Tema 6
Teoría de los Ciclos Reales

Macroeconomía II
Escuela de Economía, 2006

Objectives

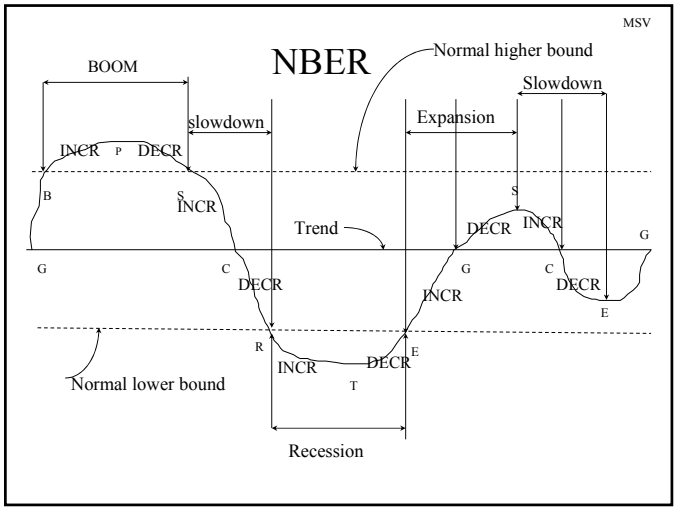
•After studying this chapter, you will able to
- Distinguish among the different theories of the business cycle
- Explain the Keynesian and monetarist theories of the business cycle
- Explain the new classical and new Keynesian theories of the business cycle
- Explain real business cycle theory
- Describe the origins of, and the mechanisms at work during, the expansion of the 1990s, the recession of 2001, and the Great Depression

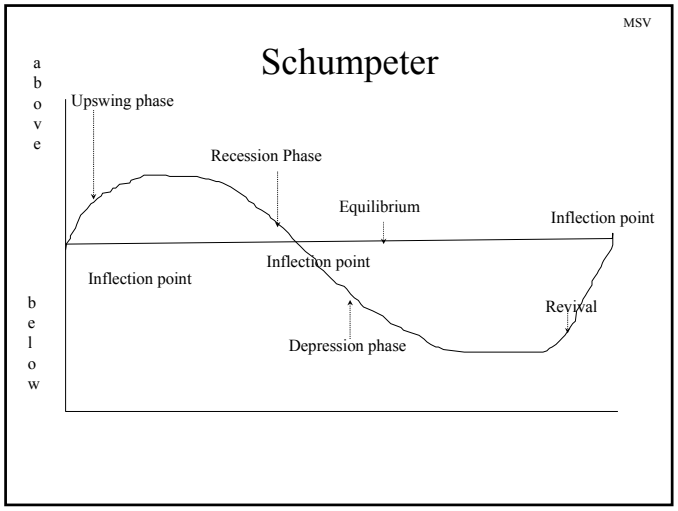
Must What Goes Up Always Come Down?

- In some ways, the 1990s were like the 1920s: rapid economic growth and unprecedented prosperity
- From 1929 through 1933, real GDP fell 30 percent and the economy entered the Great Depression, which lasted until World War II
- There have been ten recessions since 1945; must the cycle continue?

Cycle Patterns, Impulses, and Mechanisms

- Business Cycle Patterns
  - The business cycle is an irregular and nonrepeating up-and-down movement of business activity that takes place around a generally rising trend and that shows great diversity.





Cycle Patterns, Impulses, and Mechanisms

- Cycle Impulses and Mechanisms
  - Cycles can be like the ball in a tennis match, the light of night and day, or a child's rocking horse.
  - These cycles differ according to the role of outside force and basic system design.

Cycle Patterns, Impulses, and Mechanisms

- In a tennis match, an outside force is applied at each turning point
- In the night and day cycle, no outside force is applied and the cycle results from the design of the solar system
- In the rocking of a horse, an outside force must be applied to start the cycle but then the cycle proceeds automatically until it needs another outside force.
- The business cycle is a combination of all three types of cycles; that is, both outside forces (the "impulse") and design (the "mechanism") are important.

Cycle Patterns, Impulses, and Mechanisms

- The Central Role of Investment and Capital
  - All theories of the business cycle agree that investment and the accumulation of capital play a crucial role.
  - Recessions begin when investment slows and recessions turn into expansions when investment increases.
  - Investment and capital are crucial parts of cycles, but are not the only important parts.

Cycle Patterns, Impulses, and Mechanisms

- The *AS-AD* Model
  - All business cycle theories can be described in terms of the *AS-AD* model.
  - Business cycle theories can be divided into two types
  - Aggregate demand theories
  - Real business cycle theory.

Aggregate Demand Theories of the Business Cycle

- Three types of aggregate demand theories have been proposed:

1. Keynesian
2. Monetarist
3. Rational expectations

Aggregate Demand Theories of the Business Cycle

- Keynesian Theory
  - The **Keynesian theory of the business cycle** regards volatile expectations as the main source of business cycle fluctuations.

Aggregate Demand Theories of the Business Cycle

- **Keynesian Impulse**
- The impulse in the Keynesian theory is expected future sales and expected future profits.
- A change in expected future sales and expected future profits changes investment.
- Keynes described these expectations as "animal spirits," which means that because such expectations are hard to form, they may change radically in response to a small bit of new information.

Aggregate Demand Theories of the Business Cycle

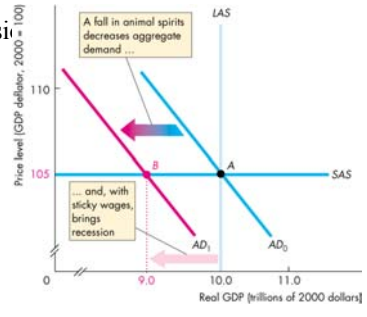
- **Keynesian Cycle Mechanism**
- The mechanism of the business cycle is the initial change in investment, which affects aggregate demand, combined with a flat (or nearly so) *SAS* curve.
- An increase in investment has multiplier effects that shift the *AD* curve rightward; a decrease has similar multiplier effects that shift the *AD* curve leftward.

