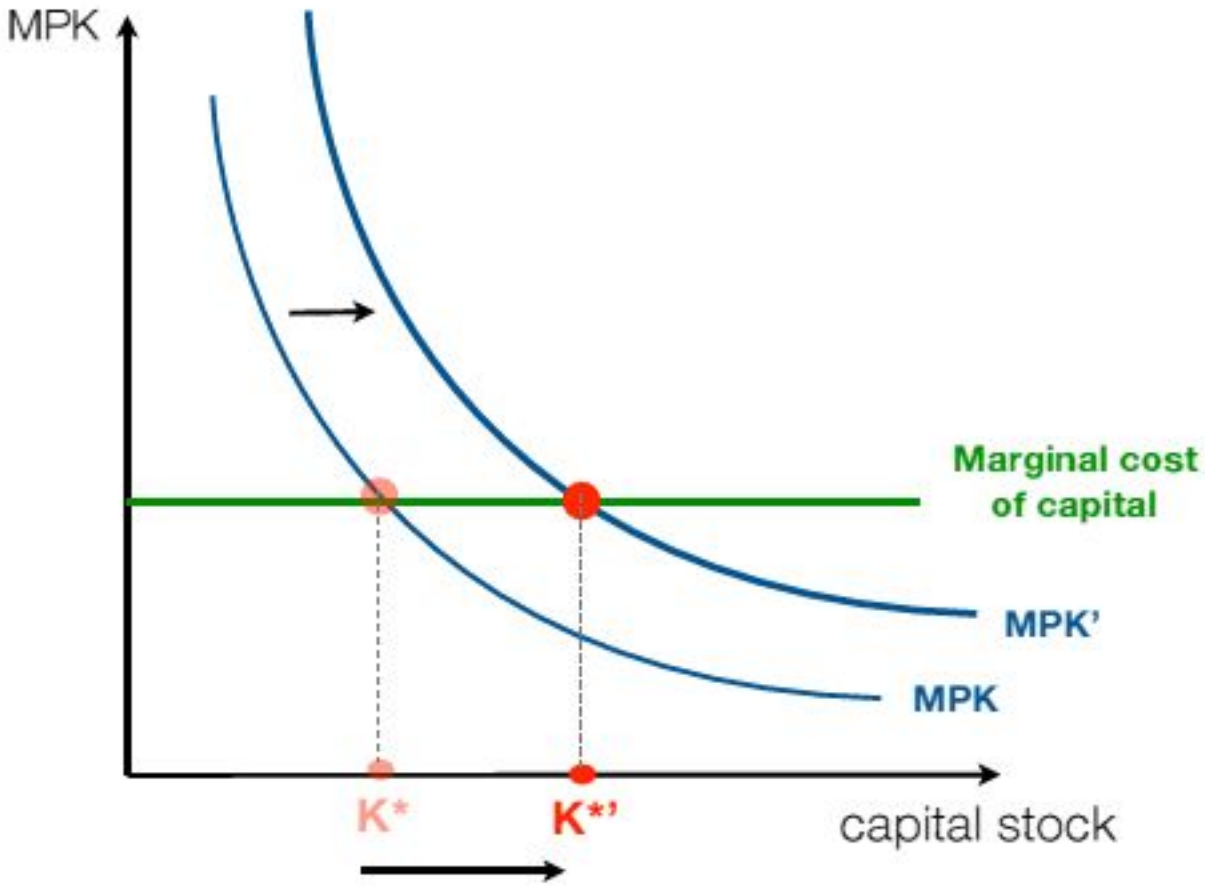
$$MPK = (1 + r)$$

The Optimal Stock of Capital



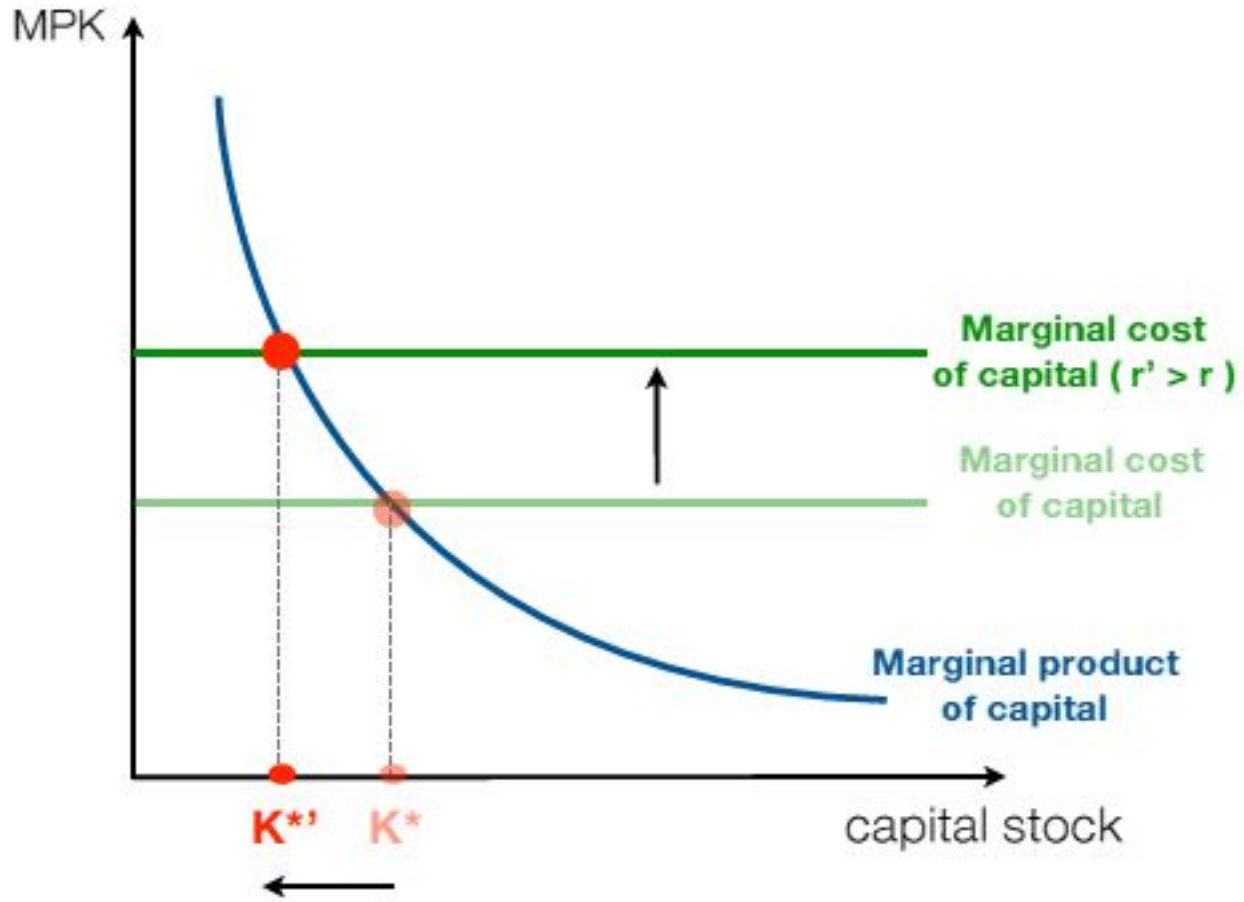
The Optimal Stock of Capital

Improvement in technology



The Optimal Stock of Capital

Increase in real interest rate



Depreciation Rate

- Resale market for capital goods: in calculating the optimal stock of capital, need to consider if firms can resell some of their equipment
- Without depreciation we have

$$\begin{aligned} MPK + 1 &= 1 + r \\ MPK &= r \end{aligned}$$

- However, if installed capital loses value over time (resale value decreases)

$$MPK + (1 - \delta) = 1 + r$$

where $(1 - \delta)$ is the resale value

$$MPK = r + \delta$$

where δ is the **depreciation** as an additional cost of capital and $(r + \delta)$ is the **user cost** of capital

The Optimal Stock of Capital

Arbitrage condition

$$MPK = r + \delta$$

The optimal capital stock depends

- Positively on the expected effectiveness of the available technology (MPK)
- Negatively on the user cost of capital

Investment Demand

Investment occurs

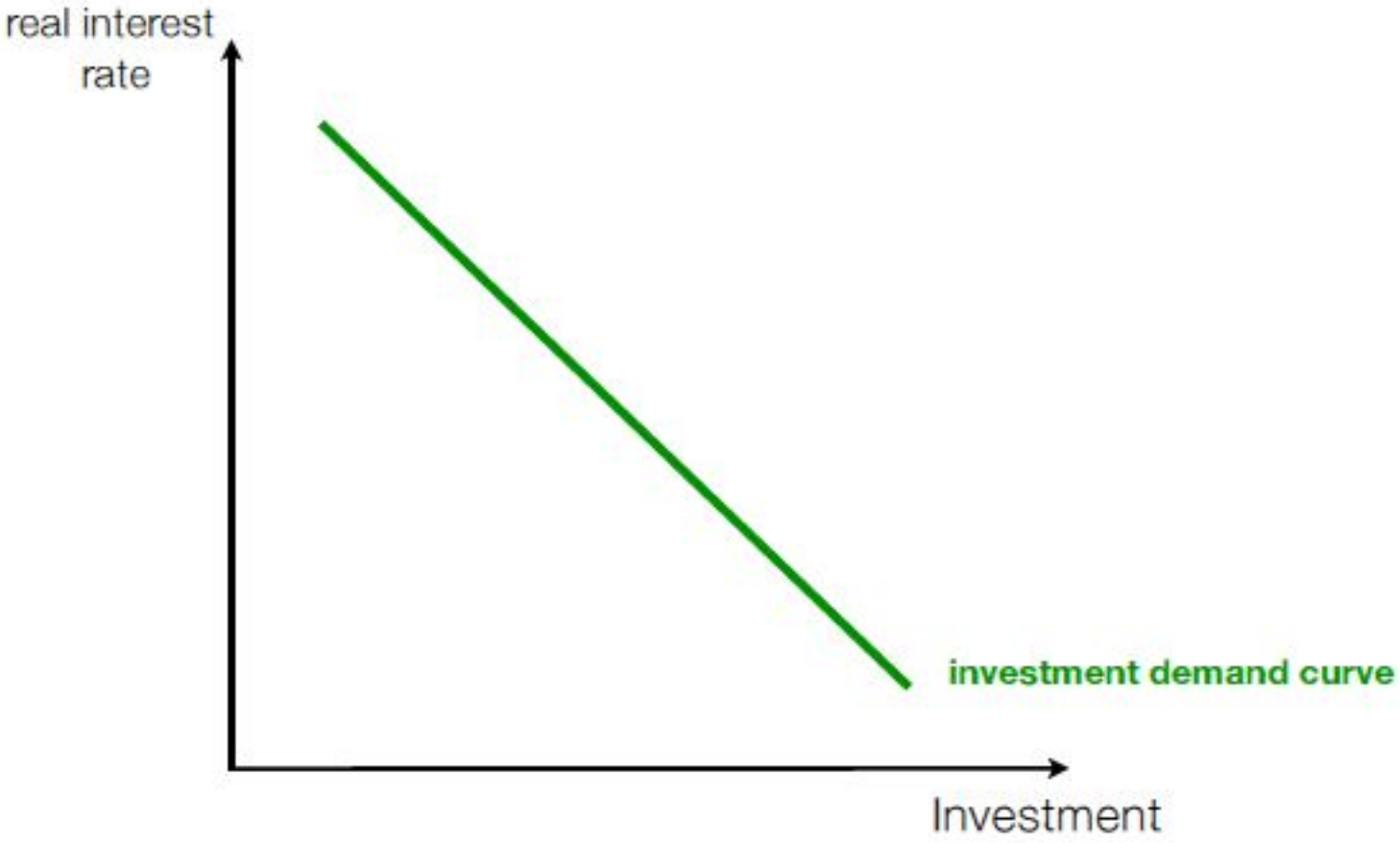
- To bring the capital stock to its desired level
- To make up for capital lost through depreciation

$$\begin{aligned} K_{t+1} &= I_t + (1-\delta) K_t \\ I_t &= K_{t+1} - (1-\delta) K_t \end{aligned}$$

- If $\delta = 0$,

$$I_t = \Delta K_{t+1}$$

Investment Demand



Investment demand is negatively related to the real interest rate

Forward Looking Behavior

Present value calculations

- The investment decisions of firms depend on their **expectations** about the future (i.e., the future demand for their products and input costs)

- A firm will undertake an investment only if it offers a return that is higher than its costs. What if returns are spread over future years? Assuming that the interest rate r remains constant, the **present value** of the income/profit received in the future is

$$V\left(\Pi_t^e\right) = \Pi_t + \frac{\Pi_{t+1}}{(1+r)} + \frac{\Pi_{t+2}}{(1+r)^2} + \frac{\Pi_{t+3}}{(1+r)^3} + \ldots$$

- If the cost of the machine is greater than the present value of the flow of revenues, then it is not profitable to buy the machine

Forward Looking Behavior

Intuition for present value calculation

- Suppose the interest rate is 10%. If I save $\pounds 100$ today, I will have $\pounds 110$ in a year's time ($\pounds 100(1+0.1) = \pounds 110$)
- This implies that $\pounds 110$ in a year's time has the same value as $\pounds 100$ today
- More generally, if interest rates are constant at r, the value of X in n years' time is the same as $X/(1+r)^n$
- Therefore, the present value of a stream of expected revenues Π_t^e from an investment project with revenues over T years is

$$V\left(\Pi_t^e\right) = \Pi_t + \frac{\Pi_{t+1}}{(1+r)} + \frac{\Pi_{t+2}}{(1+r)^2} + \frac{\Pi_{t+3}}{(1+r)^3} + ... + \frac{\Pi_{t+T}}{(1+r)^T}$$

