Chapter 10
long-run real business cycle (RBC) analysis

The two business cycle issues

- What causes business cycles?
- What can policy makers do about the negative effects of business cycles?

What are the long-run determinates of business cycles? – Chicago school version

- Primary unexplained behavior – the growth in the money supply precedes the growth of income
- Chicago hypothesis is that money is neutral – no effect on real variables; affects inflation only – the **Real Business Cycle** (RBC) model

Microeconomic foundations of classical macro

- Changes in economic growth are the result of “real shocks”
- Not “nominal shocks” changes in the demand and supply of money
- The real business cycle model focuses on shocks to production

Adverse productivity shocks

- Sources
  - Increase in the price of oil
  - War
  - Disease
- RBC economists argue that shocks change equilibrium real relationships – they are not the result of temporary disequilibrium

Comparing RBC theory to facts – consistent facts

- Frequent shocks are consistent with recurring business cycles
- Real income moves together with unemployment
- Real wages will be higher during expansions than contractions
- Labor productivity is procyclical (increases when GDP increases)

Comparing RBC theory to facts – inconsistent facts

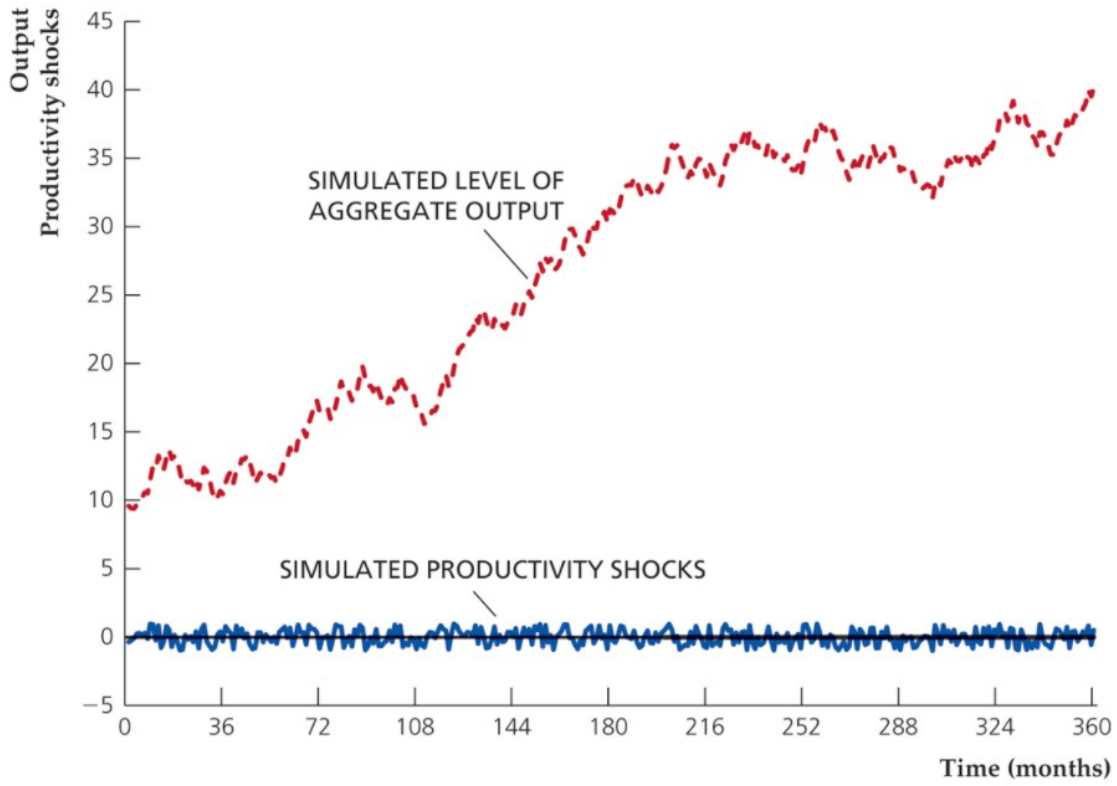
- Inflation slows during and after a recession
  - Some RBC economists argue that inflation does not slow
  - They argue that the slowing was observed in data between WW1 and WW2.