Aggregate Demand Theories of the Business Cycle

- The asymmetry of money wages means that leftward shifts of *AD* lower real GDP but, without some other change, money wages do not fall and so the economy remains in a below full-employment equilibrium.
- The Keynesian theory is most like the tennis match, in which cycles are the result of outside forces applied at the turning points.

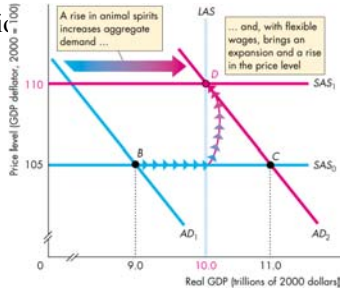
Aggregate Demand Theories of the Business Cycle

- Keynesian recessi



Aggregate Demand Theories of the Business Cycle

– Keynesian expansio



Aggregate Demand Theories of the Business Cycle

- Monetarist Theory
  - The **monetarist theory of the business cycle** regards fluctuations in the quantity of money as the main source of business cycle fluctuations in economic activity.
  - **Monetarist Impulse**
  - The initial impulse is the growth rate of the money supply.

Aggregate Demand Theories of the Business Cycle

- **Monetarist Cycle Mechanism**
- The mechanism is a change in the monetary growth rate that shifts the *AD* curve combined with an upward sloping *SAS* curve.
- An increase in the growth rate of the money supply lowers interest rates and the foreign exchange rate, both of which have multiplier effects that shift the *AD* curve rightward.
- A decrease in the monetary growth rate has opposite effects.

Aggregate Demand Theories of the Business Cycle

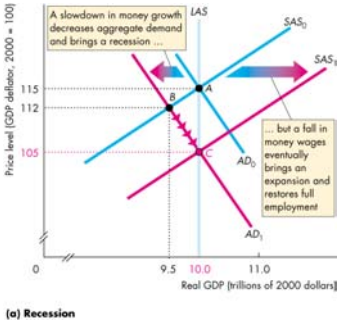
- Money wages are only temporarily sticky, so an increase in aggregate demand eventually raises money wage rates and a decrease in aggregate demand eventually lowers money wage rates.
- Rightward shifts in the *AD* curve cause an initial expansion in real GDP, but money wages rise and the expansion ends as GDP returns to potential GDP.
- Decreases in *AD* are similar: they cause an initial decrease in real GDP, but money wages fall and the recession ends as GDP returns to potential GDP.

Aggregate Demand Theories of the Business Cycle

– The monetarist theory is like a rocking horse, in that an initial force is required to set it in motion, but once started the cycle automatically moves to the next phase.

Aggregate Demand Theories of the Business Cycle

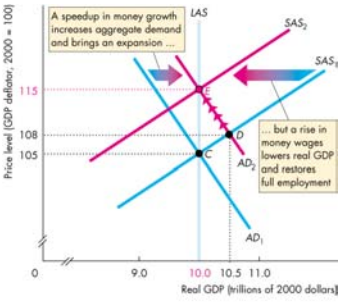
– Monetarist business cycle.
– Part (a) shows a recession phase.



(a) Recession

Aggregate Demand Theories of the Business Cycle

– Part (b) shows an
– expansion phase.



(b) Expansion

Aggregate Demand Theories of the Business Cycle

- Rational Expectations Theories
  – A *rational expectation* is a forecast based on all the available relevant information.
  – There are two rational expectations theories.
  – The **new classical theory of the business cycle** regards *unanticipated* fluctuations in aggregate demand as the main source of economic fluctuations.

Aggregate Demand Theories of the Business Cycle

- The **new Keynesian theory of the business cycle** also regards unanticipated fluctuations in aggregate demand as the main source of economic fluctuations but also leaves room for *anticipated* fluctuations in aggregate demand to play a role.

Aggregate Demand Theories of the Business Cycle

- **Rational Expectations Impulse**
- Both rational expectations theories regard unanticipated fluctuations in aggregate demand as the impulse of the business cycle.
- But the new Keynesian theory says that workers are locked into long-term contracts, so even though a fluctuation in aggregate demand is today anticipated, if it was unanticipated when the contract was signed, it will create a fluctuation in economic activity.

Aggregate Demand Theories of the Business Cycle

- **Rational Expectations Cycle Mechanisms**
- The mechanism in both theories stresses that changes in aggregate demand affect the price level and hence the real wage, which then leads firms to alter their levels of employment and production.
- In both theories, a recession occurs when a decrease in aggregate demand lowers the price level and thereby raises the real wage rate.
- This change causes firms to reduce employment so that unemployment rises.

Aggregate Demand Theories of the Business Cycle

- In both theories, eventually money wages fall so that the recession ends.
- The new classical theory asserts that only unanticipated changes in aggregate demand affect real wages; anticipated changes affect the nominal wage rate and have no effect on real wage rates.
- Anticipated changes in aggregate demand have no effect on real GDP.

Aggregate Demand Theories of the Business Cycle

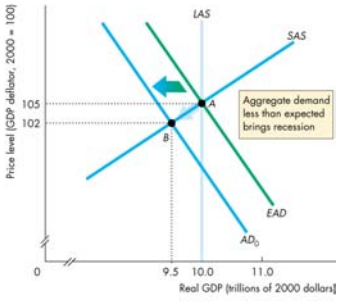
– The new Keynesian theory asserts that long-term labor contracts prevent anticipated changes from affecting the nominal wage rate, so even if a change is correct anticipated today, if it was unanticipated when the labor contract was signed, it affects the real wage rate. Hence, both anticipated and unanticipated changes in aggregate demand affect real GDP.

Aggregate Demand Theories of the Business Cycle

– Both theories are like rocking horses, in which an initial force starts the business cycle but then the fluctuation automatically proceeds to the end of the cycle.

Aggregate Demand Theories of the Business Cycle

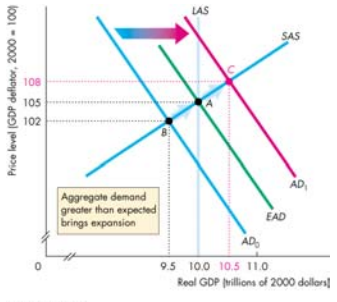
– Rational expectations business cycle.
– Part (a) shows a recession.