Tobin's q Theory of Investment

An alternative theory of investment

- This theory was developed by Nobel Prize winner James Tobin
- It is **forward looking**. Firms choose the amount to invest with a view to maximizing expected discounted profits over the lifetime of the project

$$
\begin{aligned}
q &= \frac{\text{Market Value of the Firm}}{\text{Cost of Capital}} \\
&= \frac{\text{Value of the firm's capital as determined by the stock market}}{\text{Price of that capital if it were purchased today}}
\end{aligned}
$$

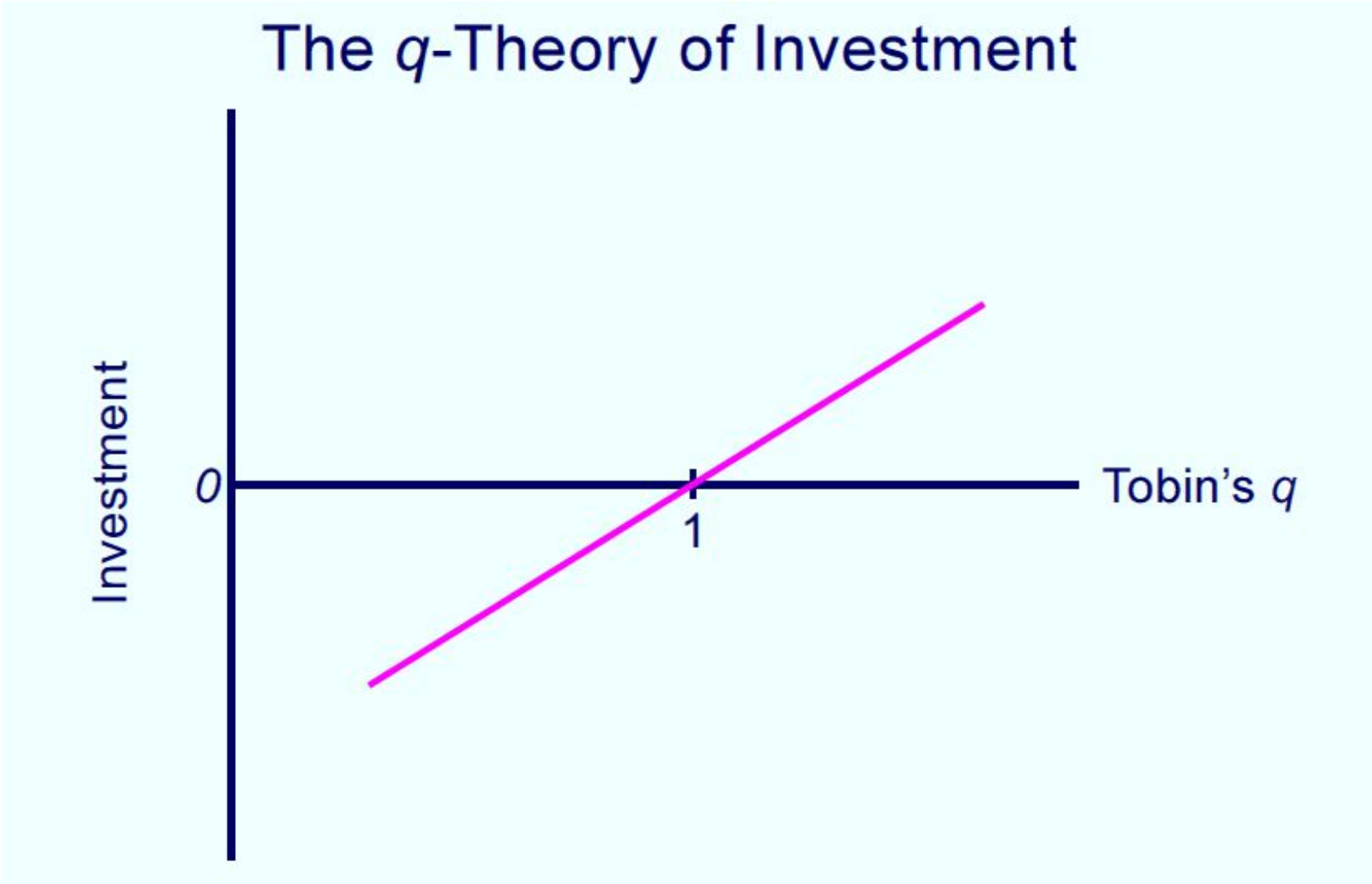
- The market value of the firm depends on **expected present and future profits**. This can be captured by the firm's stock market valuation
- The cost of capital is the replacement cost

Tobin's q Theory of Investment

$$q = \frac{\text{Market Value of the Firm}}{\text{Cost of Capital}}$$

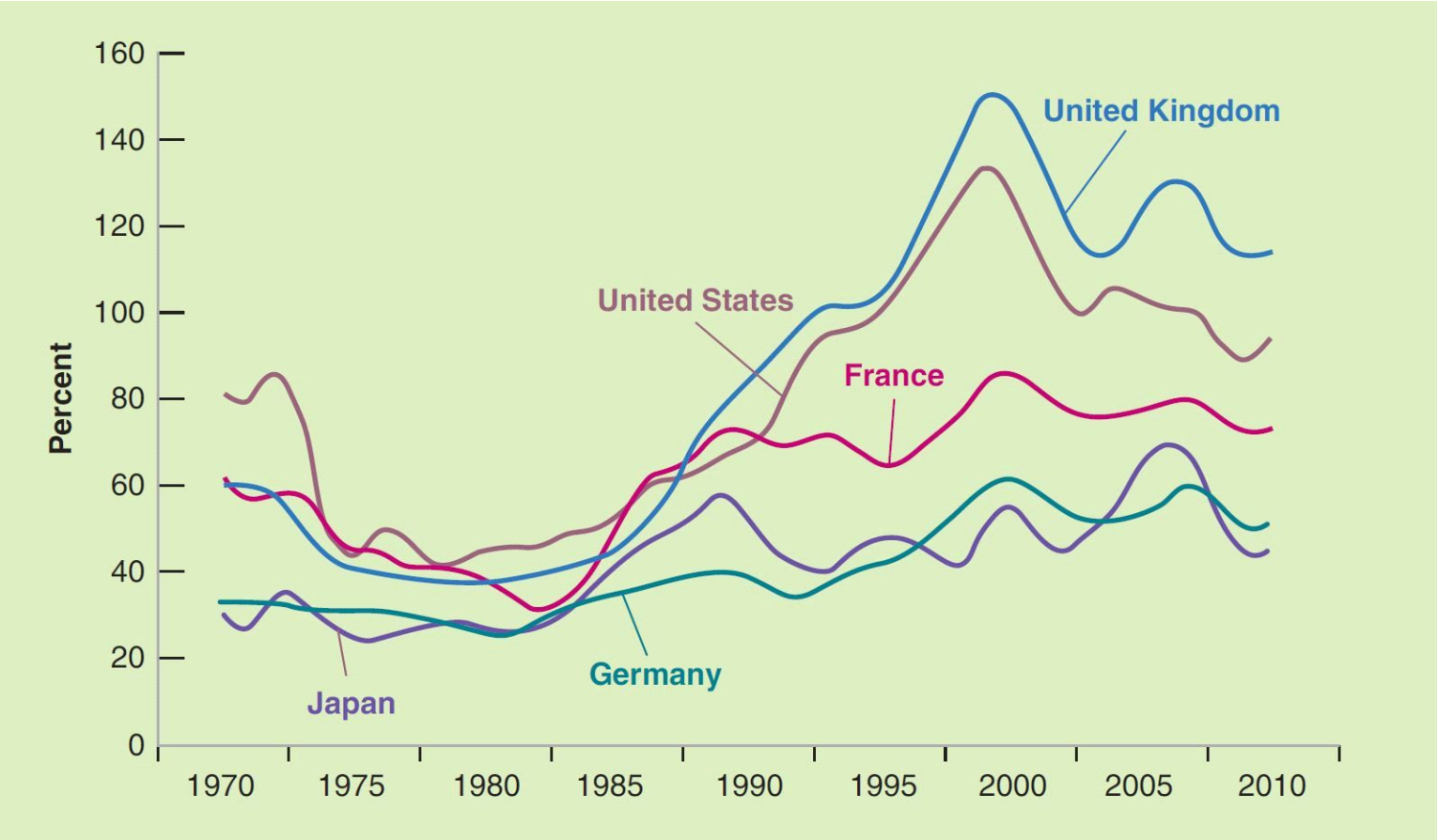
- $q > 1$: managers can raise the market value of their firm's stock by buying more capital
- $q < 1$: managers will not replace capital as it wears out

If the value of a company on the stock market is substantially larger than the replacement cost of the assets that the firm employs, then the company has a major incentive to increase investment



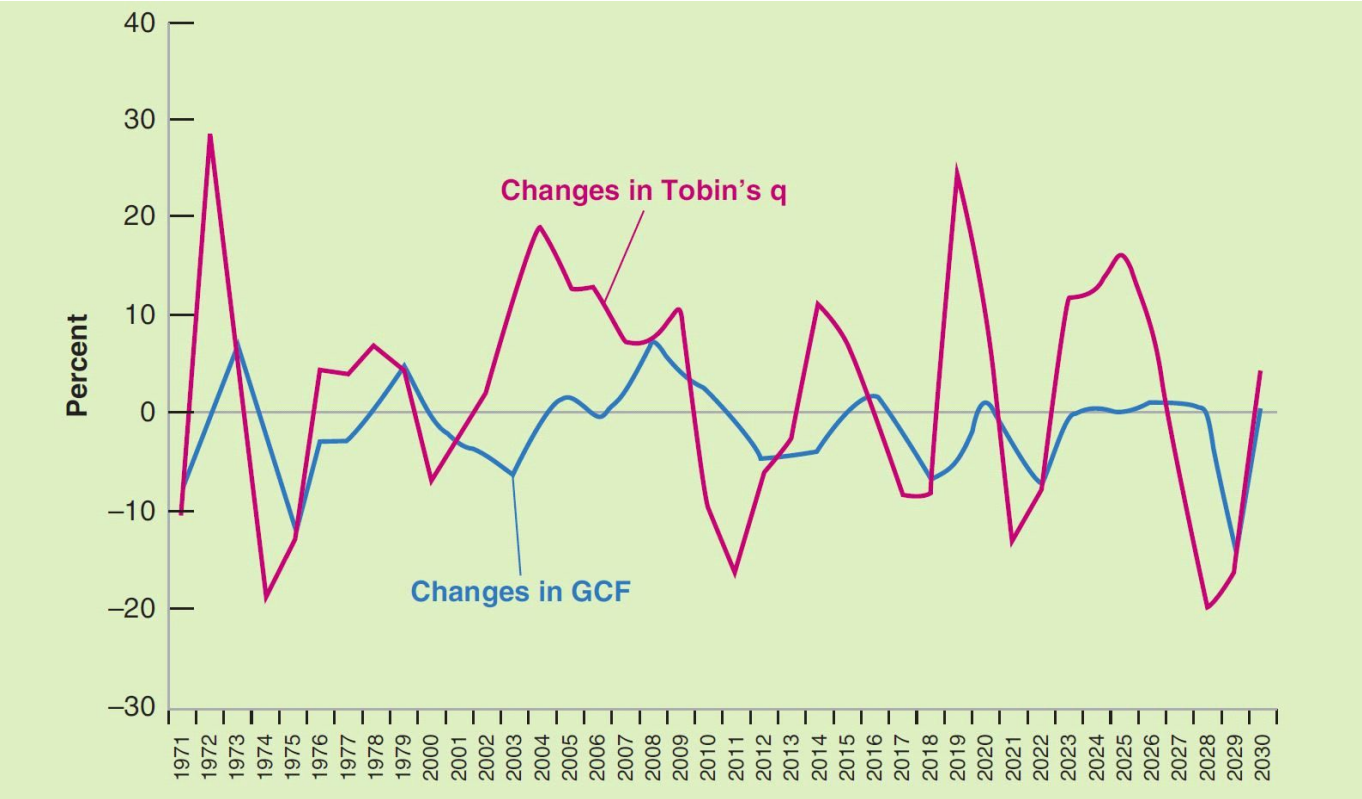
Source: Burda and Wyplosz (2017)

Investment and the Stock Market



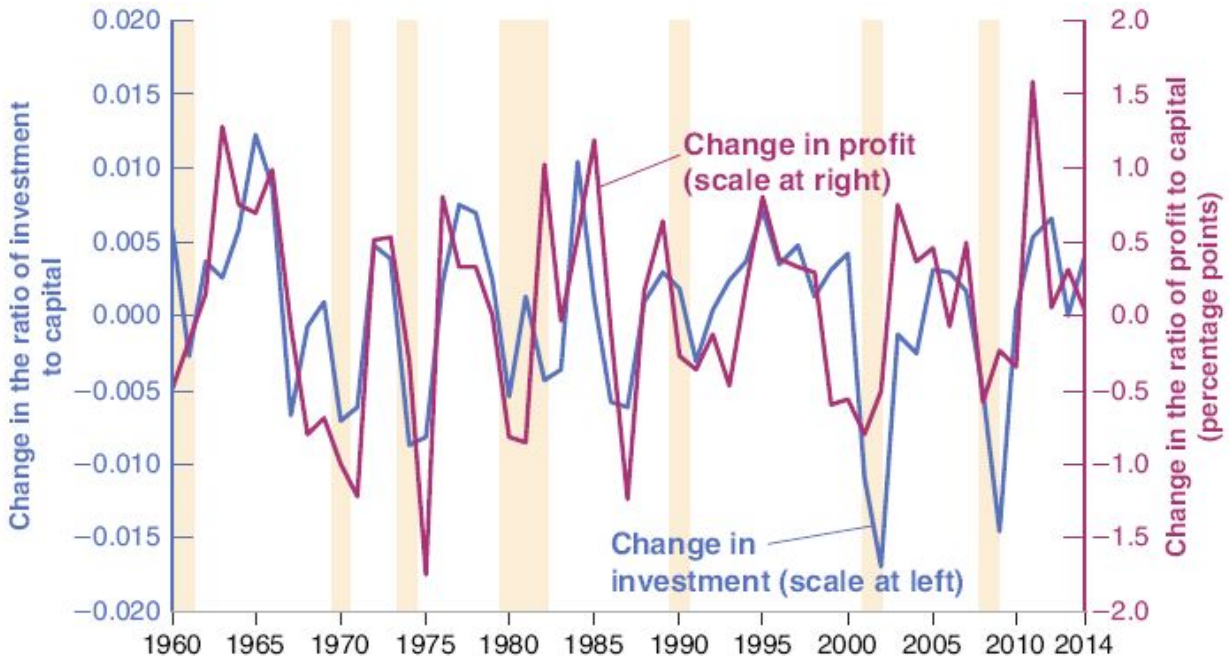
Estimated Tobin's q for Selected Countries, 1970–2010 (Blanchard, 2017)

Investment and the Stock Market



Changes in Tobin's q and in Gross Capital Formation as % of GDP for Japan, 1971–2010 (Blanchard, 2017)

Investment



Changes in Investment and Changes in Profit in the US since 1960 (Blanchard, 2017)

Investment and profit move very much together

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Macroeconomics 1 (EC108)

Lecture 7

Goods and Financial Markets
The IS-LM Model

Lecturer: Natalie Chen

Goods and Financial Markets: The IS-LM Model

- The Goods Market and the IS Relation
- Financial Markets and the LM Relation
- Putting the IS and LM Relations Together
- Using a Policy Mix
- How Does the IS-LM Model Fit the Facts?

