Intermediate Macroeconomics

Business Cycle

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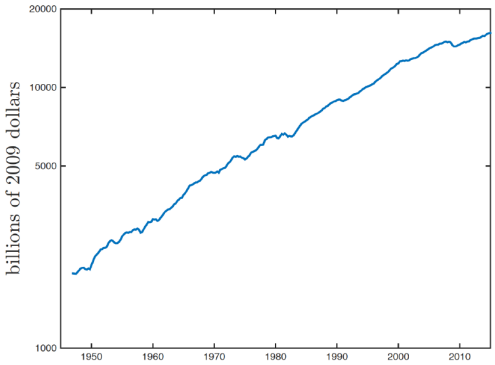
Introduction to Economic Fluctuations

What are business cycles?



- In long run, upward trend
- with wiggles $\rightarrow$ Business Cycles

What are business cycle?

- "recession" and "expansion" are used to describe BC
  - Expansion: periods when GDP is growing
  - Recessions: periods when GDP is shrinking
  - for 2 consecutive quarters

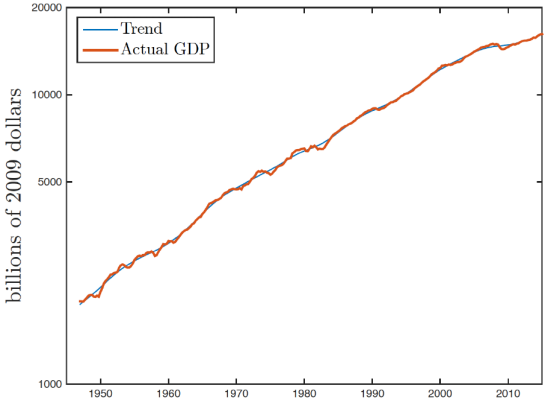
- It is not as simple as it looks, that is why there is a BC official dating committee
- NBER BC dating committe declares when recessions and expansions begin ad end
  - end of an expansion (begin of recession) is called a "peak"
  - end of a recession (begin of expansion) is called a "trough"
  - there is no exact rule of how they determine peaks and troughs. They usually look at a broad range of indicators, not just GDP

How do we obtain a series of cyclical fluctuations?

- Simply take growth rates
- Use filter: econometric technique that decomposes GDP into
  - a smooth trend component
  - and short-term deviations from that trend
    - most popular: Hodrick – Prescott filter

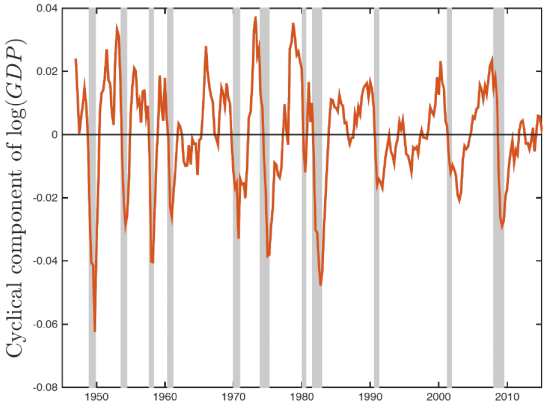
Hodrick – Prescott filter

- Trend versus Actual



Hodrick – Prescott filter

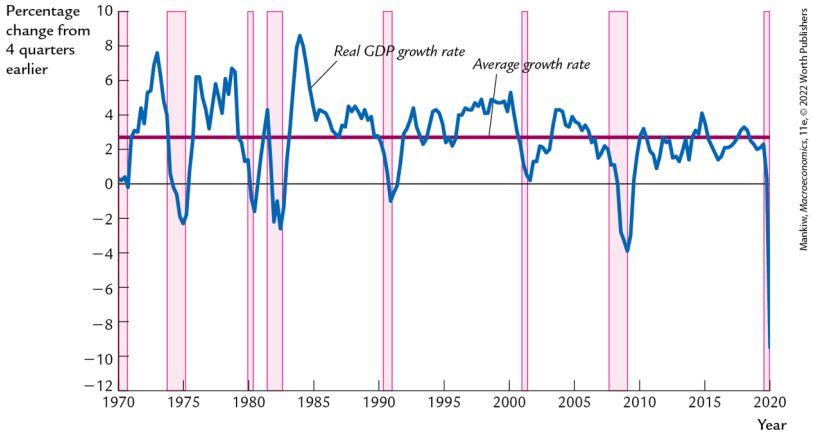
- Decomposition



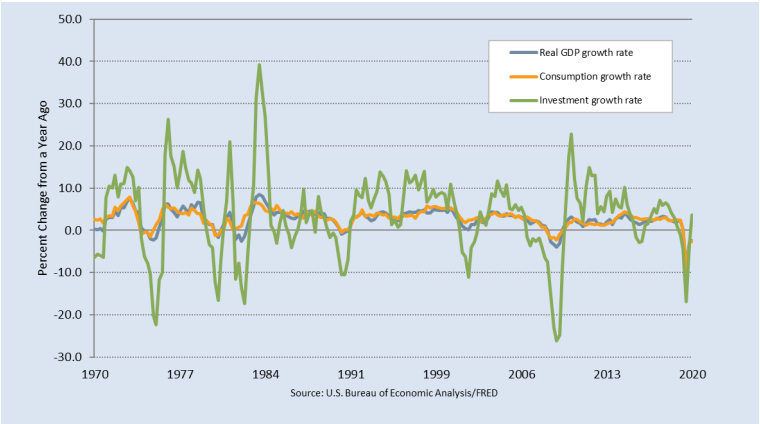
Some facts about business cycle

- GDP growth averages 3 percent per year over the long run, with large fluctuations in the short run.
- Consumption and investment fluctuate with GDP
  - but consumption tends to be less volatile
  - investment tends to be more volatile
- Unemployment rises during recessions and falls during expansions
  - Okun's Law: negative relationship between GDP and unemployment

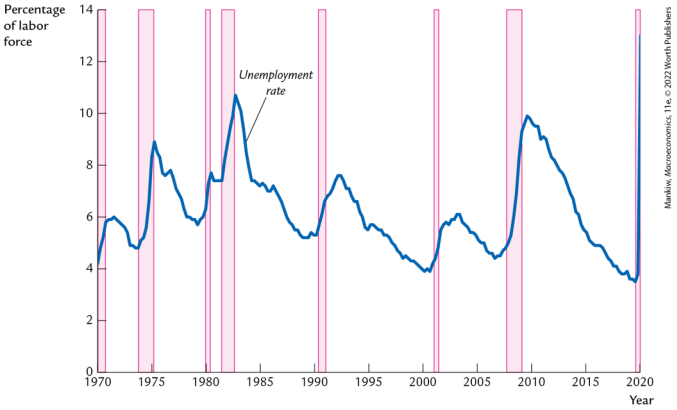
U.S. real GDP growth rate



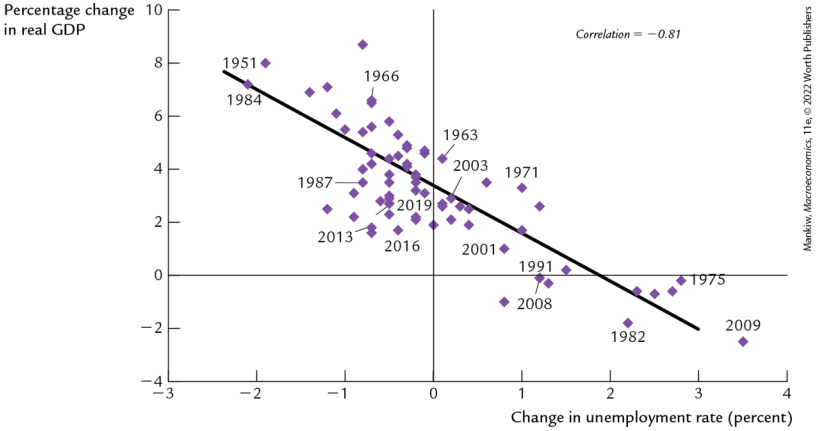
Growth rate of GDP, consumption, and investment



Unemployment



Okun's law


Percentage change in real GDP
Correlation = −0.81
1951
1966
1984
1963
2003
1971
1987
2019
2013
2016
2001
1991
1975
2008
1982
2009
Change in unemployment rate (percent)
Mankiw, Macroeconomics, 11e, © 2022 Worth Publishers

Time horizons in macroeconomics

- Long run
  - Prices are flexible, responding to changes in supply or demand
- Short run
  - Many prices are "sticky" at a predetermined level

Modeling the short run

- Long run: prices are flexible
  - they have time to adjust and make sure the equilibrium conditions on Chapter 3 are satisfied.
  - output only depends on technology and factors
  - prices adjust to make sure $C + I + G = Y$
- Short run: price are sticky
  - Some of the equations we saw will not hold exactly as prices do not have time to adjust
  - output(employment) will also depend on demand
  - demand responds to many factors, like fiscal and monetary policy