(a) Recession

Aggregate Demand Theories of the Business Cycle

– Expansion.



(b) Expansion

Aggregate Demand Theories of the Business Cycle

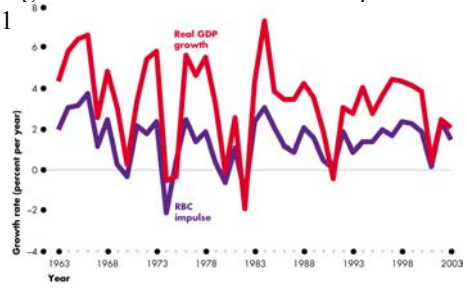
- *AS-AD* General Theory
  - All three of these types of business cycle explanation can be thought of as special cases of a general *AS-AD* theory of the business cycle, in which fluctuations in aggregate demand (and sometimes aggregate supply) cause the business cycle.

Real Business Cycle Theory

  - The **real business cycle theory** (RBC theory) regards technological change that creates random fluctuations in productivity as the source of the business cycle.
- The RBC Impulse
  - The *impulse* in RBC theory is the growth rate of productivity that results from technological change.
  - Growth accounting is used to measure the effects of technological change.

Real Business Cycle Theory

  - Figure 30.5 illustrates the RBC Impulse over 1

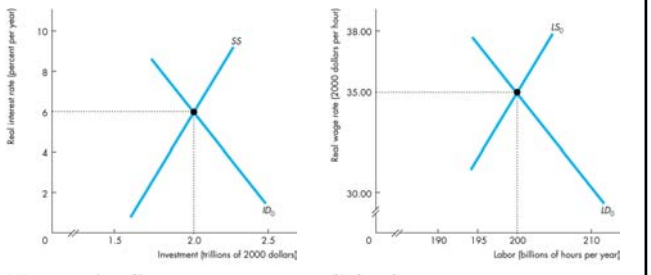


Real Business Cycle Theory

- The RBC Mechanism
  - Two immediate effects follow from a change in productivity
  - Investment demand changes
  - The demand for labor changes

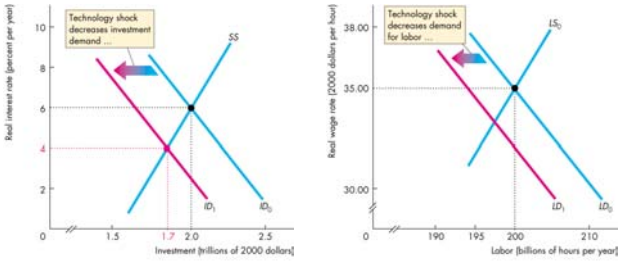
Real Business Cycle Theory

– Capital and labor markets in a real business cycle recession.



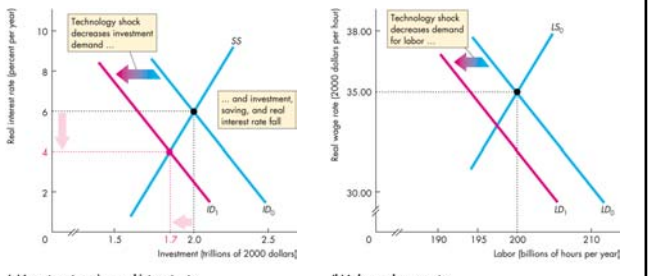
Real Business Cycle Theory

– A decrease in productivity lowers firms' profit expectations and decreases both investment demand and the demand for labor.



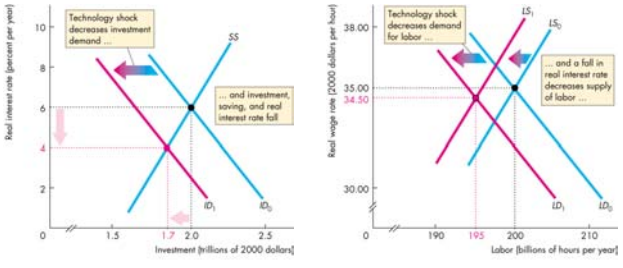
Real Business Cycle Theory

– The interest rate falls.



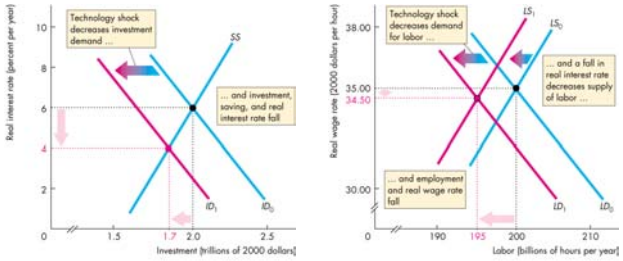
Real Business Cycle Theory

– The lower the real interest rate lowers the return from current work so the supply of labor decreases.



Real Business Cycle Theory

– Employment falls by a large amount and the real wage rate falls by a small amount.



Real Business Cycle Theory

– **Real GDP and the Price Level**

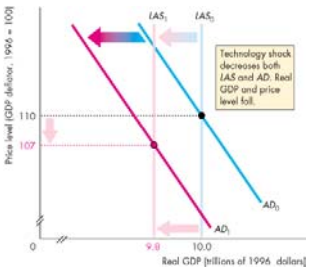
– The decrease in productivity shifts the *LAS* curve leftward (there is no *SAS* curve in the RBC theory).

– The decrease in investment demand shifts the *AD* curve leftward.

– The price level falls and real GDP decreases.

Real Business Cycle Theory

– Changes in aggregate supply and aggregate demand during a real business cycle recession.



Real Business Cycle Theory

– What Happened to Money?

– Money plays no role in the RBC theory; the theory emphasizes that real things, not nominal or monetary things, cause business cycles.

– **Cycles and Growth**

– The shock that drives the cycle in RBC is the same force as generates economic growth.

– RBC concentrates on its short-run consequences: growth theory concentrates on its long-term consequences.

