Chapter 10: Classical Business Cycle Analysis: Market-Clearing Macroeconomics

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Chapter Outline

- Summarize the real business cycle theory and describe how well it accounts for the business cycle facts.
- Discuss the effects of fiscal policy shocks in the classical model.
- Discuss unemployment in the classical model.
- Discuss the roles of money and monetary policy in the classical model.
- Summarize the fundamentals and implications of the misperceptions theory.

The real business cycle theory

- Two key questions about business cycles:
  - What are the underlying economic causes?
  - What should government policymakers do about them?
- Any business cycle theory has two components:
  - A description of the types of shocks believed to affect the economy the most.
  - A model that describes how key macroeconomic variables respond to economic shocks.

- (Conti.) Real business cycle (RBC) theory (Kydland and Prescott): Real shocks to the economy are the primary cause of business cycles.
- Examples of real shocks:
  - Shocks to the production function.
  - Shocks to the size of the labor force.
  - Shocks to the real quantity of government purchases.
  - Shocks to the spending and saving decisions of consumers (affecting the IS curve or the FE line).
- Nominal shocks are shocks to money supply or demand (affecting the LM curve).

- (Conti.) The largest role is played by shocks to the production function, which the text has called supply shocks, and RBC theorists call productivity shocks.
- Examples of productivity shocks:
  - Development of new products or production techniques.
  - Introduction of new management techniques.
  - Changes in the quality of capital or labor.
  - Changes in the availability of raw materials or energy.
  - Unusually good or bad weather.
  - Changes in government regulations affecting production.

- (Conti.) Most economic booms result from beneficial productivity shocks; most recessions are caused by adverse productivity shocks.
- The recessionary impact of an adverse productivity shock
  - Results from Chapter 3: Real wage, employment, output, consumption, and investment decline, while the real interest rate and price level rise.
  - So an adverse productivity shock causes a recession (output declines), whereas a beneficial productivity shock causes a boom (output increases); but output always equals full-employment output.

The RBC theory is consistent with many business cycle facts

- If the economy is continuously buffeted by productivity shocks, the theory predicts recurrent fluctuations in aggregate output, which we observe.
- The theory correctly predicts procyclical employment and real wages.
- The theory correctly predicts procyclical average labor productivity.
  - If booms weren't due to productivity shocks, we would expect average labor productivity to be countercyclical because of diminishing marginal productivity of labor.

Real business cycle theory and the business cycle facts

- The theory predicts countercyclical movements of the price level, which seems to be inconsistent with the data.
- But Kydland and Prescott, when using some newer statistical techniques for calculating the trends in inflation and output, find evidence that the price level is countercyclical.
- Though the Great Depression appears to have been caused by a sequence of large, adverse aggregate demand shocks, Kydland and Prescott argue that since World War II, large adverse supply shocks have caused the price level to rise while output fell.
- The surge in inflation during the recessions associated with the oil price shocks of $1973 - 1974$ and $1979 - 1980$ is consistent with RBC theory.

Application: Calibrating the business cycle

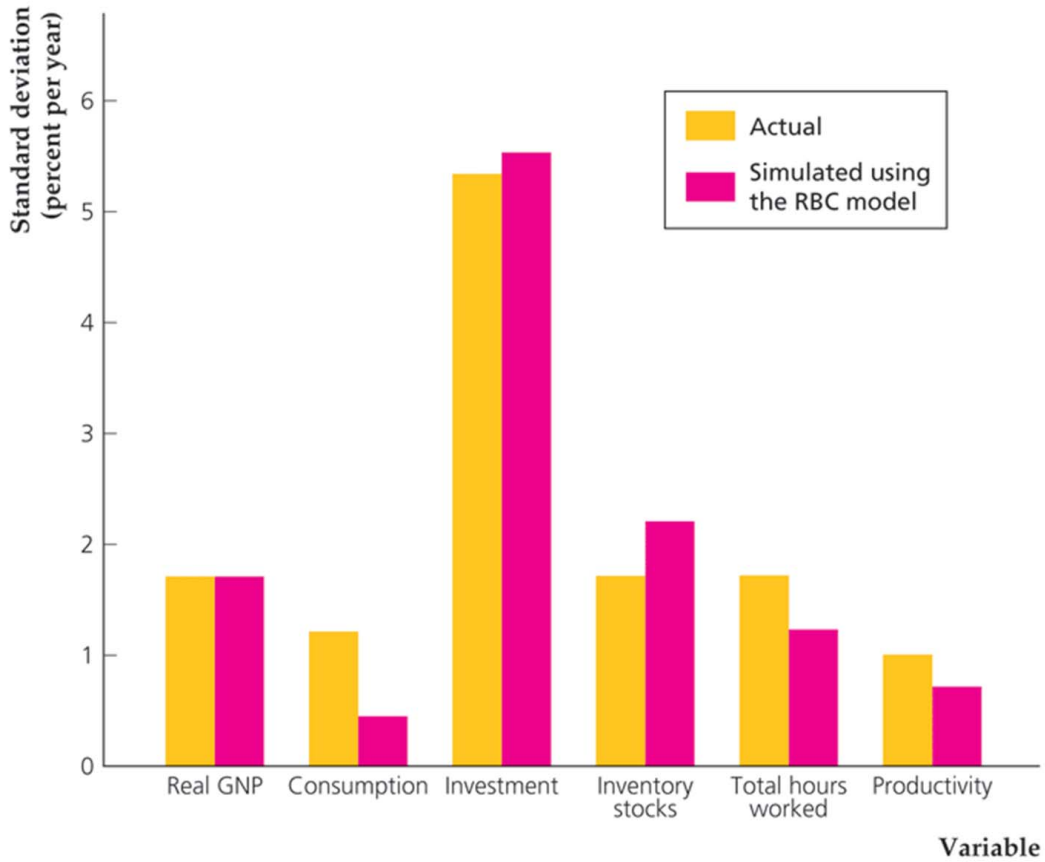
- A major element of RBC theory is that it attempts to make quantitative, not just qualitative, predictions about the business cycle.
- RBC theorists use the method of calibration to work out a detailed numerical example of the theory.
- First they write down specific functions explaining the behavior of people in the economy; for example, they might choose as the production function for the economy:

$$Y = AK^{\alpha}N^{1-\alpha}. \tag{1}$$

- Then they use existing studies of the economy to choose numbers for parameters like a in the production function; for example, $\alpha = 0.3$.
- Next they simulate what happens when the economy is hit by various shocks to different sectors of the economy.

- (Conti.) Prescott's computer simulations (Figs. 10.1 and 10.2) match post–World War II data fairly well.
- The work on calibration has led to a major scientific debate within the economics profession about how to do empirical work.
- Economists working on RBC models, led by Prescott, believe strongly in calibration as the only way to do empirical work in macroeconomics.
- Others disagree, just as vehemently.

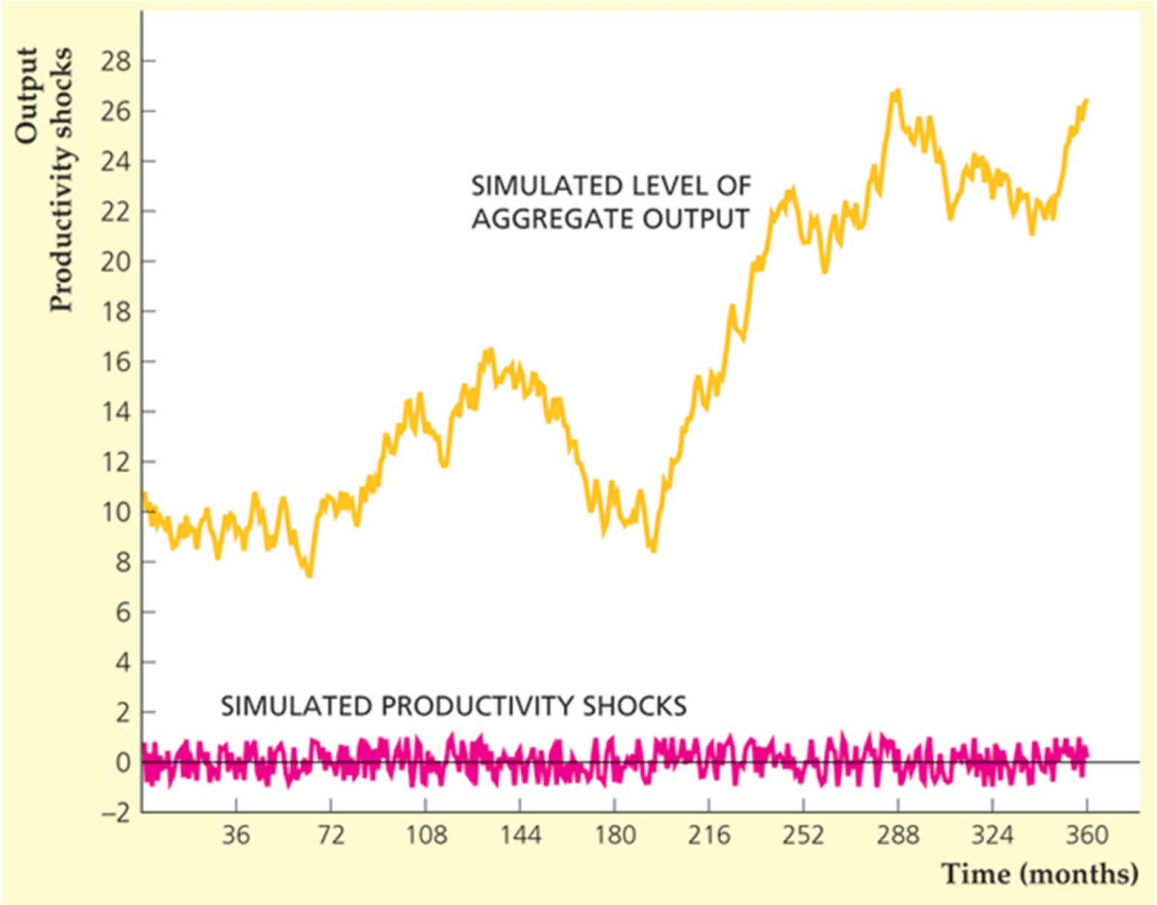
Figure 10.1 Actual versus simulated volatilities of key macroeconomic variables



Are productivity shocks the only source of recessions?

- Critics of the RBC theory suggest that except for the oil price shocks of 1973, 1979, and 1990, there are no productivity shocks that one can easily identify that caused recessions.
- One RBC response is that it doesn't have to be a big shock; instead, the cumulation of many small shocks can cause a business cycle (Fig. 10.3).

Figure 10.3 Small shocks and large cycles



Does the Solow residual measure technology shocks?