Traditional Business - Cycle Theory

- Aggregate Demand: establish the relationship between
  - price level (CPI)
  - total output demanded
  - start with $MP = PY$
- Aggregate supply: establish the relationship between
  - price level (CPI)
  - total output supplied
  - start with $\bar{P}$

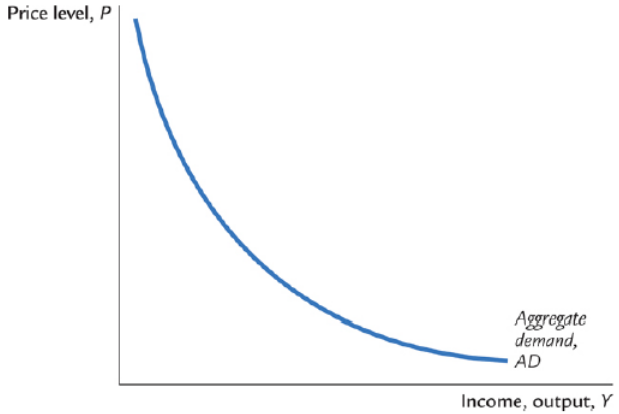
Aggregate Demand

- Goal: find how total demand responds to price level
- recall Chapter 5

$$\bar{M}\bar{V} = PY$$
$$\frac{\bar{M}}{P} = \frac{1}{\bar{V}}Y$$

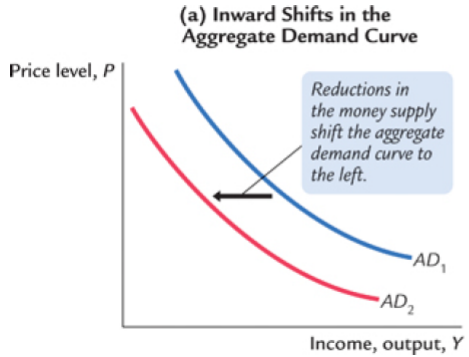
  - If $P \uparrow \Rightarrow Y \downarrow$, hold others constant

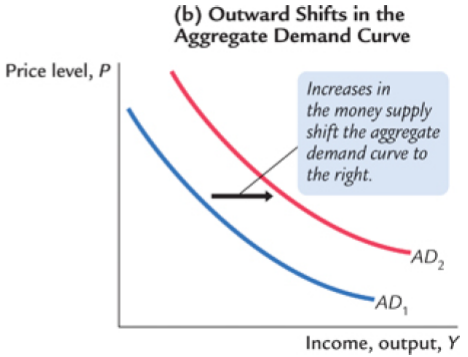
Aggregate Demand



AD and money supply

- AD curve is drawn for a fixed exogenous level of money supply M
- changes in M will shift curve given same price level





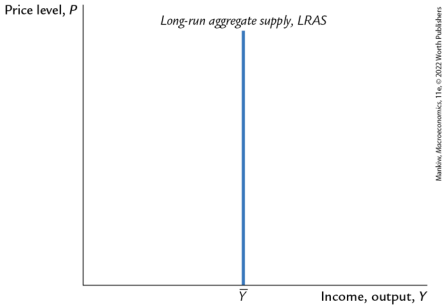
Aggregate supply in the long run

- Recall from Chapter 3: in the long run, output is determined by factor supplies and technology

$$\bar{Y} = F(\bar{K}, \bar{L})$$

- $\bar{Y}$ is the full-employment or natural level of output, at which the economy's resources are fully employed
  - Note: "Full employment" means that unemployment equals its natural rate (not zero)

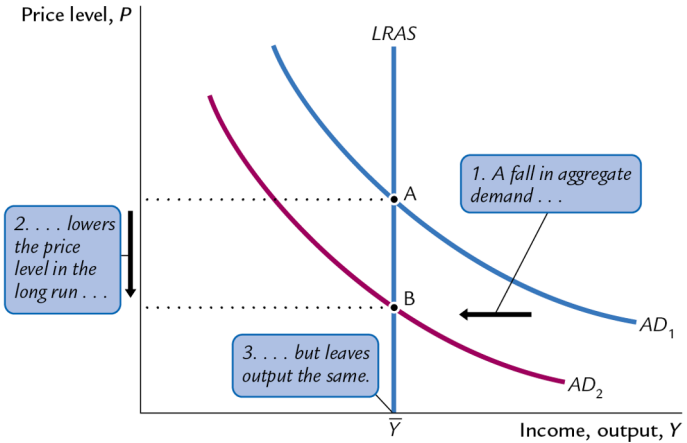
Aggregate supply in the long run



In the long run, supply is determined by amounts of capital, labor, and technology. It does not depend on the price

- If there 10% increasing in price, the all other price woulds increase by 10%

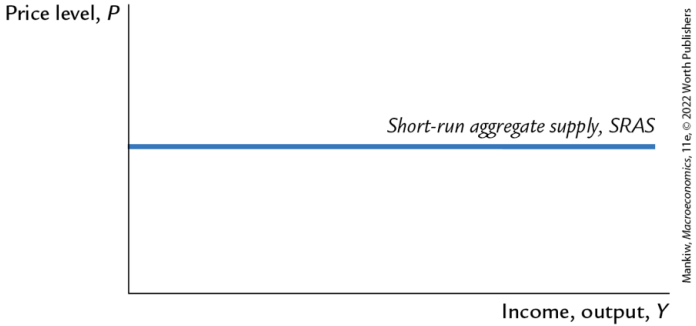
Long run effects of a decrease in M



Aggregate supply in the short run

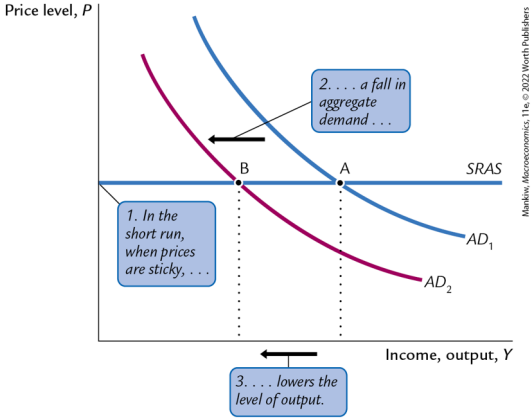
- In the long run, we assume price is flexible
  - firm can adjust price
- However, in the short run, firms might not able to make price change
  - price is sticky
  - stuck at a predetermined level
  - firms willing to sell as much as their customers are willing to buy at that price level
  - Imply short run aggregate supply curve is horizontal

Aggregate supply in the short run

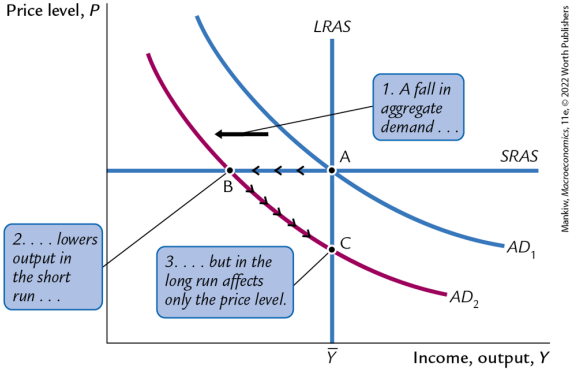


- price is sticky

Short run effects of a decrease in M

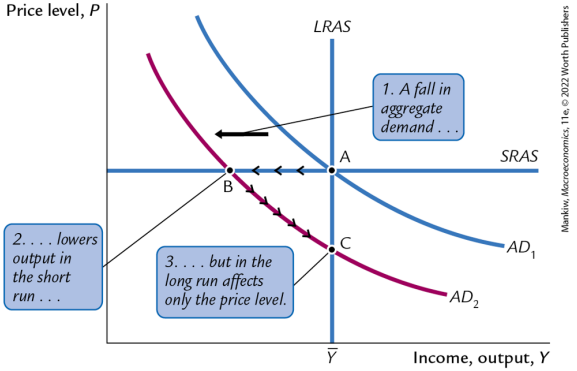


The short run and long run effects of a decrease in M



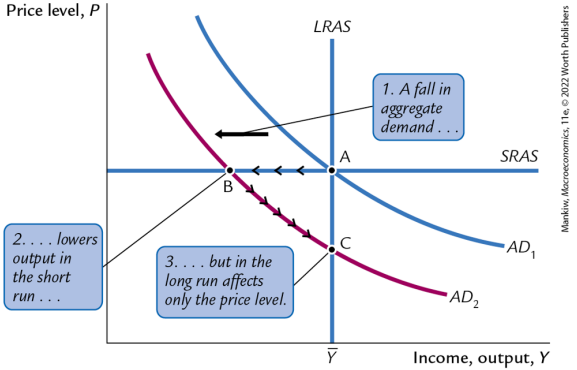
A decrease in M shift AD to left. In short run, price is sticky so firms will decrease production