Real Business Cycle Theory

- Criticisms of Real Business Cycle Theory
  - Money wages *are* sticky—a fact ignored by RBC theory
  - The intertemporal substitution effect is too weak to shift the labor supply curve by enough to decrease employment with only a small change in the real wage rate.
  - Technology shocks an implausible source of business cycle fluctuations and measured technology shocks are correlated with factors that change aggregate demand so are not good measures of pure aggregate supply shocks

Real Business Cycle Theory

- Defense of Real Business Cycle Theory
  - RBC theory explains both cycles and growth in a unified framework
  - RBC theory is consistent with a wide range of microeconomic evidence about labor demand and supply, investment demand, and other data
  - The correlation between money and the business cycles can arise from economic activity causing changes in the quantity of money and not vice versa.

Real Business Cycle Theory

- RBC theory raises the possibility that business cycles are efficient so that efforts to smooth the business cycle reduce economic welfare.

Expansion and Recession During the 1990s and 2000s

- The U.S. Expansion of the 1990s
  - The expansion that started in March 1991 lasted 120 months.
  - The previous all-time record for an expansion was 106 months, which took place in the 1960s.

Expansion and Recession During the 1990s and 2000s

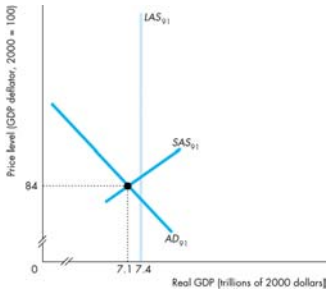
- **Productivity Growth in the Information Age**
- Massive technological change occurred during the 1990s (computers and related technologies exploded, as did biotechnology.)
- The technological change created profit opportunities, which increased investment demand.
- In turn, the higher capital stock increased aggregate supply.

Expansion and Recession During the 1990s and 2000s

- **Fiscal policy and monetary policy**
- Fiscal policy was restrained.
- As a fraction of GDP, government purchases remained about constant and tax revenues increased, largely as a result of a growing economy.
- Monetary policy also was restrained.
- The Fed generally kept the money supply at a relatively slow and steady rate that lead to falling inflation and interest rates.

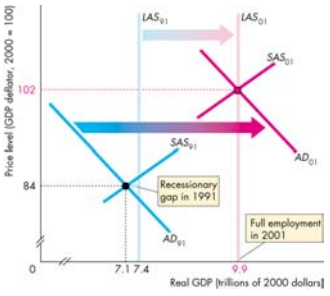
Expansion and Recession During the 1990s and 2000s

- **Aggregate Demand and Aggregate Supply During the Expansion**
- Changes in aggregate demand and aggregate supply that occurred during the 1990s expansion.
- In 1991, there was a small recessionary gap.



Expansion and Recession During the 1990s and 2000s

- Aggregate demand and long-run aggregate supply both increased.
- But aggregate demand increased more than long-run aggregate supply, so both the price level and real GDP increased.
- In 2001, the economy was at full employment.



Expansion and Recession During the 1990s and 2000s

- **A Real Business Cycle Expansion Phase**
- This expansion seems identical to those RBC predicts: technological change increases productivity, with the result that labor demand and aggregate supply increase.

Expansion and Recession During the 1990s and 2000s

- The U.S. Recession of 2001
  - The 2001 recession was the mildest on record.
  - There was no clearly visible external shock to set off the recession.
  - There were no major fiscal shocks to trigger the recession.
  - There were no major monetary shocks prior to the start of the recession, although the Fed had raised interest rates a little in 2000 and held M2 growth steady.

Expansion and Recession During the 1990s and 2000s

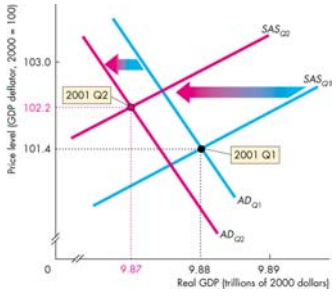
- **Real Business Cycle Effects**
- The growth of productivity did slow in early 2001 according to preliminary data, and this would have slowed the real GDP growth rate.
- In itself, it seems insufficient to have caused a recession, but it was associated with a very severe reduction of business investment that was the proximate cause of the fall in aggregate demand and the start of the recession.

Expansion and Recession During the 1990s and 2000s

- **Labor Market and Productivity**
- Labor productivity increased, as did the real wage, because employment and aggregate hours fell more than GDP and unemployment rose.
- The rise in real wages reduced short-run aggregate supply.

Expansion and Recession During the 1990s and 2000s

– Changes in aggregate demand and aggregate supply in the 2001 recession.



The Great Depression

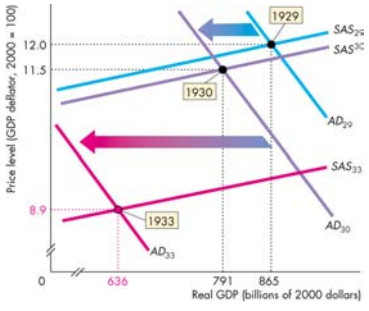
– In early 1929 unemployment was at 3.2 percent.
– In October the stock market fell by a third in two weeks.
– The following four years were a terrible economic experience: the Great Depression.
– In 1930, the price level fell by about three percent and real GDP declined by also about nine percent.
– Over the next three years several adverse shocks hit aggregate demand and real GDP declined by 29 percent and the price level by 24 percent from their 1929 levels.

The Great Depression

– The 1920s were a prosperous era but as they drew to a close increased uncertainty affected investment and consumption demand for durables.
– The stock market crash of 1929 also heightened uncertainty.
– The uncertainty caused investment to fall, which decreased aggregate demand and real GDP in 1930.
– Until 1930, the Great Depression was similar to an ordinary recession.

The Great Depression

– Changes in aggregate demand and aggregate supply during the Great Depression.



The Great Depression

- Why the Great Depression Happened
  - Some economists think that decrease in investment was the primary cause that decreased aggregate demand and created the depression.
  - Other economists (notably Milton Friedman) assert that inept monetary policy was the primary cause of the decrease in aggregate demand.

The Great Depression

- Banks failed in an unprecedented amount during the Depression.
- The main initial reason was loans made in the 1920s that went sour.
- Bank failures fed on themselves; people seeing one bank fail took their money out of other banks and caused the other banks to fail.
- The massive number of bank failures caused a huge contraction in the money supply that was not offset by the Federal Reserve.