Are supply shocks the only source of recessions?

- The theoretical argument – simulate an economy with two sources of growth
  - Normal growth through added factors and increased productivity
  - Supply shocks
- Although the individual shocks below are small, the chart appears to have business cycles

Are supply shocks the only source of recessions?

Figure 10.3 Small shocks and large cycles



A computer simulation of a simple RBC model is used to find the relationship between computer-generated random productivity shocks (shown at the bottom of the figure) and aggregate output (shown in the middle of the figure). Even though all of the productivity shocks are small, the simulation produces large cyclical fluctuations in aggregate output. Thus large productivity shocks aren't necessary to generate large cyclical fluctuations.

Shocks and the Solow model

- Measuring the size of shocks using the Solow residual
- Begin by solving the production relationship for A

$$\text{Solow residual} = \frac{Y}{K^a N^{1-a}} = A.$$

- When the residual is estimated from US data, it turns out to be procyclical

The counter-argument

- If RBC is the basis of shocks, the business cycle should be uncorrelated with shifts in fiscal and monetary policy – but these correlations are positive
- An explanation based on varying factor use intensity
  - Capital factor intensity $u_k K$ and labor factor intensity $u_N N$

Rewrite the production to include intensity and substitute into the Solow residual

- The production function

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

- The Solow residual

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

3 things that determine level of productivity

- The Solow residual cancels the effect of the quantities of each factor, leaving the three productivity factors

The source of procyclical A

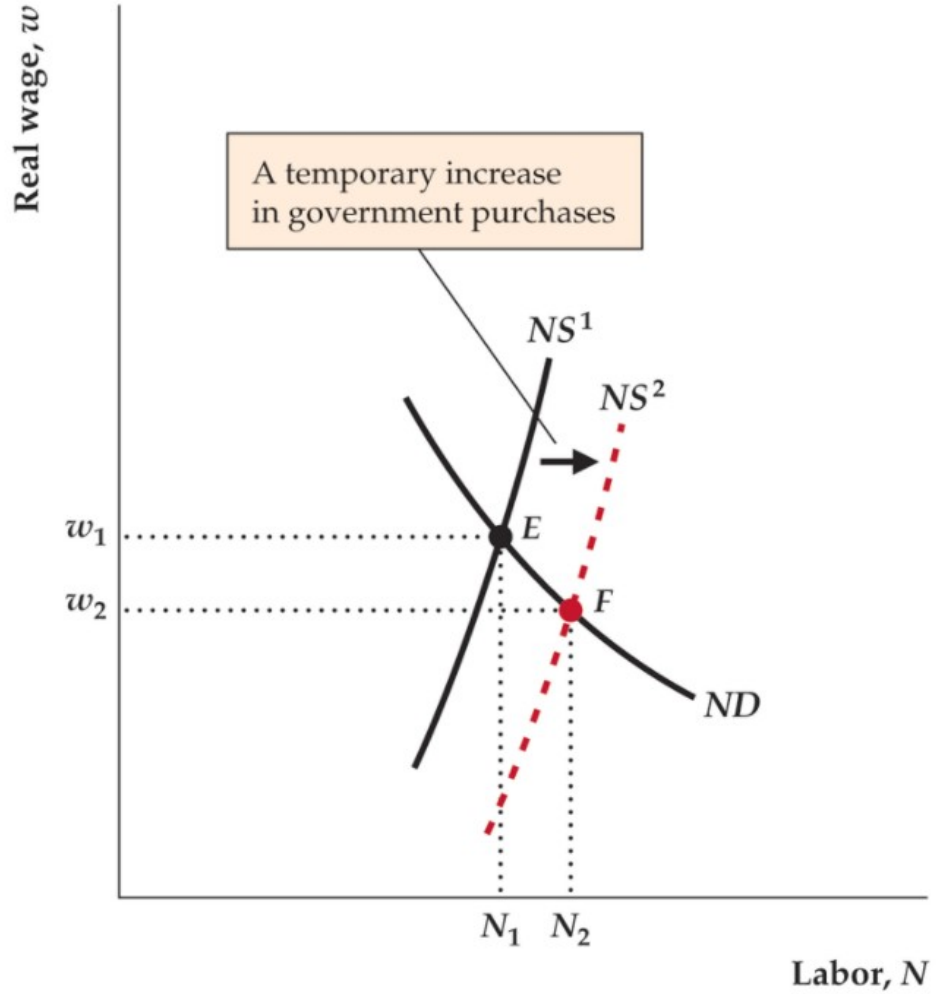
- If the factor intensities are procyclical, the Solow residual would be procyclical
- The evidence that both factors are procyclical is strong

