Economic Fluctuations

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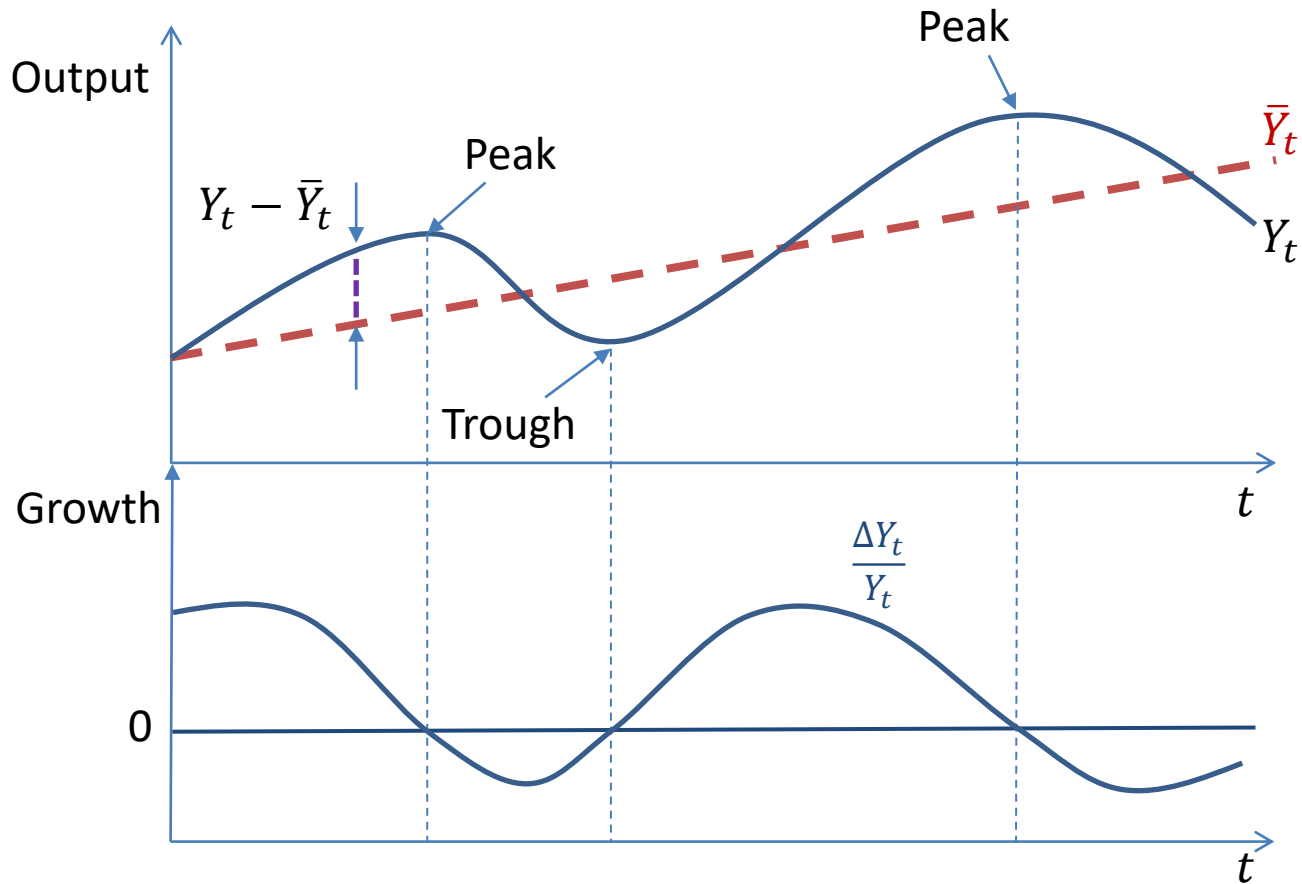
Content

- Overview
- The IS-LM Models
- The AD-AS Model
- Keynes Theory
- Concluding Remarks

Business Cycle

- The business cycle is the upward and downward movement of output around the long-term trend of output potential.

- The business cycle is most often measured in terms of the growth rate of real GDP.
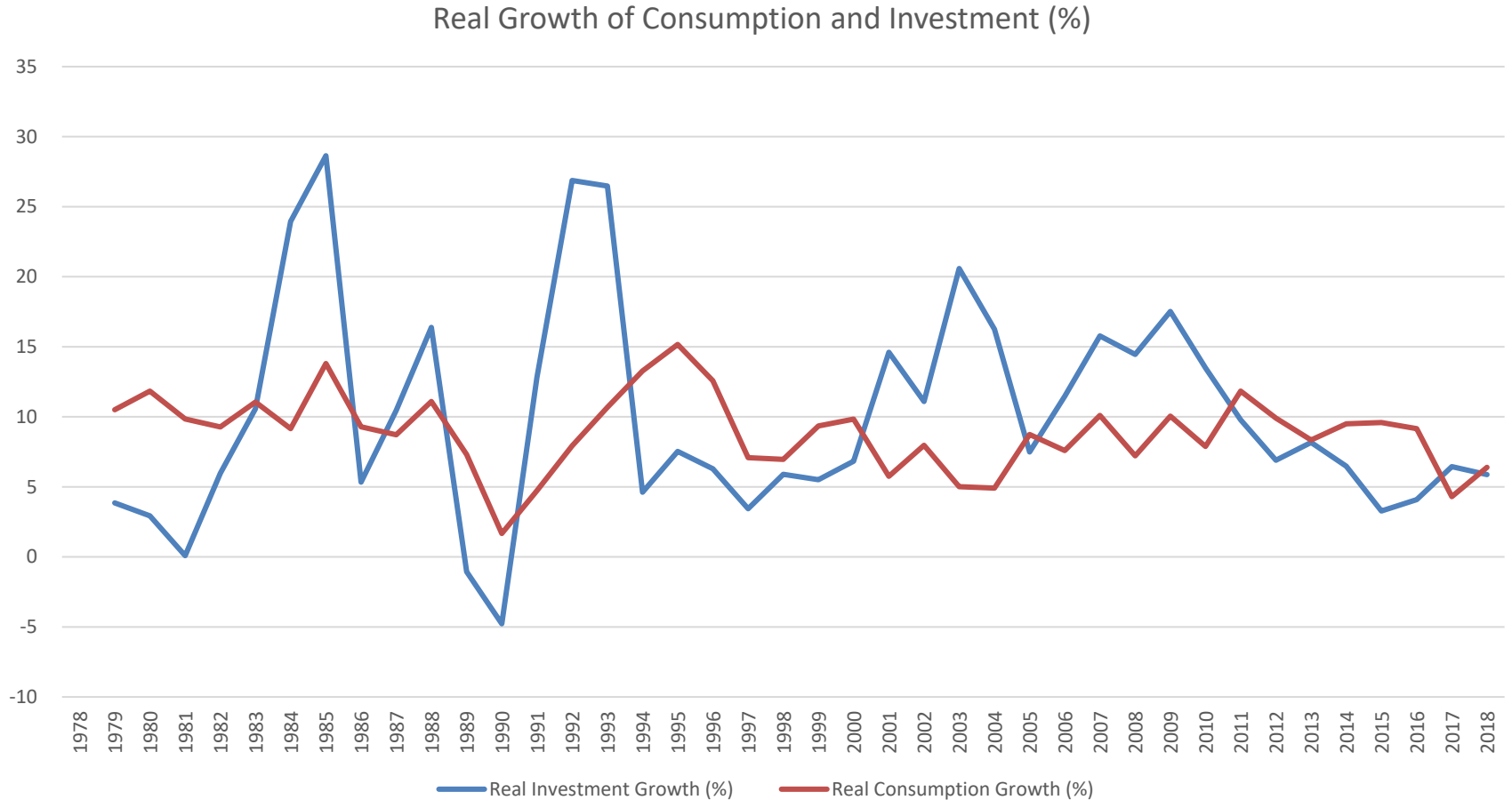
Stylized Business Cycles