Goods and Financial Markets: The IS-LM Model

- We looked at the goods market and at financial markets
- In this lecture, we look at goods and financial markets together, and understand how output and the interest rate are determined in the **short run**
- John Hicks and Alvin Hansen called this framework the IS-LM model

The Goods Market and the IS Relation

- In the model developed in lecture 2, investment was assumed to be constant for simplicity $\left(I = \overline{I}\right)$
- In fact, investment depends on production Y (or sales) and the interest rate i (as we then saw in lecture 6)

$$I = \underset{(+,-)}{I(Y, i)} \tag{1}$$

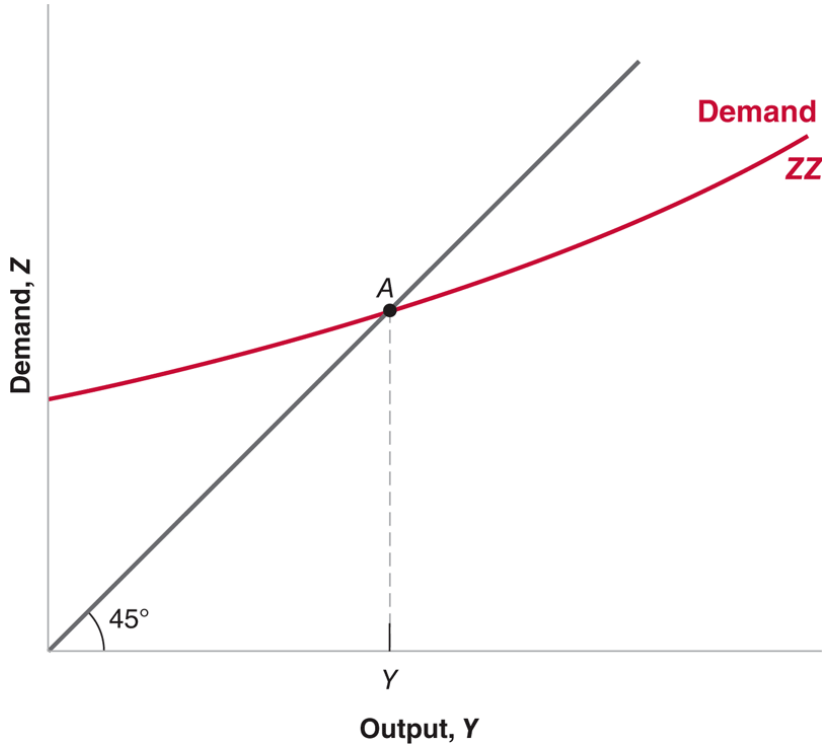
- Equilibrium in the goods market becomes (closed economy)

$$Y = C\left(Y - T\right) + I\left(Y, i\right) + G \tag{2}$$

  which is the **IS relation**

- Short-run analysis: $\pi = 0$ so $i = r$

The Goods Market and the IS Relation



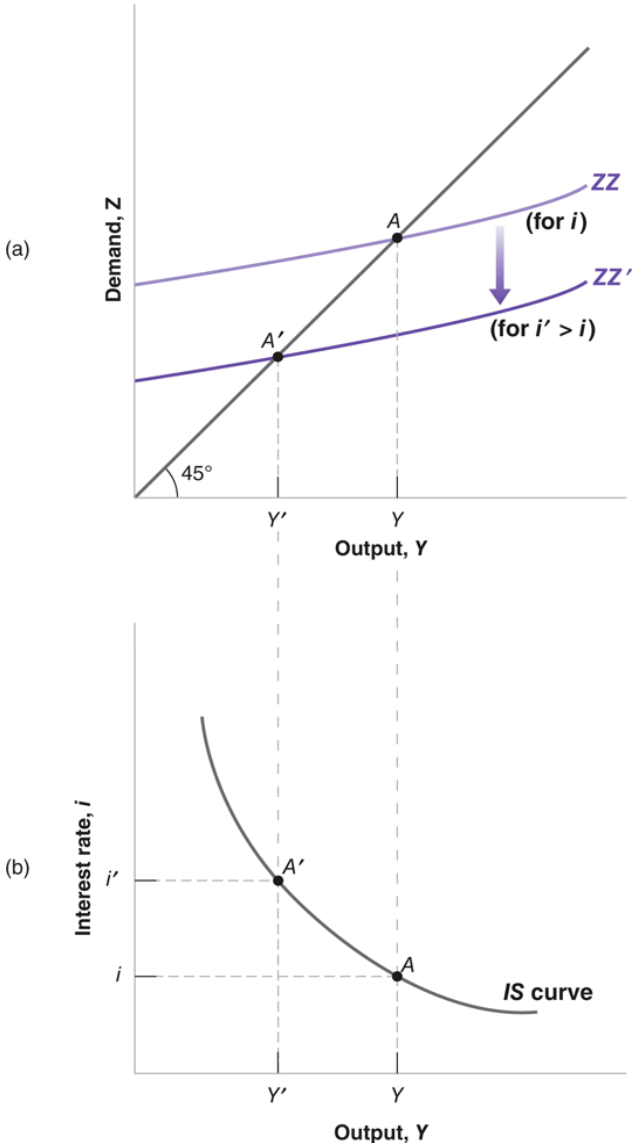
Equilibrium in the Goods Market (Blanchard, 2017)

The demand for goods ZZ is an increasing function of output. Equilibrium requires that the demand for goods is equal to output

The Goods Market and the IS Relation

- ZZ is upward-sloping because, for a given value of the interest rate, an increase in output leads to an increase in the demand for goods through its effects on consumption and investment
- ZZ is a curve rather than a line because we have not assumed that the consumption and investment relations in equations (1) and (2) are linear
- ZZ is flatter than the 45-degree line because we have assumed that an increase in output leads to a less than one-for-one increase in demand
- The intersection of ZZ and the 45-degree line (point A) is the equilibrium level of output

The Goods Market and the IS Relation



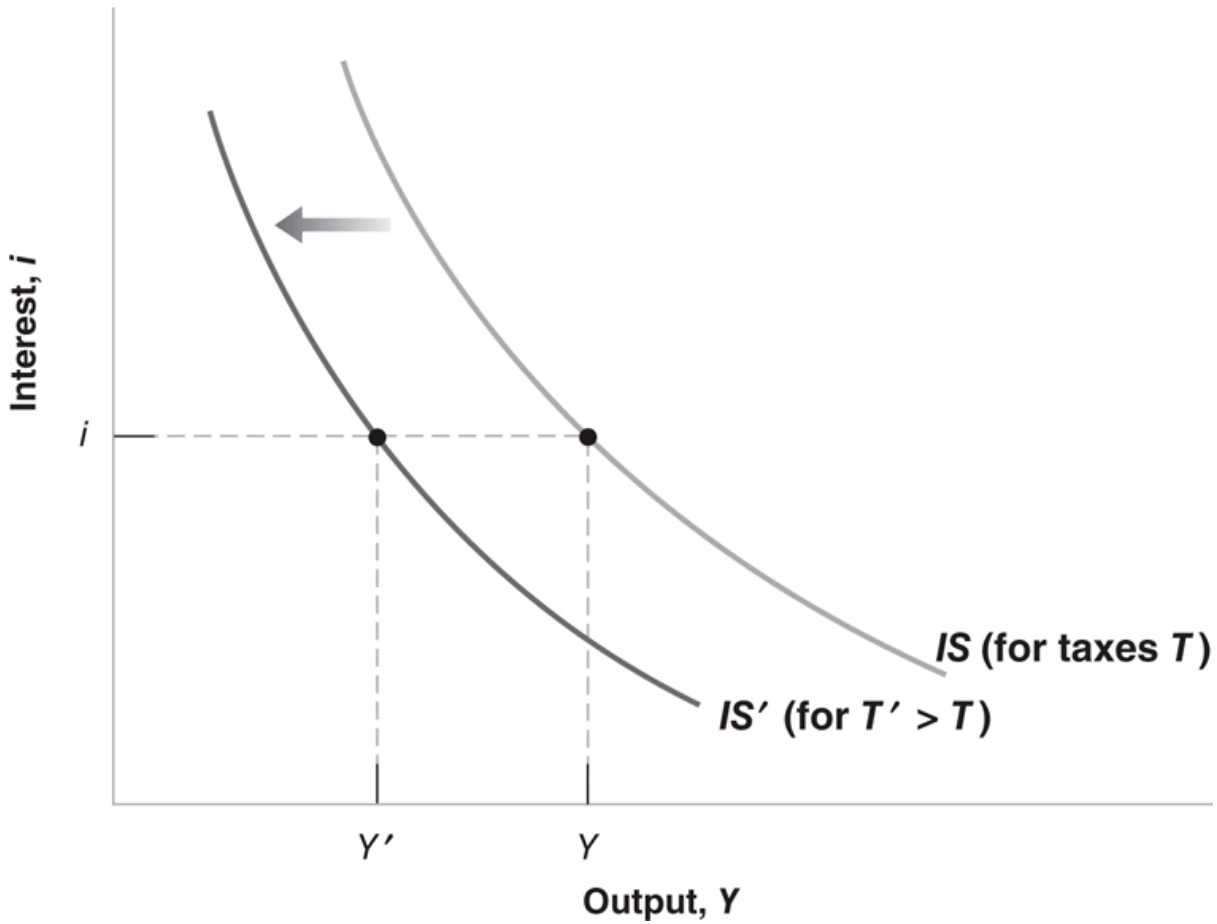
The Derivation of the IS Curve (Blanchard, 2017)

(a) An increase in the interest rate decreases the demand for goods at any level of output, leading to a decrease in the equilibrium level of output

(b) Equilibrium in the goods market implies that an increase in the interest rate leads to a decrease in output

The **IS curve** is therefore **downward sloping**

The Goods Market and the IS Relation



Shifts of the IS Curve (Blanchard, 2017)

An increase in taxes T shifts the IS curve to the left (increase in G?)

The Goods Market and the IS Relation

- Downward-sloping IS curve: equilibrium in the goods market implies that an increase in the interest rate leads to a decrease in output **(movement along the curve)**

- Changes in factors that decrease/increase the demand for goods given the interest rate shift the IS curve to the left/right **(shifting the IS curve)**

Financial Markets and the LM Relation

- Recall $M = \$YL(i)$, i.e., money demand is equal to money supply and $\$Y$ is nominal income (GDP), where $\$Y = PY$ and Y is real income (GDP)

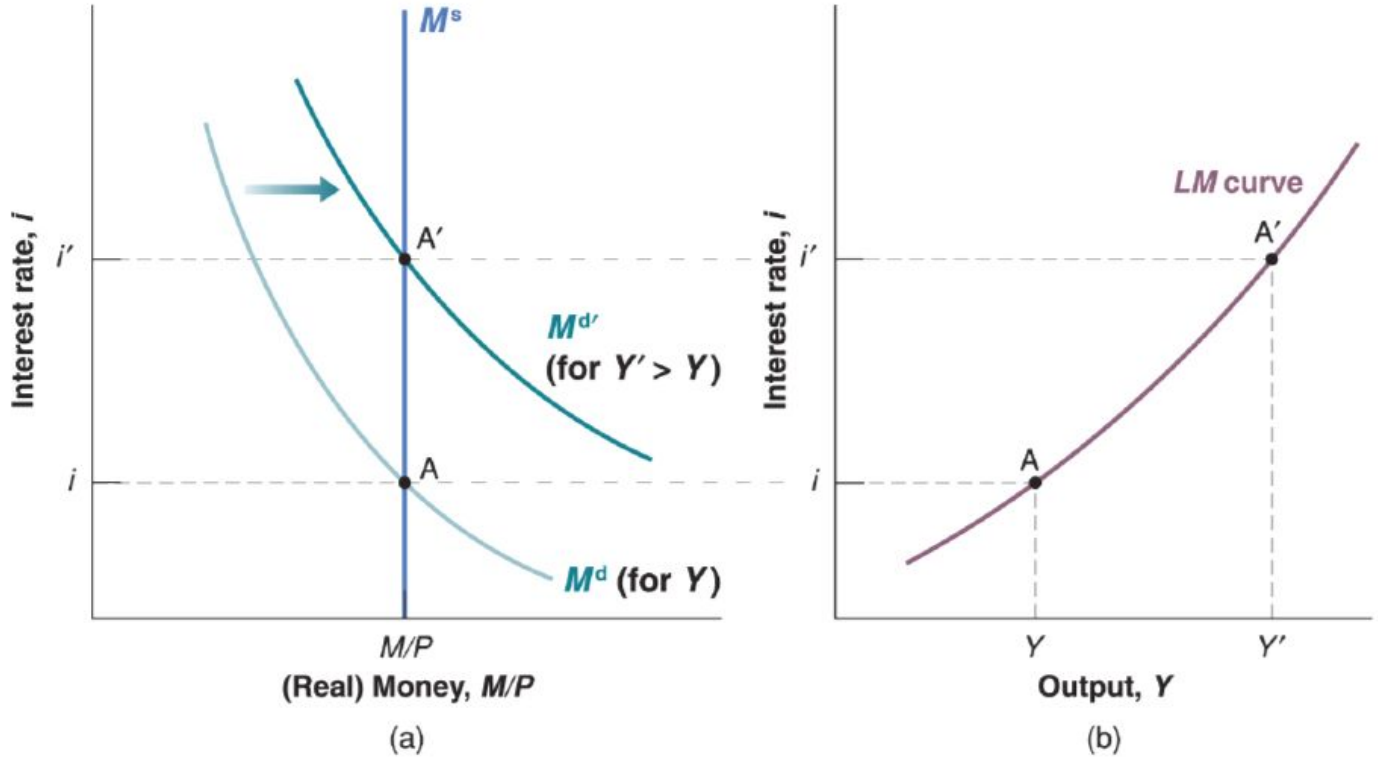
- Divide both sides of the equation by the price level P

$$\frac{M}{P} = YL(i) \tag{3}$$

  which is the **LM relation**

- In equilibrium, **real money supply** equals **real money demand**, which depends on real income Y and the interest rate i