The Great Depression

- Can It Happen Again?
  - Four reasons make it less likely that another Great Depression will occur
  - Bank deposit insurance
  - Lender of last resort.
  - Taxes and government spending
  - Multi-income families

Hechos estilizados de la Macroeconomía

"Stylized facts" of macroeconomics

In the long run:

- **Output - real growth rate of ←3% p.a.**

There are two components to this:

- **The rate of growth of the labour force (numbers at work or hours worked)**

+

- **The rate of growth of productivity, that is, output per person employed or per hour worked**

The rate of growth of the labour force (numbers at work or hours worked)

In Ireland and the United States, the labour force has been growing at up to 1.5% a year, due to

Demographic forces

Past birth rate, immigration

Increasing participation in the labour force

In continental Europe, these forces are much weaker

Productivity

Productivity = Output/hour worked

- **In mature economies, averages ← 2% p.a. over the long run**

But it is variable

- **slow-down in 1970s**
- **recovery in 1990s**
- **Countries that are "catching up" can grow faster for a while**
  - **Ireland in the 1990s**
  - **China**

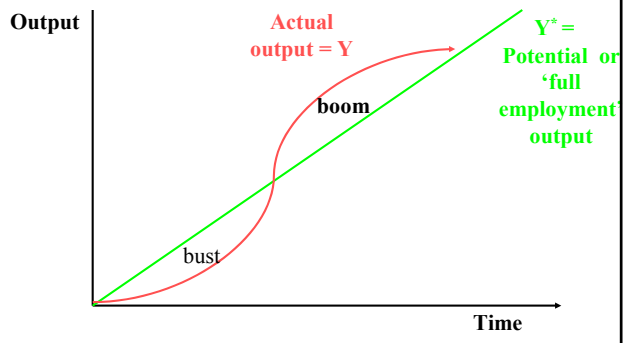
"Stylized facts" of macroeconomics

- **Inflation rate**
  - **no trend**
  - **Historically variable over time and across countries**
  - **Lower and more stable now**
    - **Inflation targeting by independent central banks**
- **Unemployment**
  - **No trend**
    - **But contrast between US and EU**
      - **Hysteresis in EU?**

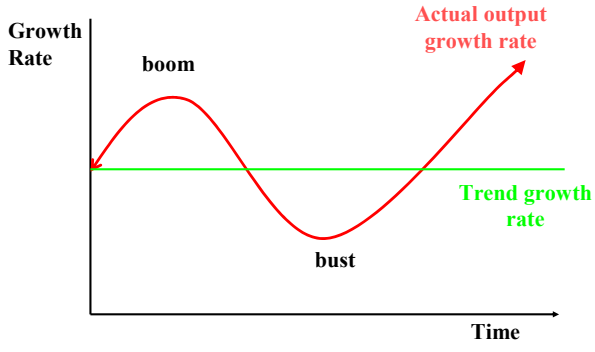
"Stylized facts" of macroeconomics

- Economies do not always remain on their trend growth paths
- The "business cycle" is not dead
  - But it may be tamed compared with the past
- Deviations from the trend growth rate rate caused by *shocks*
  - Demand side –
    - Monetary/fiscal policy
    - Exchange rate fluctuations
  - Supply side
    - Productivity booms/busts
    - Changes in input prices

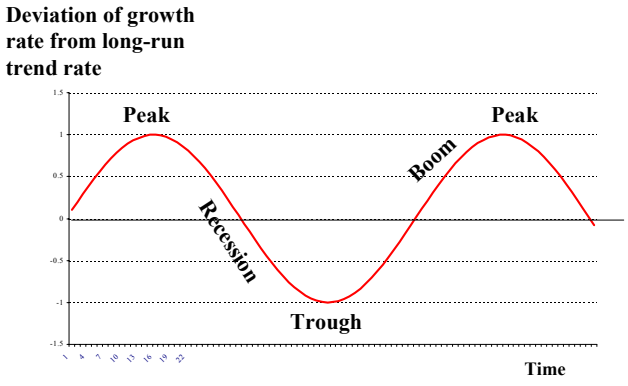
The Business Cycle: Levels



The Business Cycle: Growth Rates



The Business Cycle



How does the economy adjust in the short run?

- **Link between unemployment and growth**
  - **Okun's law**
- **Trade-off between inflation and unemployment**
  - **Phillips curve**
  - **"New paradigm" in 1990s?**
  - **Combining low inflation with rapid growth and low unemployment?**

"Stylized facts" of the business cycle

- **Recurrent but not periodic**
  - **In the sense that there is no predictable pattern**
- **Output movements correlated across all sectors of the economy - *comovement***
- **Industrial production, consumption, and investment, are *procyclical***
- **Investment more *volatile* than consumption**
- **Employment *procyclical,* unemployment *countercyclical***

"Stylized facts" of the business cycle

- **Real wage and labour productivity procyclical, real wages only weakly**
- **Money supply and stock prices procyclical and leading**
- **Inflation (and the price level) and nominal interest rates are procyclical and lagging**
- **The real interest rate is acyclical**
- **Disinflation involves higher unemployment and lost output**
- **Becoming less severe?**
  - **Economy more stable since 1950s than in first in nineteenth century and first half of twentieth?**

Business Cycle Measurement

Business Cycle Measurement

- Look at short run fluctuations in output and other variables

Business cycles are fluctuations around the trend

  - *Peak*: Maximum positive deviation from trend
  - *Trough*: Maximum negative deviation from trend

Figure 3.1 Idealized Business Cycle

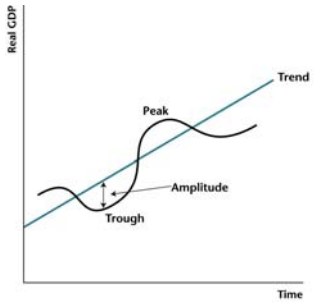
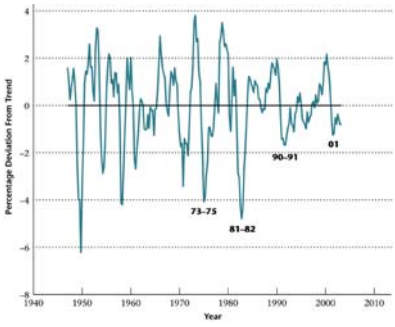