Fiscal policy in the classical model

- Consider the effect of a temporary increase in government spending
  - Since government spending doesn't directly affect production – in particular, has no effect on the Marginal Product of Labor Curve (MPN) – there is no change in the demand for labor
  - In the classical way of looking at government spending, an increase in G affects workers' wealth – for example by increasing military spending by increasing taxes.
  - The negative effect on wealth shifts the labor supply function to the right.

wealth effect

Fiscal policy in the classical model



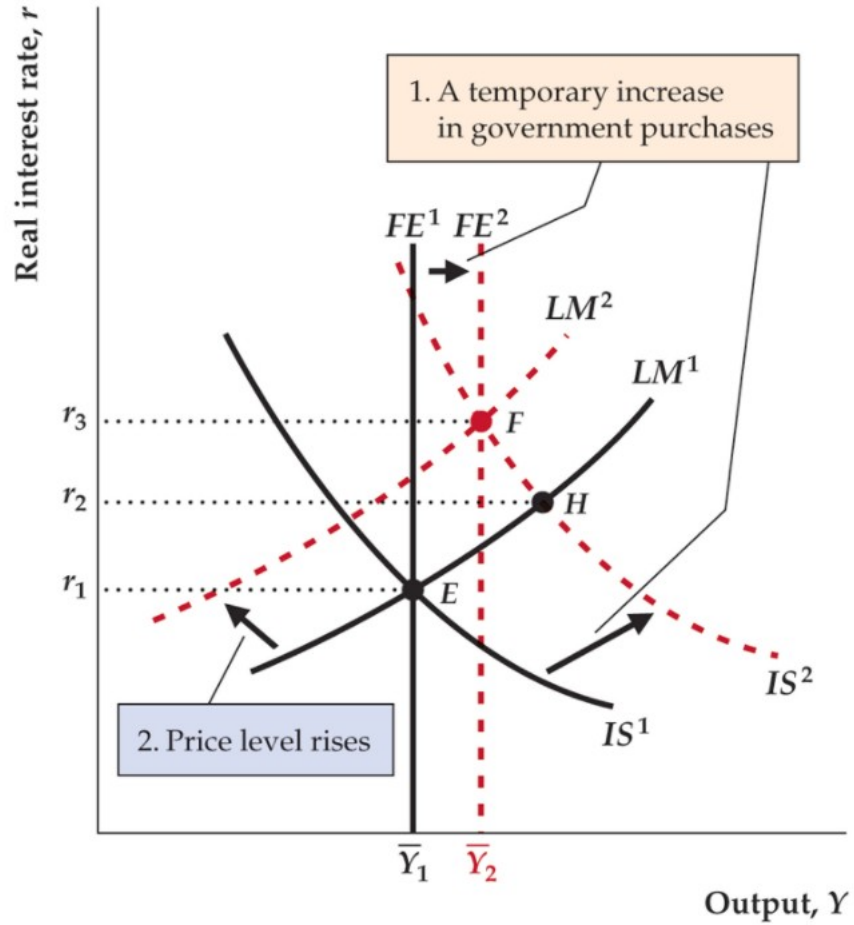
Fiscal policy in the classical model

- Temporary increase in G and IS LM FE
  - The first effect is to shift the FE line to the right temporarily because of the increase in hours worked for each level of interest rates.
  - Next, the IS curve shifts up and to the right since the increase in saving increases the interest rate for every level of income.
  - This moves income and interest rates to the point H, since the LM curve is not affected

