

# 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 cyclical nature 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

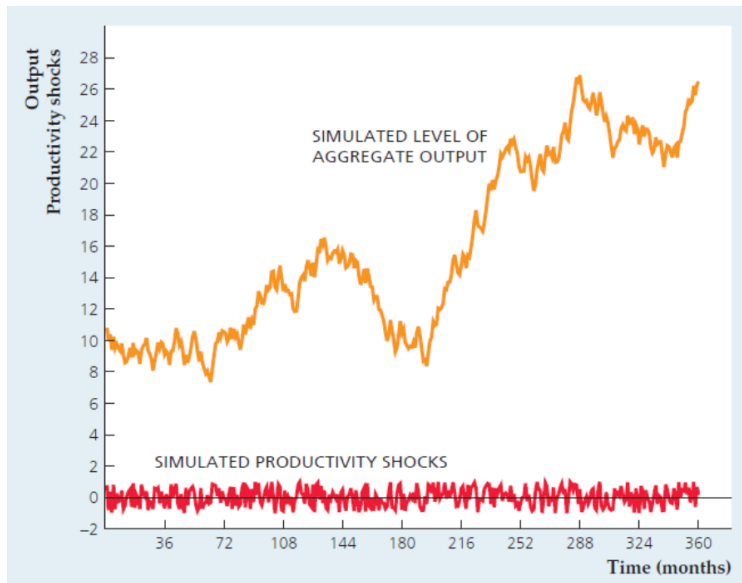
Imagine that aggregate output follows a process of the kind **autoregressive process**

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

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

- ▶ Depending on the value of  $\rho$ , 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

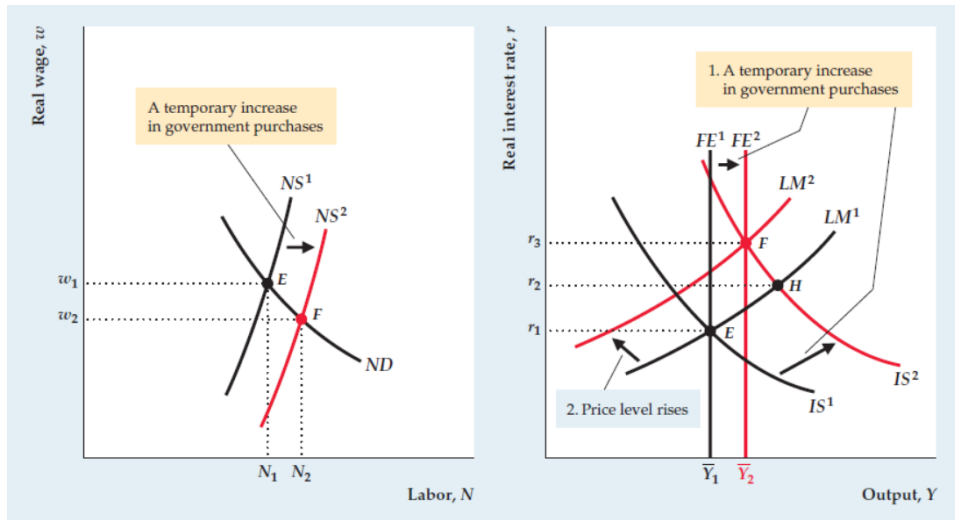
## 2. Fiscal Policy Shocks in the Classical Model



## 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
- ▶  $G \uparrow$  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

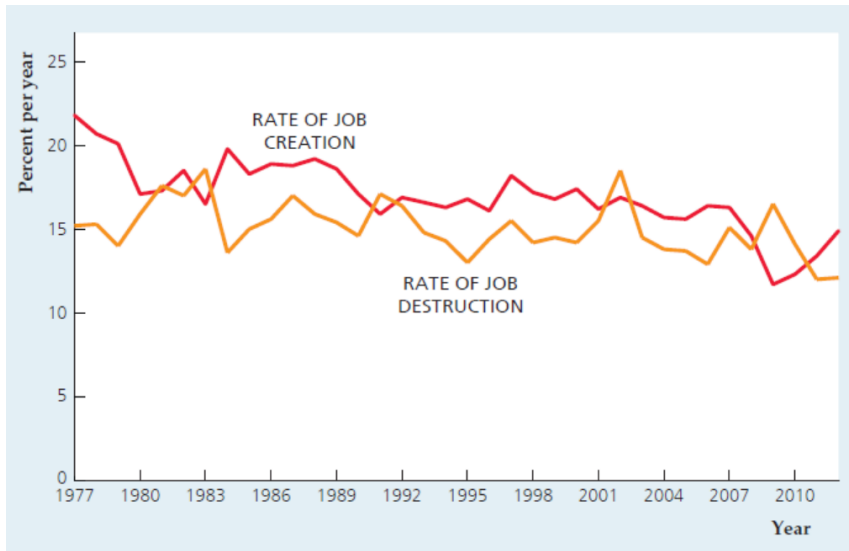
- ▶ Classical economists have developed more sophisticated models of the labor market
- ▶ In these **matching models of the labor market**, not all workers, firms, and jobs are the same
  - ▶ Workers have different skills, abilities, and interests
  - ▶ Firms have different skill requirements, productivities,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