Macroeconomic Fluctuations: China

China Real GDP Growth (Annual, %)

Intermediate Macroeconomics

Macroeconomic Fluctuations: China

China Real GDP Growth (Quarterly, %)

Macroeconomic Fluctuations: China

Real Growth of Consumption and Investment (%)

—— Real Investment Growth (%)　　—— Real Consumption Growth (%)

Intermediate Macroeconomics

Macroeconomic Fluctuations: China

Non-farm Employment Growth (%)

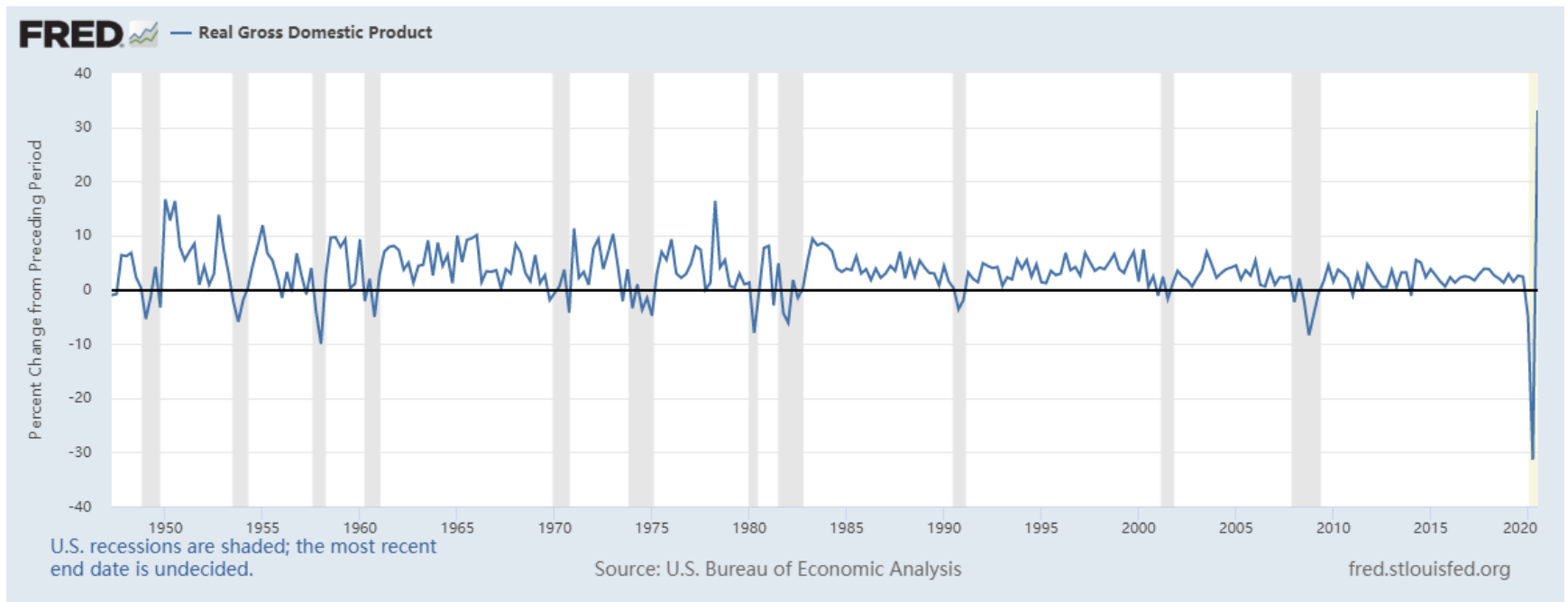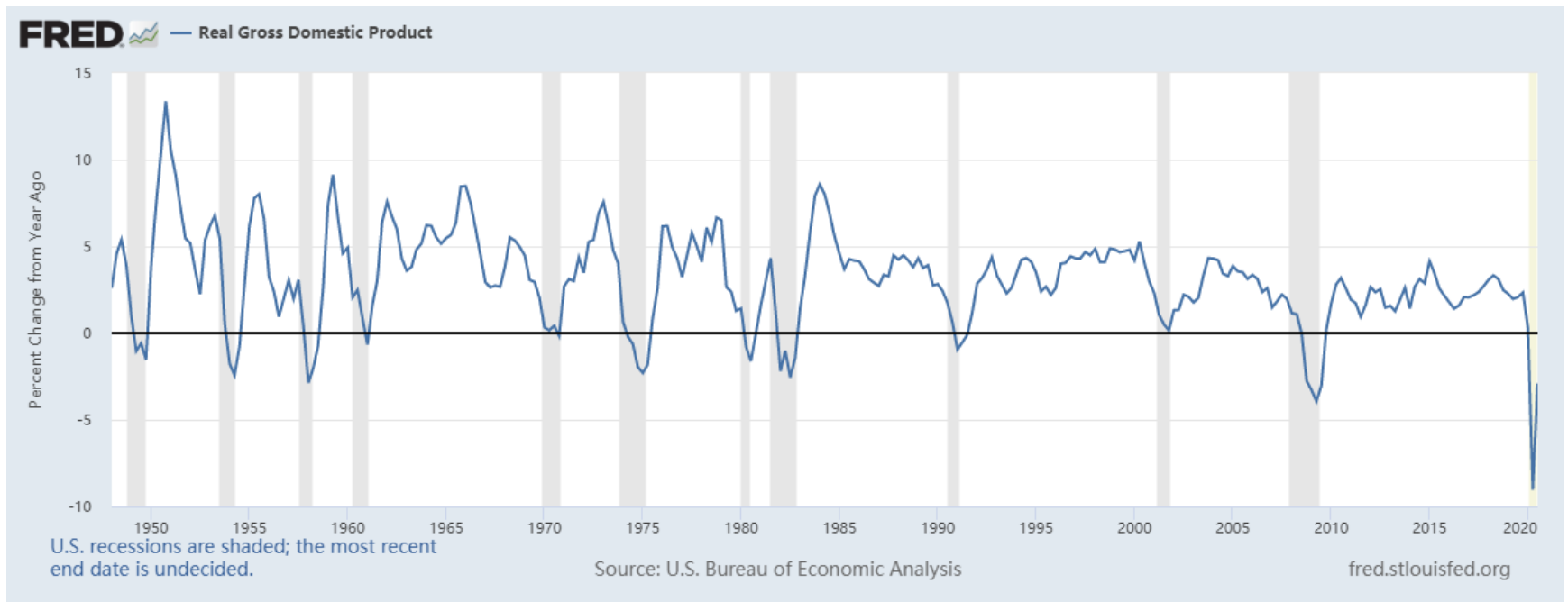Intermediate Macroeconomics

Macroeconomic Fluctuations: US

Quarterly RGDP Growth (Seasonal Adjusted Annual Rate (SAAR))