Fiscal policy in the classical model

- Temporary increase in G and IS LM FE
  - This leaves the markets in disequilibrium since the IS and LM curve intersect at a level of income different from the income produced
  - If we assume that the effect on FE is to produce a level of Y to the left of the IS LM intersection, there will be an excess demand for Y and the price level must rise, moving the LM curve to the left and upward (see below)

Fiscal policy in the classical model



Fiscal policy in the classical model

- Temporary increase in G and IS LM FE
  - Since the first effect of the increase in G is on labor supply, not demand, the effect on wage rates is negative.
  - Since we are moving down the MPN curve, output per worker also falls although total output rises

Should fiscal policy be used to moderate the business cycle in this classical model?

- Classical economists argue that the fiscal policy such as an increase in G impedes the economy's efficient self-adjustment
- Classical economists accept that recessions are costly, but argue that the policy adjustment produces greater cost
- In the example above, the fiscal adjustment increased the supply of labor at a lower wage, due to the adverse wealth effect of increased G
- Thus, the increase in Y masks the fact that workers are worse off
- Classical economists further argue that the timing of fiscal policy adjustment may not match the timing of the economy's adjustment.

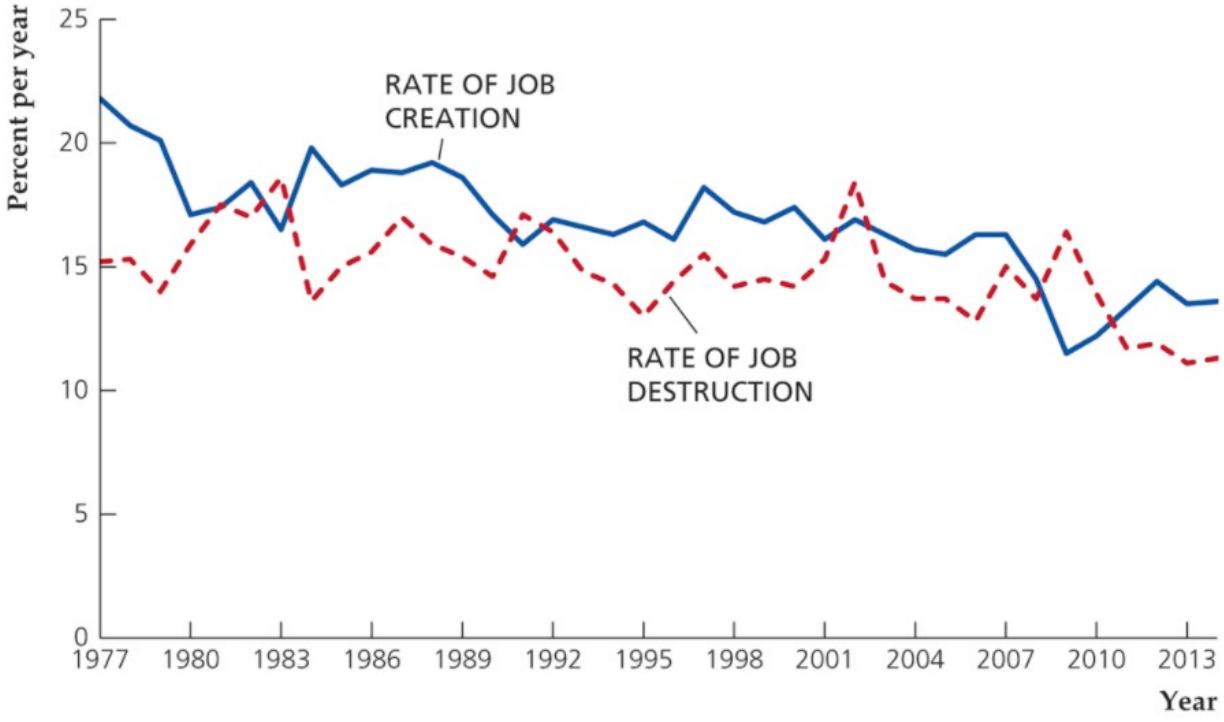
Unemployment in the classical model

Unemployment in the classical model

- As it stands the classical model does not explain unemployment
  - In the efficient world of classical macro, unemployment would be zero without modification of the model
  - The modification includes the costs of job search and retraining to provide labor services consistent with the supply shocks that create recessions
  - This is called frictional unemployment
  - Even without a supply shock, the nature of skills changes over time, requiring a permanent level of unemployment
  - The graph below displays the levels of job creation and job destruction over time