- RBC theorists measure productivity shocks as the Solow residual.
- Named after Robert Solow, the originator of modern growth theory.
- Given a Cobb-Douglas production function and data on Y, K, and N, the Solow residual is

$$A = \frac{Y}{K^{\alpha} N^{1-\alpha}} \tag{2}$$

- It's called a residual because it can't be measured directly.

- (Conti.) The Solow residual is strongly procyclical in U.S. data:
  - This accords with RBC theory, which says the cycle is driven by productivity shocks.
- But should the Solow residual be interpreted as a measure of technology?
  - If it's a measure of technology, it should not be related to factors that don't directly affect scientific and technological progress, like govt. purchases or monetary policy.
  - But statistical studies show a correlation between these.
- Measured productivity can vary even if the actual technology doesn't change:
  - Capital and labor are used more intensively at times.
  - More intensive use of inputs leads to higher output.
  - Define the utilization rate of capital u_K and the utilization rate of labor u_N.
  - Define capital services as $u_K \times K$ and labor services as $u_N \times N$.

- (Conti.) Rewrite the production function as:

$$Y = AF(u_K \times K, u_N \times N) = A(u_K \times K)^{\alpha}(u_N \times N)^{1-\alpha} \quad (3)$$

- Use this to substitute for Y in the last equation to get:

$$\text{Solow residual} = A{u_K}^{\alpha}{u_N}^{1-\alpha}. \quad (4)$$

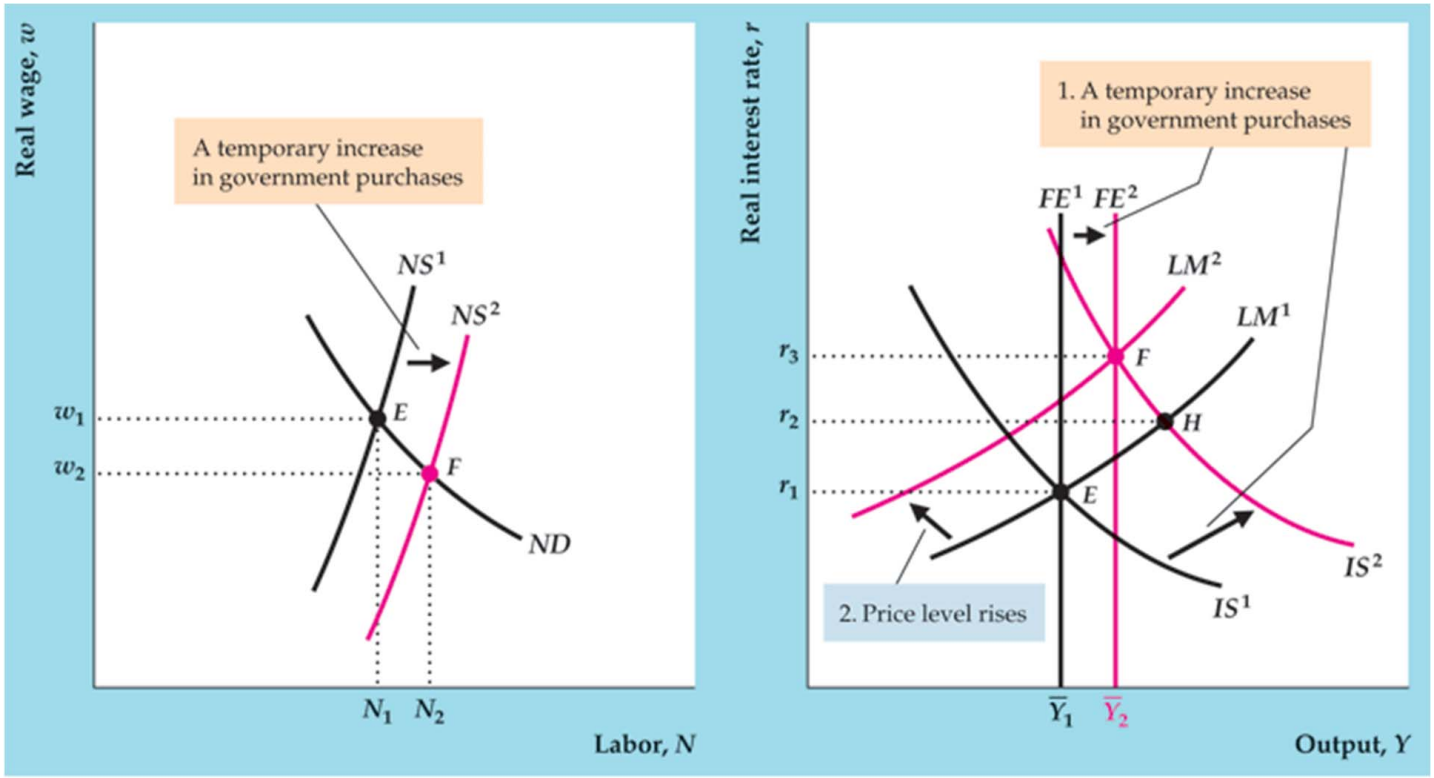
- So the Solow residual isn't just A, but depends on u_K and u_N.
- Utilization is procyclical, so the measured Solow residual is more procyclical than is the true productivity term A:
  - Labor hoarding: firms keep workers in recessions to avoid incurring hiring and firing costs.
  - Hoarded labor doesn't work as hard, or performs maintenance.
  - The lower productivity of hoarded labor doesn't reflect technological change, just the rate of utilization.
- Conclusion: Changes in the measured Solow residual don't necessarily reflect changes in technology.

