Classical Business Cycle Analysis

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Introduction

▶ Classicals and Keynesians agree on many points

▶ Disagree mainly (but not only) on the speed of adjustment of prices and wages in response to shocks

▶ This has implications for whether monetary and fiscal policy are effective and should be used at all

▶ We are now able to study the different types of business cycle theories in a single unified framework

▶ We begin with the classical perspective

Introduction

This series of lectures:

1. Real Business Cycle Theory

2. Fiscal Policy in the Classical Model

3. Unemployment in the Classical Model

4. Money in the Classical Model

5. Misperceptions Theory

1. Real Business Cycle Theory

Real Business Cycle Theory

▶ Economists are interested in answering two key questions about business cycles:

    1. What are the underlying causes of these business cycles?

    2. What, if anything, should government policymakers do about them?

▶ RBC theory was developed in the 1970s by Finn Kydland and Edward Prescott

▶ They argue that **real shocks** are the primary cause of business cycles

Real Shocks

- ▶ Examples of real shocks:

    1. Shocks to productivity/production function

    2. Shocks to the size of the labor force

    3. Shocks to the quantity of government purchases

    4. Shocks to the saving decisions of consumers

- ▶ Real shocks affect the *IS* or the *FE* curves

- ▶ As opposed to **nominal shocks**, which are shocks to money supply or demand

    - ▶ Nominal shocks affect the *LM* curve

Real Business Cycle Theory

▶ RBC theory gives a lot of importance to **productivity shocks**

▶ Examples of productivity shocks include

  ▶ Technological innovations

  ▶ New management techniques

  ▶ Changes in the quality of capital or labor

  ▶ Changes in the availability of raw materials or energy

  ▶ Weather

  ▶ Government regulations

▶ RBC theory argues that most expansions are caused by positive productivity shocks and most recessions are caused by adverse productivity shocks

RBC recessions

What happens in response to a negative productivity shock?

- ▶ i.e., an increase in the price of oil or an increase in government redtape

- ▶ Labor demand shifts to the left

- ▶ New labor market equilibrium: $\bar{N} \downarrow, w \downarrow$

- ▶ This leads to a fall of full-employment output

$$\bar{Y} = AF(K, \bar{N})$$

Note that both $A \downarrow$ and $\bar{N} \downarrow$

- ▶ The $IS - LM - FE$ model also tells us that

    1. Real interest rates rise, $r \uparrow$
    2. The price level rises, $P \uparrow$
    3. Consumption and investment fall

RBC theory and Business Cycle facts

Are the predictions of the RBC theory consistent with the data?

▶ Although simple, it is consistent with many BC facts

▶ If the economy is constantly hit by productivity shocks, the theory predicts recurrent fluctuations in aggregate output, which we observe

▶ The theory correctly predicts that employment and real wages are procyclical

▶ The theory also correctly predicts procyclical average labor productivity

$$ALP = \frac{Y}{N} = \frac{AF(K, N)}{N}$$

▶ RBC proponents argue that without productivity shocks, ALP would not be procyclical

▶ Due to diminishing marginal returns of labor, a boom caused by something other than a productivity shock would lower ALP

RBC theory and Business Cycle facts

- ▶ RBC theory predicts countercyclical movements of the price level, which seem to be inconsistent with the data

- ▶ In the data, inflation tends to be procyclical, rising during expansions and slowing down during recessions

- ▶ The cyclicality of the price level has been the subject of some debate among economists

What about other shocks?

- ▶ RBC theorists emphasize the role of productivity shocks in driving the business cycle

- ▶ Critics of RBC theory argue that except for the oil price shocks of 1973, 1979, 1990 there are no obvious productivity shocks causing recessions

- ▶ RBC proponents argue that you don't need a big shock - a cumulation of many small shocks can cause a business cycle

Cumulating Small Shocks

Imagine that aggregate output follows a process of the kind **autoregressive process**

$$Y_t = \mu + \rho Y_{t-1} + \sigma \varepsilon_t$$

where $\varepsilon_t \sim \mathcal{N}(0, 1)$ follows a normal distribution

▶ Depending on the value of ρ, the past level of output can have a large effect on current output

▶ Thus if the economy experiences many small negative shocks $\varepsilon_t < 0$, output can remain low for a long time