Unemployment in the classical model

Figure 10.5 Rates of job creation and job destruction in U.S. private, nonfarm businesses, 1977–2014



Unemployment in the classical model

- During recession periods more jobs are destroyed than created
- The biggest reversal comes during the financial crisis of 2007-2009
- The creation/destruction mismatch doesn’t account for the entire increase in unemployment
  - Temporary layoffs
  - Worker slowdown
- Classical economists argue for direct methods such as training programs
- They also argue to eliminate barriers to employment such as labor unions

Jobless recoveries

Jobless recoveries

- Just as adjustments other than reducing the labor force expand employment during a recession over what a frictionless economy would experience
- As recovery begins, the excess labor of the recession reduces the rate at which new hiring would otherwise occur
- Sometimes the unemployment rate briefly rises at the beginning of a recovery

Jobless recoveries

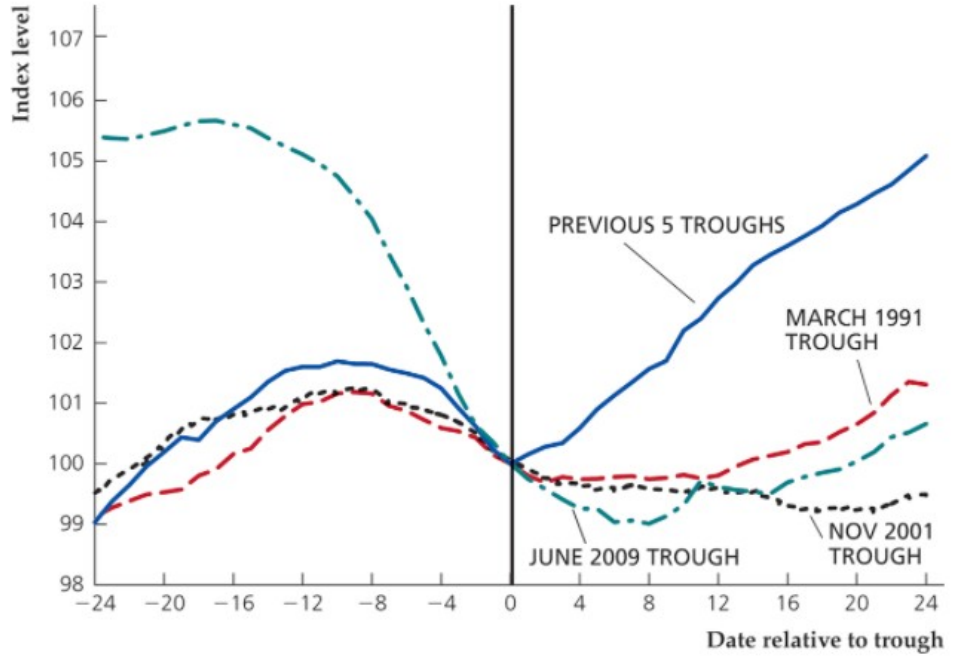
- There is a measure of this effect called the index of employment at the trough of the recession

$$\text{Index in given month} = 100 \times \frac{\text{employment in given month}}{\text{employment in trough month}}.$$

- If the employment rate in a given month is 5% higher than at the trough, the index is 105
- The graph below describes the behavior of the index during recent recessions

Jobless recoveries

Figure 10.6 Payroll employment relative to business-cycle trough



Jobless recoveries

- The last three recessions were followed by jobless recoveries
- The dominant explanation is that increased productivity of the existing labor force is a fundamental explanation of recovery from recent recessions

Money in the classical model

Money in the classical model

- There is agreement that in the long run, money is neutral. Increases in the supply of money cannot affect real variables in the long run
- The debate is about the effect of a surprise increase in money supply or demand in the short run
- Classical economists believe the adjustment is quick