- (Conti.) Technology shocks may not lead to procyclical productivity:
  - Research shows that technology shocks are not closely related to cyclical movements in output.
  - Shocks to technology are followed by a transition period in which resources are reallocated.
  - Initially, less capital and labor are needed to produce the same amount of output.
  - Later, resources are adjusted and output increases.
- Critics of RBC theory suggest that shocks other than productivity shocks, such as wars and military buildups, have caused BCs.
- Models allowing for other shocks are DSGE models (dynamic, stochastic, general equilibrium models).

The effects of a temporary increase in government expenditures

- The current or future taxes needed to pay for the govt. expenditures effectively reduce people's wealth, causing an income effect on labor supply.
- The increased labor supply leads to a fall in the real wage and a rise in employment.
- The rise in employment increases output, so the FE line shifts to the right.
- The temporary rise in govt. purchases shifts the IS curve up and to the right as national saving declines.

Figure 10.4 Effects of a temporary increase in government purchases



- (Conti.) Assume shift of the *IS* curve is bigger than shift of *FE* line:
  - Prices must rise to shift the *LM* curve up and to the left to restore equilibrium.
- Rise in employment means average labor productivity declines:
  - Helps match data better.
  - Without fiscal policy the RBC model shows a correlation between output and average labor productivity that is too high.
- So adding fiscal policy shocks to the model increases its ability to match the actual behavior of the economy.

Should fiscal policy be used to dampen the cycle?

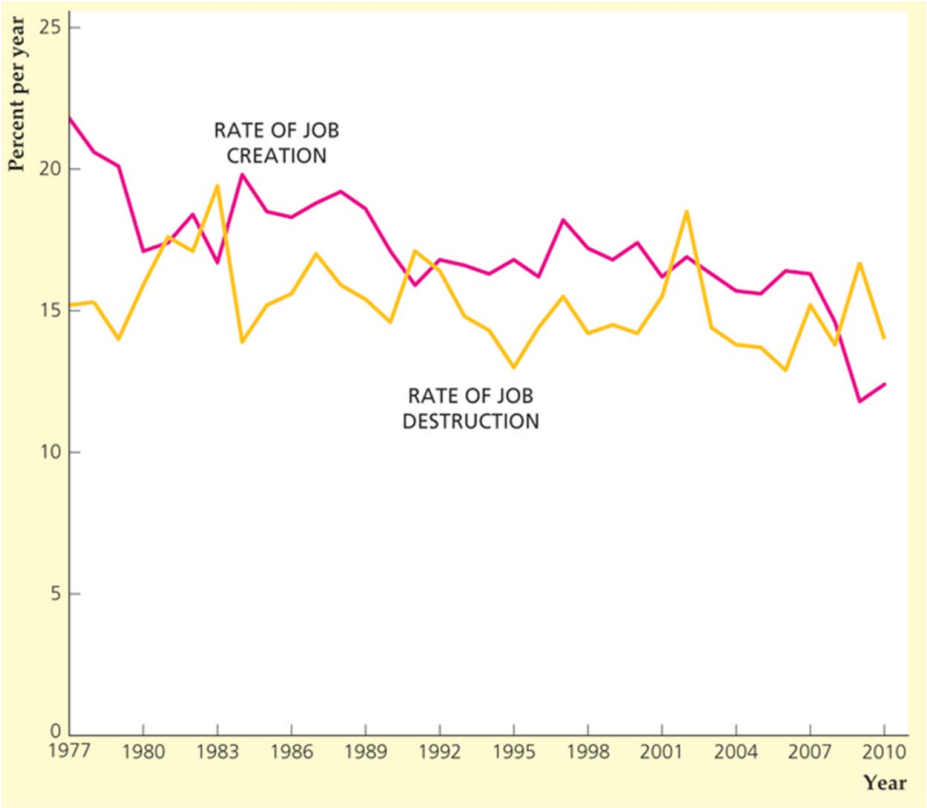
- Classical economists oppose attempts to dampen the cycle, since prices and wages adjust quickly to restore equilibrium.
- Besides, fiscal policy increases output by making workers worse off, since they face higher taxes.
- Instead, government spending should be determined by cost-benefit analysis.
- Also, there may be lags in enacting the correct policy and in implementing it:
  - So choosing the right policy today depends on where you think the economy will be in the future.
  - This creates problems, because forecasts of the future state of the economy are imperfect.
- It's also not clear how much to change fiscal policy to get the desired effect on employment and output.

Unemployment in the Classical Model

- In the classical model there is no unemployment; people who aren't working are voluntarily not in the labor force.
- In reality measured unemployment is never zero, and it is the problem of unemployment in recessions that concerns policymakers the most.
- Classical economists have a more sophisticated version of the model to account for unemployment.
- Workers and jobs have different requirements, so there is a matching problem.
- It takes time to match workers to jobs, so there is always some unemployment.
- Unemployment rises in recessions because productivity shocks cause increased mismatches between workers and jobs.

- (Conti.) A shock that increases mismatching raises frictional unemployment and may also cause structural unemployment if the types of skills needed by employers change.
- So the shock causes the natural rate of unemployment to rise; there's still no cyclical unemployment in the classical model.
- Davis and Haltiwanger show that there is a tremendous amount of churning of jobs both within and across industries
- Figure 10.5 shows rates of job creation and destruction.

