

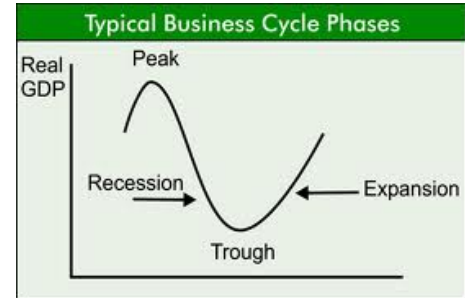
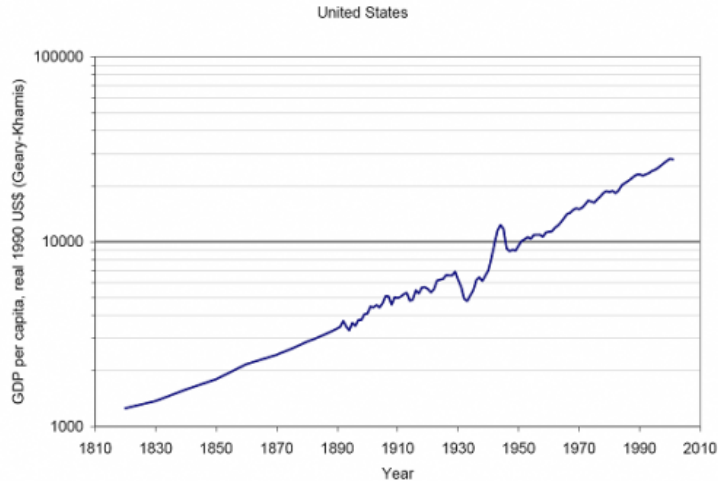
# BUSINESS CYCLES

## OUTLINE

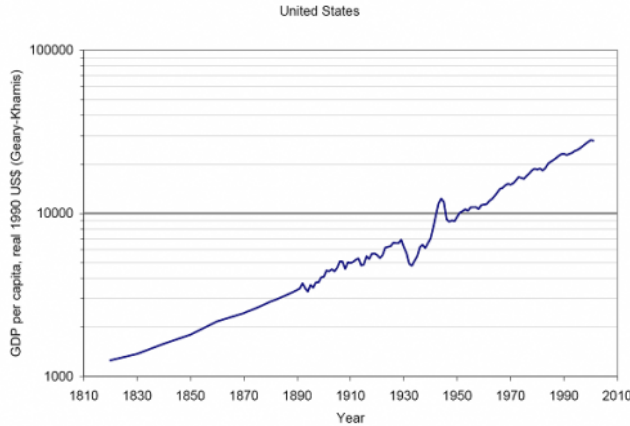
- What is a Business Cycle?
- What do Economic Theories say about It?
  - Classical Theory
  - Keynesian Theory
- Current Method of Explaining Business Cycles: DSGE Models
- Two DSGE Models: A Real Business Cycle (RBC) and a New-Keynesian Model
  - Solution Methods for RBC Model (which is a competitive, an optimal model)
  - Solution Methods for New-Keynesian Model (which is a monopolistic competitive, a sub-optimal model)
- Extracting BCs from Raw Data

# 1- What are Business Cycles?

- They are fluctuations in the main macroeconomic variables of a country (GDP, consumption, employment rate, ...) that may have period of three months to a couple of years. If we are interested in analyzing economy in the short-run, we are interested in the Business Cycle Theory

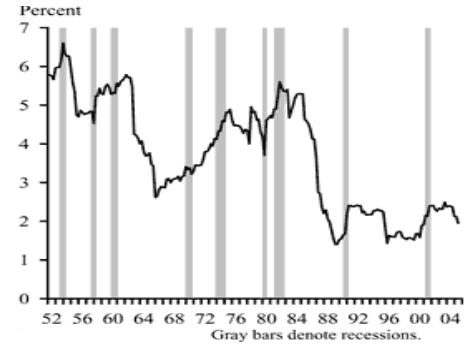


- The figure on the right measures the volatility of Real GDP Growth from 1950 to 2004 that is measured by the standard deviation of the growth rate of the variable.



### Volatility of US GDP growth

Standard deviation of real output growth over previous 20 quarters



The main interesting question is why the volatility of GDP changes over a course of time? Is it due to changes in macroeconomic policy or due to changes in magnitude of the shocks affecting the economy?