Cumulating Small Shocks
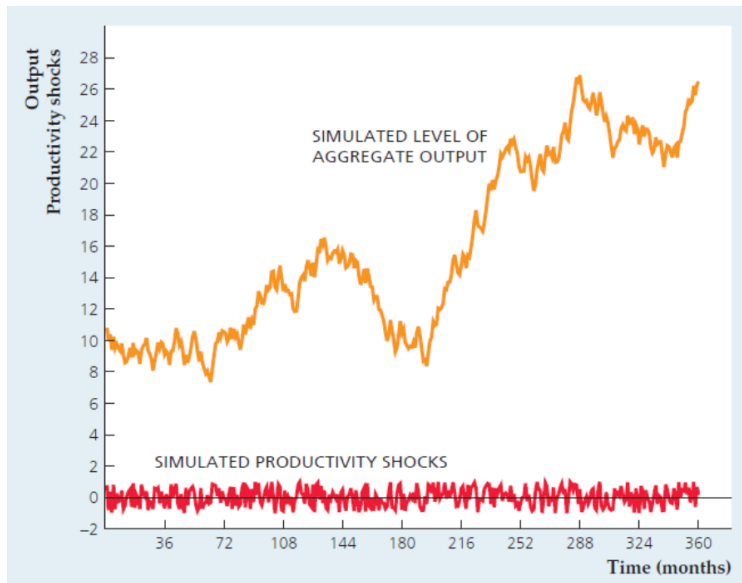
Measuring Productivity Shocks

▶ Since productivity shocks are the main driver of business cycles in their theory, RBC proponents have tried to measure them

▶ One direct way of doing so is via the **Solow residual**

▶ Given data on output, capital, and labor, one can measure productivity from the data as

$$A = \frac{Y}{K^\alpha N^{1-\alpha}}$$

▶ The Solow residual is strongly procyclical in US data, consistent with RBC theory

▶ Some people argue that the Solow residual is not a pure measure of technology

▶ If it were a pure measure of technology, it should not be related with factors such as government purchases or monetary policy

▶ But statistical studies show a correlation between these

Measuring Productivity Shocks

▶ Measured productivity may change even if the underlying technology does not

▶ One reason for this is that inputs may be used more or less intensively at times

▶ More intense use of the same inputs leads to more output even if technology has not changed

▶ Let u_K, u_N be the **utilization rates** of capital and labor

▶ In practice, only "used" capital and labor enter the production function, these are called capital and labor services

$$Y = AF(u_K K, u_N N) = A(u_K K)^{\alpha}(u_N N)^{1-\alpha}$$

Measuring Productivity Shocks

▶ We can then rewrite the expression for the Solow residual as

$$\text{Solow residual} = \frac{Y}{K^\alpha N^\alpha} = \frac{A(u_K K)^\alpha (u_N N)^{1-\alpha}}{K^\alpha N^\alpha} = A u_K^\alpha u_N^{1-\alpha}$$

▶ This shows us that when utilization of either input rises, so does measured productivity

▶ As long as utilization rates are procyclical, measured productivity will be procyclical regardless of the behavior of technology

▶ Can we measure utilization? Yes:
  1. Burnside, Eichenbaum, and Rebelo (1995) measure u_K with data on electricity usage
  2. Fay and Medoff (1985) measure u_N by asking factories about worker downtime and reassignment to other types of jobs
  3. Since firing and hiring is costly, firms may engage in **labor hoarding**, which involves retaining workers during recessions but making them work less instead of firing them and rehiring them later

2. Fiscal Policy Shocks in the Classical Model

Fiscal Policy Shocks in the Classical Model

► Classical theories argue that fiscal policy shocks can also be a source of economic fluctuations

► These are usually changes in government purchases of goods and services, or changes in the tax code that are not directly related to the business cycle

► Examples include military buildups or public infrastructure programs

► The data shows us that government purchases are procyclical: output tends to be high when government spending is also high