The short run and long run effects of a decrease in M



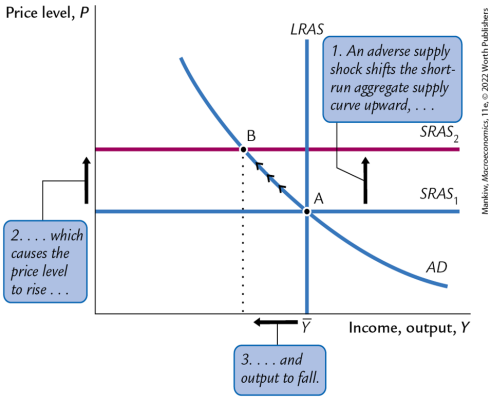
Since firms reduce production, they will demand less capital and labor $\Rightarrow$ firms willing to pay lower wage and rental rate

The short run and long run effects of a decrease in M



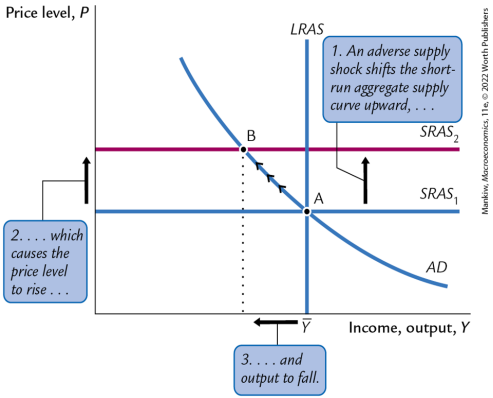
Long run adjustment: costs of production decrease $\Rightarrow$ price decreases $\Rightarrow$ demand for goods increases

A negative shock on short run supply



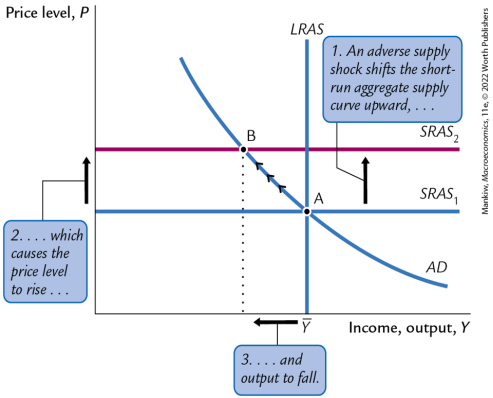
Pandemics disrupt global value chain $\Rightarrow$ supply of intermediates falls, shift SRAS up

A negative shock on short run supply



In short run, price increases, output decreases $\Rightarrow$ stagflation

A negative shock on short run supply

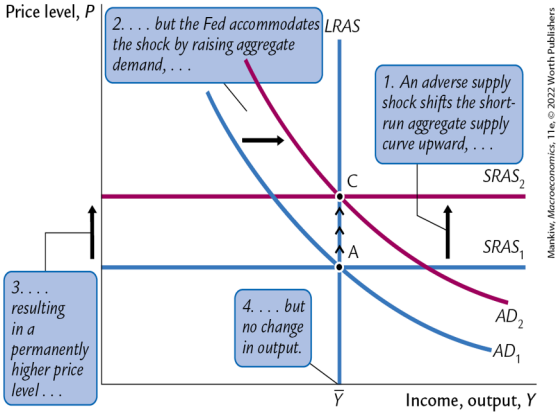


In long run, price falls, we eventually back to original long run equilibrium A

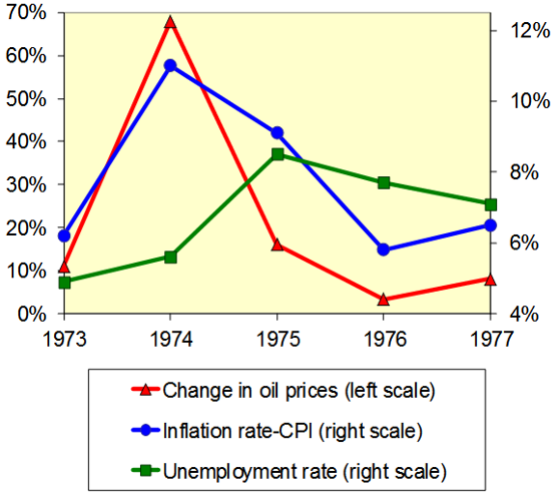
Supply shocks and stabilize policy

- A short run supply shock alters the cost of production
  - a drought destroys crops, reduces food supply pushes up prices
  - new environmental protection law that requires firms to reduce emissions of pollutants.
  - an increase in union aggressiveness, pushes up wages so prices
  - organizational of an international oil carter.
- In long run, economy will recover to its original equilibrium
  - but, process might be very long and painful
  - policymaker can use stabilization policy

Stabilize policy



Case study: 1970 oil shocks



Aggregate Demand I: Building IS - LM model

Context

- Previous chapter introduced the model of AD and AS
- Long run
  - prices flexible
  - output determined by factors of production & technology
  - unemployment equals its natural rate
- Short run
  - prices fixed
  - output determined by aggregate demand
  - unemployment negatively related to output

Context

- So far, all models we discussed are Neoclassical models.
  - emphasize equilibrium. e.g. GDP identity
  - long run growth. e.g. Solow growth model
  - price can adjust by itself (invisible hands)

From Neoclassical perspective, economy has its own pattern toward to long run equilibrium. It may deviate (shock) from equilibrium path, but will and always back to original path,

- long run growth and equilibrium $\Rightarrow$ Neoclassical

New Model: Keynesian

Named after **John Maynard Keynes**, arouse attention after the Great Depression. During recession, US government initiate a large infrastructure investment

- Hover Dam
- inter-state highway system

The infrastructure investment increase jobs $\Rightarrow$ output increase

- What's role of government and central bank in short run?
- Given sticky price, why fiscal and monetary policy shift AD curve which increase output in short run?

Keynesian theory: IS-LM

- IS: investment and saving
- LM: liquidity and money

Keynesian model further decompose aggregate demand (AD)

- interaction between goods and money market
- essential linkage: real interest rate

New Model

Classical Model

Keynesian Model

New Model: same part

- Say good by to Neoclassical
  - but keep knowledge, since model will use similar block
- Main difference,
  - instead of actual investment, we will focus on planned investment
  - equilibrium not only supply = demand
    - Planned = Actual

Expenditure

- Total expenditure $\Rightarrow$ total income
  - it's all about $Y = C + G + I$
- But we are going to reinterpret this equilibrium equation in the short run with sticky prices and planned expenditure
  - Y, is actual expenditure that household, firms and the government spend on goods and services, which has to equal to GDP
  - $PE = C + I + G$, is planned expenditure that households, firms, and the government would like to spend on goods and services.
- Why would $Y \neq PE$? inventories
  - Firms' sales might not coincide with what they planned and, since the cannot change prices, they will decide to stock up the difference in the form of inventory investment (or decrease inventories in the opposite case)

Planned expenditure

We are going to assume,

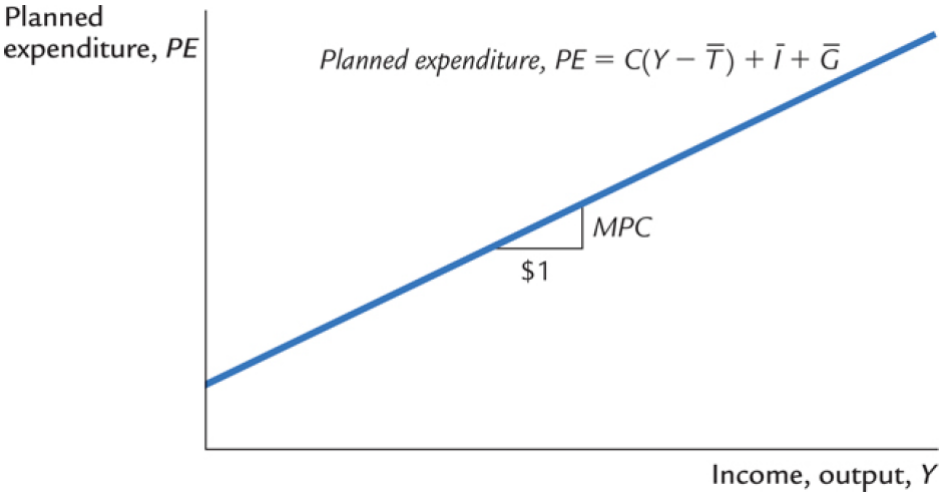
- government policy is exogenous and fixed: $T = \bar{T}$, $G = \bar{G}$
- investment is exogenous fixed: $I = \bar{I}$
- consumption is a function of disposable income