Macroeconomic Fluctuations: US

Quarterly YoY RGDP Growth

Intermediate Macroeconomics

Macroeconomic Fluctuations: US
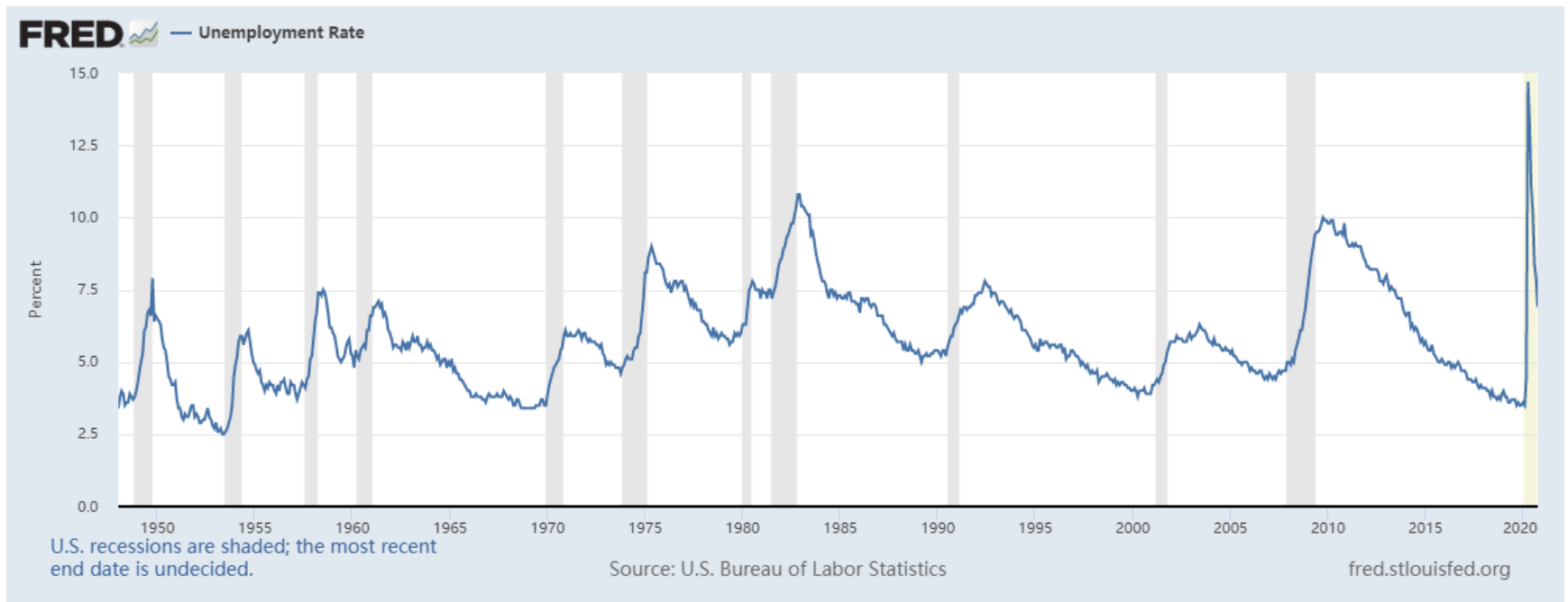
Some Facts About Business Cycle

- The growth rate is persistent: High growth often follows high growth.

- Expansion is often long and recession is often short-lived.

- Growth in consumption is less volatile than that in investment.

- The labor market moves, albeit imperfectly, with the business cycles.

  - Okun's Law: $(Y_t - \bar{Y}) = -\gamma(u_t - u^n)$,

  where u^n is natural rate of unemployment, $\bar{Y}$ is output potential, and $\gamma > 0$.

Identifying Recessions

- In the United States, the official arbiter of when recessions begin and end is the NBER (National Bureau of Economic Research), a nonprofit economic research group.

- The old rule of thumb: a recession is a period of <u>at least two consecutive quarters of declining real GDP</u>.

- However, the NBER does not follow any fixed rule but use discretion in identifying recessions.

Forecasting Business Cycles

- Economists rely on <u>empirical models</u> and <u>leading indicators</u> to forecast business cycles.
- Most often, forecasts differ because economists use different models and different indicators.
- A well-known leading indicator is the Conference Board Leading Economic Index, which compiles 10 time series (themselves leading indicators) into an index for various regions in the world.
  - Average workweek of production workers in manufacturing.
  - Average initial weekly claims for unemployment insurance.
  - New orders for consumer goods and materials, adjusted for inflation.
  - New orders for nondefense capital goods.
  - Index of supplier deliveries.
  - New building permits issued.
  - Index of stock prices.
  - Money supply (M2), adjusted for inflation.
  - Interest rate spread: the yield spread between 10-year Treasury notes and 3-month Treasury bills.
  - Index of consumer expectations.

The Conference Board Leading Economic Index
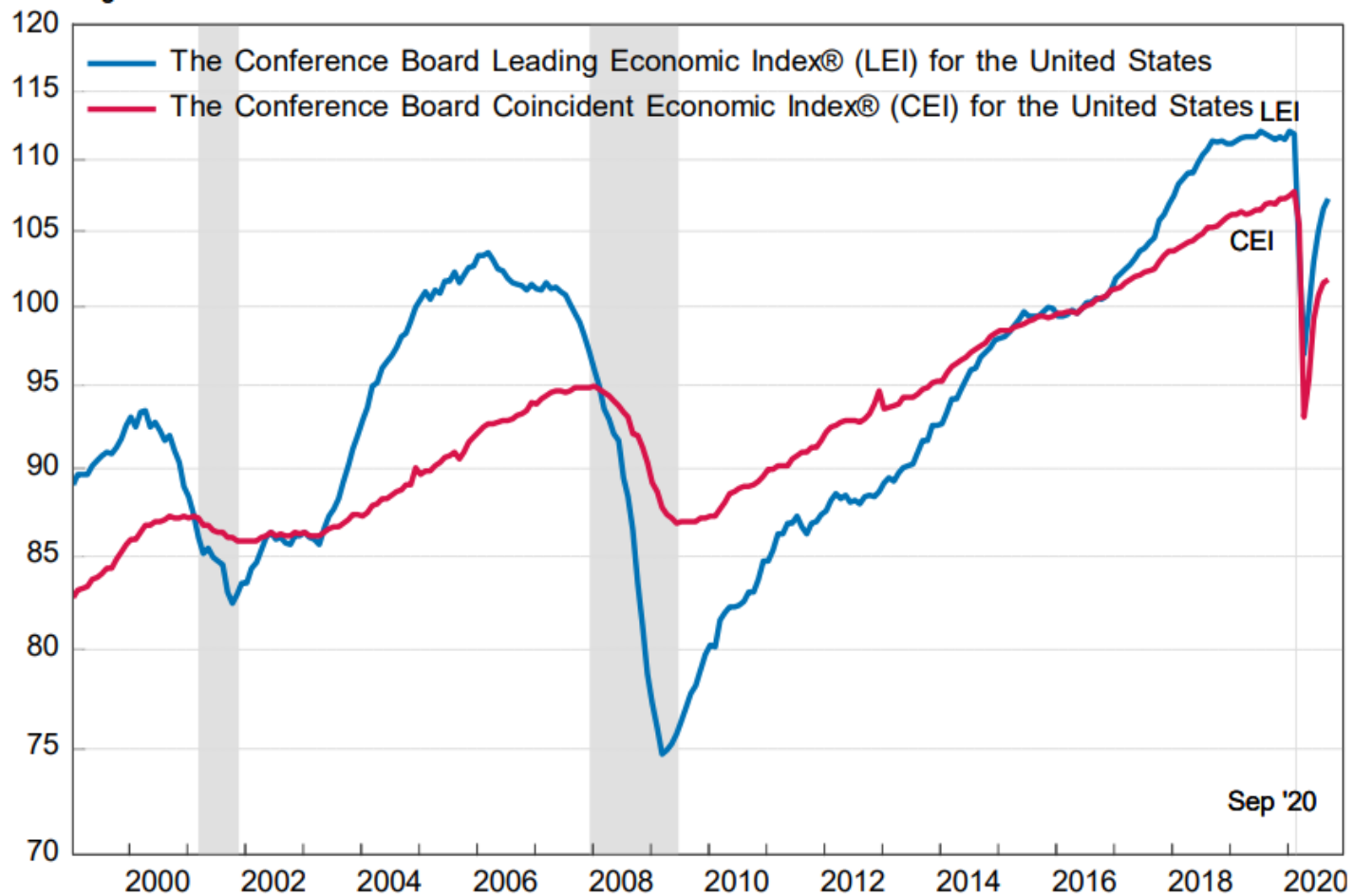
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The Keynesian Cross Model