Monetary non-neutrality and reverse causation

- Why do changes in the money supply precede change in real variables?
  - Is it like putting storm windows in before winter (winter causes storm windows but the timing is reversed)
  - People anticipate increases in income by holding more money in advance of the change

Monetary non-neutrality and reverse causation

- Increased advance money demand
  - Firms anticipating increased demand for their product might spend more to assure the product is available to meet future demand
  - In order to avoid an unwelcome effect on prices and interest rates, the Fed might accommodate this increased demand with a similar increase in supply

Additional evidence of money's non-neutrality

- Friedman and Schwarz' Monetary History of the United States
  - There is a close relationship between changes in money and changes in real variables
  - The relationship is stable over time
  - Changes in the money supply are often the result of shocks to the markets for assets – not simply reactions to changes in the real sector.
- The third observation is the important one – it suggests that monetary shocks (like a gold rush) have real effects
- In other words, they conclude that money is not neutral

Additional evidence of money's non-neutrality

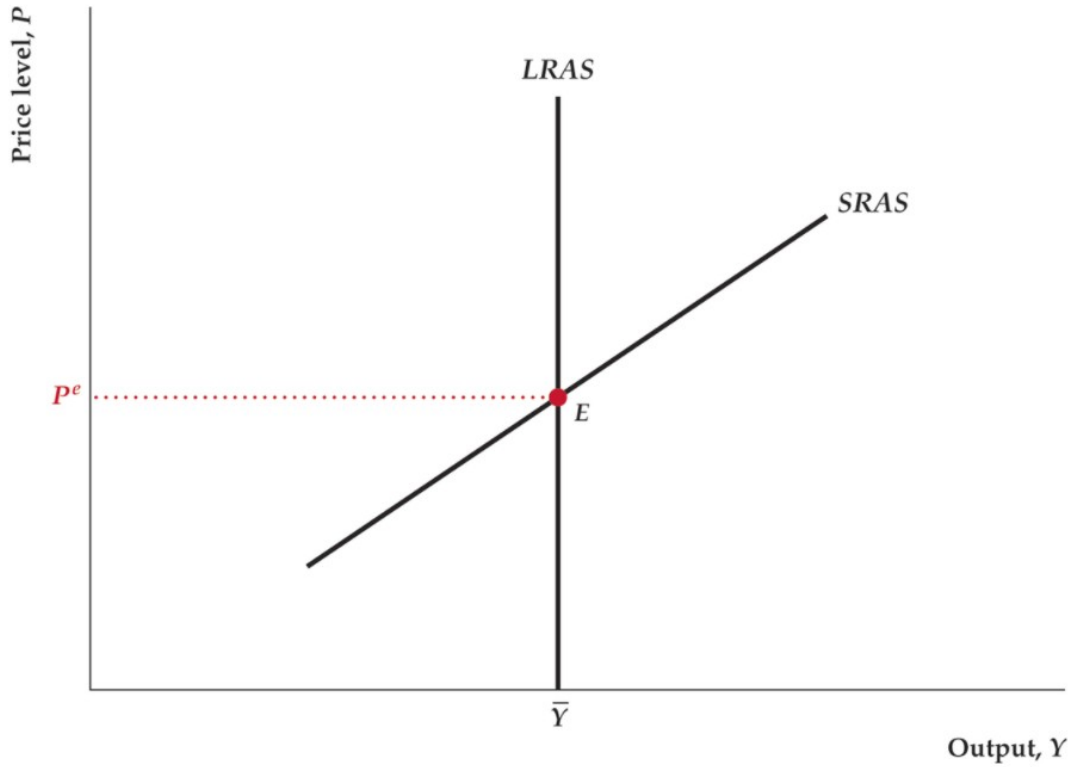
- Since Friedman and Schwarz, evidence of changes in money and changes in real variables continue to demonstrate that money is far from neutral in the short run
- The most important evidence since is the behavior of money and the economy under Fed chairman Paul Voelker
  - In wringing the high inflation of the late 70's and early 80's out of the economy the Fed needed two major recessions
  - The process took nearly a decade