$$C = \sigma(Y - \bar{T})$$

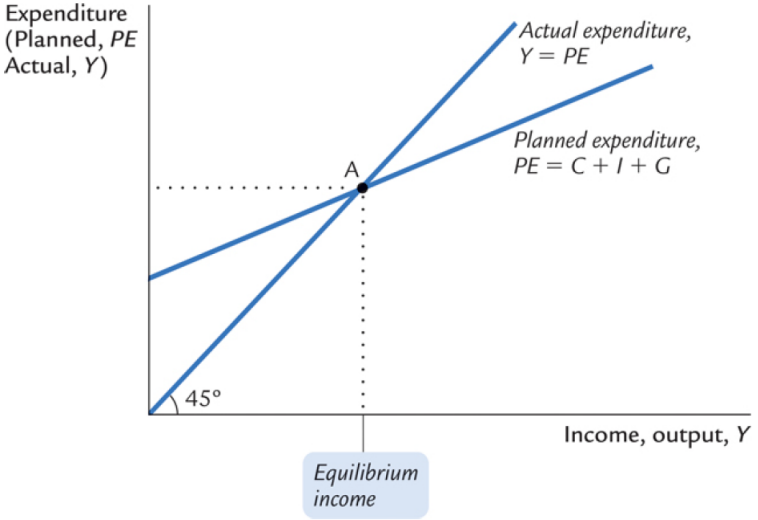
  - where σ is marginal propensity to consumption
- Planned expenditure

$$PE = \sigma(Y - \bar{T}) + \bar{G} + \bar{I}$$

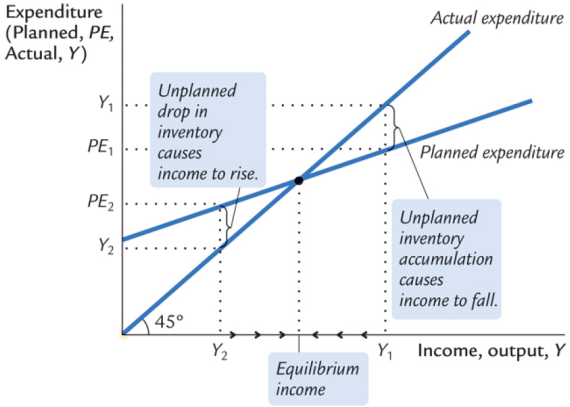
Planned expenditure



Keynesian Cross: $Y = PE$

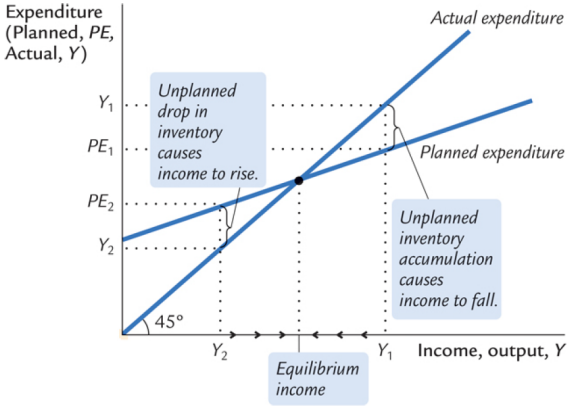


How do we reach $Y = PE$



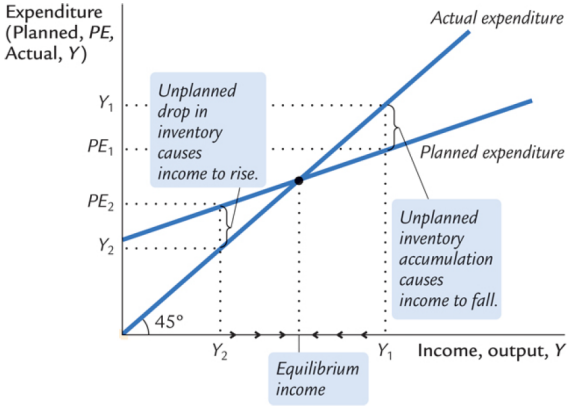
Suppose firms produce at $Y_1 \Rightarrow Y > PE$

How do we reach $Y = PE$



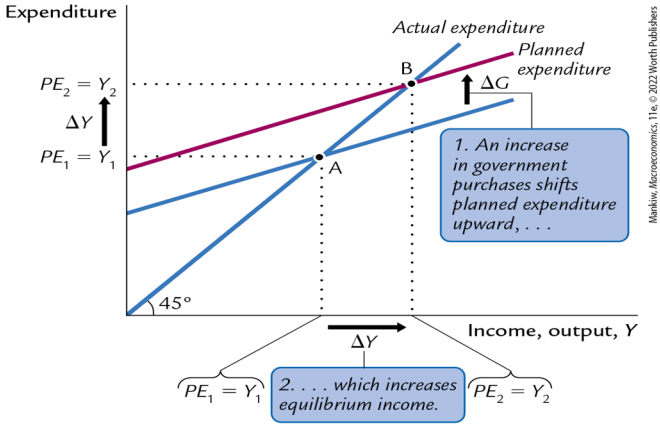
Production is greater than expenditure $\Rightarrow$ firms accumulate inventories

How do we reach $Y = PE$



Since price is sticky $\Rightarrow$ firms layoff workers $\Rightarrow$ Y falls

Impact of government purchase



Note: $\Delta Y > \Delta G$

Solving for ΔY

First, re-write expenditure as Δ terms,

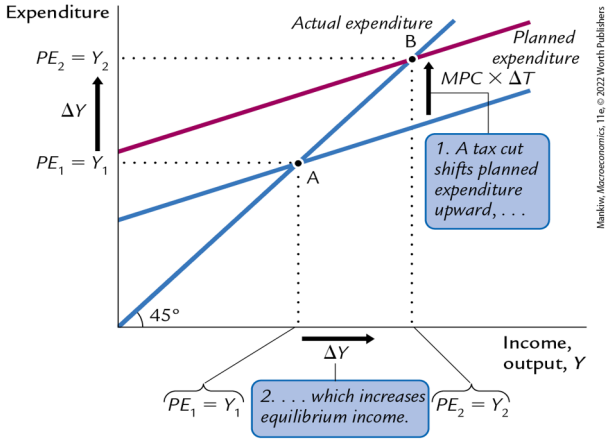
$$\begin{aligned}\Delta Y &= \Delta C + \Delta I + \Delta G \\ &= \sigma(\Delta Y - \Delta T) + \Delta G + \Delta I\end{aligned}$$

- assume no changes on Investment $\Delta I = 0$ and tax policy $\Delta T = 0$

$$\Delta Y = \sigma \Delta Y + \Delta G$$
$$\Delta Y = \frac{1}{1-\sigma}\Delta G = \frac{1}{1-MPC}\Delta G$$

- $1/(1 - MPC)$: government purchase multiplier, defined as increase in income resulting from a \$1 increase in gov. purchases

Impact of tax cut



Note: decreasing in tax increase PE by $\Delta T \times MPC$

Solve for ΔY

Similarly, re-write expenditure as Δ terms,

$$\begin{aligned}\Delta Y &= \Delta C + \Delta I + \Delta G \\ &= \sigma(\Delta Y - \Delta T) + \Delta G + \Delta I\end{aligned}$$

- assume no changes on investment $\Delta I = 0$ and government purchases $\Delta G = 0$

$$\Delta Y = \sigma(\Delta Y - \Delta T)$$
$$\Delta Y = -\frac{\sigma}{1-\sigma}\Delta T = -\frac{MPC}{1-MPC}\Delta T$$

- $-MPC/(1-MPC)$: tax multiplier, defined as increase in income resulting from a \$1 decrease in taxes

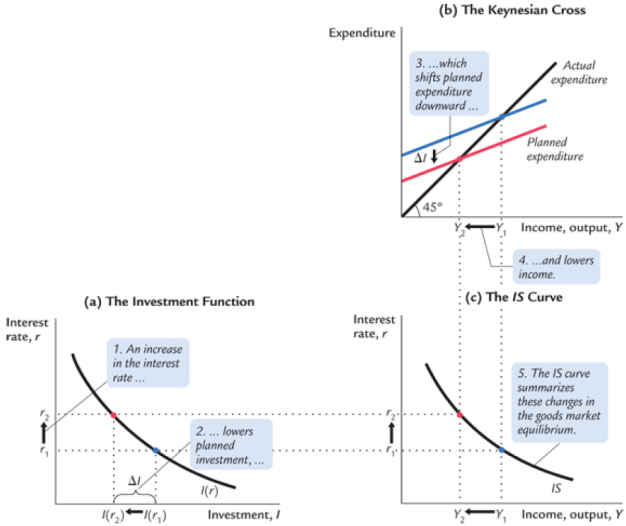
Impact of fiscal policy

As previous slides shown, government can implement two policy that increase income

- increase government purchase: $\frac{1}{1-MPC}$
- decrease taxes: $-\frac{MPC}{1-MPC}$