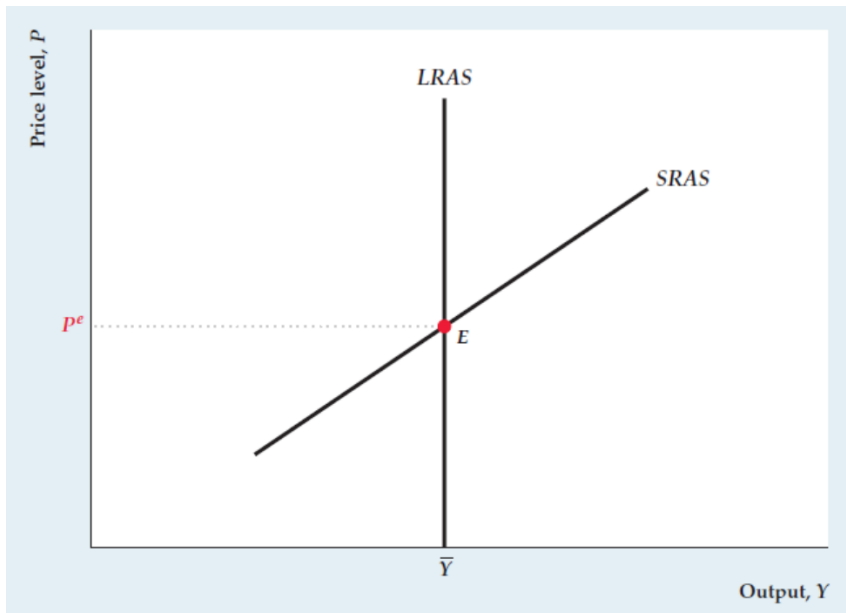
- ▶ If everyone expects inflation to be 5% but prices actually increase by 8%, all producers tend to produce more
- ▶ Thus an increase in the price level that is higher than expected induces people to work more and produce more output
- ▶ Similarly, an increase that is smaller than expected reduces output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

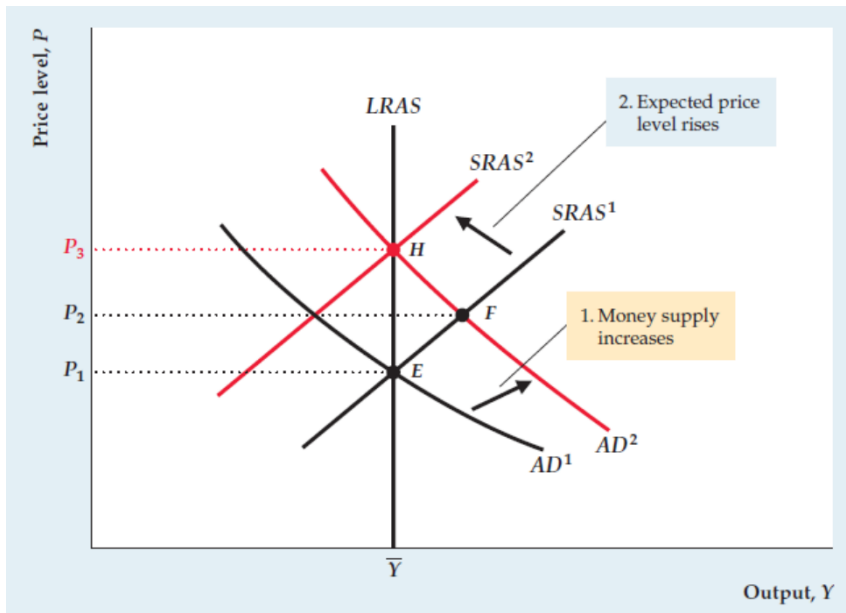
## Short-Run Aggregate Supply under the Misperceptions Theory



# 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

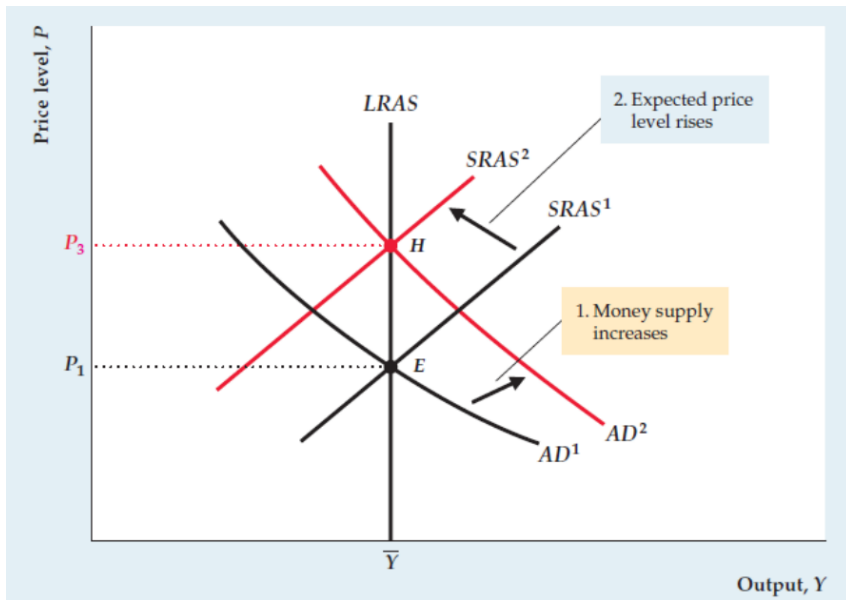


## Unanticipated Change to Money Supply

- ▶ 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 anticipated 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