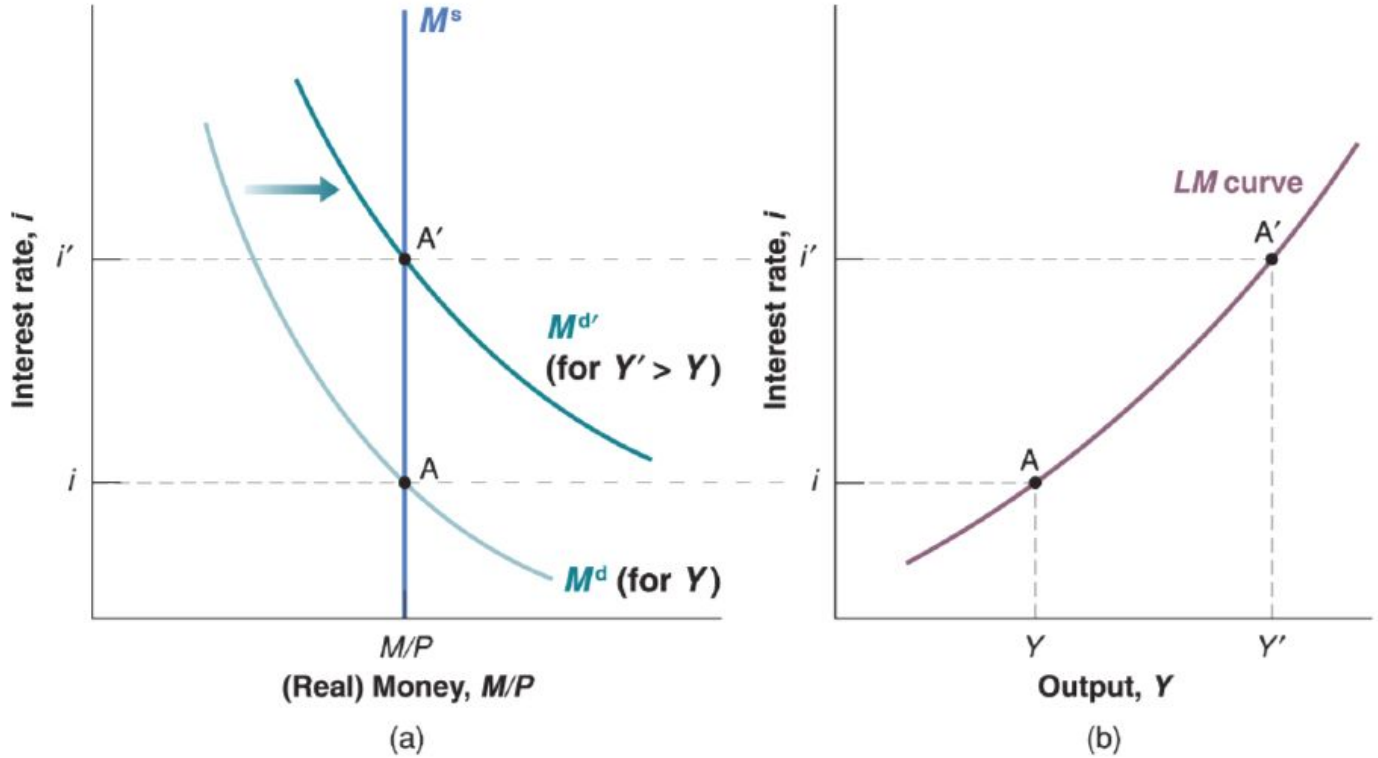
Financial Markets and the LM Relation



Source: Blanchard et al. (2013)

An increase in income leads, at a given interest rate, to an increase in the demand for money. Given the money supply, this increase in the demand for money leads to an increase in the equilibrium interest rate

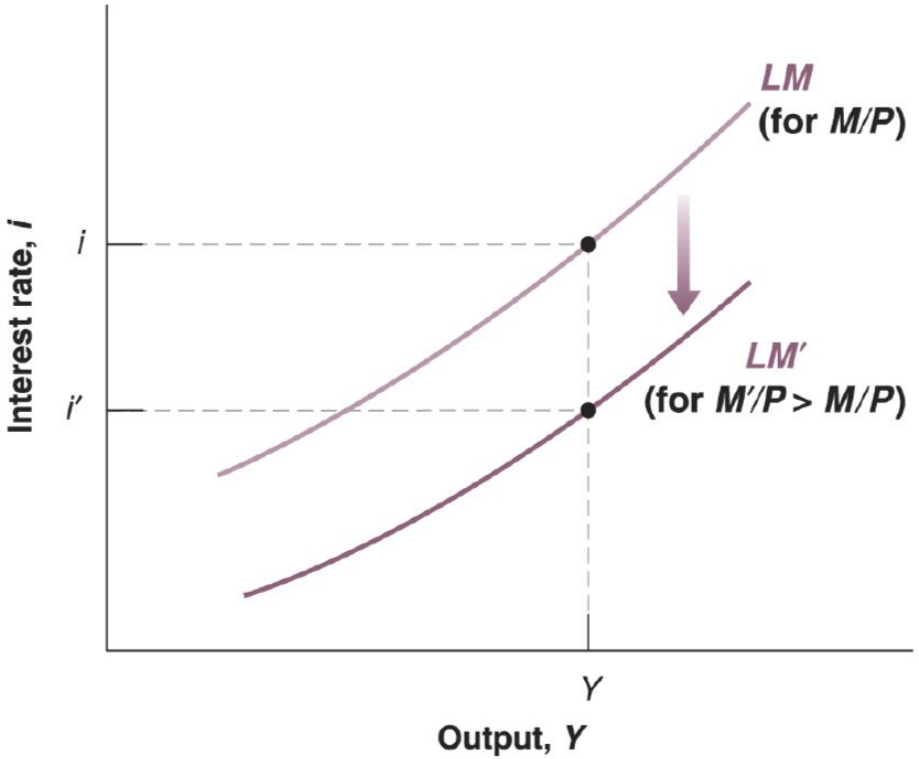
Financial Markets and the LM Relation



Source: Blanchard et al. (2013)

Equilibrium in the financial markets implies that an increase in real income leads to an increase in the interest rate. The LM curve is therefore **upward sloping**

Financial Markets and the LM Relation



Shifts in the LM curve (Blanchard et al., 2013)

An increase in money causes the LM curve to shift down

Financial Markets and the LM Relation

- Upward-sloping LM curve: equilibrium in financial markets implies that an increase in real income leads to an increase in the interest rate **(movement along the curve)**

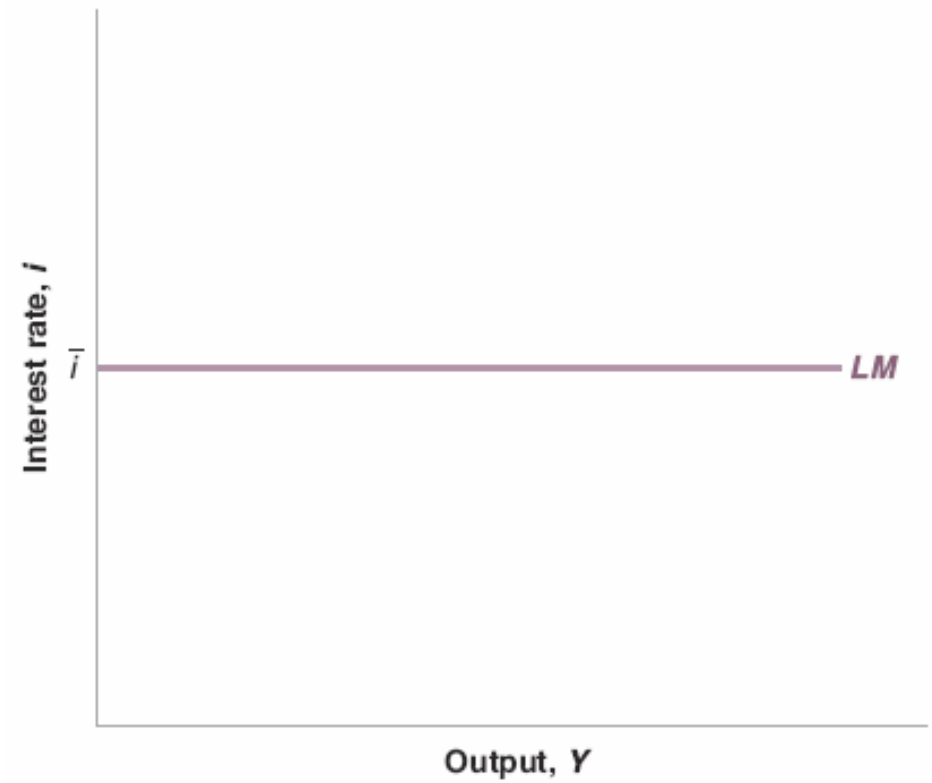
- Increases/decreases in money supply for a given real income shift the LM curve to the right/left **(shifting the LM curve)**

Financial Markets and the LM Relation

$$\frac{M}{P} = YL(i) \tag{3}$$

- **If central banks choose nominal money supply** M, and therefore M/P (prices are fixed in the short run), equation (3) tells us that for a given money supply, an increase in real income (which increases money demand) must be associated with higher interest rates (which decrease money demand) to keep real money demand constant
- Recall from lecture 2, however, that nowadays **central banks choose the interest rate**, and adjust money supply accordingly
- In that case, the LM curve is very simple as it is such that $i = \bar{i}$

Financial Markets and the LM Relation



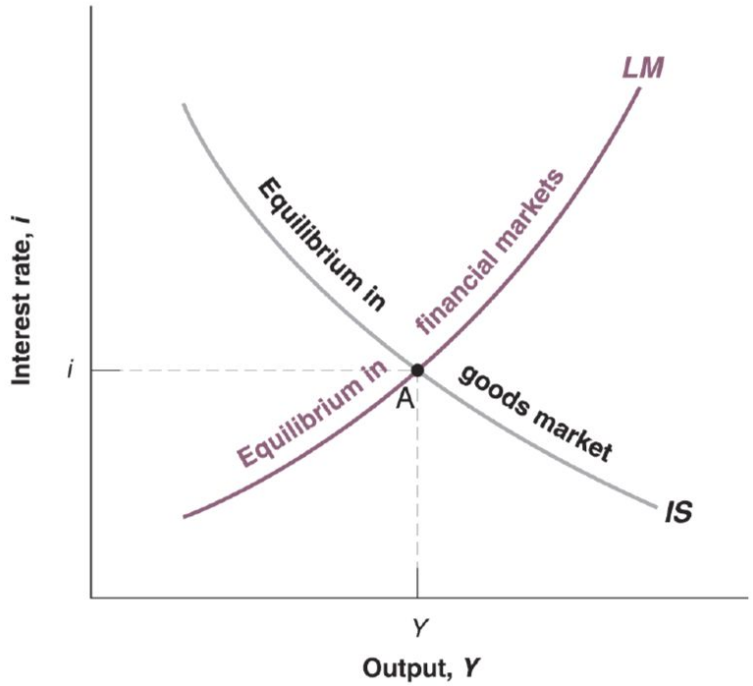
The LM Curve (Blanchard, 2017)

The central bank chooses the interest rate (and adjusts the money supply so as to achieve it)

Putting the IS and LM Relations Together

- IS relation: $Y = C(Y - T) + I(Y, i) + G$
- LM relation: $\frac{M}{P} = YL(i)$
- The IS and LM relations together determine output
- *Any point* on the downward sloping IS curve corresponds to equilibrium in the goods market
- *Any point* on the LM curve corresponds to equilibrium in financial markets
- *Only at their intersection* (point A) are both equilibrium relations satisfied

Putting the IS and LM Relations Together



The IS–LM Model (Blanchard et al., 2013)

- Equilibrium in the goods market implies that an increase in the interest rate leads to a decrease in output. This is represented by the IS curve
- Equilibrium in financial markets is represented by the LM curve
- Only at point A (on both curves) are both goods and financial markets in equilibrium