- We assume that the total expenditure is the sum of consumption, investment, and government expenditure,
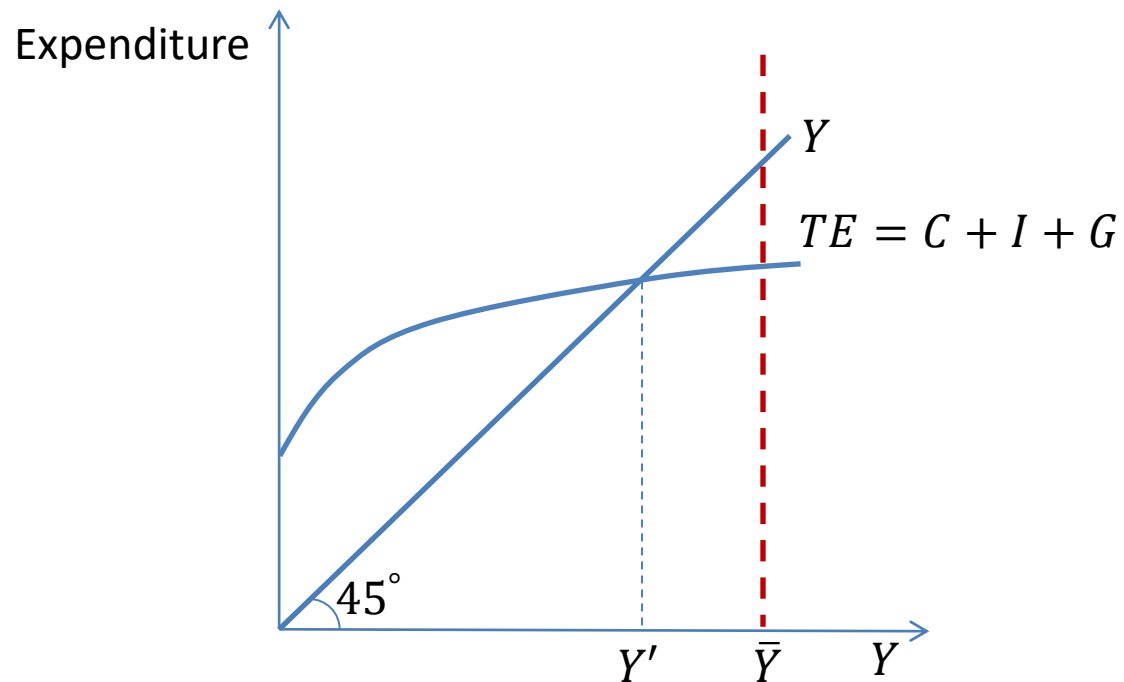$$TE = C + I + G,$$

  - $C = C(Y - T)$
  - T, I, and G are exogenous.
- In equilibrium, the expenditure has to be equal to total income (Y),
$$Y = C(Y - T) + I + G.$$

- If the consumption function is linear, e.g., $C(Y - T) = C_0 + C_1(Y - T)$, then the right-hand-side is a straight line with slope $C_1 < 1$, while the left-hand-side is a 45 degree line.

The Keynesian Cross

Expenditure

Y

$TE = C + I + G$

$45°$

Y' $\bar{Y}$ Y

Insights from the Keynesian Cross Equation

- Total expenditure determines total income.
  - "Paradox of thrift"
- The total output may be lower than the output potential, hence cyclical unemployment.
- The importance of I and G: to accommodate a higher income, the sum of investment and government expenditure must rise more than consumption.
- "Multiplier effect": an increase in investment or government expenditure would lead to a larger increase in the total income.

The Government Purchase Multiplier

- Assume that the consumption function is linear,
$$C(Y - T) = C_0 + C_1(Y - T),$$
where C_0 is often called autonomous consumption and C_1 is called the marginal propensity consume (MPC).

- Take partial differentiation of the following equation with respect to G,
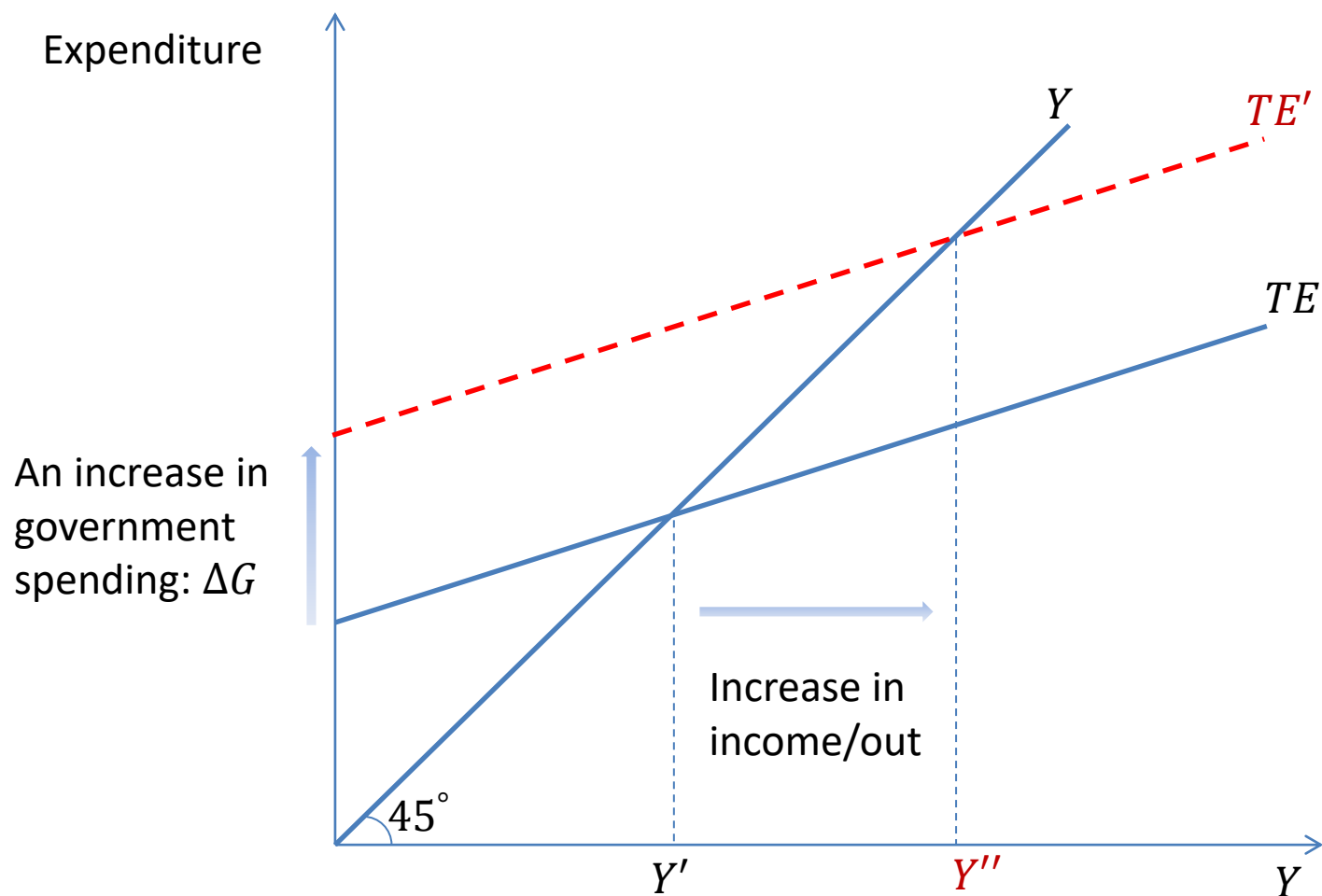$$Y = C_0 + C_1(Y - T) + I + G.$$
We have
$$\frac{\partial Y}{\partial G} = \frac{1}{1 - C_1} = \frac{1}{1 - MPC}.$$

- $\frac{1}{1 - MPC}$ is called the government purchase multiplier.

- Similarly, an increase in I also leads to the same multiplication effect in Y.

The Effect of Fiscal Stimulus

Intermediate Macroeconomics

The Tax Multiplier

- Similarly, we obtain

$$\frac{\partial Y}{\partial T} = -\frac{C_1}{1-C_1} = -\frac{MPC}{1-MPC}.$$

- $-\frac{MPC}{1-MPC}$ is called the tax multiplier.

The Limitation of Keynesian Cross

- The investment I is assumed to be exogenously given. The assumption is not realistic, since investment tends to depend on, among other factors, financing cost measured by interest rate, which is endogenously determined in the financial market.