Since $MPC < 1 \Rightarrow \$1$ increase in government purchases has larger impact than $\$1$ tax cut

Build IS curve



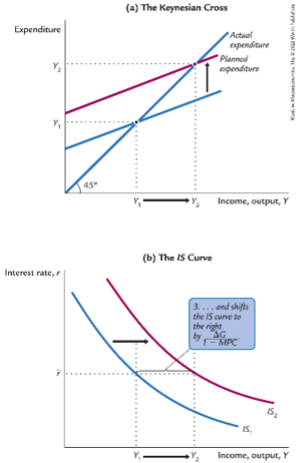
Shifting IS curve: ΔG

At any value of r, $\uparrow G \rightarrow \uparrow PE \rightarrow \uparrow Y$

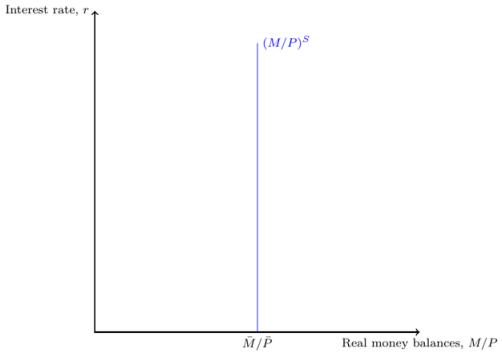
. . . so the *IS* curve shifts to the right.

The horizontal distance of the *IS* shift equals

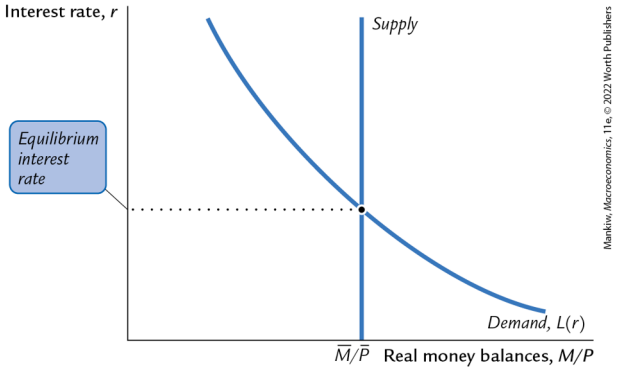
$$\Delta Y = \frac{1}{1-\text{MPC}} \Delta G$$



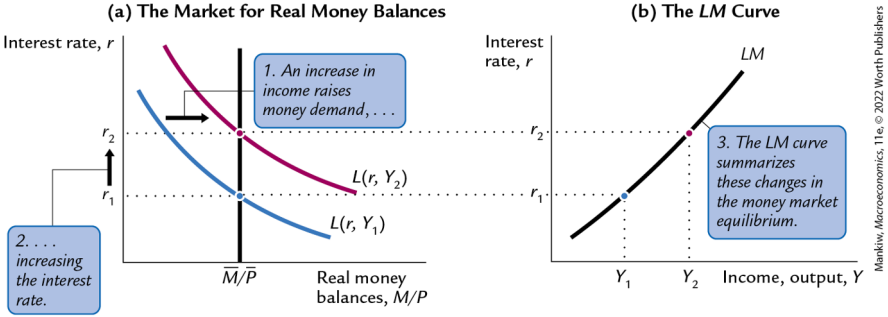
Build LM curve: money supply



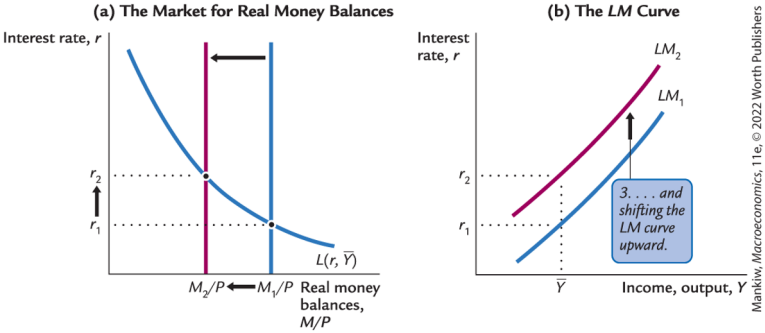
Build LM curve: money market equilibrium



Build LM curve

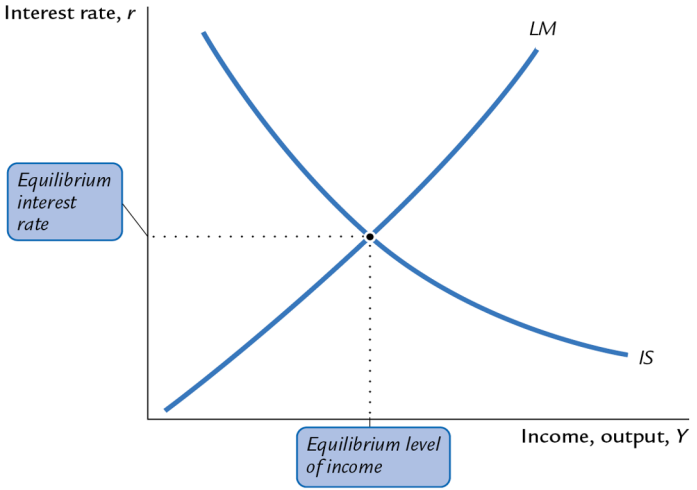


Shift LM curve: ΔM

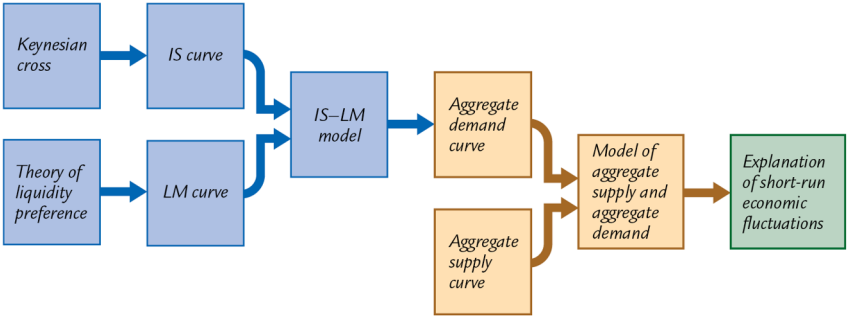


At given Y, reduce M generates exceed demand, interest rate restore to new equilibrium $\Rightarrow$ shift LM upward

The short run equilibrium



Big picture


Keynesian cross
IS curve
Theory of liquidity preference
LM curve
IS–LM model
Aggregate demand curve
Aggregate supply curve
Model of aggregate supply and aggregate demand
Explanation of short-run economic fluctuations
Mankiw, Macroeconomics, 11e, © 2022 Worth Publishers

Numerical excise

Goods market,

$$
\begin{aligned}
Y &= C + I + G \\
C &= 120 + 0.5(Y - T) \\
I &= 100 - 10r \\
G &= 50 \\
T &= 40
\end{aligned}
$$

Money market

$$
\begin{aligned}
(M/P)^d &= Y - 20r \\
M &= 20 \\
P &= 2
\end{aligned}
$$

Numerical excise

Assume planned investment $I = 100$

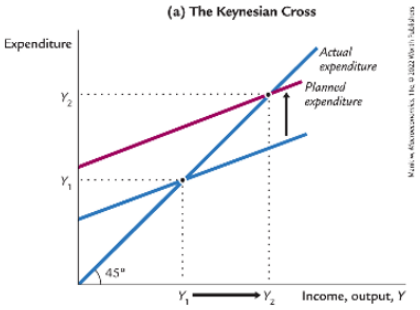
- derive PE
- plot Keynesian Cross
- what if $I = 150$
- derive and plot IS
- plot money supply
- plot money demand
- solve equilibrium in money market
- derive LM
- solve equilibrium r^* and Y^*

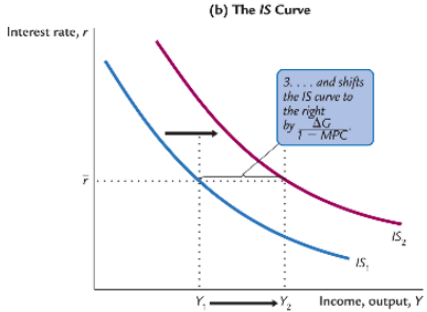
Aggregate Demand II: applying the $IS - LM$ model