Putting the IS and LM Relations Together

Steps for analyzing the effects of changes in policy or exogenous variables

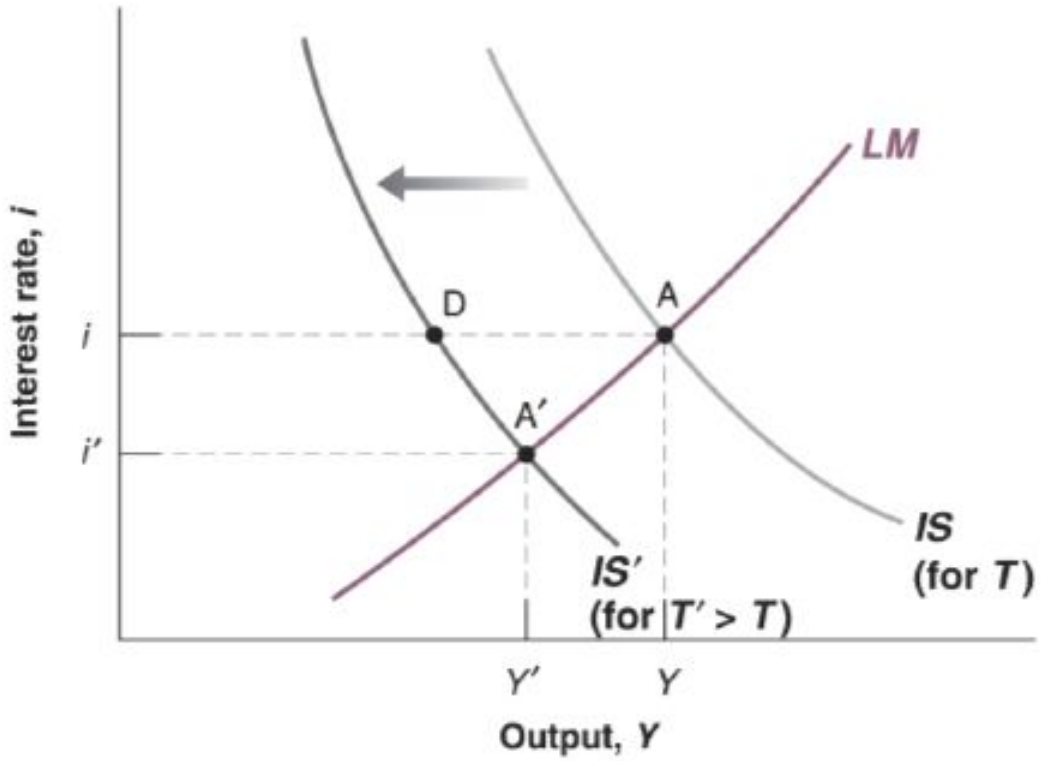
- Does it shift the IS curve and/or the LM curve?
- What does this do to equilibrium output and the equilibrium interest rate?
- Describe the effects in words

Putting the IS and LM Relations Together

Fiscal Policy

- Decrease in $G - T \iff$ **fiscal contraction** $\iff$ **fiscal consolidation**
- Increase in $G - T \iff$ **fiscal expansion**
- Fiscal policy affects the IS curve, not the LM curve

Putting the IS and LM Relations Together



The Effects of an Increase in Taxes (Blanchard et al., 2013)

An increase in taxes shifts the IS curve to the left. This leads to a decrease in the equilibrium level of output and a lower interest rate

Putting the IS and LM Relations Together

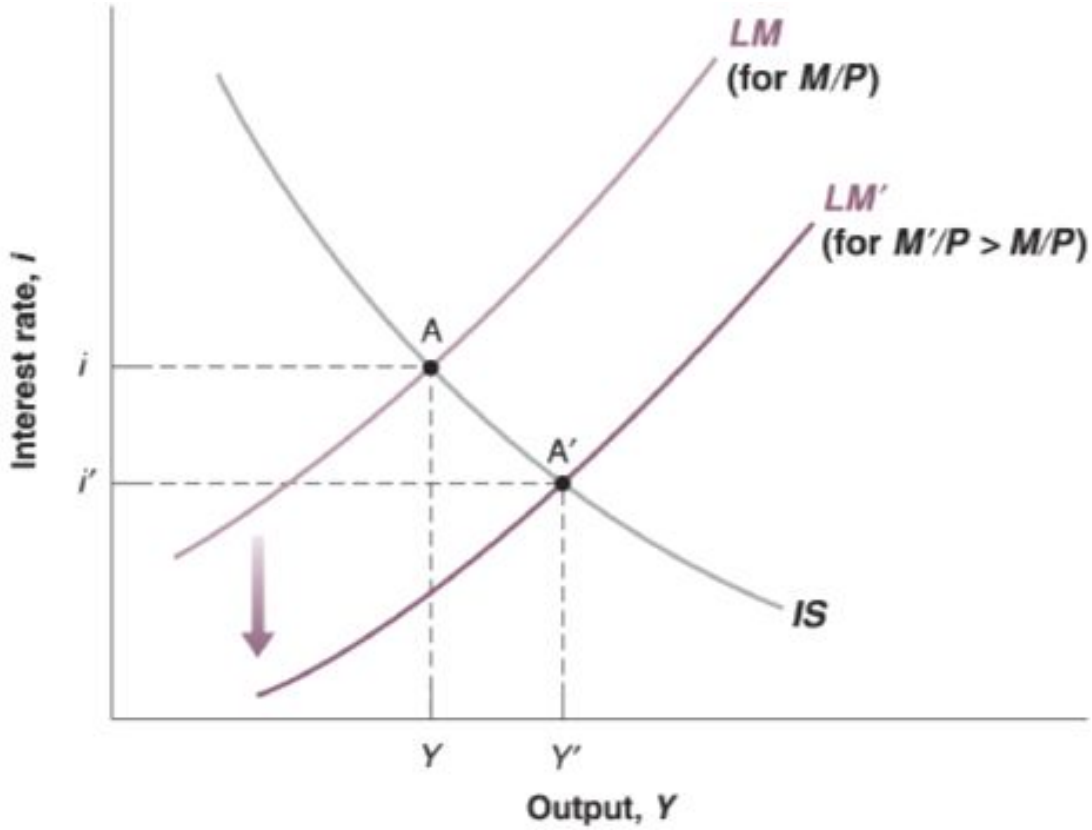
Monetary Policy

- Increase in $M \iff$ decrease in $i \iff$ **monetary expansion**

- Decrease in $M \iff$ increase in $i \iff$ **monetary contraction** $\iff$ **monetary tightening**

- Monetary policy affects the LM curve, not the IS curve

Putting the IS and LM Relations Together



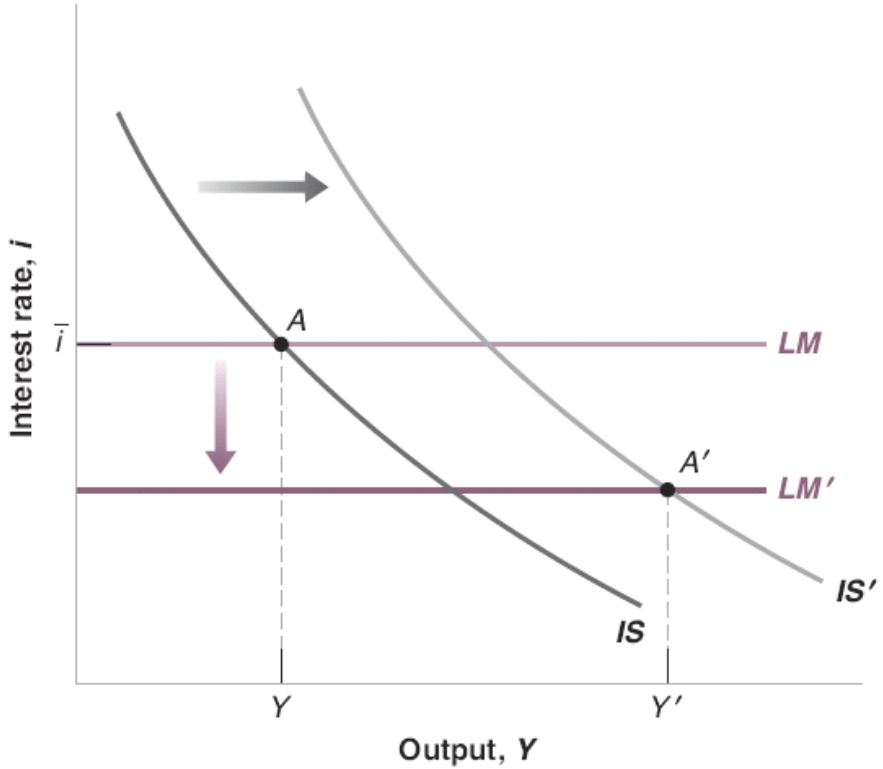
The Effects of a Monetary Expansion (Blanchard et al., 2013)

A monetary expansion shifts the LM curve down, and leads to higher output and a lower interest rate

Using a Policy Mix

- Monetary-fiscal policy mix is the combination of monetary and fiscal policies
- Sometimes, the right mix is to use fiscal and monetary policy in the same direction
- Sometimes, the right mix is to use the two policies in opposite directions – for example, combining a fiscal contraction with a monetary expansion
- Now suppose that the economy is in a recession and output is too low
- Both fiscal and monetary policies can be used to increase output

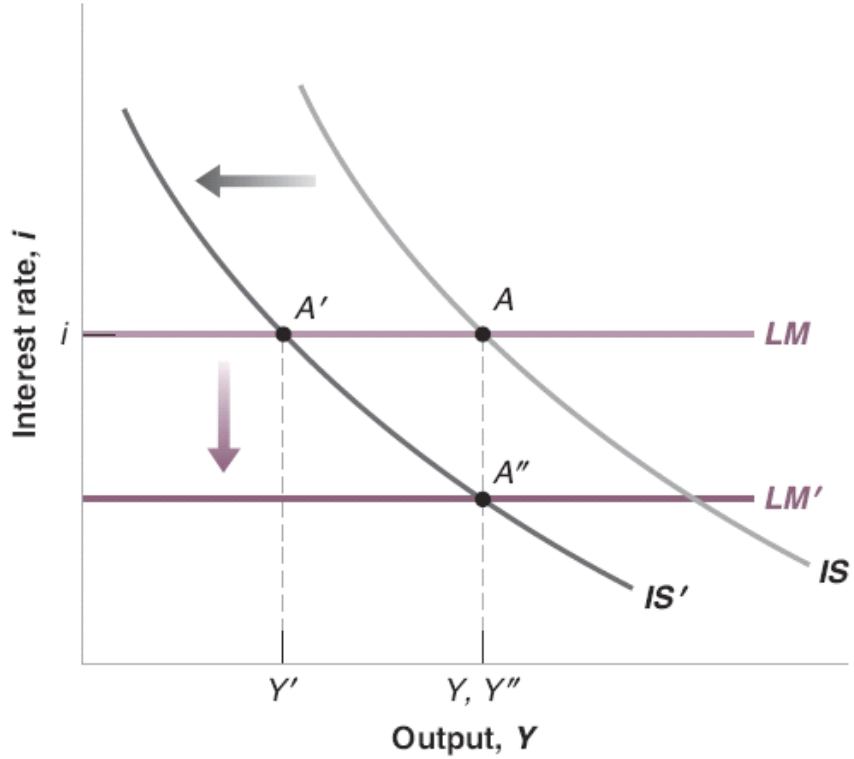
Using a Policy Mix



The Effects of a Combined Fiscal and Monetary Expansion (Blanchard, 2017)

The fiscal expansion shifts the IS curve to the right. A monetary expansion shifts the LM curve down. Both lead to higher output (the same happens with a positively sloped LM curve)

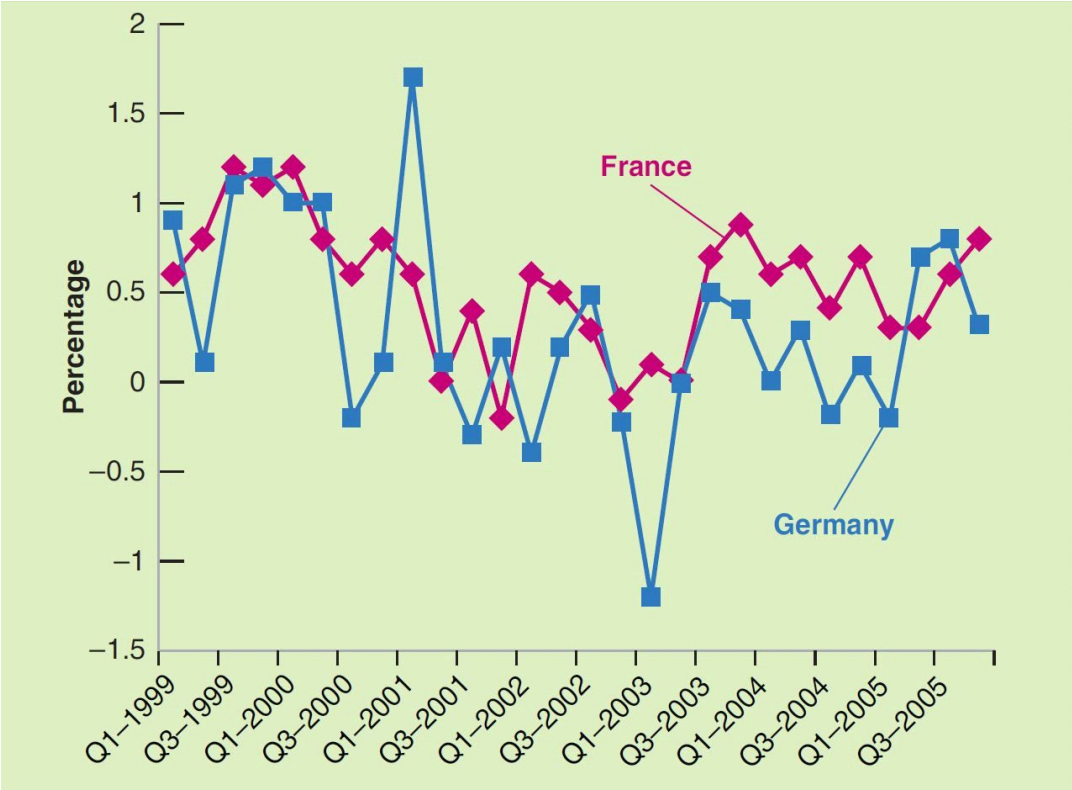
Using a Policy Mix



Combined Fiscal Consolidation and Monetary Expansion (Blanchard, 2017)