- Treating investment as exogenous results in an over-estimated multiplier effect, since "crowding-out" is ruled out.

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The Sticky-Price Assumption

- The assumption says that prices are fixed in the short run.

- The sticky-price assumption is crucial in the Keynesian models.

  - The price level can be treated as exogenous.

  - Markets do not automatically clear.

  - Classical dichotomy breaks down.

Time Horizons in Macroeconomics

- Long run: Prices are flexible, responding to changes in supply or demand.
- Short run: Many prices are "sticky" at some predetermined level.
- In classical macroeconomic theory, output is determined by the supply side and changes in the demand side affects only prices. Hence price flexibility is a crucial assumption, which is only reasonable in the long run.
- When prices are sticky, output and employment also depend on the demand.

Frequency of Price Adjustment

This table is based on answers to the question: How often do the prices of your most important products change in a typical year?

Frequency	Percentage of Firms
Less than once	10.2
Once	39.3
1.01 to 2	15.6
2.01 to 4	12.9
4.01 to 12	7.5
12.01 to 52	4.3
52.01 to 365	8.6
More than 365	1.6

Source: Table 4.1, Alan S. Blinder, "On Sticky Prices: Academic Theories Meet the Real World," in N. G. Mankiw, ed., *Monetary Policy* (Chicago: University of Chicago Press, 1994), 117–154.

Theories of Price Stickiness

- Coordination failure: 60.6% (percentage of managers who accept)
  - Firms hold back on price changes, waiting for others to go first
- Cost-based pricing with lags: 55.5%
  - Price increases are delayed until costs rise
- Delivery lags, service, etc.: 54.8%
  - Firms prefer to vary other product attributes, such as delivery lags, service, or product quality
- Implicit contracts: 50.4%
  - Firms tacitly agree to stabilize prices, perhaps out of "fairness" to customers
- Nominal contracts: 35.7%
  - Prices are fixed by explicit contracts

Source: A.S. Blinder, 1994, "On sticky prices: academic theories meet the real world", in N.G. Mankiw, ed., Monetary Policy, University of Chicago Press, 117-154.

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Overview of IS-LM

- IS stands for "investment" and "saving".

- LM stands for "liquidity" and "money".

- The IS-LM model consists two equations that describe the financial market (IS, or equivalently the market for goods and services) and the money market (LM).

- The IS-LM model is the leading interpretation of John Maynard Keynes's theory, which was developed in the depth of the Great Depression.

The IS Equation

- Assume that investment is a function of the interest rate,
$$I = I(r).$$

- We assume that $I(r)$ is differentiable and $I' < 0$. That is, higher interest rate increases the borrowing cost, hence lowers the level of investment in the economy.

- The IS equation is given by
$$Y = C(Y - T) + I(r) + G.$$

- As we have learned previously, the IS equation characterizes the financial market (or goods market) equilibrium and defines an implicit function of $Y(r)$ or $r(Y)$, the IS curve.

The IS Curve

- Since $I(r)$ is a decreasing function, a decline in r results in higher investment, which leads further to higher Y. Hence $r(Y)$ is downward sloping.
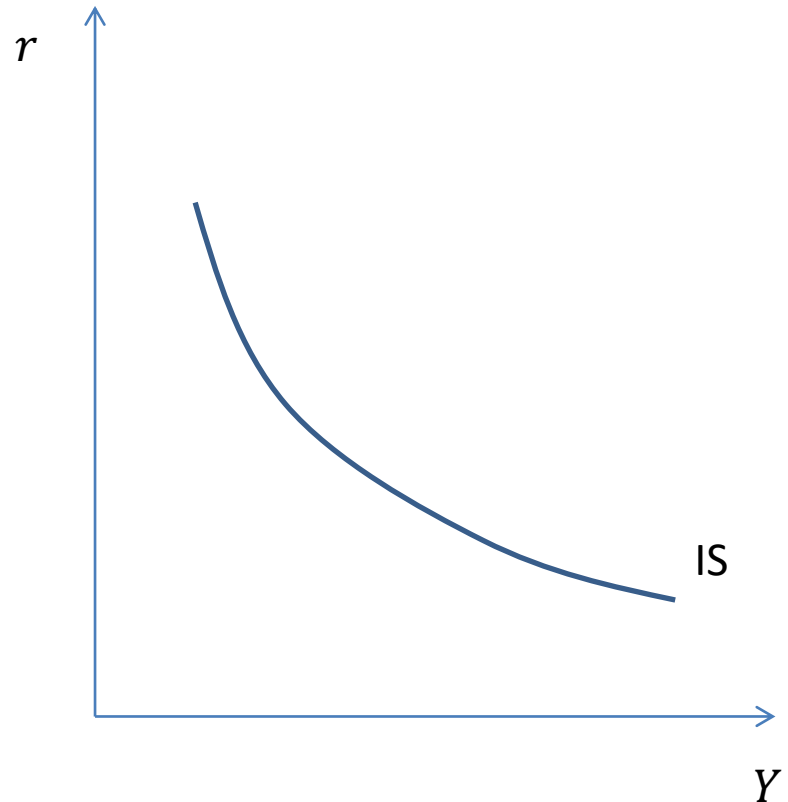
The IS Curve

- The IS equation defines an implicit function,
$$r = r(Y, T, G).$$

- The slope of the IS curve is nothing but $\partial r / \partial Y$, which is defined as
$$\frac{\partial r}{\partial Y} \equiv \lim_{\Delta Y \to 0} \frac{r(Y + \Delta Y, T, G) - r(Y, T, G)}{\Delta Y}.$$
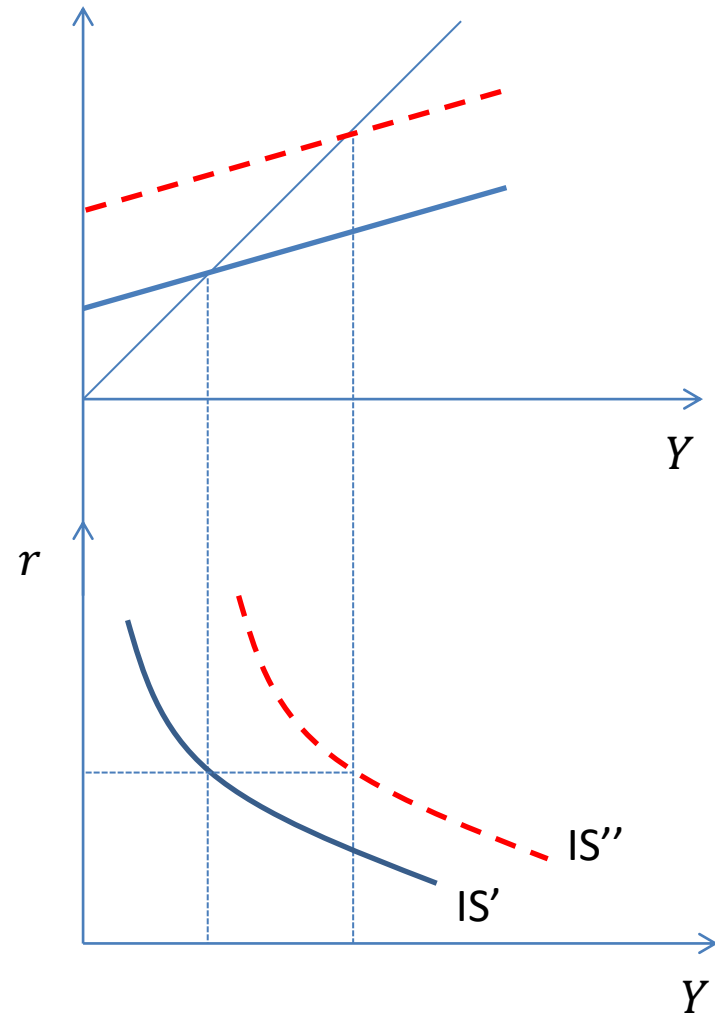 - That is, fixing T and G, how r changes with a unit change in Y.