Figure 10.5 Rates of job creation and job destruction



Source: Data from U.S. Census Bureau, Business Dynamic Statistics, *www2.census.gov/ces/bds/firm/bds_f_all_release.xls.*

The worker match theory can't explain all unemployment

- Many workers are laid off temporarily; there's no mismatch, just a change in the timing of work.
- If recessions were times of increased mismatch, there should be a rise in help-wanted ads in recessions, but in fact they fall.

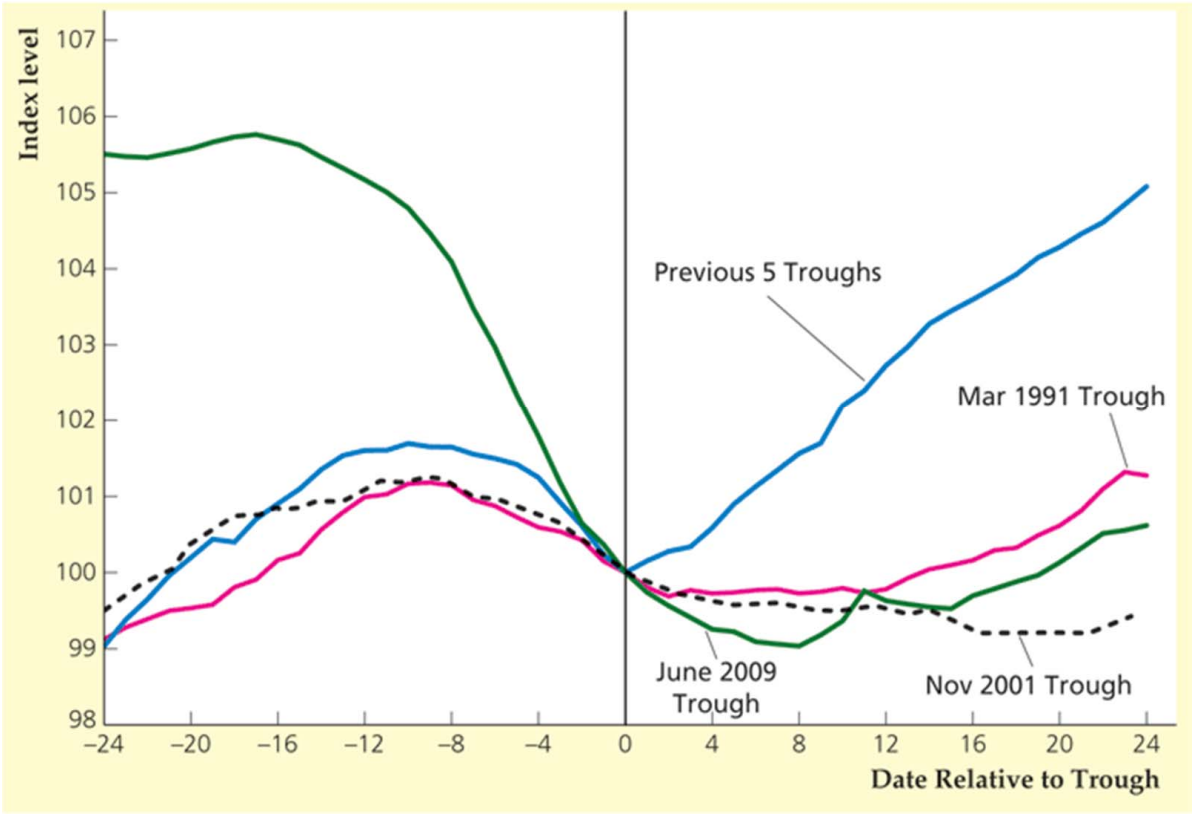
So can the government use fiscal policy to reduce unemployment?

- Doing so doesn't improve the mismatch problem.
- A better approach is to eliminate barriers to labor-market adjustment by reducing burdensome regulations on businesses or by getting rid of the minimum wage.

Jobless recoveries

- After each of the last three recessions, employment continued to decline during the recovery, so the recoveries have come to be known as "jobless recoveries".
- The previous 5 recessions (before 1990) all featured a sharp rebound in employment as soon as the recession ended (Fig. 10.6).

Fig. 10.6 Payroll employment relative to business-cycle trough



Sources: Authors' calculations based on data from Bureau of Economic Analysis, National Income and Product Accounts, available on-line at *research.stlouisfed.org/fred2/series/PAYEMS.*

Monetary policy and the economy

- Money is neutral in both the short run and the long run in the classical model, because prices adjust rapidly to restore equilibrium.
- Monetary nonneutrality and reverse causation:
  - If money is neutral, why does the data show that 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.

If money is neutral, why does the data show that money is a leading, procyclical variable?

- The classical answer: Reverse causation.
- Just because changes in money growth precede changes in output doesn't mean that the money changes cause the output changes.
- Example: People put storm windows on their houses before winter, but it's the coming winter that causes the storm windows to go on, the storm windows don't cause winter.
- Reverse causation means money growth is higher because people expect higher output in the future; the higher money growth doesn't cause the higher future output.
- If so, money can be procyclical and leading even though money is neutral.

Why would higher future output cause people to increase money demand?

- Firms, anticipating higher sales, would need more money for transactions to pay for materials and workers.
- The Fed would respond to the higher demand for money by increasing money supply; otherwise, the price level would decline.
- The early theoretical RBC models did not include a monetary sector at all—they assumed that money was unimportant for the business cycle.
- More recently, RBC theorists have been trying to incorporate money into their models.
- The focus so far has been trying to get the models to produce a liquidity effect, in which an increase in the money supply temporarily reduces nominal interest rates.