## Summarizing Business Cycle Facts

- First we summarize the behaviour of economic variables during the volatile times. Their standard deviation shows the magnitude of their fluctuations, their first order auto-correlation  $-\text{corr}(y_t, y_{t-1})$ - shows the persistency of the changes, and their contemporaneous correlation with output show if variables move in the similar or reverse directions with each other during the volatile times of the economy

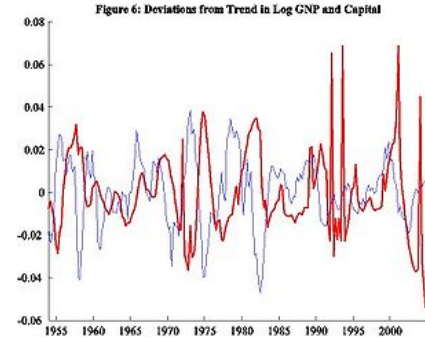
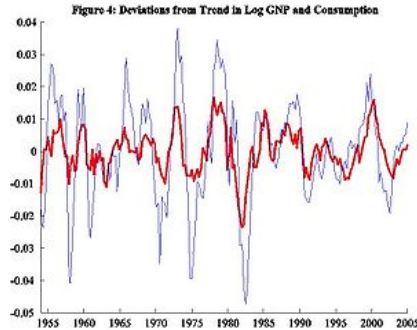
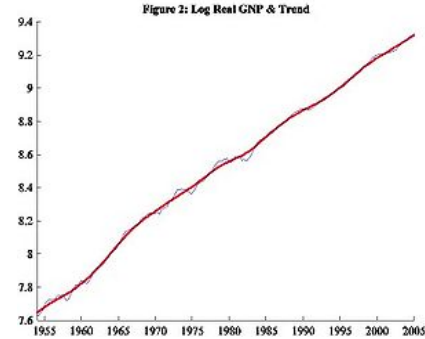
Business Cycle Statistics for the U.S. Economy

	Standard Deviation	Relative Standard Deviation	First Order Auto-correlation	Contemporaneous Correlation with Output
Y	1.81	1.00	0.84	1.00
C	1.35	0.74	0.80	0.88
I	5.30	2.93	0.87	0.80
N	1.79	0.99	0.88	0.88
Y/N	1.02	0.56	0.74	0.55
w	0.68	0.38	0.66	0.12
r	0.30	0.16	0.60	-0.35
A	0.98	0.54	0.74	0.78

- Another way of observing the same information with the above table is to use figures that show the deviations of variables from their trend

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- The fact that components of GDP behaves differently than each other at the volatile times, and the fact that there are other variables than GDP that needs to be modelled (each having different patterns of persistence, comovement with GDP, and volatilities) make it hard to build a model that is able to explain the data
- *Note:* Even though Business Cycles are the fluctuations in the several main macroeconomic variables, in the coming slides I will refer to fluctuations in the growth rate of income (Real GDP)

### **More About Business Cycles: Some Definitions**

- *Procyclical:* Any economic quantity that is positively correlated with the overall state of the economy is said to be procyclical
- *Countercyclical:* It is opposite of procyclical
- *Acyclical:* Moving independent of the overall state of an economy

### 3- What do Economic Theories Say about Business Cycles?

- How can we explain Business Cycles with economic theory?
- Formally, *Business Cycle (or economic cycle)* is an irregular up-and-down movements in the economic activity, often measured by the fluctuations in the growth rate of income (Real GDP). These fluctuations are undesirable since we want economies to have stable growth rate. However, just because they are undesirable, it does not mean that governments and central banks should respond to them. This decision depends how they see the cause of fluctuation
  - We know that equilibrium outcome (income) of the economy occurs at the point where the demand for goods and services is equal to supply. Hence, the change in equilibrium occurs either as a result of a change in the aggregate demand (Keynesian View), or a change in aggregate supply (Classical View)
- We are about to give a detailed insight to these theories, which requires a through review of *History of Macroeconomic Thought*. But before doing that let's take a look at some definitions

- *Full Employment*: When there is no unemployment (Even though there are two types of employment; employment of capital and labor, in theory we use a simplifying assumption that capital is fully employed. So when I refer employment, I refer to employment of labor)
- *Natural Level of Unemployment*: The level of unemployment that is caused by the permanent problems in the supply side of the economy, such as frictional and structural unemployment
  - \* *Frictional (Search) Unemployment*: Frictional unemployment is the time period between jobs when a worker is searching for, or transitioning from one job to another
  - \* *Structural Unemployment*: Even though there exist enough jobs for the number of unemployed workers, the unemployed workers may lack the skills needed for the jobs
    - The labour market is in equilibrium with the natural level of unemployment



- *Natural Level of Output (Potential Amount)*: This is the amount of production when the unemployment is at its natural level
- *Output Gap*: The difference between the actual output and potential (natural level of) output (the deviation of output from its trend)