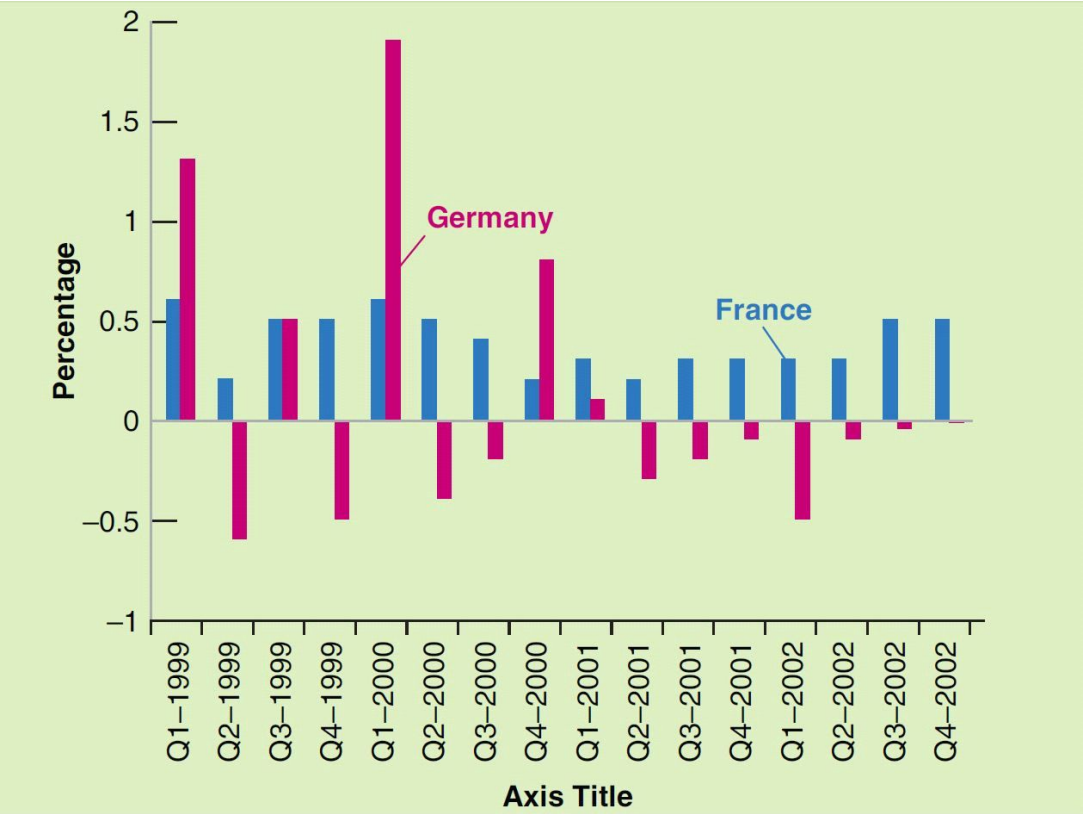
The fiscal consolidation shifts the IS curve to the left. A monetary expansion shifts the LM curve down. This allows for a reduction in the deficit without a recession (the same happens with a positively sloped LM curve)

The German and French Recessions of 2001–2002



France and Germany Quarterly GDP Growth Rates (Blanchard, 2017)

The German and French Recessions of 2001–2002



Government Expenditure in France and Germany (1999–2002) (Blanchard, 2017)

The German and French Recessions of 2001–2002

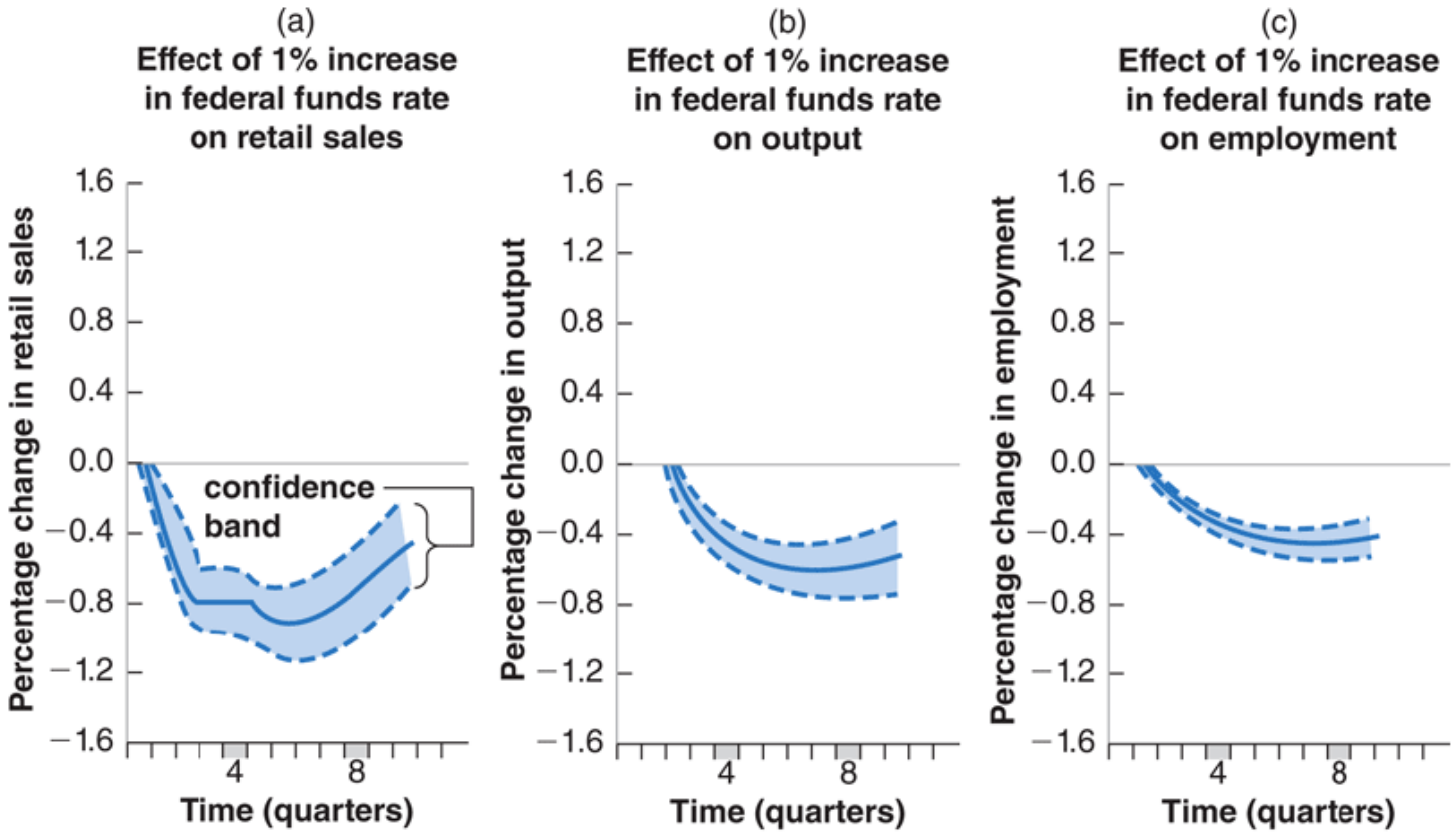
European Central Bank Euro Interbank Rates (1999–2005) (Blanchard, 2017)

How Does the IS-LM Model Fit the Facts?

Because the adjustment of output takes time, we need to reintroduce dynamics

- Consumers are likely to take time to adjust their **consumption** following a change in **disposable income**
- Firms are likely to take time to adjust **investment spending** following a change in their **sales**
- Firms are likely to take time to adjust **investment spending** following a change in the **interest rate**
- Firms are likely to take time to adjust **production** following a change in their **sales**

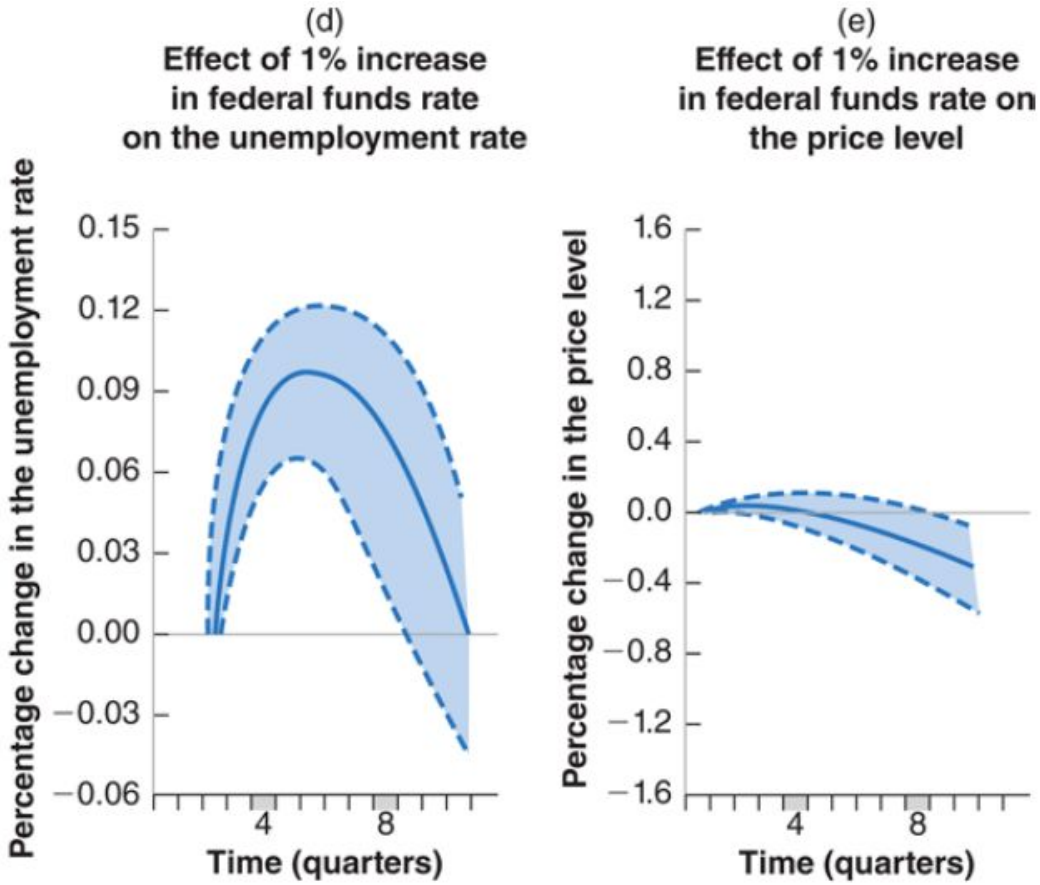
How Does the IS-LM Model Fit the Facts?



Empirical Effects of an Increase in the Federal Funds Rate (Blanchard, 2017)

In the short run, an increase in the federal funds rate leads to a decrease in output and to an increase in unemployment, but it has little effect on the price level

How Does the IS-LM Model Fit the Facts?



Empirical Effects of an Increase in the Federal Funds Rate (Blanchard, 2017)

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Lecture 8

The Goods Market in an Open Economy

Lecturer: Natalie Chen

The Goods Market in an Open Economy

- The IS Relation in an Open Economy
- Equilibrium Output and the Trade Balance
  - Increases in Demand – Domestic vs Foreign
  - Depreciation, the Trade Balance, and Output
  - Combining Exchange Rates and Fiscal Policies
- Looking at Dynamics: the J-Curve
- Saving, Investment, and the Current Account Balance

The Goods Market in an Open Economy

- The US recession in 2009 led to a worldwide recession
- To understand what happened, we must expand the analysis and account for openness in the analysis of goods markets
- This is what we now do

The IS Relation in the Open Economy

In an open economy, the **demand for domestic goods** is

$$Z = C + I + G + X - \frac{IM}{\varepsilon}$$

where C, I, and G constitue the total **domestic demand for goods**, domestic or foreign

Domestic demand

$$C + I + G = C\left(\underset{(+)}{Y - T}\right) + I\left(\underset{(+,-)}{Y, r}\right) + G$$