The nonneutrality of money: Additional evidence

- Friedman and Schwartz have extensively documented that often monetary changes have had an independent origin; they weren't just a reflection of changes or future changes in economic activity:
  - These independent changes in money supply were followed by changes in income and prices.
  - The independent origins of money changes include such things as gold discoveries, changes in monetary institutions, and changes in the leadership of the Fed.
- More recently, Romer and Romer documented additional episodes of monetary nonneutrality since 1960:
  - One example is the Fed's tight money policy begun in 1979 that was followed by a minor recession in 1980 and a deeper one in 1981.
  - That was followed by monetary expansion in 1982 that led to an economic boom.
- So money does not appear to be neutral.
- There is a version of the classical model in which money isn't neutral—the misperceptions theory discussed next.

Introduction to the misperceptions theory

- In the classical model, money is neutral since prices adjust quickly:
  - In this case, the only relevant supply curve is the long-run AS curve
  - So movements in AD have no effect on output.
- But if producers misperceive the aggregate price level, then the relevant AS curve in the short run isn't vertical
  - This happens because producers have imperfect information about the general price level.
  - As a result, they misinterpret changes in the general price level as changes in relative prices.
  - This leads to a short-run AS curve that isn't vertical. But prices still adjust rapidly.
- The misperceptions theory is that the aggregate quantity of output supplied rises above the full-employment level when the aggregate P is higher than expected. This makes the AS curve slope upward.

Example: 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.
- If the relative price of bread rises, the baker may work more and produce more bread.
- If the baker can't observe the general price level as easily as the price of bread, he or she must estimate the relative price of bread.
- If the price of bread rises 5% and the baker thinks inflation is 5%, there's no change in the relative price of bread, so there's no change in the baker's labor supply.

- (Conti.) But suppose the baker expects the general PL to rise by 5%, but sees the price of bread rising by 8%; then the baker will work more in response to the wage increase.
- Generalizing this example, if everyone expects prices to increase 5% but they actually increase 8%, they'll work more:
  - So an increase in the PL that is higher than expected induces people to work more and thus increases the economy's output.
  - Similarly, an increase in the PL that is lower than expected reduces output.
- The equation:

$$Y = \overline{Y} + b\left(P - P^e\right) \tag{5}$$

  In the short run, the aggregate supply ($SRAS$) curve slopes upward and intersects the $LRAS$ curve at $P = P^e$ (Fig. 10.7).
- Because of misperceptions, unanticipated monetary policy has real effects; but *anticipated* monetary policy has no real effects because there are no misperceptions.
- *Unanticipated* changes in the money supply (Fig. 10.8).