## **Early Business Cycle Theory**

- *(Early) Classical Theory*: This theory is based on the Say's Law and the belief that prices, wages, and interest rates are flexible
  - *Say's Law*: When an economy produces a certain level of real GDP, it also generates the income needed to purchase that level of real GDP. Hence, the economy is always capable of achieving the natural level of real GDP (the long-run level of GDP)
  - *Flexible prices, wages, and interest rates*: It starts with Adam Smith's writing of the *Wealth of Nations* in 1776. This analysis suggest that self adjusting prices equates the demand to the supply. (so called invisible hand). For example, during a recession, wages and prices would decline to restore full

employment. So economic fluctuations cannot be explained by the demand shocks, but supply shocks (i.e. they have an external cause, like a change in oil prices). And fluctuations are the optimal response of an economy to these external (exogenous) changes. Thus, there is not much to do about them by using monetary or fiscal policies, or by regulation

- \* Classical economists also accept that there is an unemployment more than natural level of unemployment. However, they consider it as voluntary unemployment. Voluntarily unemployed workers are unemployed because they refuse to accept lower wages, or maybe wages are held too high by social and political forces, such as minimum wage laws, not because of market imperfections
- *(Early) Keynesian Theory*: States that there are imperfections in the markets (for goods and services, for labor, and for capital) so that wages, prices and the interest rate are not fully flexible and due to this fact in these markets demand does not come into balance with supply immediately. Also that private sector decisions sometimes lead to inefficient macroeconomic outcomes. For example,

in recession, falling prices and wages depresses people's incomes and affects the expectations of consumers for the future state of the economy, which further affect aggregate demand and would lead to inefficient outcomes ( Inspired by Great Depression in the US, around 1930). This theory is not consistent with Say's Law since it suggests that change in demand can lead to inefficient outcomes. This theory suggests that (i) a change in aggregate demand may cause fluctuations as well (ii) fluctuations in ane economy can be confronted with government and monetary policies

- Denying or supporting Say's law is referred to as the "general glut" debate. In macroeconomics, a general glut is when supply exceeds demand. This exhibits itself in a general recession or depression; underutilization of resources. The Great Depression is often cited as an example of a general glut
- One of the fundamental distinction between Classical and Keynesian view is that Classical Economists tend to accept dichotomy between nominal and real sectors (i.e. they are distinct), while Keynesian Economists believe that money can influence real sector and monetary intervention, just like

government spending, can be used as a policy tool to stabilize demand

- \* Keynesian Theory presents vastly oversimplified view of the economy since it constructs an equilibrium without referring to the labor market. The point is to show that the economy can be in an equilibrium that is far from full employment

- *Neo Classical Synthesis*: It a "synthesis" of Neoclassical and Keynesian theory. The conclusions of the model in the "long or medium run" or in a "perfectly working" IS-LM system are Neoclassical, but in the "short-run" or "imperfectly working" IS-LM system, Keynesian conclusions held. This synthesis is what you are used to see in undergraduate macro textbooks
- (*Early*) *Monetary Theory*: The distinction between Keynes and Monetarists (like Milton Friedman and Anna Schwartz) is that in the era of great Depression Keynes proposed government spending to stimulate aggregate demand, whereas Monetarist thought that the Great Depression was caused by a massive contraction of the money supply and remedy is steadily increase it. Keynes believed

that especially during severe recession in which people stock money no matter how much the central bank tries to expand the money supply

## Criticisms on the Early Business Cycle Literature

- *Lucas Critique* had led Neo-classical and Neo-Keynesian models into so called New-Classical and New-Keynesian models. In doing so, he offered the use of the *rational expectation assumption* and *microfounded models*
- Before Lucas, expectations about the future were used to be formed based on what has happened in the past (*Adaptive Expectations*)
  - Think about the effect of an increase in the money supply. Based on the previous experience, people may expect aggregate demand to increase, which increases prices as well. As a result, producers increase the supply too. New equilibrium is obtained where there is higher price level and higher output (this historical negative correlation between inflation and unemployment known as the Phillips Curve)

- Lucas argued that such linear relationships between various aggregate macroeconomic quantities over time (in the above example inflation and unemployment) may differ depending on what macroeconomic policy regime is in place. This is because any policy change would alter the structure of econometric models on which the policy change may have been based. As a result, it may give wrong results to predict the effects of a change in economic policy entirely on the basis of relationships observed in historical data
  - Again think about the previous example for the effect of an increase in money supply and an increase in output. Lucas Critique suggests that this negative relation between inflation and unemployment could break down if the monetary authorities attempted to exploit it. Permanently raising inflation would eventually cause firms' inflation forecasts to rise, not altering their employment decisions. Eventually, all that the government can do is raise the inflation rate, not employment. This analysis suggests that just because high inflation was associated with low unemployment under early-twentieth-century monetary policy does not mean we should expect high

inflation to lead to low unemployment under all alternative monetary policy regimes (we had similar experience in Turkey)