- Apply the implicit function theorem,
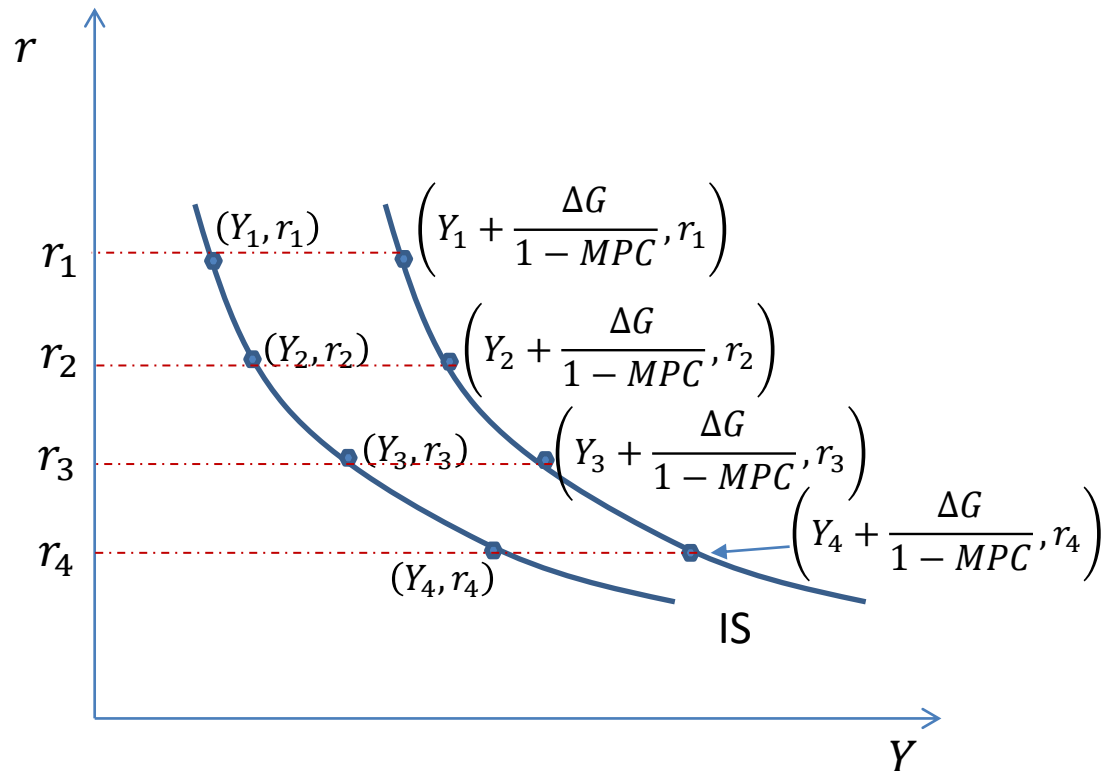$$\frac{\partial r}{\partial Y} = -\frac{1 - C'}{-I'} = \frac{1 - C'}{I'} < 0.$$

The Effect of Fiscal Policy

- Given an interest rate r, the Keynesian Cross analysis tells us that an increase in G brings $\frac{\Delta G}{1-MPC}$ in Y.
- This implies that a ΔG-increase in government purchase would shift the IS curve to the right by $\frac{\Delta G}{1-MPC}$.

The effect of an increase in government spending

The effect of an increase in government spending

- The IS equations also defines an implicit function $Y(r, T, G)$. To calculate the effect of a unit-increase in G on Y, keeping r fixed, is to calculate the partial derivative,

$$\frac{\partial Y(r, T, G)}{\partial G} \equiv \lim_{\Delta G \to 0} \frac{Y(r, T, G + \Delta G) - Y(r, T, G)}{\Delta G}.$$

- Apply the implicit function theorem,

$$\frac{\partial Y}{\partial G} = -\frac{-1}{1 - C'(Y - T)} = \frac{1}{1 - MPC}.$$

- That is, if the government expenditure increases by ΔG, then the IS curve would shift to the right by $\frac{\Delta G}{1 - MPC}$, approximately.

The LM Equation

- The LM equation characterizes the money market equilibrium (Liquidity demand = Money supply),

$$\frac{M}{P} = L(r, Y).$$

  - M is the money supply, which is assumed to be exogenously given. (Imagine that the monetary authority controls M.)
  - P is the price level, which is assumed to be fixed in the short term.
  - $L(r, Y)$ is decreasing in r and increasing in Y. $L_1 < 0, L_2 > 0$.
- Like the IS equation, the LM equation also defines an implicit function of $Y(r)$ or $r(Y)$, the LM curve.
- The LM equation theorizes Keynes' view of how interest rate is determined. It was called the theory of liquidity preference.

The LM Curve

- Given M and P, for the LM equation to hold, a decline in r must be accompanied by a decline in Y.

- Intuition: a decline in income reduces demand for money. Given the fixed money supply, the interest rate declines.

- Hence the LM curve is an upward-sloping curve.
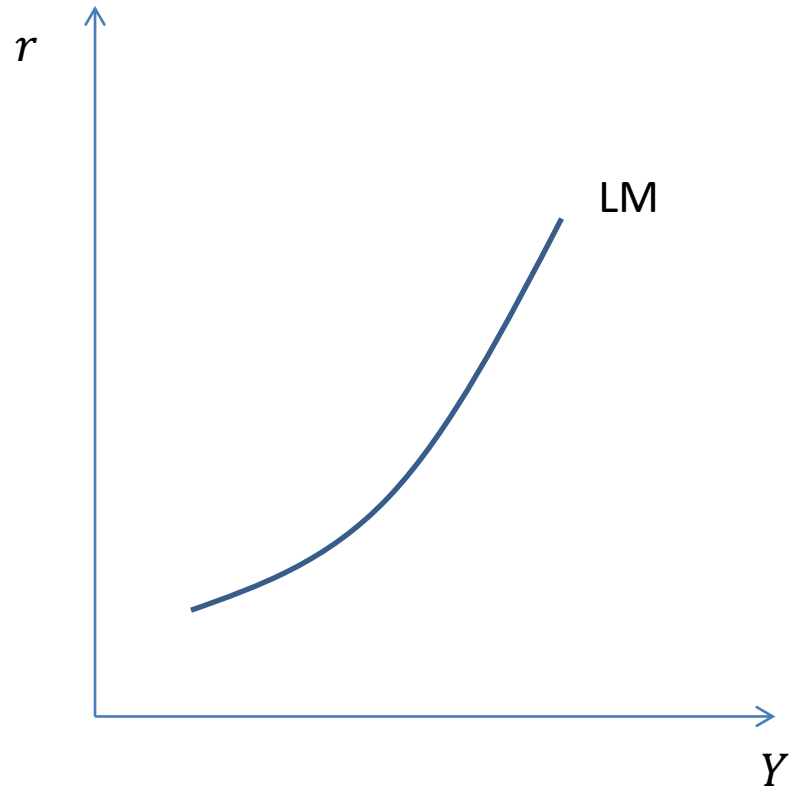
Moving Along The LM Curve

- Points on an LM curve are all consistent with equilibrium in the money market, given the money supply M and price level P.

- A change in Y or r would result in movement *along* the LM.

- Using the implicit function theorem, we obtain the slope of the LM curve,

$$\frac{\partial r}{\partial Y} = -\frac{L_2}{L_1} \equiv -\frac{\frac{\delta L(r,Y)}{\delta Y}}{\frac{\delta L(r,Y)}{\delta r}}.$$

  - If $L_1 = \infty$, the LM curve is horizontal (liquidity trap).
  - If $L_1 = 0$, the LM curve is vertical (quantity theory of money).

How Monetary Policy Shifts the LM Curve

- An exogenous change in M or P would shift the LM curve.