Figure 10.7 The aggregate supply curve in the misperceptions theory

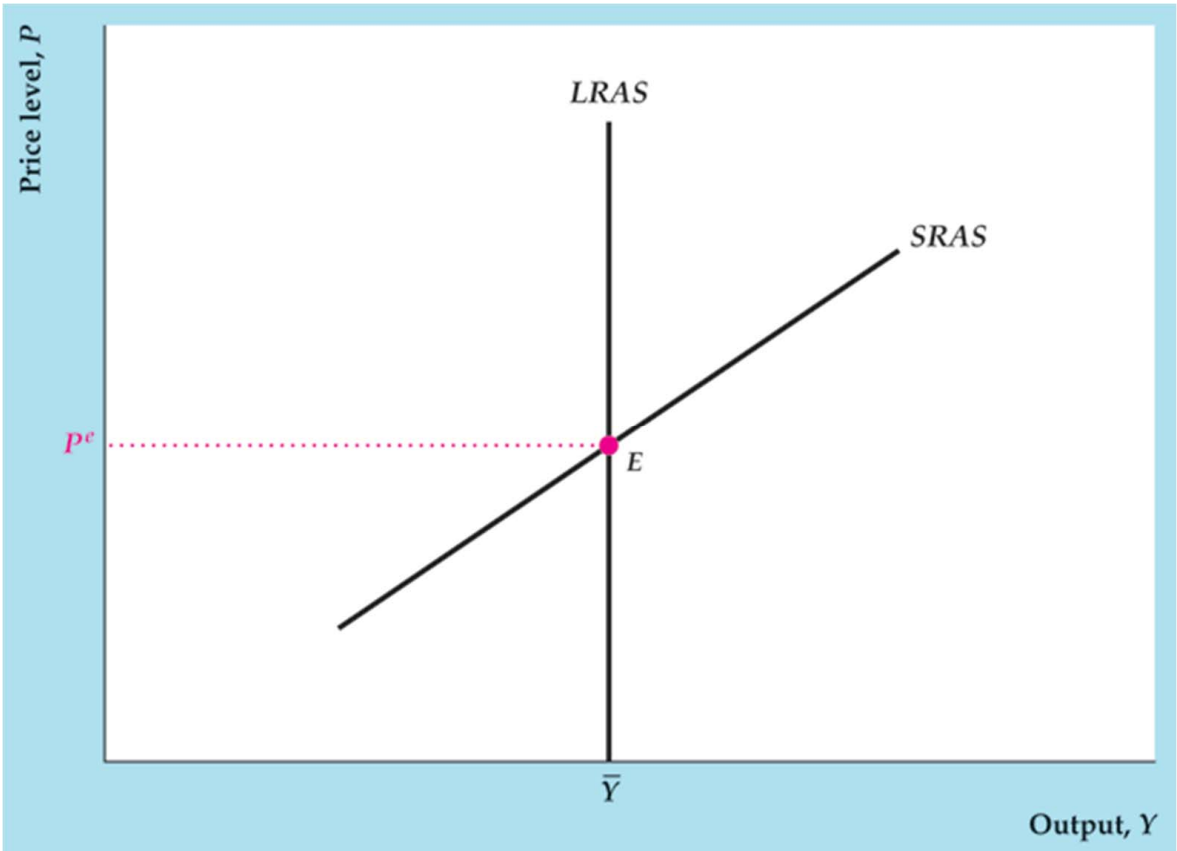


Figure 10.8 An unanticipated increase in the money supply

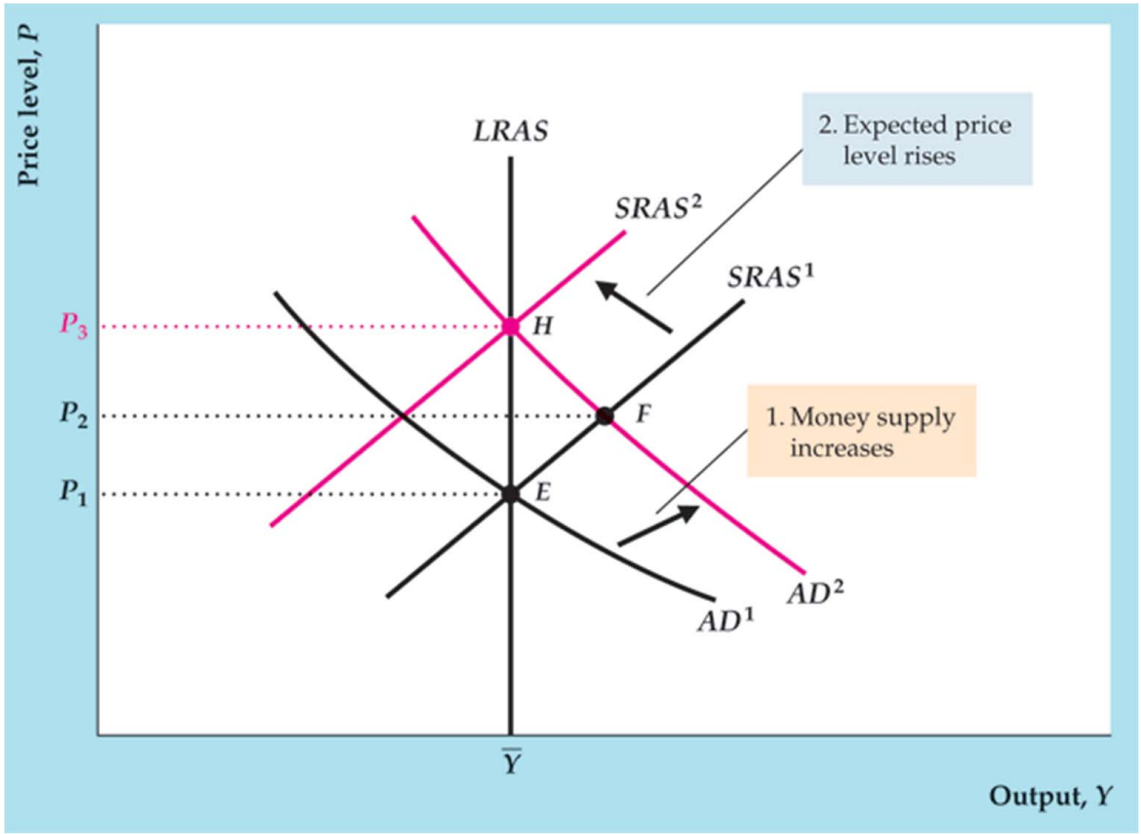
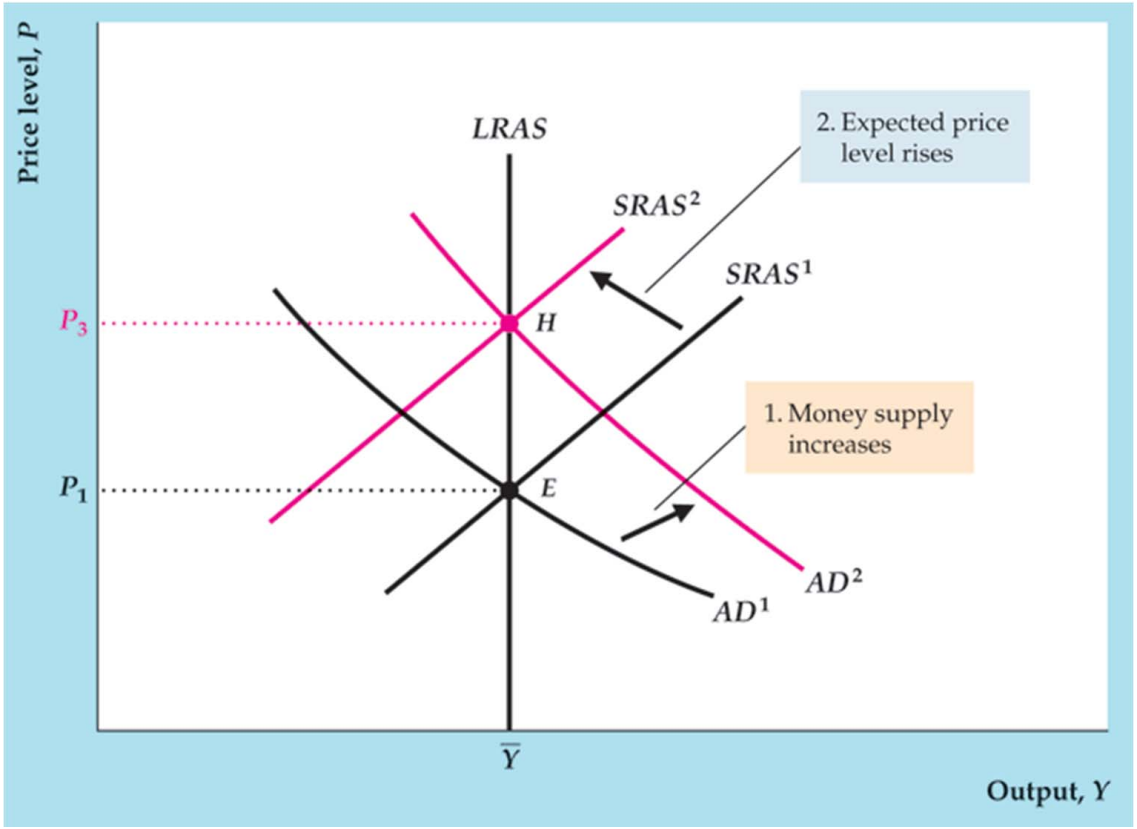