Figure 3.2 Percentage Deviations from Trend in Real GDP from 1947--2003



Time series

- Look for
  - *variability* of fluctuations (are the deviations relatively large or not?)
  - *persistency* (is positive deviation going to stay for more periods?)
  - *comovement* (do any two series move together?)
    - Correlation
    - Leading/lagging

Figure 3.5 Variability and persistency: Imports and GDP

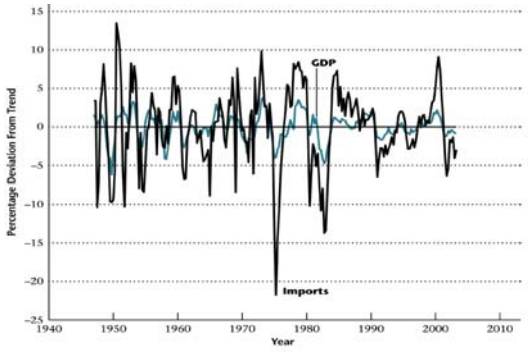
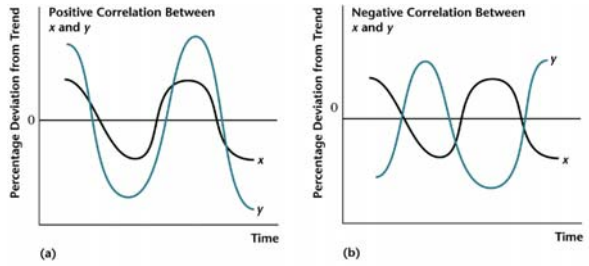


Figure 3.3 Comovement: Correlation



Comovement with GDP

- Positively correlated variable: *procyclical*
- Negatively correlated variable: *countercyclical*
- No correlation with GDP: *acyclical*

Figure 3.7 Comovement: Leading and Lagging Variables

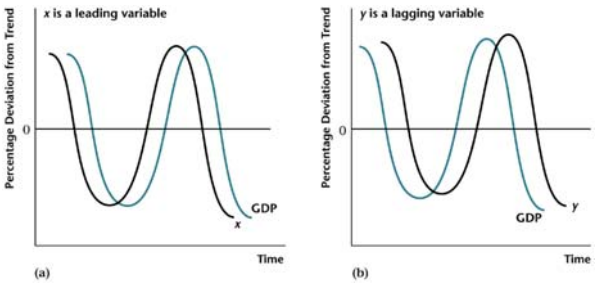


Figure 3.9 Real Consumption and Real GDP

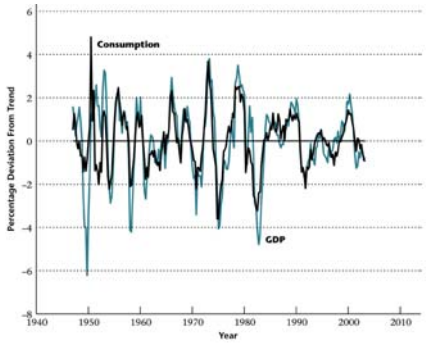


Figure 3.10 Real Investment and Real GDP

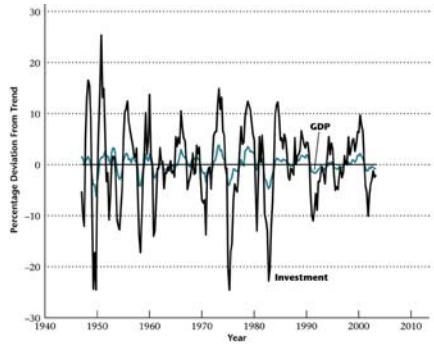


Figure 3.12 Price Level and Real GDP

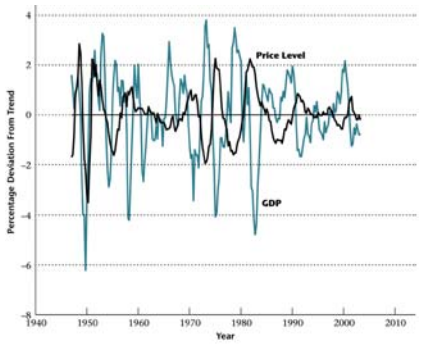


Figure 3.13 Money Supply and Real GDP

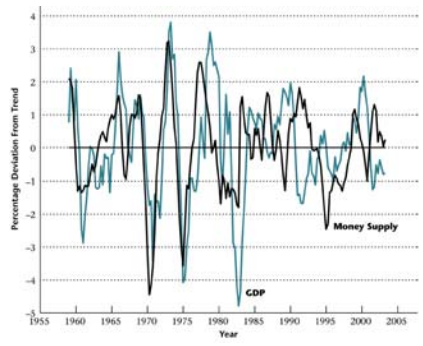


Figure 3.14 Employment and Real GDP

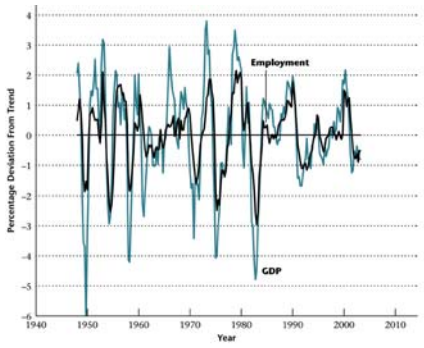


Figure 3.15 Average Labor Productivity and Real GDP

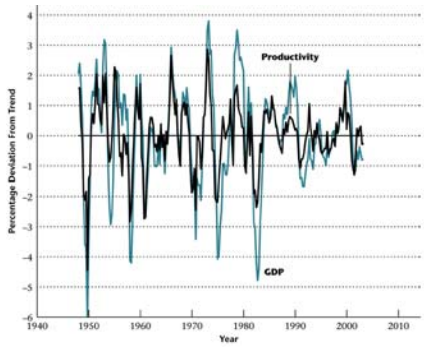


Table 3.1 Correlation Coefficients and Variability of Percentage Deviations from Trend