Temporary Increase in Government Purchases
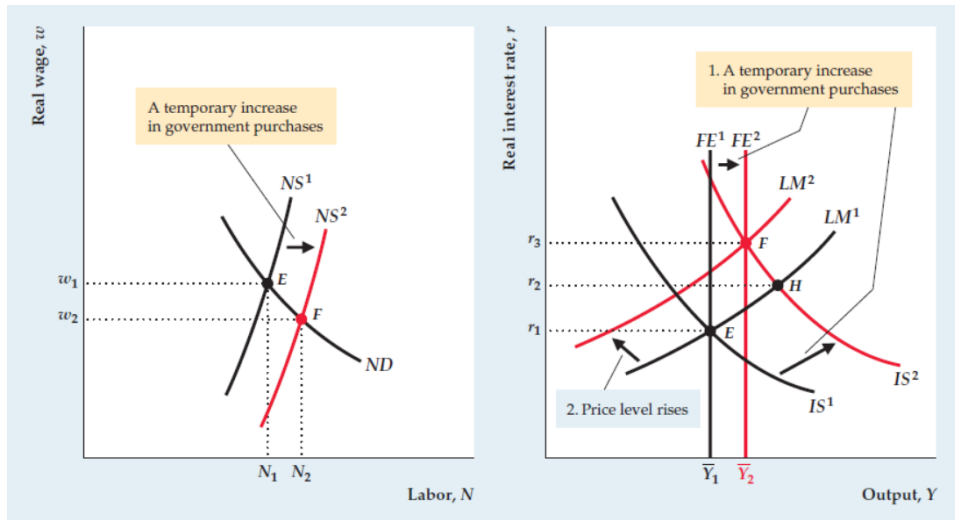
Temporary Increase in Government Purchases

▶ The increase in G must be financed with either debt or current taxes

▶ This is a negative wealth effect for workers that makes them want to work more at the same wage

▶ Labor supply expands $NS^1 \Rightarrow NS^2$

▶ This change in the labor market equilibrium leads to an expansion of $FE^1 \Rightarrow FE^2$

▶ At the same time, the increase in G has expanded the IS curve $IS^1 \Rightarrow IS^2$

▶ General equilibrium is restored via an adjustment of the price level that brings the LM curve to the point where IS^2 and FE^2 intersect

Temporary Increase in Government Purchases

▶ Does the price level rise or fall?

▶ It depends: fiscal policy has affected both the demand and the supply side of the economy

▶ The answer depends on which effect is strongest

1. If the expansion of the *IS* curve is larger than that of the *FE* line, the *LM* curve must contract and thus the price level has to rise
2. If the expansion of the *IS* curve is smaller than that of the *FE* line, the *LM* curve must expand and thus the price level has to fall

▶ In (1) the demand effect dominates, while in (2) the supply effect dominates

▶ *G* ↑ leads to unambiguous:

▶ increase in output, employment, real interest rate

▶ decrease in wages, average labor productivity, consumption, and investment (why?)

Fiscal Policy in the Classical Model

▶ Fiscal policy has real effects in the classical model - but should it be used?

▶ Classical economists oppose attempts to dampen the cycle, since prices and wages adjust quickly to restore general equilibrium

▶ Consider a recession that causes output, employment, and real wages to fall

▶ In the Classical model, an increase in G increases output and employment

▶ ...but by making workers even poorer (via taxes) and depressing real wages even further!

▶ Both consumption and leisure fall, meaning that workers are left worse off

▶ Classical economists argue that government spending should be determined by cost-benefit analysis, and not necessarily just for the sake of dampening the cycle

3. Unemployment in the Classical Model

Unemployment in the Classical Model

▶ In the Classical model, the labor market is always in equilibrium

▶ Thus all workers supply exactly the amount of labor they would like to supply at the prevailing equilibrium wage

▶ Unemployment is literally zero!

▶ This is one of the major weaknesses of the classical model

▶ Unemployment is one of the main reasons why policymakers and the public worry about downturns

Unemployment in the Classical Model

- ▶ Classical economists have developed more sophisticated models of the labor market

- ▶ In these **matching models of the labor market**, not all workers, firms, and jobs are the same
    - ▶ Workers have different skills, abilities, and interests
    - ▶ Firms have different skill requirements, productivities, etc.

- ▶ It takes time to match compatible workers and jobs, so there is always some unemployment

- ▶ During recessions, adverse productivity shocks cause mismatches between workers and jobs

- ▶ Example: a recession may particularly hit the coal industry in WV or the car industry in MI

Matching Models of the Labor Market

► These workers are then induced to search elsewhere for jobs, which raises frictional unemployment

► These workers may not have the skills to obtain jobs in the sectors that are looking for workers

► They may become chronically unemployed, which raises structural unemployment

► Since many workers will be looking for jobs that take time to create, unemployment rises during recessions