The IS Relation in the Open Economy

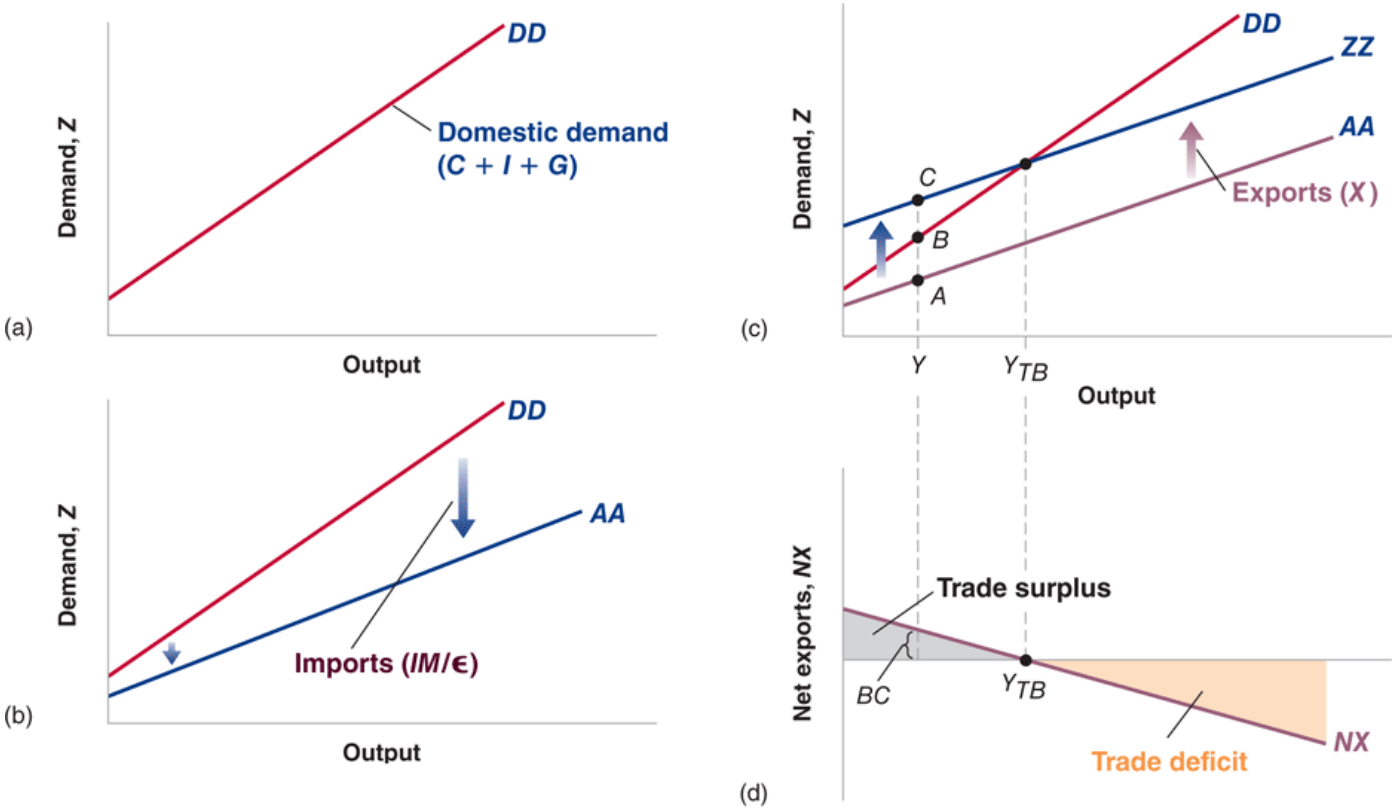
- Imports are positively related to domestic income Y and to the real exchange rate ε

$$IM = IM\begin{pmatrix} Y, \varepsilon \\ (+,+) \end{pmatrix}$$

- Exports are positively related to foreign income Y^* and negatively related to the real exchange rate ε

$$X = X\begin{pmatrix} Y^*, \varepsilon \\ (+,-) \end{pmatrix}$$

The IS Relation in the Open Economy



The Demand for Domestic Goods and Net Exports (Blanchard, 2017)

- (a) The domestic demand for goods is an increasing function of income (output)
- Demand for domestic goods: subtract imports (b) and add exports (c)
- (d) The trade balance is a decreasing function of output

The IS Relation in the Open Economy

- The line AA represents the domestic demand for domestic goods, and the line DD represents domestic demand
- AA is flatter than DD
- As long as some of the additional demand falls on domestic goods, AA has a positive slope
- The line ZZ represents the demand for domestic goods (including exports)
- The distance between ZZ and AA is constant because exports do not depend on domestic income but they depend on foreign income

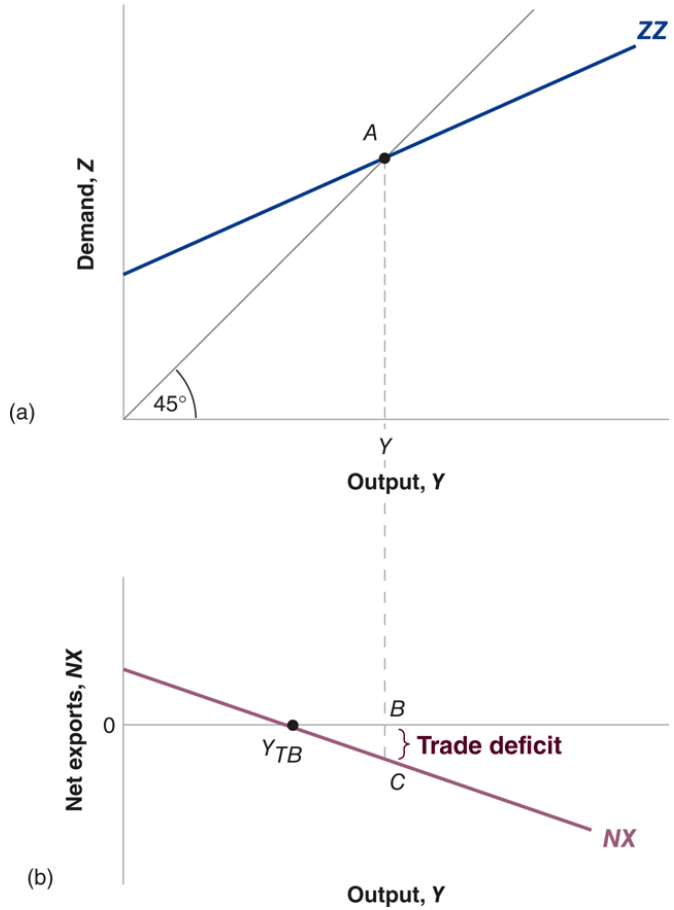
Equilibrium Output and the Trade Balance

- Because $Y = Z$, the equilibrium condition for output can be expressed as

$$Y = C(Y - T) + I(Y, r) + G + X(Y^*, \varepsilon) - \frac{IM}{\varepsilon}(Y, \varepsilon)$$

- Graphically, equilibrium output is at the point where demand equals output, the intersection of ZZ and the 45-degree line

Equilibrium Output and the Trade Balance



Equilibrium Output and Net Exports (Blanchard, 2017)

The goods market is in equilibrium when domestic output is equal to the demand for domestic goods. At the equilibrium level of output, the trade balance may show a deficit or a surplus

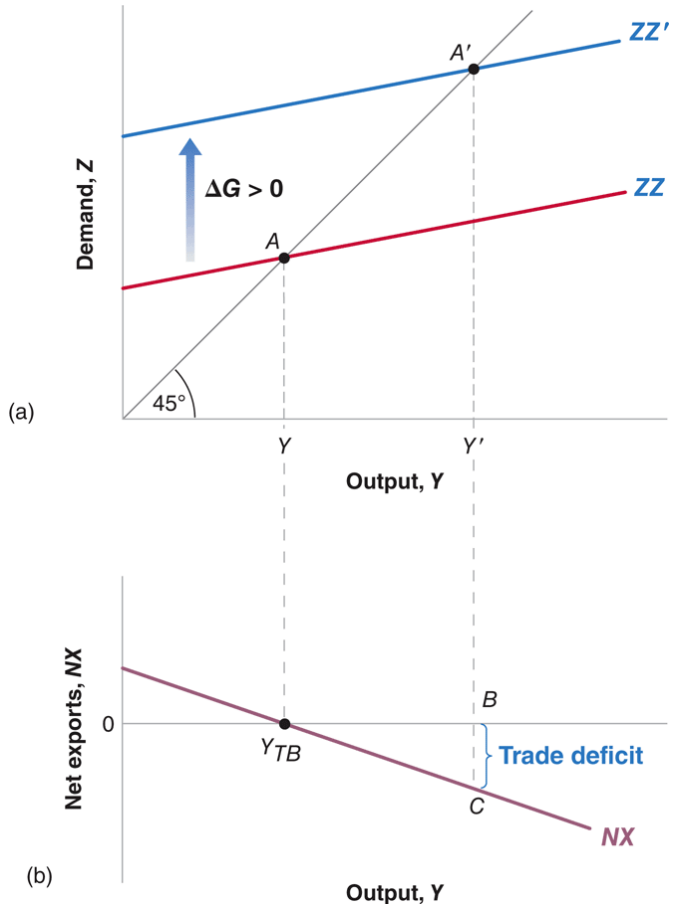
Increases in Demand – Domestic vs Foreign

Differences with a closed economy

- Effect on trade balance: an increase in output leads to a **trade deficit**

- Smaller effect of government spending on output: because ZZ is flatter than DD, the multiplier is **smaller in the open economy**

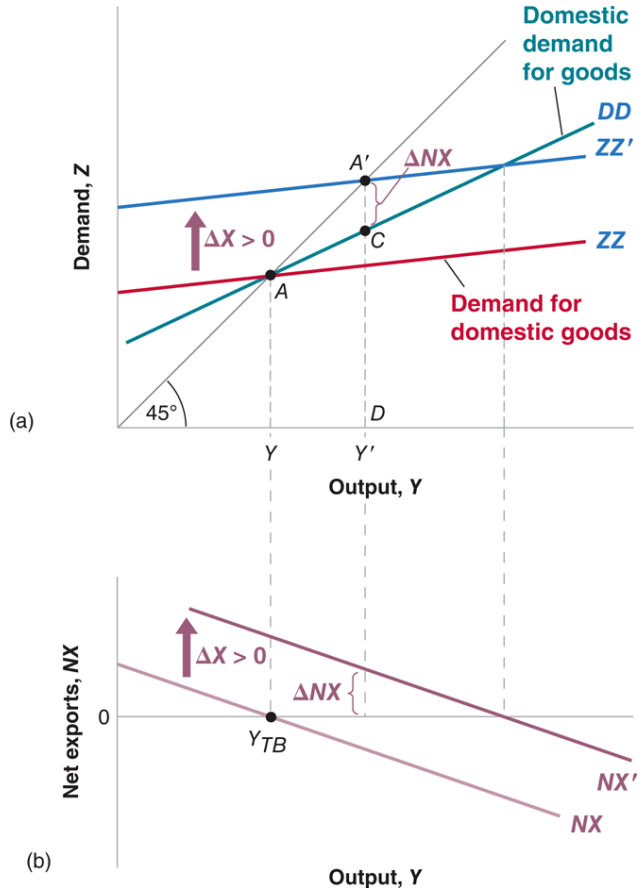
Increases in Demand – Domestic vs Foreign



The Effects of an Increase in Government Spending (Blanchard, 2017)

An increase in government spending leads to an increase in output and to a trade deficit

Increases in Demand – Domestic vs Foreign



The Effects of an Increase in Foreign Demand (Blanchard, 2017)

An increase in foreign demand leads to an increase in output and to a trade surplus

Increases in Demand – Domestic vs Foreign

- Summary
  - An increase in domestic demand leads to an increase in domestic output but leads also to a deterioration of the trade balance
  - An increase in foreign demand leads to an increase in domestic output and to an improvement in the trade balance

- Implications
  - Shocks to demand in one country affect all other countries
  - Economic interactions complicate the task of policymakers. **Policy coordination** is not so easy to achieve

Depreciation, the Trade Balance, and Output

- Recall the real exchange rate equation

$$\varepsilon = \frac{EP}{P^*}$$

- And the definition of net exports

$$NX = X - \frac{IM}{\varepsilon}$$

- Therefore

$$NX = X\left(Y^*, \varepsilon\right) - \frac{IM}{\varepsilon}\left(Y, \varepsilon\right)$$

Depreciation, the Trade Balance, and Output

- A real depreciation affects the trade balance through three channels
  - Exports X increase
  - Imports IM decrease
  - The relative price of foreign goods in terms of domestic goods $1/\varepsilon$ increases
- **Marshall-Lerner condition**: a real depreciation leads to an increase in net exports
- *A depreciation leads to a shift in demand, both foreign and domestic, toward domestic goods. The shift in demand leads, in turn, to both an increase in domestic output and an improvement in the trade balance*

Marshall-Lerner Condition

- The Marshall-Lerner condition is the condition under which a real depreciation (lower ε) leads to an increase in net exports

- Consider the definition of net exports $NX = X - IM/\varepsilon$

- Assume that trade is initially balanced so that $NX = 0$ and $X = IM/\varepsilon$, or $\varepsilon X = IM$

- Multiply both sides of $NX = X - IM/\varepsilon$ by ε to get

$$\varepsilon NX = \varepsilon X - IM$$

Marshall-Lerner Condition

- Consider the effect of a change in the real exchange rate $\Delta\varepsilon$. Its effect is $(\Delta\varepsilon)\, NX + \varepsilon\, (\Delta NX)$. If trade is initially balanced, $NX = 0$. Therefore

$$\varepsilon(\Delta NX) = (\Delta\varepsilon)X + \varepsilon(\Delta X) - (\Delta IM)$$

- Divide both sides by εX to get

$$[\varepsilon\, (\Delta NX)]\, /\varepsilon X = [(\Delta\varepsilon)\, X]\, /\varepsilon X + [\varepsilon\, (\Delta X)]\, /\varepsilon X - [\Delta IM]\, /\varepsilon X$$

- If trade is initially balanced ($\varepsilon X = IM$), then

$$(\Delta NX)\, /X = (\Delta\varepsilon)\, /\varepsilon + (\Delta X)\, /X - \Delta IM/IM$$

Marshall-Lerner Condition

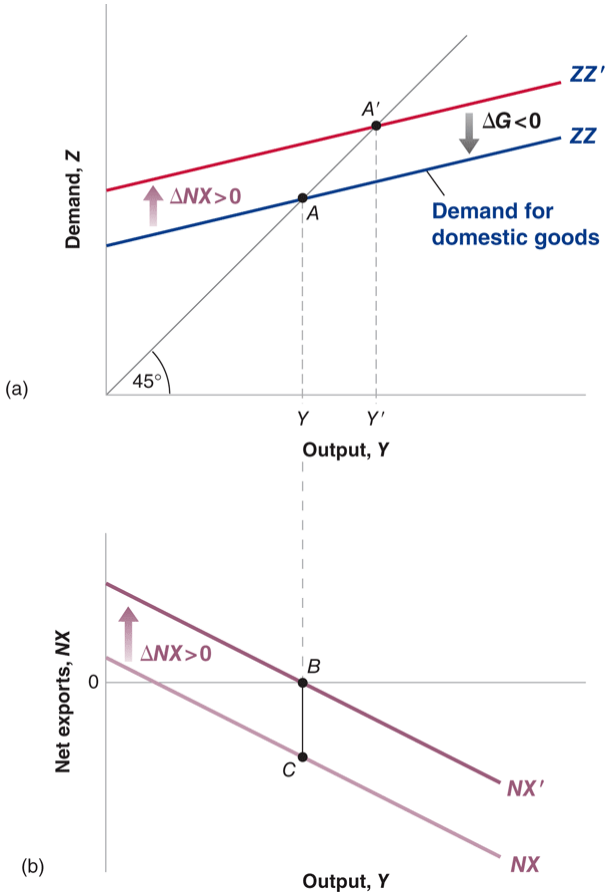
$$(\Delta NX)/X = (\Delta\varepsilon)/\varepsilon + (\Delta X)/X - \Delta IM/IM$$