- In particular, if the monetary authority increases M, then the LM curve would shift rightward.
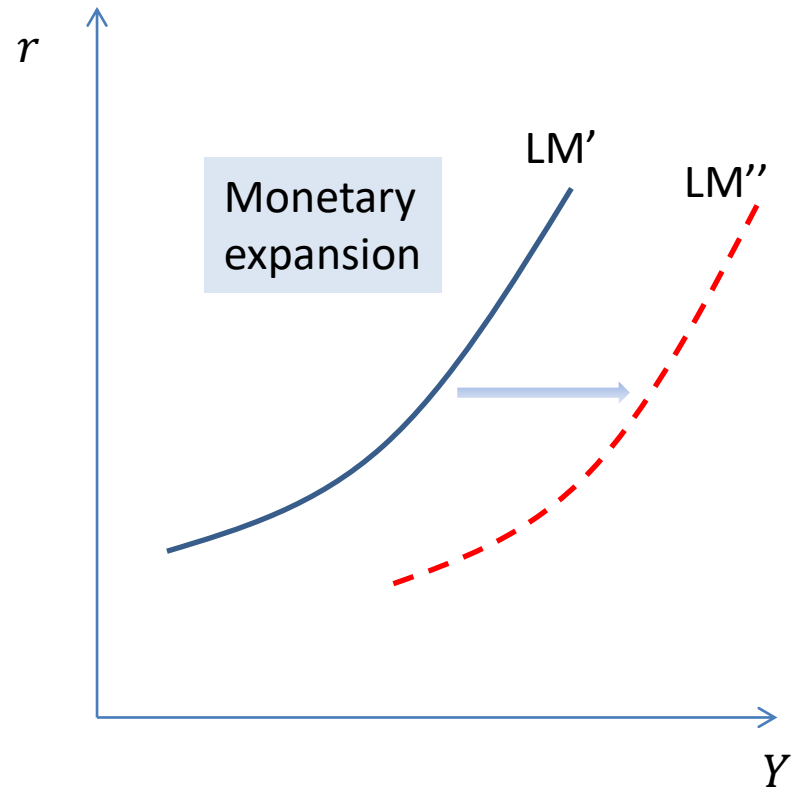
How Monetary Policy Shifts the LM Curve

- The LM equation defines an implicit function $Y(r, M, P)$. We apply the implicit function theorem and obtain

$$\frac{\partial Y(r, M, P)}{\partial M} \equiv \lim_{\Delta M \to 0} \frac{Y(r, M + \Delta M, P) - Y(r, M, P)}{\Delta M} = \frac{1}{PL_2}.$$

- That is, if the monetary authority increases the money supply by ΔM, then the LM curve would shift to the right by $\frac{\Delta M}{PL_2}$, approximately.

The IS-LM Model

- The IS-LM model is composed of two equations characterizing goods and money markets, respectively,

$$Y = C(Y - T) + I(r) + G$$

$$\frac{M}{P} = L(r, Y).$$

- The equilibrium of the economy is the solution to the above two equations, i.e., the point at which the IS curve and the LM curve cross.

The IS-LM Curves

Interest rate, r

Equilibrium interest rate

r'

Equilibrium output

LM

IS

Y' $\bar{Y}$

Output, Y

Intermediate Macroeconomics
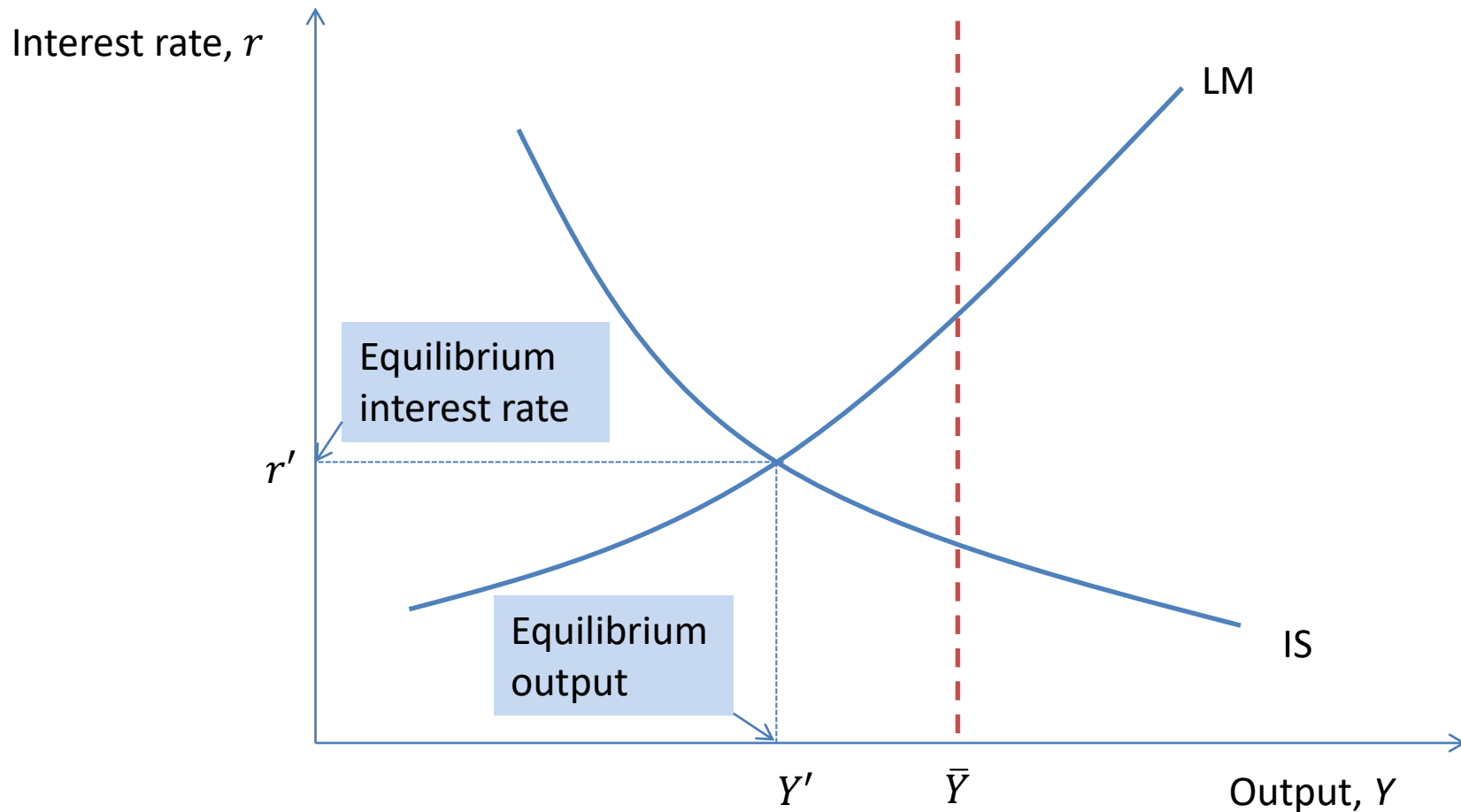
The IS-Shock Recession

- As in the Keynesian Cross model, there is no reason to believe that the equilibrium output in the IS-LM stays at the level of output potential.