	Correlation Coefficient	*Standard Deviation (% of S.D. of GDP)*
Consumption	0.76	75.6%
Investment	0.83	469.2
Price Level	−0.26	57.6
Money Supply	0.38	77.9
Employment	0.81	59.3
Average Labor Productivity	0.83	62.8

Table 3.2 Summary of Business Cycle Facts

	Cyclicality	*Lead/Lag*	*Variability Relative to GDP*
Consumption	Procyclical	Coincident	Smaller
Investment	Procyclical	Coincident	Larger
Price Level	Countercyclical	Coincident	Smaller
Money Supply	Procyclical	Leading	Smaller
Employment	Procyclical	Lagging	Smaller
Real Wage	Procyclical	?	?
Average Labor Productivity	Procyclical	Coincident	Smaller

The difference between the Long and Short Term

- **In the long run, the Classical Dichotomy holds:**
  - **Nominal (money) variables do not affects real variables**
  - **Money is neutral**
  - **Output, employment, unemployment return quickly to the "natural" or full-employment levels after a shock**

In the long run, the Classical Dichotomy holds

- **Nominal (money) variables do not affects real variables**
- **Money is neutral**
- **Output, employment, unemployment return quickly to the "natural" or full-employment levels after a shock**
- **Growth depends on real forces such as**
  - **The savings rate (s),**
  - **The rate of labour force growth (n),**
  - **The rate of technical progress (g)**

But

"*In the long run* we are all dead. Economists set themselves too easy, too useless a task if in tempestuous seasons they can only tell us that when the storm is long past the ocean is flat again"

J. M. Keynes *Tract on Monetary Reform* 1924

The Economy in the Short Term Introduction

Understanding the business cycle

What were you told in First Year?

- **Due to shocks**
- **Shifts in aggregate demand and/or aggregate supply**
- **What do you think happened in 2000-2001?**
  - **Why did the economy move from boom to bust?**

Major issues in contemporary macro

- **Keeping the economy close to its full employment growth path**
  - **Maintaining high growth, low unemployment, *and* low inflation (price stability)**
- **Should low inflation be the over-arching goal?**
  - **Achieve this and all else will follow?**
  - **The European Central Bank places major emphasis on maintaining price stability**
  - **The Fed places more emphasis on getting the balance right between price stability and low unemployment**

Policy effectiveness

- **How effective is stabilisation policy?**
  - **Can fiscal and monetary policy offset shocks and keep the economy closer to its full employment growth path?**
- **What sort of coherent, credible policy rules should central banks follow?**
  - **In a world of floating exchange rates**
  - **With volatile asset (stock and property) markets**

Do shocks have permanent effects?

- **Real shocks (e.g. technological change) expected to have permanent effect**
- **Nominal shocks (e.g. monetary policy) not expected to have a lasting impact on real variables**
- **This issue relates to the distinction between**
  - **Stationary and**
  - **non-stationary**

variables

Stationary variables

- **Mean-reverting**
- **Vary randomly round a stable mean**
  - **With constant variance**

Non-stationary variables

- **Not mean-reverting**
- **Vary randomly round a mean that varies over time**
- **Random walks – no "memory"**

Stationary variables

- **GNP and its components?**
- **Inflation?**
- **Unemployment?**

Non-stationary variables

- **Stock market prices**
- **Exchange rates**

Nelson and Plosser (1982) claimed than many US macroeconomic variables, such as GDP, are *random walks*. Shocks have permanent effects. The cyclical behaviour of these variables therefore could not be explained by monetary disturbances, which would be a source of purely temporary fluctuations. They claim that the evidence that variables such as GDP are random walks implies that the main source of economic instability must be real shocks. If this is the case, it is impossible to separate the explanation of business cycle from the process of long-term growth.

Non-stationary variable: follows a random walk

$$x_t = \alpha x_{t-1} + \varepsilon_t$$

If $\alpha = 1$

$$x_t = x_{t-1} + \varepsilon_t$$

$$x_t = x_{t-2} + \varepsilon_t + \varepsilon_{t-1}$$

$$x_t = x_0 + \sum_{j=0}^{t-1} \varepsilon_{t-j}$$

$$= \sum_{j=0}^{t-1} \varepsilon_{t-j} \quad \textit{starting from} \quad x_0 = 0$$

Market Clearing Models of the Business Cycle

- Wages and prices adjust quickly enough so that 'market-clearing' models of the economy are good approximations to reality.
- Market clearing business cycle models have strong theoretical foundations (the microfoundations).
- Real Business Cycle Theory: business cycles are the optimal responses of consumers & firms to TFP shocks
- Lucas Money Surprise (misperception): Take the RBC model as a starting point, but give the consumer only partial information about economic events
- Keynesian Coordination Failure Model: A market-clearing model with a role for government intervention

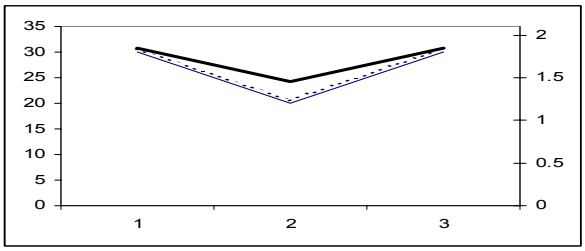
The Real Business Cycle Model

- Introduced in the early 1980s. Can random TFP shocks (we call these 'real' shocks) cause business cycles? Potential since detrended Solow residuals from the exogenous growth model tracks fluctuations in GDP closely
- TFP changes: weather, technological innovations, government regulations. We know that the economy is repeatedly hit with TFP shocks.
- The Solow residual plays a central role in the arguments of both the proponents and opponents of RBC theory
- The RBC model can be studied with or without money because money has no effect in the model
- We add money to the model to attempt to explain how the price level changes over the business cycle

- Proponents of RBC theory calculate Solow residuals (TFP, or 'Z' in the production function) on an annual or quarterly basis. They plot these against GDP and point out the close relationship.
- Opponents of RBC theory argue that the Solow residual is mis-measured. As we saw earlier, there are measurement errors associated with estimating TFP shocks.