The change in the trade balance (as a ratio of exports) in response to a real depreciation is equal to the sum of three terms

- The proportional change in the real exchange rate (negative for a real depreciation)
- The proportional change in exports (positive for a real depreciation)
- The proportional change in imports (positive for a real depreciation)

If the Marshall-Lerner condition holds, the sum of the three terms is positive (in which case a real depreciation improves the trade balance)

Combining Exchange Rates and Fiscal Policies



Reducing the Trade Deficit without Changing Output (Blanchard, 2017)

To reduce the trade deficit without changing output, the government must both achieve a depreciation and decrease government spending

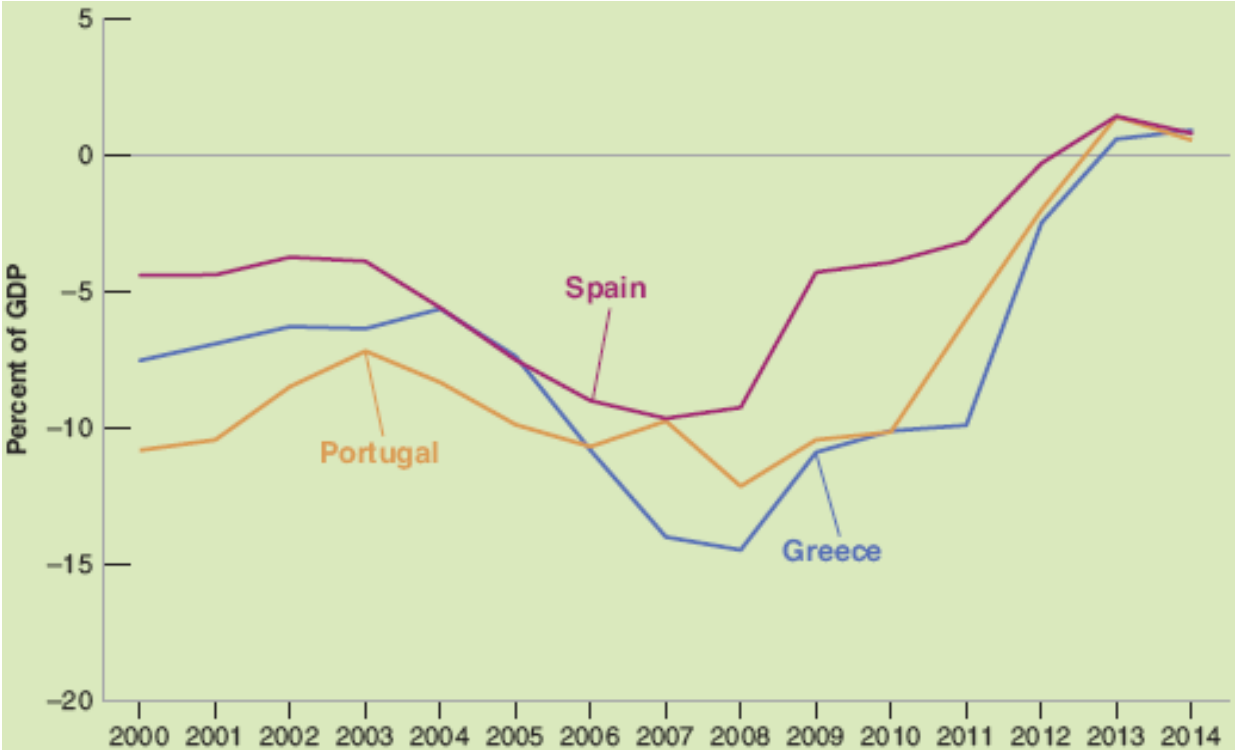
Combining Exchange Rates and Fiscal Policies

If the government wants to eliminate the trade deficit without changing output, it must do two things

- Achieve a depreciation sufficient to eliminate the trade deficit
- Reduce government spending so as to shift ZZ back

The Disappearance of Current Account Deficits in Euro Periphery Countries

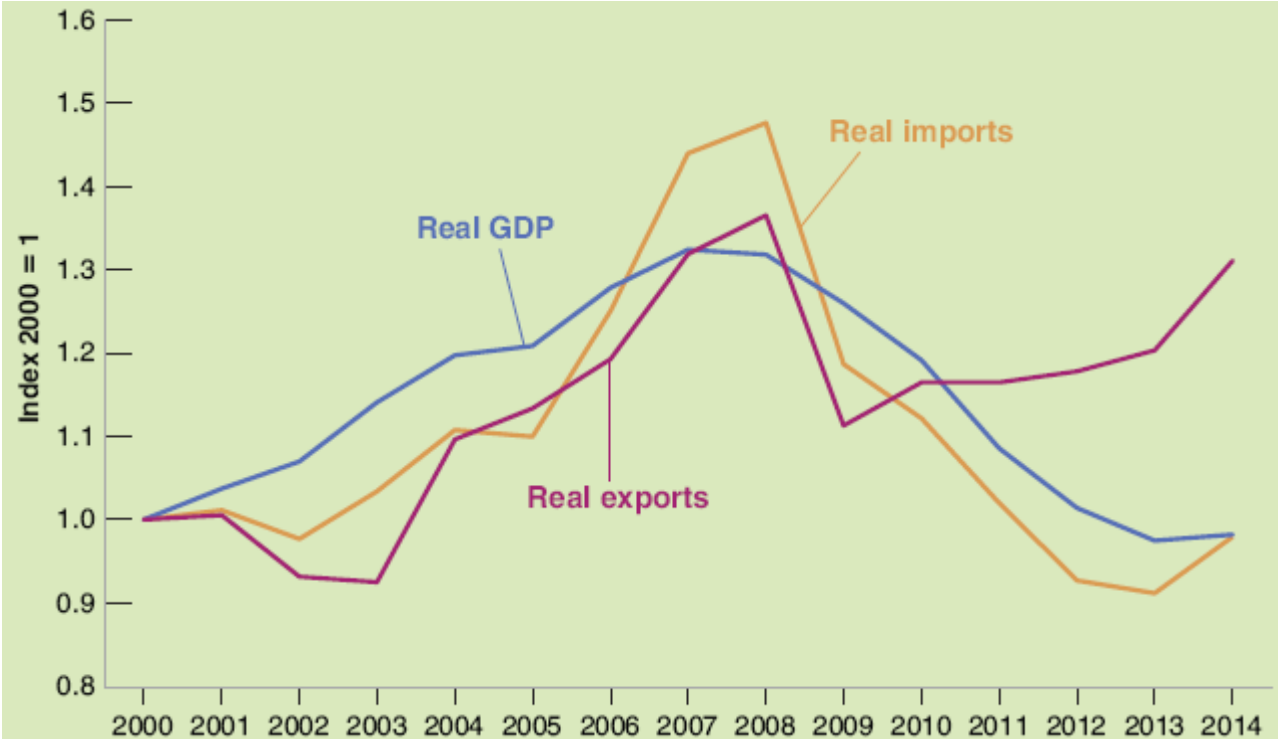
Import compression: A decrease in imports (improved current account balance) triggered by a decrease in output



Euro Periphery Current Accound Deficits since 2000 (Blanchard, 2017)

The Disappearance of Current Account Deficits in Euro Periphery Countries

Greece's real GDP, imports and exports all declined after 2008



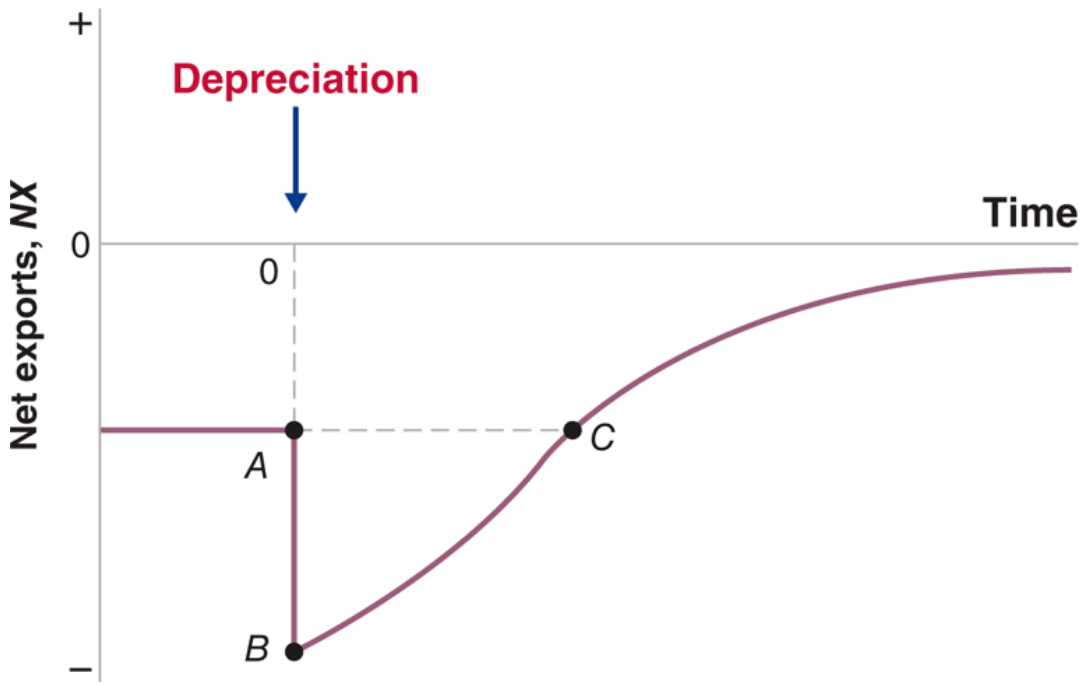
Imports, Exports, and GDP in Greece since 2000 (Blanchard, 2017)

Looking at Dynamics: The J-Curve

- J-**curve**: the adjustment process in the trade balance in response to a real depreciation

- A depreciation initially increases the trade deficit and, over time, exports increase and imports decrease, reducing the trade deficit

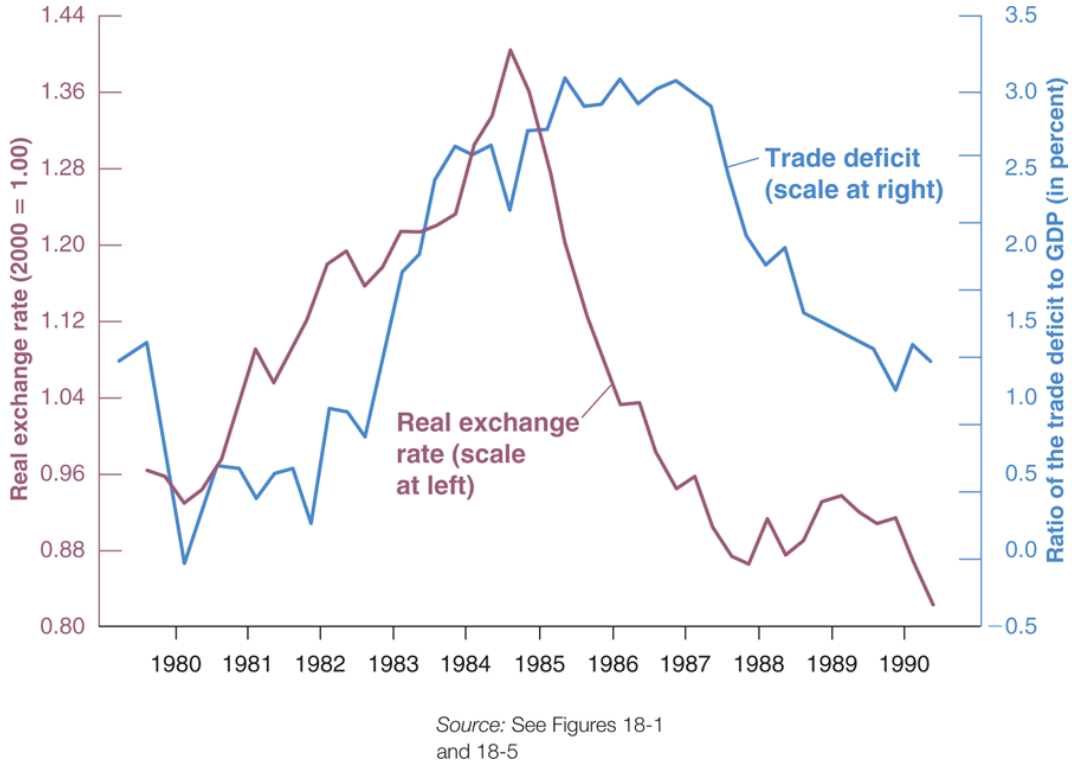
Looking at Dynamics: The J-Curve



The J-Curve (Blanchard, 2017)

A real depreciation leads initially to a deterioration and then to an improvement of the trade balance

Looking at Dynamics: The J-Curve



The Real Exchange Rate and the Ratio of the Trade Deficit to GDP: US 1980–1990 (Blanchard, 2017)

The large real appreciation and subsequent real depreciation from 1980 to 1990 were mirrored, with a lag, by an increase and then a decrease in the trade deficit

Saving, Investment, and Current Account Balance

- Recall

$$Y = C + I + G + X - \frac{IM}{\varepsilon}$$

- Therefore

$$Y - C - T = I + G - T + X - \frac{IM}{\varepsilon}$$

- Denote the current account by CA, so that the above equation becomes

$$S = I + (G - T) + CA$$

  so the current account balance is

$$CA = S - I + (T - G)$$

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$$CA = S - I + (T - G)$$

- An increase in investment must be reflected either by an increase in private saving or public saving, or by a deterioration of the current account balance

- A deterioration in the government budget balance must be reflected by an increase in either private saving, or by a decrease in investment, or else by a deterioration of the current account balance

- A country with a high saving rate must have either a high investment rate or a large current account surplus