The misperceptions theory and the non-neutrality of money

- Classical economists believe supply adjustments are instantaneous, so the short run aggregate supply curve in classical analysis is not horizontal
- The relationship between the short and the long run supply curve is described below

The misperceptions theory and the non-neutrality of money

Figure 10.7 The aggregate supply curve in the misperceptions theory



The misperceptions theory and the non-neutrality of money

- In the misperceptions analysis
  - The aggregate supply of goods (the FE line) shifts to the right when prices rise more than anticipated
  - Thus, the short run aggregate supply curve slopes upward
  - Assume producers have incomplete information
    - They perceive an increase in the price of the goods they produce as an increase in the relative price
    - When the price level increases, this is a misperception

The misperceptions theory and the non-neutrality of money

- Producers have an expected inflation forecast (say 5%)
  - If the price of their produce increases at the same 5% rate they make no adjustments to their intended production
  - But if the price increases by more (10%) due to an increase in the price level, producers misperceive this to be an increase in the relative price of their product
  - They shift their factor demand curves to the right and upward in response
- The relevant variable in the short run supply curve is unexpected price level increases, which gives us the relationship below

The misperceptions theory and the non-neutrality of money

- This misperception explains why Y increases when the price level changes

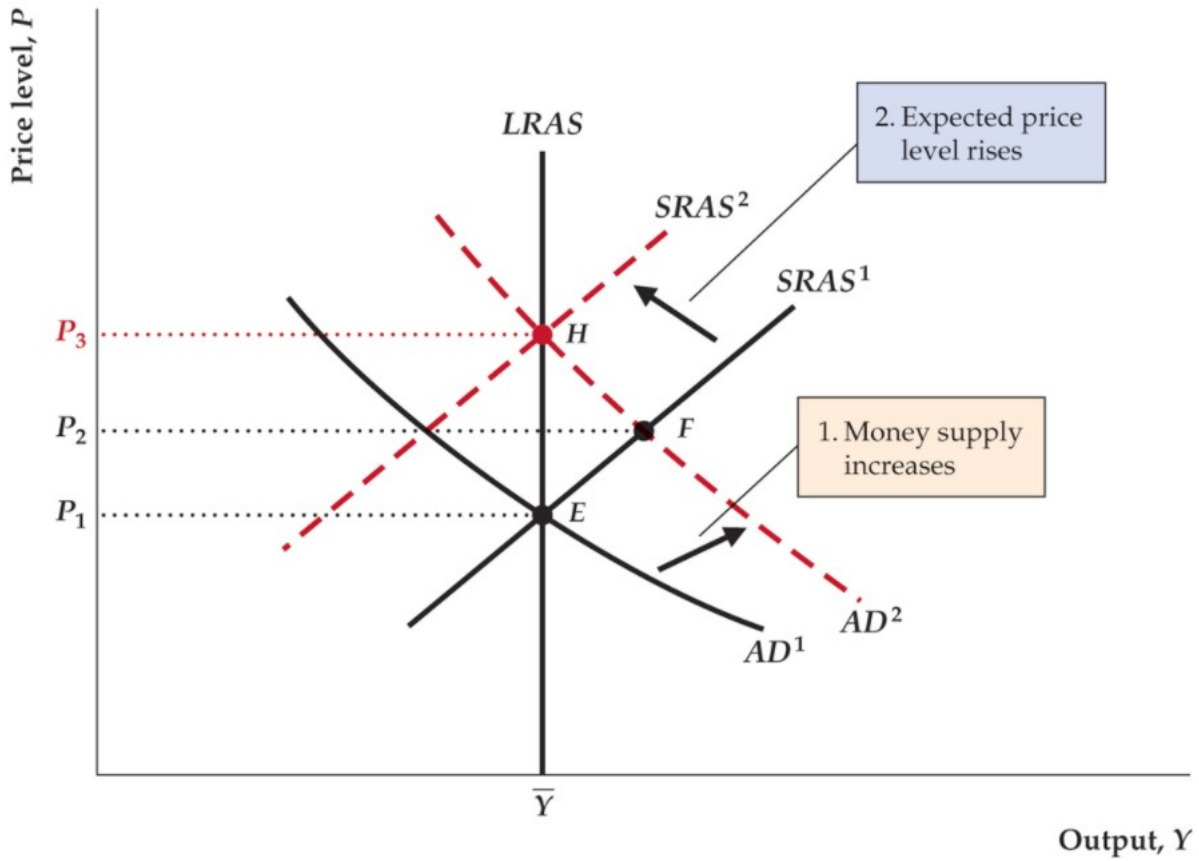
$$Y = \overline{Y} + b(P - P^e),$$

Monetary policy and the misperceptions theory
Unanticipated changes in the money supply

- Consider the graph below

Unanticipated changes in the money supply

Figure 10.8 An unanticipated increase in the money supply



Unanticipated changes in the money supply

- The analysis begins when the Fed increases the money supply by more than the anticipated amount (the shift to the right and upward of the AD curve)
- This drives both prices and Y higher
- The unanticipated increase in prices causes a movement along the SRAS curve to point F
- Producers are not better off. They produce more than they would have if they perceived the change in the price level correctly

Unanticipated changes in the money supply

- But the surprise increase in the price level is temporary
  - As producers understand the price level has increased, not the relative price of the goods they produce
  - Then the relevant supply curve is the LRAS curve
  - Production returns to its old level and prices increase further to shift the SRAS curve up (point H in the graph)
- Thus, money has real effects in the short run but affects only prices in the long run

Anticipated changes in the money supply

- If the increase in the money supply is anticipated, the adjustment of SRAS to the higher anticipated price occurs at the same time as the money supply-induced increase in aggregate demand