Preface

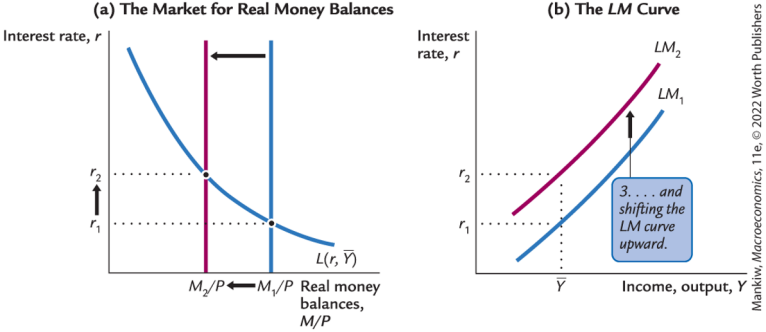
- In previous chapter, we discussed a simple version of Keynesian Model.
- This chapter
  - interaction between fiscal policy and monetary policy
  - shocks and stabilize policy
  - remember, price is sticky $\Delta P = 0$ in short run

Fiscal policy





Monetary policy



IS - LM

Careful: IS - LM curve **are not** similar to Supply - Demand

- link Goods and Money market by interest rate r

Goods,

$$\begin{aligned} Y &= C + I + G \\ C &= \sigma(Y - T) \\ I &= I(r) \end{aligned}$$

Money,

$$\frac{M}{P} = \left(\frac{M}{P}\right)^d = L(r, Y)$$

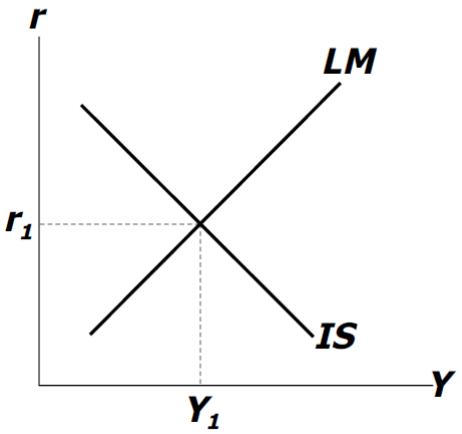
Policy analysis with the *IS-LM* model

$$Y = C(Y - \overline{T}) + I(r) + \overline{G}$$

$$\overline{M}/\overline{P} = L(r, Y)$$

We can use the *IS-LM* model to analyze the effects of

- fiscal policy: G and/or T
- monetary policy: M



An increase in government purchases

1. *IS* curve shifts right

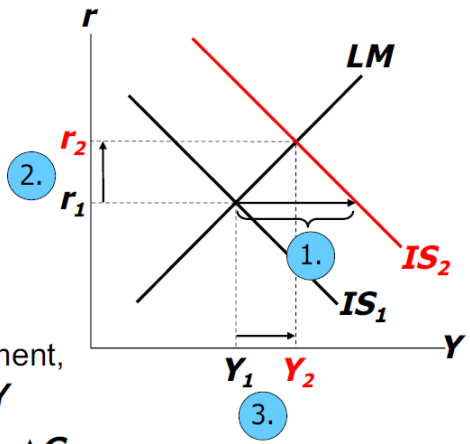
   by $\frac{1}{1 - MPC} \Delta G$

   causing output & income to rise.

2. This raises money demand, causing the interest rate to rise…

3. …which reduces investment, so the final increase in Y

   is smaller than $\frac{1}{1 - MPC} \Delta G$



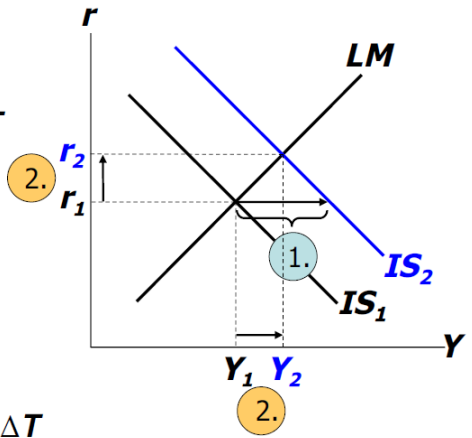
A tax cut

Consumers save (1−*MPC*) of the tax cut, so the initial boost in spending is smaller for ΔT than for an equal ΔG…

and the *IS* curve shifts by

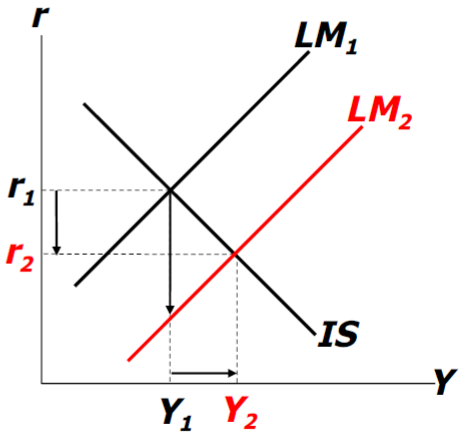
1. $\dfrac{-MPC}{1-MPC}\Delta T$

2. …so the effects on r and Y are smaller for ΔT than for an equal ΔG.



Monetary policy: An increase in M

1. $\Delta M > 0$ shifts the LM curve down (or to the right)
2. …causing the interest rate to fall
3. …which increases investment, causing output & income to rise.



A numerical example

- consumption: $C = 200 + 0.5(Y - T)$
- investment: $I = 200 - 25r$
- $G = T = 100$
- money demand: $(M/P)^d = Y - 100r$
- $\bar{M} = 1000$
- $\bar{P} = 2$

A numerical example

- calculate IS curve
- calculate LM curve
- calculate r^* and Y^*
- plot graphs
- assume $G \uparrow$ to 150. What happens to previous questions?
- assume instead of government spending, $M \uparrow$ to 1200.

Interaction between fiscal and monetary policy

- In real world, it is very common that Fed and government change the policy simultaneously.
  - e.g. during pandemics, government purchases medical equipment, invest in vaccine development. Meanwhile, Fed increase money supply.
- We are going to see an example of increase in government spending

Response 1: Hold *M* constant

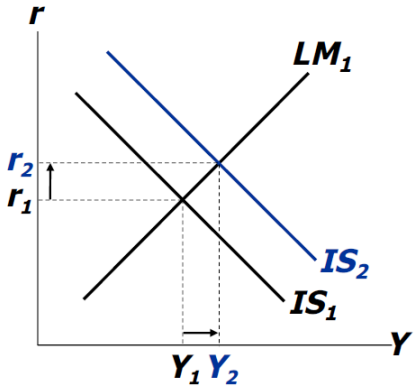
If Congress raises ***G***, the *IS* curve shifts right.

If Fed holds ***M*** constant, then *LM* curve doesn't shift.

Results:

$$\Delta \boldsymbol{Y} = \boldsymbol{Y}_2 - \boldsymbol{Y}_1$$

$$\Delta \boldsymbol{r} = \boldsymbol{r}_2 - \boldsymbol{r}_1$$



Response 2: Hold r constant

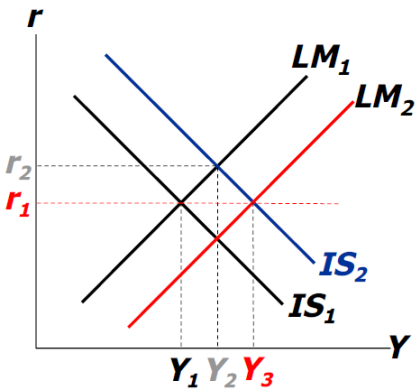
If Congress raises G, the IS curve shifts right.

To keep r constant, Fed increases M to shift LM curve right.

Results:

$$\Delta Y = Y_3 - Y_1$$

$$\Delta r = 0$$



Response 3: Hold *Y* constant

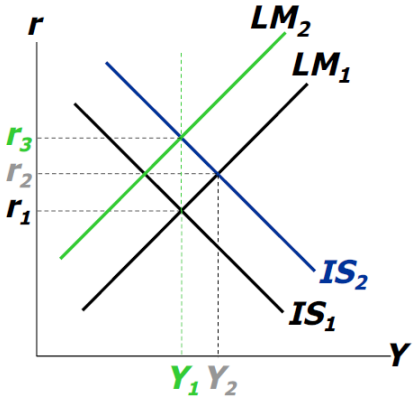
If Congress raises ***G***,
the *IS* curve shifts right.

To keep ***Y*** constant,
Fed reduces ***M***
to shift *LM* curve left.

Results:

$$\Delta \boldsymbol{Y} = 0$$

$$\Delta \boldsymbol{r} = \boldsymbol{r}_3 - \boldsymbol{r}_1$$



Monetary policy: M or r

- You might heard this frequently from media " Fed will raise or lower interest rate "
- Federal Open Market Committee hold a meeting for every 6 weeks to set monetary policy
  - they discuss the future interest rate target (funds rate), which is the interest rate that banks charges to each other
    - suppose Fed buy government bonds
    - banks will have more reserve (more money)
    - lower borrowing interest rate
- after meeting, New York Fed will conduct open market operation to hit target.

Shocks

- We have seen how fiscal policy affect IS
- We have seen how monetary policy affect LM

- Similarly, we can group other disruptions into two categories
  - shocks to IS curve
  - shocks to LM curve

Shocks: *IS*

- *IS* shocks: exogenous changes in the demand for goods and services.