Job Creation and Job Destruction
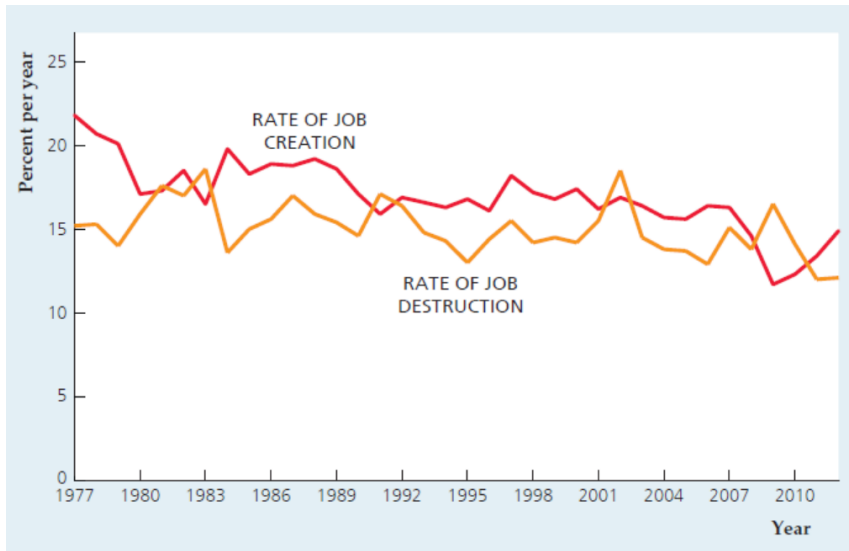
Job Creation, Destruction, and Reallocation

▶ Increased mismatch between workers and jobs cannot explain all of the unemployment we see in recessions

▶ Much of the increase in unemployment comes in the form of temporary layoffs, with workers waiting to be called back instead of searching for new jobs

▶ Additionally, according to the mismatch story, firms whose workers are now mismatched should be looking for better matches during recessions

▶ But both vacancies and job creation fall during recessions

▶ Classical models of unemployment still provide no role for fiscal policy in dampening business cycles

▶ Instead, the government should focus on reducing matching frictions: costs of hiring and firing, minimum wages, etc.

4. Money in the Classical Model

Money in the Classical Model

- In the long-run, changes in the money supply have no effect in real variables

- Money is neutral in the long-run

- Because classical economists assume rapid adjustment of wages and prices, there is no role for money and monetary policy

Monetary Nonneutrality

- ▶ In practice, money is a leading procyclical variable
    - ▶ Increases in the money supply are often followed by increases in output
    - ▶ Reductions in the money supply are often followed by recessions
- ▶ Classical economists argue that there is **reverse causation**
    - ▶ Just because changes in money growth precede changes in output growth does not mean the former cause the latter
    - ▶ If people expect output to be higher tomorrow, they may demand more money today
    - ▶ If money supply is unchanged, this shifts LM to the left and AD to the left, causing $P \downarrow$
    - ▶ The Fed, seeking stable prices, may supply that money
    - ▶ Thus money rises before output, even though expected output growth was the cause
    - ▶ (and money is still neutral!)

Monetary Nonneutrality: Further Evidence

Milton Friedman and Anna Schwartz, *A Monetary History of the United States*

▶ Carefully document the behavior of money supply in the US during the 1867-1960 period

▶ They show that changes in the money supply often had an independent origin

▶ Did not just reflect changes or future changes in economic activity

▶ Focus on things like gold discoveries or the establishment of the Federal Reserve and show that these shocks were followed by changes of real output in the same direction

▶ More recently: "monetary policy shocks" (Romer & Romer, Nakamura & Steinsson)

▶ Detected unexpected changes in monetary policy and show that it has real effects

5. Misperceptions Theory

Misperceptions Theory

- ▶ Strong empirical evidence that money is not neutral is a challenge to the classical model

- ▶ The main problem is that changes in the money supply are shocks to aggregate demand

- ▶ If aggregate supply is vertical in the (Y, P) space, any movement in AD has no effects on Y, only on P

- ▶ For money to be nonneutral, the supply curve must not be vertical

- ▶ The **misperceptions theory** is an extension of the classical model that allows for money to be nonneutral

Misperceptions Theory

▶ The key assumption of the Misperceptions Theory is that producers misperceive the aggregate price level

▶ This implies a short-run AS curve that is not vertical, but is not flat either

  ▶ Thus prices do not adjust immediately, but still adjust rapidly

▶ In the misperceptions theory, the aggregate quantity of output that is supplied rises above the full-employment level $\bar{Y}$ when the aggregate price level is higher than expected, $P > P^e$