- Output remains at the equilibrium level
- Only the price level changes

Rational expectations and the role of monetary policy

- The misperceptions theory leads to the conclusion that to influence real variables, the Fed must surprise the economy
- Surprise money supply increases to stimulate the economy; decreases to slow the economy down
- The problem with this conclusion is the presence of sophisticated "Fed watchers"
- These Fed watchers are as sophisticated and aware of the economy as are policymakers.
- The implication is that **the Fed may influence the real economy only with mistakes**

Propagating the effects of unanticipated increases in the money supply

- A propagation mechanism is an aspect of the economy that allows short-term shocks to have long-term effects
- The example of inventories
  - An increase in demand resulting from a money shock will cause a firm to meet the greater demand by increased production and also by the use of existing inventories
  - Suppose that this producer realizes the source of the expansion was a temporary money shock
  - Then the producer may still increase production to restore inventories to their old level.
  - Thus, production is at an elevated level after the producer realizes that the earlier increased production was a mistake

Chapter summary

- RBC theory uses the ordinary IS LM analysis with the added assumption that wage and price adjustment is speedy
- The RBC assumes that the primary source of recessions is supply shocks
- The Solow residual, a measure of total productivity
  - *A* measures productivity growth independent of factor contributions to productivity
  - The Solow residual is affected by factor utilization rates as well as *A*

Chapter summary

- RBC allows for other factors than supply shocks such as changes in fiscal policy
  - Ordinary IS LM analysis argues that an increase in G increases real variables and later leads to increases in the price level
  - Adding fiscal policy effects improves the ability of RBC to explain economic behavior
  - RBC economists argue that policies addressing the business cycle should be avoided because their ill effects are greater than any stabilization of the business cycle
- RBC assumes money is neutral in the long run

Chapter summary

- RBC economists explain the evidence that policy changes affect real variables using reverse causation
  - Expected income growth increases money demand in the present, for example
- The evidence of history strongly suggests that monetary changes are not neutral
- The misperceptions theory – producers mistake economy-wide price changes as changes in the relative price of the goods they produce

Chapter summary

- RBC economists believe the SRAS curve is not horizontal but slopes upward due to misperceptions
- But in the long run, misperceptions are reevaluated leading to further increases in the price level and ultimately no effect on real variables
- Thus, RBC economists view unanticipated policy changes to be the primary drivers of changes in real variables
- But if economic actors have rational expectations, only policy mistakes have real effects.