For example,

- stock market boom or crash
  - change in household wealth $\Rightarrow \Delta C$
- change in business or consumer confidence or expectations
  - ΔI andor ΔC

Shocks: *LM*

- *LM* shocks: exogenous changes in the demand for money.

For example,

- During Covid-19, consumers and companies did not wish to handle cash and switched to more cashless methods of payments.
- More ATMs or the internet reduce money demand.

NOW YOU TRY

Analyze shocks with the *IS–LM* model

Use the *IS–LM* model to analyze the effects of

1. a housing market crash that reduces consumers' wealth
2. consumers using cash in transactions more frequently in response to an increase in identity theft

For each shock,

a. use the *IS–LM* diagram to determine the effects on ***Y*** and ***r***.

b. figure out what happens to ***C***, ***I***, and the unemployment rate.

Recession 2001 (book: p334 - p335)

During 2001,

- 2.1 million jobs lost (unemployment rose from 3.9% to 5.8%)
- GDP growth slowed to 0.8% (compare to average 3.9% annual growth during 1994 - 2000)

Causes(shocks)

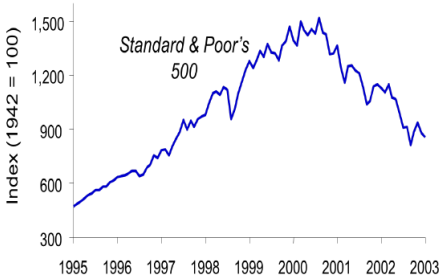
- driven by a fall in aggregate demand

Consequence (policy reactions),

- The recession lasted barely a year (2-3 years for unemployment to recover)

Recession 2001: shock 1

- dot–com bubble burst $\rightarrow$ stock market decline
  - dot-com bubble ($I \uparrow$)
  - stock market crush (C and I $\downarrow$)
  - *IS* shift to left



Recession 2001: shock 2 and 3

Shock 2: 9/11

- further market decline, C and I $\downarrow$
- increase uncertainty $C \downarrow$
- further shift *IS* to left

Shock 3: Corporate accounting scandals

- Enron, WorldCom
- stock market crush further
- further shift *IS* to left

Recession 2001: policy responses

Fiscal policy,

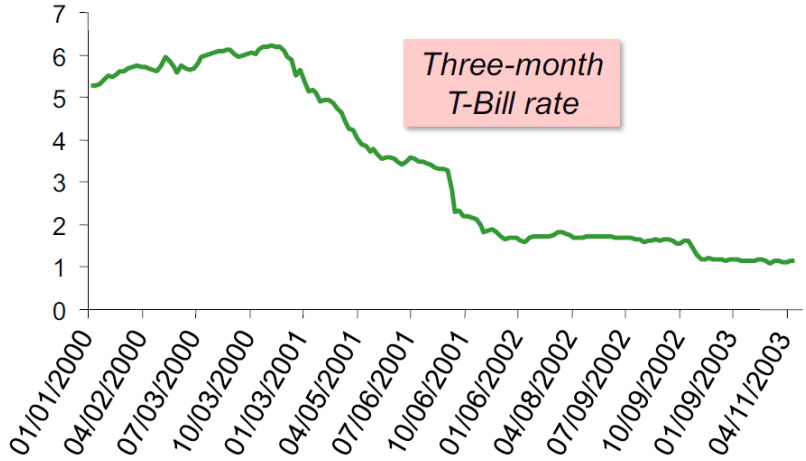
- tax cuts in 2001 and 2003
- spending increase: airline industry bailout, NYC reconstruction, Afghanistan war
- shift IS to right

Monetary policy,

- increase M
- shift LM to right

Recession 2001: monetary policy

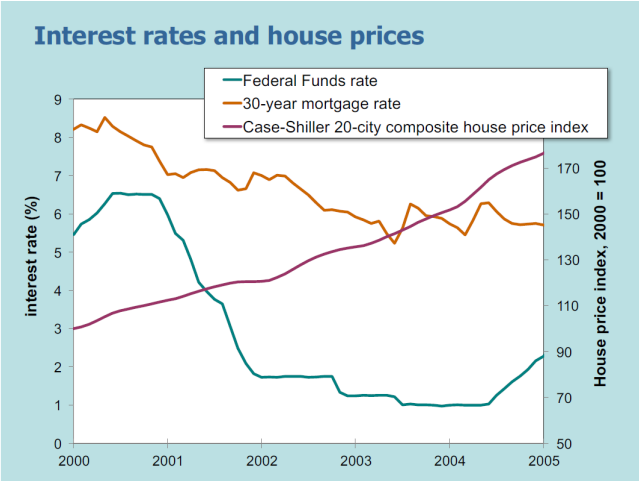
Monetary policy response: shifted *LM* curve right



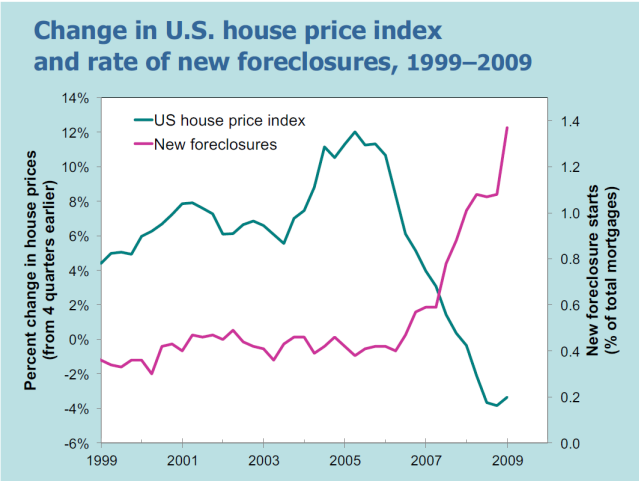
Financial crisis: 2008-2009

- 2009: Real GDP fell, u-rate approached 10%
- important factors in the crisis
  - early 2000s Federal Reserve interest rate policy
  - subprime mortgage crisis
  - bursting of house price bubble, rising foreclosure rates
  - falling stock prices
  - failing financial institutions
  - declining consumer confidence, drop in spending on consumer durables and investment goods

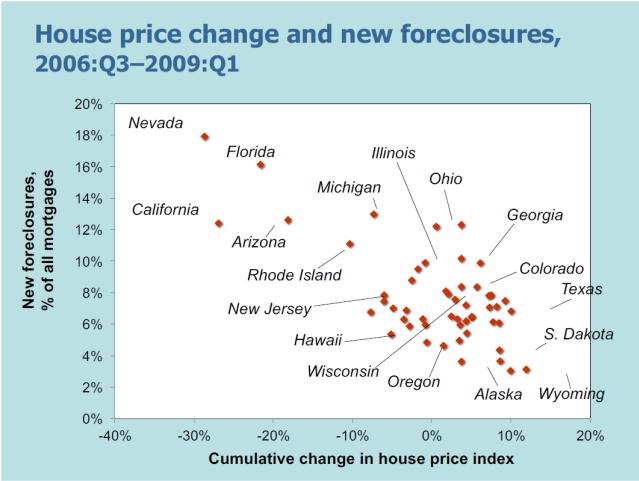
Financial crisis: prior interest rate and housing price



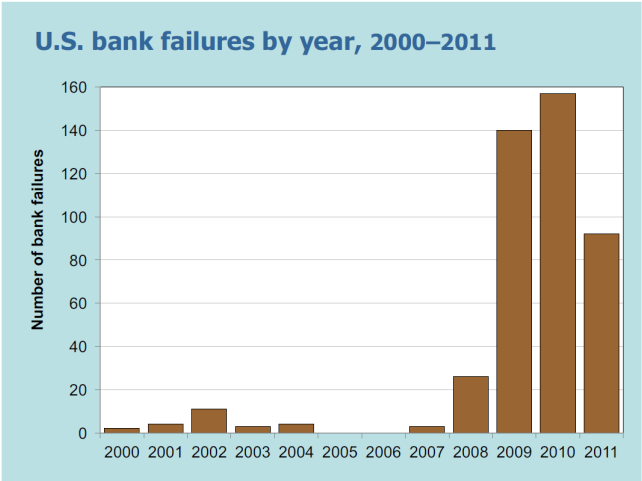
Financial crisis: housing price and foreclosure