Misperceptions Theory

Consider the example of a bakery that makes bread

► The price of bread is the baker's nominal wage; the price of bread relative to the general price level is the baker's real wage

► When the *relative price* of bread rises, the baker's real wage rises and so they may work more and produce more bread

► If the price of bread rises by 5% and the baker expects 5% inflation, then there is no change in the real wage and so the baker does not work more

► But if the baker expects 5% and sees a 8% increase in the price of bread, then they may work more in response to the perceived increase in the real wage

This is the key assumption of the Misperceptions Theory: producers have better information about the price of the goods they sell than they have about the general price level
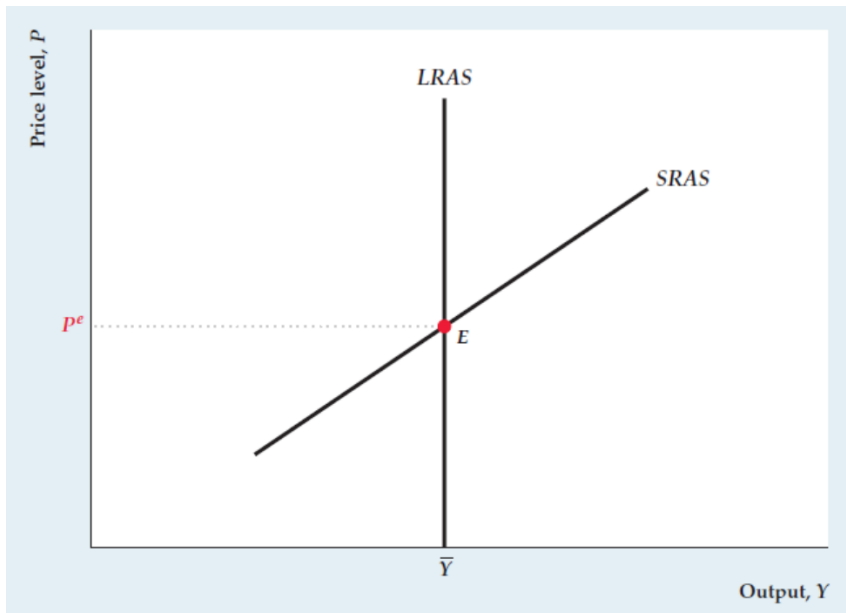
Misperceptions Theory

- ▶ If everyone expects inflation to be 5% but prices actually increase by 8%, all producers tend to produce more
- ▶ Thus an increase in the price level that is higher than expected induces people to work more and produce more output
- ▶ Similarly, an increase that is smaller than expected reduces output
- ▶ Short-run aggregate supply under the Misperceptions Theory is described by:

$$Y = \bar{Y} + b(P - P^e)$$

where

- ▶ Y is actual (realized) output
- ▶ $\bar{Y}$ is full-employment output
- ▶ P is the actual (realized) price level
- ▶ P^e is the expected price level

Short-Run Aggregate Supply under the Misperceptions Theory

Monetary Policy under the Misperceptions Theory

▶ Since *SRAS* is upward-sloping, changes in *AD* can now have real effects on output

▶ Importantly, these changes have to be **unanticipated**, i.e. they must not affect the price level in a way that is expected

▶ If shocks to *AD* are expected, then producers will update their expectations P^e, which shifts the *SRAS*