Figure 10.9 An anticipated increase in the money supply



- (Conti.) Initial equilibrium where $AD1$ intersects $SRAS1$ and $LRAS$:
  - Unanticipated increase in money supply shifts AD curve to $AD2$.
  - The price level rises to $P2$ and output rises above its full-employment level, so money isn't neutral
  - As people get information about the true price level, their expectations change, and the $SRAS$ curve shifts left to $SRAS2$, with output returning to its full-employment level.
  - So unanticipated money isn't neutral in the short run, but it is neutral in the long run.

Do the data support the misperceptions theory?

- Robert Barro found support for the misperceptions theory:
  - His results suggested that output was affected only by unanticipated money growth.
- But others challenged these results and found that both anticipated and unanticipated money growth seem to affect output.
- Anticipated changes in the money supply:
  - If people anticipate the change in the money supply and thus in the price level, they aren't fooled, there are no misperceptions, and the *SRAS* curve shifts immediately to its higher level.
  - So anticipated money is neutral in both the short run and the long run.

Rational expectations and the role of monetary policy

- The only way the Fed can use monetary policy to affect output is to surprise people.
- But people realize that the Fed would want to increase the money supply in recessions and decrease it in booms, so they won't be fooled.
- The rational expectations hypothesis suggests that the public's forecasts of economic variables are well-reasoned and use all the available data.
- If the public has rational expectations, the Fed won't be able to surprise people in response to the business cycle; only random monetary policy has any effects.
- So even if smoothing the business cycle were desirable, the combination of misperceptions theory and rational expectations suggests that the Fed can't systematically use monetary policy to stabilize the economy.

Propagating the effects of unanticipated changes in the money supply

- It doesn't seem like people could be fooled for long, since money supply figures are reported weekly and inflation is reported monthly.
- Classical economists argue that propagation mechanisms allow short-lived shocks to have long-lived effects.
- Example of propagation: The behavior of inventories:
  - Firms hold a normal level of inventories against their normal level of sales.
  - An unanticipated increase in the money supply increases sales.
  - Since the firm can't produce many more goods immediately, it draws down its inventories.
  - Even after the money supply change is known, the firm must produce more to restore its inventory level.
  - Thus the short-term monetary shock has a long-lived effect on the economy.

- (Conti.) Though the text presents the theories in the reverse order, the misperceptions theory came first (being developed in the 1970s) and the RBC theory came later (in the 1980s).
- Many classical economists moved away from the misperceptions theory because they weren't convinced by its arguments for monetary non-neutrality; in particular, the information lag in observing money and prices didn't seem long enough to cause much effect.

In touch with data and research: Are price forecasts rational?

- Economists can test whether price forecasts are rational by looking at surveys of people's expectations.
- The forecast error of a forecast is the difference between the actual value of the variable and the forecast value.
- If people have rational expectations (RE), forecast errors should be unpredictable random numbers; otherwise, people would be making systematic errors and thus not have RE.

Are price forecasts rational?

- Many statistical studies suggest that people don't have RE.
- But people who answer surveys may not have a lot at stake in making forecasts, so couldn't be expected to produce rational forecasts.
- Instead, professional forecasters are more likely to produce rational forecasts.
- Keane and Runkle, using a survey of professional forecasters, find evidence that these forecasters do have RE.
- Croushore used inflation forecasts made by the general public, as well as economists, and found evidence broadly consistent with RE, though expectations tend to lag reality when inflation changes sharply.
- If you examine a survey of forecasters, like the Livingston Survey, you'll see that the forecasters made very bad forecasts of inflation around 1973 to 1974 and again around 1979 to 1980.

- (Conti.) Both time periods are associated with large rises in oil prices.
- Looking at data on interest rates, if you take nominal interest rates and subtract the expected inflation rate (using the Livingston Survey forecasts of inflation), the resulting real interest rates are nearly always positive.
- But if you subtract actual inflation rates from nominal interest rates, you'll find negative realized real interest rates around the time of the oil price shocks.
- In fact, the real interest rate was as low as negative 5% at one point.
- So making bad inflation forecasts has expensive consequences in financial markets.