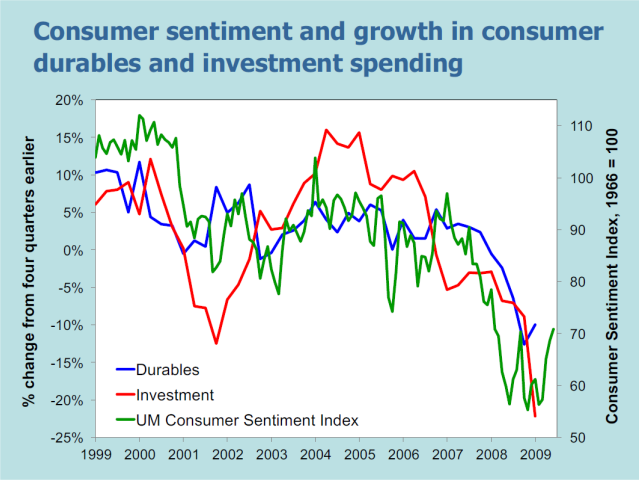
Financial crisis: cross states differences



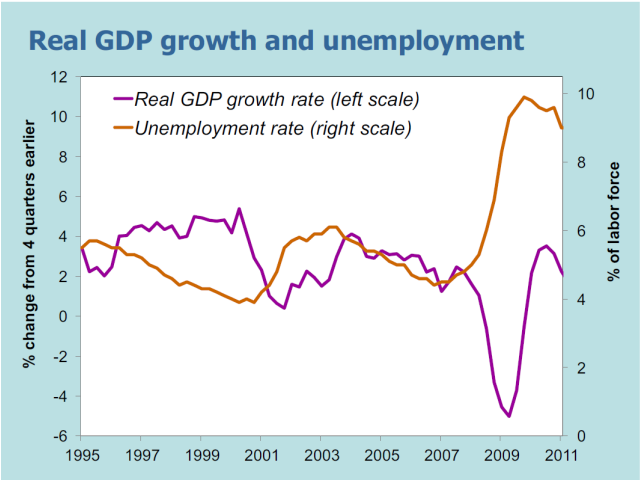
Financial crisis: bank failure



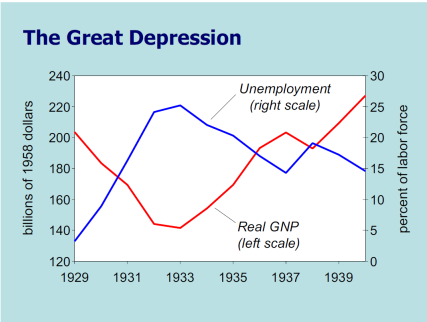
Financial crisis: consumer spending and expectation



Financial crisis: GDP and unemployment



The Great Depression



Due to data limit, scholars can't provide robustness explanations. However, there are some hypothesis

The Great Depression

Spending Hypothesis, (shocks to *IS*)

- evidence: output and interest rates both fell, which is a leftward *IS* shift
- stock market crash reduced consumption
  - Oct 1929 - Dec 1929: S&P500 fell by 17%
  - Oct 1929 - Dec 1933: S&P500 fell by 71%
- drop in investment
  - correction after overbuilding in the 1920s
  - wildspread bank failures made it harder to obtain financing for investment
- contractionary fiscal policy
  - raised tax rates, and cut government spending to combat increasing deficits

The Great Depression

Money hypothesis, a shock to LM

- Asserts that the Depression was largely due to huge fall in the money supply
  - M1 fell 25% during 1929 - 33
- but two problems with this hypothesis:
  - Price (P) fell even more, so M/P actually rose slightly during 1929 - 31
  - nominal interest rate fell, which is the opposite of what a leftward LM shift would cause.

The Great Depression

Money hypothesis again, the effect of falling price

- Asserts that the severity of the Depression was due to a huge deflation;
  - P fell 25% during 1929 - 33
- This deflation was probably caused by the fall in M, so perhaps money played an important role after all.
- In what ways does a deflation affect the economy?
  - stabilizing effect: $P \downarrow \Rightarrow (M/P) \downarrow \Rightarrow Y \uparrow$ (also $C \downarrow$ since goods are more cheaper)
  - destabilizing effect:
    - expected inflation: $E\pi \downarrow \Rightarrow r \uparrow \Rightarrow I \downarrow \Rightarrow$ planned expenditure
    - unexpected inflation: purchasing power transfer from borrower to lender $\Rightarrow$ if borrowers' propensity to spend is large than lenders, then aggregate spending falls.

Why another depression is unlikely

- Policymakers now know much more about macroeconomics
  - the Fed knows better than to let M fall so much, especially during a contraction
  - Fiscal policymakers know better than to raise taxes or cut spending during a contraction
- Federal deposit insurance makes widespread bank failures very unlikely
- Automatic stabilizers (e.g. UI) make fiscal policy expansionary during an economic downturn

How policies shift AD curve?

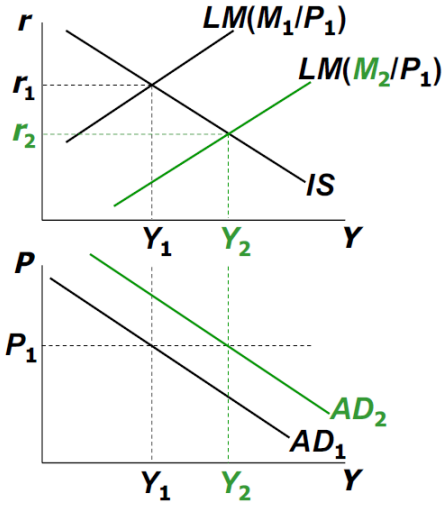
The Fed can increase aggregate demand:

$\uparrow M \rightarrow$ *LM* shifts right

$\rightarrow \downarrow r$

$\rightarrow \uparrow I$

$\rightarrow \uparrow Y$ at each value of P



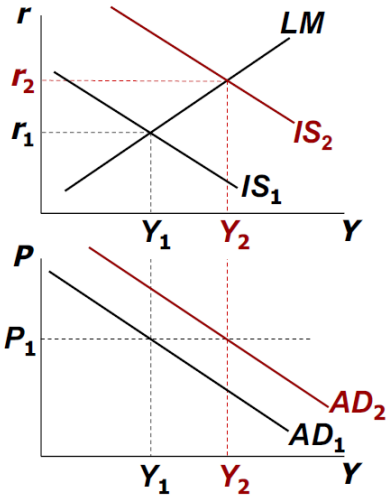
How policies shift AD curve?

Expansionary fiscal policy (↑G and/or ↓T) increases agg. demand:

↓T → ↑C

→ IS shifts right

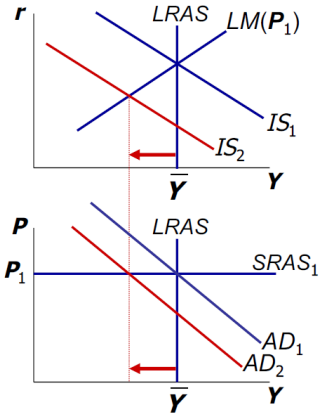
→ ↑Y at each value of P



Transition from short run to long run

The SR and LR effects of an *IS* shock

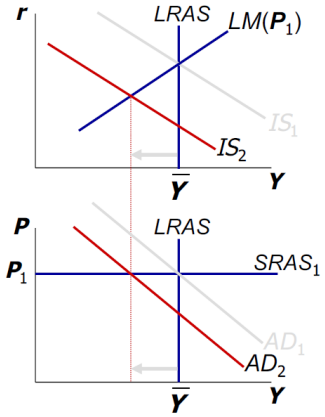
A negative *IS* shock shifts *IS* and *AD* left, causing **Y** to fall.



Transition from short run to long run

The SR and LR effects of an *IS* shock

In the new short-run equilibrium, $Y < \overline{Y}$



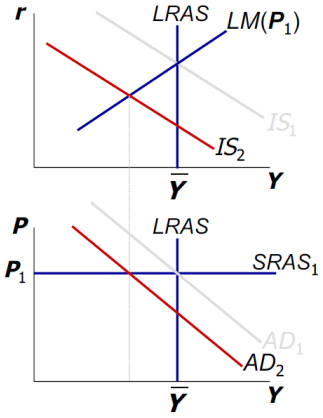
Transition from short run to long run

The SR and LR effects of an *IS* shock

In the new short-run equilibrium, $Y < \overline{Y}$

Over time, P gradually falls, causing:

- *SRAS* to move down
- M/P to increase, which causes *LM* to move down



Transition from short run to long run

The SR and LR effects of an *IS* shock

Over time, ***P*** gradually falls, causing:

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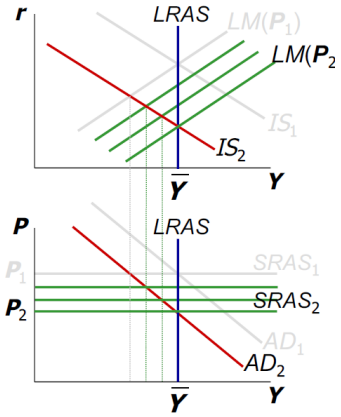

Transition from short run to long run

The SR and LR effects of an *IS* shock

This process continues until economy reaches a long-run equilibrium with

$$Y = \overline{Y}$$