▶ An important result is that changes in the money supply can have real effects only if they are unanticipated
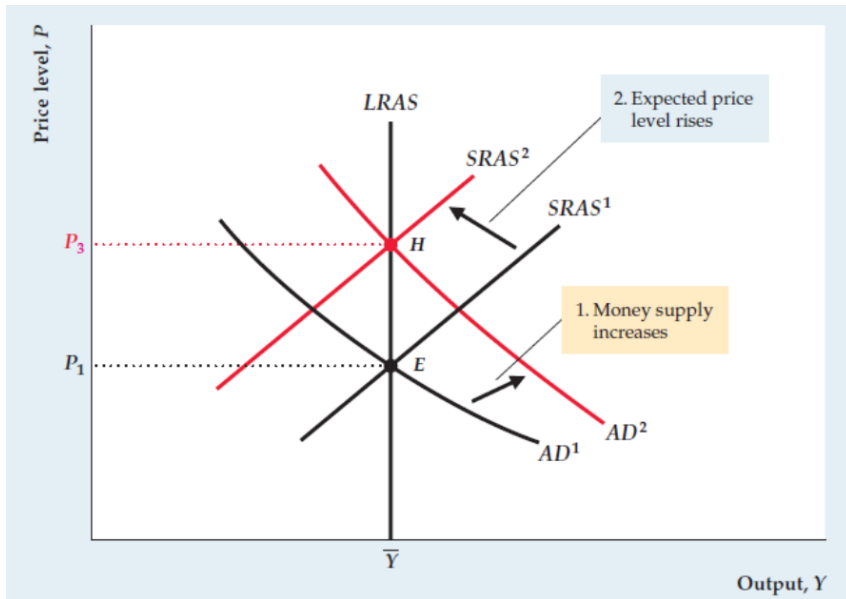
Unanticipated Change to Money Supply
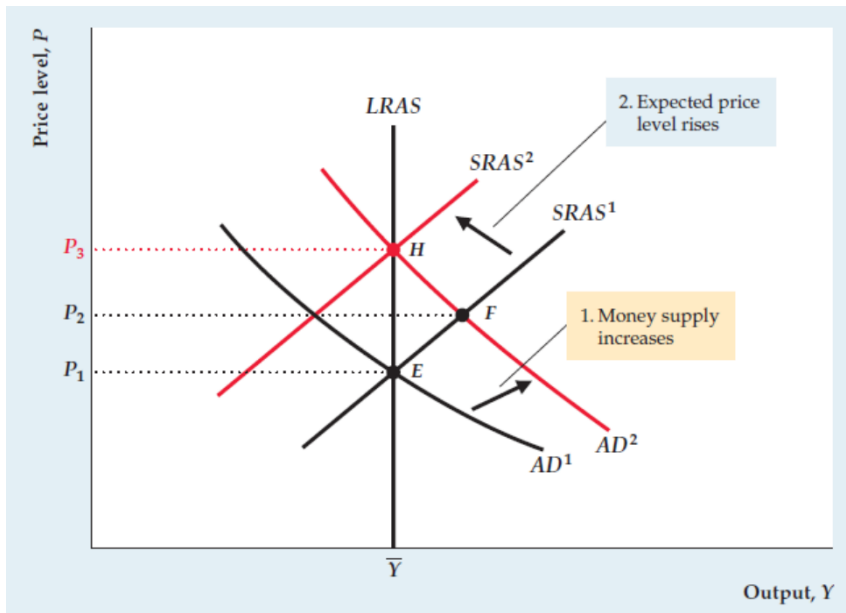
Unanticipated Change to Money Supply

▶ An unanticipated increase in the money supply $M^s \uparrow$ shifts the LM curve to the right

▶ This expands AD, shifting it to the right

▶ Equilibrium moves from E to F: producers are "fooled", as they expected $P^e = P_1$ but see $P_2 > P^e$ in their own industries. For this reason, they produce more

▶ Over time, producers learn that the price level is actually higher than they anticipate, and so they **update their expectations**

▶ Thus we have that $P^e \uparrow$, which shifts $SRAS$ to the left

▶ Eventually, the economy converges to point H, where $P^e = P_3$

▶ Money is neutral in the long-run

▶ There is still the question of **how fast** producers update their expectations

Anticipated Change to Money Supply

Anticipated Change to Money Supply

▶ If the change is anticipated, producers already know that the price level will increase

▶ This means that they adjust their expectations accordingly, $P^e = P_3$

▶ This means that *SRAS* shifts to the left at the same time as *AD* shifts to the right

▶ Thus output is unchanged and the price level rises

▶ Money is neutral in the short- and in the long-run

Rational Expectations

▶ In the classical model, two factors are essential to determine whether money is neutral or not (in the short-run):

   1. Whether changes in the money supply are anticipated or not

   2. How fast to expectations adjust in the case of unanticipated shocks

▶ If the Fed wants to raise output during a recession by raising money supply, it would have to do it in an unanticipated manner and "fool" people

▶ But if the Fed were to do this in a systematic manner, then these changes in money supply will not be unanticipated anymore!

Rational Expectations

- The idea that the Fed cannot systematically surprise the public is part of a broader hypothesis called **rational expectations**

- RE assumes that economic agents such as consumers, producers, etc. forecast economic variables in a sophisticated manner, using all information that is publicly available to them

- RE and the Misperceptions Theory suggest that the Fed cannot systematically use monetary policy to stabilize the economy

- Under RE, only "random acts" of monetary policy have any effects