- Lucas argued that instead of using aggregate variables, economists should build models based on *Microeconomic Foundations* (like preferences, technology, and budget constraints) that should be unaffected by policy changes. The term microfoundations refers to the analysis of the behavior of individual agents such as households or firms to understand the dynamics of the macroeconomic variables
- Lucas also argued that instead of looking what happened in the past (adaptive expectations), these agents use all available information to make optimal forecasts about the future (*Rational Expectations*). It is assumed that agents' expectations may be individually wrong, but are correct on average.
  - The theory of rational expectations implies that the actual data will only deviate from the expectation if there is an 'information shock' caused by information unforeseeable at the time expectations were formed
  - For instance the Lucas supply function with rational expectations implies

that only unanticipated changes in the money supply affect real output. Anticipated changes in the money supply affect only the price level leaving real output equal to potential

- \* Note: The above statement is only true when prices and wages are perfectly flexible. If prices are sticky, anticipated changes in the money supply have an effect on real output. This is to say even with Rational Expectations, by using market imperfections it is possible to construct Keynesian or Monetary models

## **Recent Business Cycle Theory: DSGE Models**

The models that address Lucas Critique and use microfounded macroeconomic models based on rational choice are called dynamic stochastic general equilibrium (DSGE) models, whether the model is New-Classical, New-Keynesian or Monetarist one that are explained below



- Remember the Ramsey Model. In that model we used both households and firms and we made utility and profit maximization and find the equilibrium interest rate, consumption, and growth rate for the economy. This makes the model Dynamic General Equilibrium Model. The Ramsey was deterministic, meaning there were no shocks to economy. If we also stochastic models (models that allow shocks), models become stochastic and are called Dynamic Stochastic General Equilibrium Models). If models are stochastic, agents needs to make some forecasts for the future state of their economies
- DSGE models *often* assume that all agents of a given type are identical (i.e. there is a ‘representative household’ and a ‘representative firm’), thereby avoiding aggregation problems. However, this is a simplifying assumption, and is not essential for the DSGE methodology. These models use (real or nominal) shocks in general equilibrium setting to analyze the effect of deviation of variables from their expected values, which create Business Cycles.

- *New-Classical View*: There are different New-Classical Models. Their common property is use a DSGE model and flexible prices, or not to use prices at all (like the RBC Model below)
  - *Real Business Cycle (RBC) Theory*: Pioneering work by Kydland and Prescott (1982). It argues that it is mistake to call them ‘fluctuations’ around the trend of the economic growth. Trend itself would be volatile and those fluctuations could be just part of the data. Remember that technological development is the basis for growth. So this discussion implies that technology is a volatile process. To model the economy, they use constant growth rate for technology, like in the Neo-Classical Growth Model of the Ramsey, but they also use technology shocks (also called supply or productivity shocks) that causes technology to deviate from its trend and explains short run fluctuations (usually in the form of labor productivity). Since these are real shocks, as they affect the production, it is called Real Business Cycle Theory. Productivity shocks—that can be measured using Solow’s 1958 growth accounting approach (it shows the change in output that cannot be

explained by changes in capital and labor (remember that  $Y=F(K,AL)$ )—could generate time series with the same complex patterns of persistence, comovement, and volatilities as complex economies. As these shocks are real, there is no need for active policy responses by the public sector, including monetary policy actions by the central bank and fiscal policy actions by the government, to stabilize output over the business cycle, which is a general inference can be made from Classical Models. Real Business Cycles shifts attention from nominal interest rate and wage rates back to the real factors of production. Unfortunately, optimization in the neoclassical growth model yields non-linear behavior, ruling out analytical solutions in general cases. The common approach is to linearize the model around the steady state of the system and consider an approximate solution

- *New-Keynesian Approach*: Demand management is in the heart of Keynesian Theory. New Keynesianism provide market imperfection in the form of sticky prices to justify demand management. Sticky price is a situation that only some of the firms are able to adjust their prices even if they all want to. This market imperfection forms a barrier in front of self adjusting mechanism of the economy assumed by Classical Economists. Besides sticky prices, another market imperfection built into most New Keynesian models is the assumption that firms are monopolistic competitors, which gives some monopoly power to firms. This modelling is necessary because under perfect competition, any firm with a price slightly higher than the others would be unable to sell anything, and any firm with a price slightly lower than the others would be obliged to sell much more than they can profitably produce. Therefore, New Keynesian models assume that firms use their market power to maintain their prices above marginal cost, so that even if they fail to set prices optimally they will remain profitable (RBC models use competitive markets instead)