- Variable capacity utilization: during an expansion capital fully utilized (less breaks, more overtime), in recessions all capital stock is not used
- The same is true labor, firms may keep workers even if using less labor (called labor hoarding) since training new workers is costly (and often firms must pay severance pay), firms can encourage workers to work harder in expansions
- Both of these facts means that labor/capital inputs are measured as higher than 'truth' in recessions, and lower than 'truth' in expansions- hence we measure bigger changes in TFP than in reality

- Example (recall that $Z_t = Y_t / K_t^{\alpha} N_t^{1-\alpha}$ in the Cobb-Douglass production function)
- Now let $Y_t = Z_t (U_t K_t)^{\alpha} (S_t N_t)^{1-\alpha}$ so that $Z_t = Y_t / [(U_t K_t)^{\alpha} (S_t N_t)^{1-\alpha}]$
- An example:



- There is a lot of empirical evidence of procyclical utilization of both labor and capital
- Care must be taken in interpreting Solow residuals calculated in the standard way
- Is the fact that we observe variable rates of capacity utilization (labor and capital) an argument against TFP shocks as the main source of business cycle fluctuations?
- We do not incorporate variable utilization directly in our model to keep the analysis tractable

- The RBC model: The complete intertemporal model with a temporary productivity shock (a temporary increase in TFP)
  - Which empirical facts of the business cycle does the RBC model match?
  - Which empirical facts of the business cycle does the RBC model miss?
  - A model with a persistent TFP shock
- Fiscal Policy in the RBC Model
  - Shocks (changes in) government spending or taxes may an additional source of fluctuations (RBC theorists believe that roughly 70% of business cycle fluctuations are due to TFP shocks, so even the strictest adherents to RBC theory think other shocks are important)

- Taxes and government spending do change over time
- An increase in Government spending in the RBC framework
- Does the result fit empirical facts?
- We would conclude that government spending is procyclical. We could argue that this is evidence in favor of fiscal shocks as another source of business cycles.
- Optimal fiscal policy in the RBC model: What should the government do to counteract a recession caused by a fall in TFP?

- Monetary Policy in the RBC Model
  - In the RBC model prices adjust immediately, so expansionary monetary policy does not even have a temporary effect on output.
  - The fact that money is procyclical is problematic for the classical approach. The RBC model predicts that money is acyclical
  - This failure of the RBC model may not be important since money is not a important component of the model
  - An alternative view of money, that money is endogenously created by the actions of private individuals and firms, not the central bank can explain the behavior of the money supply.

- Lucas Misperceptions Model introduces non-neutral money (in the short run) with markets always in equilibrium
- Key features of the Misperceptions model:
  - Workers have imperfect information about the price level.
  - Worker has complete info about his/her own nominal wage
  - Since the worker only buy goods occasionally (and not all goods), they don't know P.
  - Worker doesn't observe aggregate shocks (TFP).
  - Workers do know the structure of the economy.

- Result: An ⇑ in PxW can be perceived as a W ⇑, so worker is induced to work harder. An increase in the nominal money supply may increase nominal wages (and aggregate prices so real wages are unchanged). When PxW increases workers do not know if this is from an increase in MS (so they shouldn't work harder) or an increase in TFP (and hence their real wage so they should work harder)
- Model Assumptions
  - TFP shocks will be assumed to be temporary
  - Money shocks are permanent.
  - Consumer does know that both shocks are possible
  - Consumer can deduce which one occurred one period later since they know the structure of the economy.

- Does the Misperception model match empirical business cycle facts?
- Implications for Monetary Policy
  - The Fed can cause Y and N to increase. The manner in which this happens is bad: people are fooled
  - A better allocation of time and resources occurs when everyone is perfectly informed (all markets clear, all allocations are optimal- the best we can do)
  - Market Prices carry important signals about shocks hitting the economy. Ex: Price of Apples rises, people buy less apples, and producers try to bring more to market: both reacting to signal. Changes in money make the price signal 'noisy'

  - Optimal monetary policy: Make MS as predictable as possible.
  - Milton Friedman: Federal Reserve should commit to a 'constant money growth rule'

- Criticisms of Model:
  - Money Supply and aggregate price level numbers are published regularly
  - How often can you fool people with the same 'trick'?

- Keynesian Coordination Failure Model
  - There are strategic complementarities between different firms in the economy
  - If one firm (or industry) increases its output it may be the case that another firm (or industry) should increase output as well. Example: Movies in DVD format and DVD players
  - Both industries would benefit by increasing output at the same time (and suffer if one industry increased output while the other didn't)
  - If both industries are 'optimistic' then we can end up in a high output equilibrium

  - If both industries are 'pessimistic' then we can end up in a low output equilibrium
  - The economy then has multiple equilibria. Which equilibrium (good, or bad) we end up at depends on perceptions about the economy that are not directly related to fundamental variables in the economy
  - Statements by government officials (the president, the Federal Reserve chairman) can impact which equilibrium we are at. Media coverage can also affect perceptions of the state of the economy.

- The model assumes that the aggregate production function has increasing returns to scale. This does not imply that firm level production functions exhibit increasing returns to scale (strategic complementarities give us the aggregate production function with increasing returns to scale)
- The production function is now convex and hence the labor demand function is now *upward* sloping
- The increasing returns to scale needs to be large enough so that the labor demand function is steeper than the labor supply function
- The output supply curve is now downward sloping

- Since the output supply and output demand curve can intersect at more than 1 point we can have more than one equilibrium
- Anything non-fundamental that can move us from one equilibrium to another is called a sunspot
- We consider changes in perceptions about the economy that are not related to changes in fundamentals in the economy sunspots
- This behavior is most often mentioned in the context of stock markets

- Does the coordination failure model match the data?

- The predictions of the RBC model and Coordination failure model make the two models observationally equivalent. We cannot distinguish which is the true model based on the predictions we have looked at

- Money can serve a sunspot variable since it has no fundamental role in this model

- Fiscal Policy can be used to stabilize business cycles
  - Is this stabilization beneficial in welfare terms?

- Criticisms of Model
  - No fundamental role for money
  - The existence of increasing returns to scale at the aggregate level is questionable
  - It is difficult to explain why expectations change over the business cycle