The IS-Shock Recession

Case Study: the Great Depression

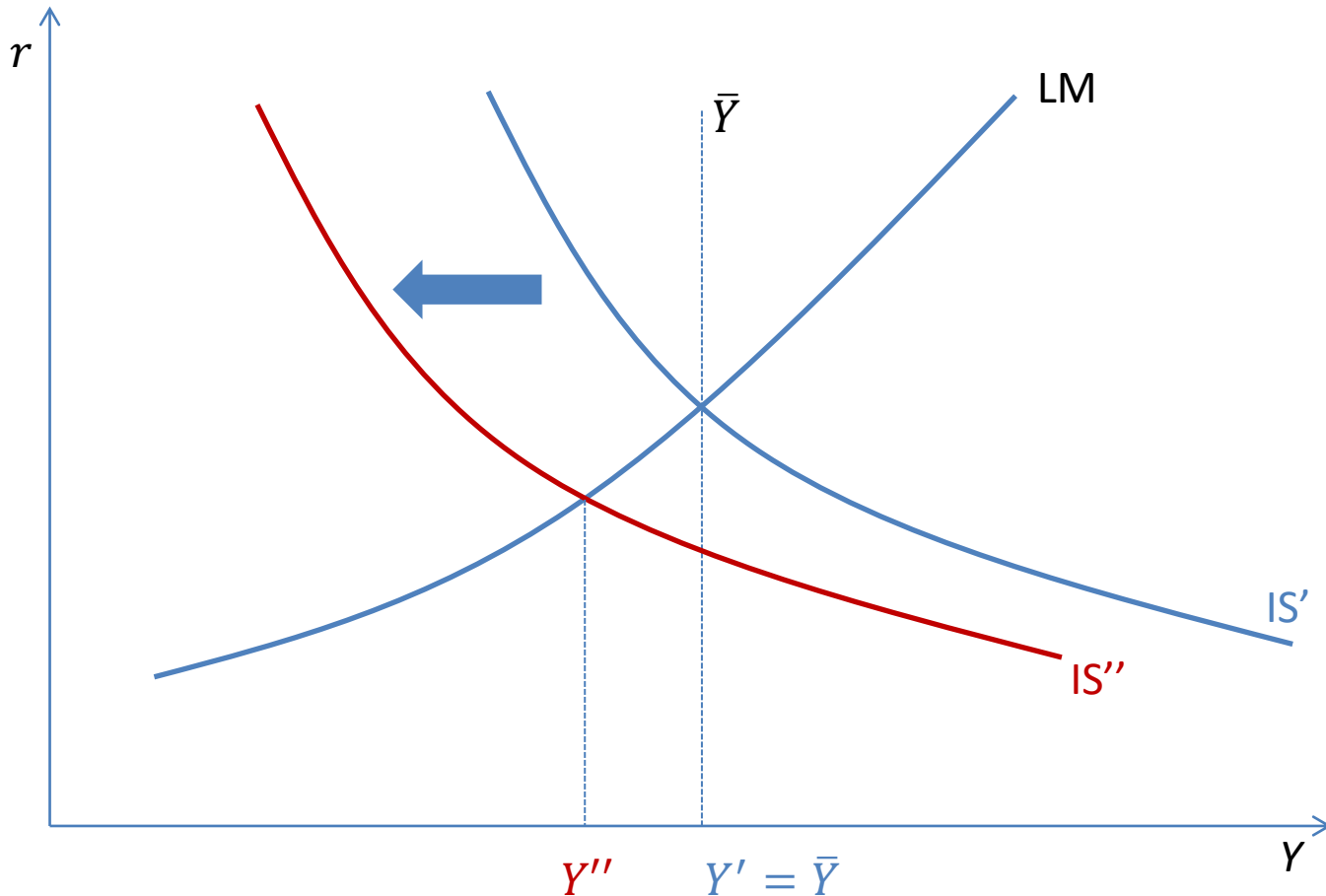| Year	Unemployment Rate (1)	Real GNP (2)	Consumption (2)	Investment (2)	Government Purchases (2)
1929	3.2	203.6	139.6	40.4	22.0
1930	8.9	183.5	130.4	27.4	24.3
1931	16.3	169.5	126.1	16.8	25.4
1932	24.1	144.2	114.8	4.7	24.2
1933	25.2	141.5	112.8	5.3	23.3
1934	22.0	154.3	118.1	9.4	26.6
1935	20.3	169.5	125.5	18.0	27.0
1936	17.0	193.2	138.4	24.0	31.8
1937	14.3	203.2	143.1	29.9	30.8
1938	19.1	192.9	140.2	17.0	33.9
1939	17.2	209.4	148.2	24.7	35.2
1940	14.6	227.2	155.7	33.0	36.4

Year	Nominal Interest Rate (3)	Money Supply (4)	Price Level (5)	Inflation (6)	Real Money Balances (7)
1929	5.9	26.6	50.6	–	52.6
1930	3.6	25.8	49.3	−2.6	52.3
1931	2.6	24.1	44.8	−10.1	54.5
1932	2.7	21.1	40.2	−9.3	52.5
1933	1.7	19.9	39.3	−2.2	50.7
1934	1.0	21.9	42.2	7.4	51.8
1935	0.8	25.9	42.6	0.9	60.8
1936	0.8	29.6	42.7	0.2	62.9
1937	0.9	30.9	44.5	4.2	69.5
1938	0.8	30.5	43.9	−1.3	69.5
1939	0.6	34.2	43.2	−1.6	79.1
1940	0.6	39.7	43.9	1.6	90.3

The Spending Hypothesis: Shocks to the IS Curve

- An exogenous fall in spending on goods and services, which shifts the IS curve to the left.
  - The stock market crash of 1929
  - The end of residential investment boom
- Once the Depression started, more negative shocks came:
  - Bank failures in the early 1930s
  - Fiscal tightening to rein in budget deficit.

The Monetary Hypothesis: Shocks to the LM Curve

- Along this vein of argument, the contraction of money supply was blamed for the Depression.

- However, there are two problems with the argument:

  - The real money balance actually increased from 1929 to 1931.

  - The nominal interest rate declined continuously from 1929 to 1933. However, the real interest rate increased in the same period.

The Monetary Hypothesis: The Effects of Deflation

- Deflation is defined as a fall in the general price level.
- Deflation was thought to be good for the economy:
  - A fall in price expands the real money supply.
  - The Pigou effect: a fall in price brings about an increase in the purchasing power of the money balance held by households. The households feel wealthier and spend more, shifting the IS to the right.
- However, deflation seems more effective in depressing income:
  - The debt-deflation theory
  - The role of expected deflation

The Debt-Deflation Theory

- Assume that debtors (those who borrow money) have higher propensity to consume than creditors do.

- Deflation increases debt burden, shifting purchasing power from debtors to creditors.

- Under our assumption, the reduction of spending by the debtors is more than the increase of spending by the creditors. The net effect is a reduction of spending, shifting the IS curve to the left.

The Role of Expectation

- Consider the following modified IS-LM equations:

$$Y = C(Y - T) + I(i - E\pi) + G$$

$$\frac{M}{P} = L(i, Y).$$

- If investors expect deflation, that is, $E\pi < 0$, then the IS curve immediately shifts to the left.

Policy Responses to Recessions

- Policy makers may use fiscal, monetary, and both, to increase aggregate demand.

- Fiscal stimulus
  - Increase in government purchasing
  - Tax reduction

- Monetary stimulus

- Combination of fiscal and monetary policies

Policy Analysis

- Holding P fixed, we take total differentiation of the IS-LM equations and obtain

$$(1 - C')dY - I'dr = dG - C'dT$$
$$PL_2 dY + PL_1 dr = dM$$

- Using the Cramer's, we can obtain:
  - The effect of increasing government purchases on income and interest rate: $\frac{dY}{dG}$ and $\frac{dr}{dG}$
  - The effect of tax reduction on income and interest rate: $\frac{dY}{dT}$ and $\frac{dr}{dT}$
  - The effect of expansionary monetary policy on income and interest rate: $\frac{dY}{dM}$ and $\frac{dr}{dM}$.

The Effect of Fiscal Policies

- Holding M fixed (that is, $dM = 0$). Using the Cramer's Rule, we obtain

$$dY = \frac{L_1(dG - C'dT)}{L_1(1 - C') + I'L_2}.$$

$$dr = -\frac{L_2(dG - C'dT)}{L_1(1 - C') + I'L_2}.$$

- The effect of fiscal policies can be summarized as follows,

  - The effect of government purchase on output: $\frac{dY}{dG} = \frac{L_1}{L_1(1-C')+I'L_2} > 0$

  - The effect of government purchase on interest rate: $\frac{dr}{dG} = -\frac{L_2}{L_1(1-C')+I'L_2} > 0$

  - The effect of tax on output: $\frac{dY}{dT} = -\frac{L_1C'}{L_1(1-C')+I'L_2} < 0$

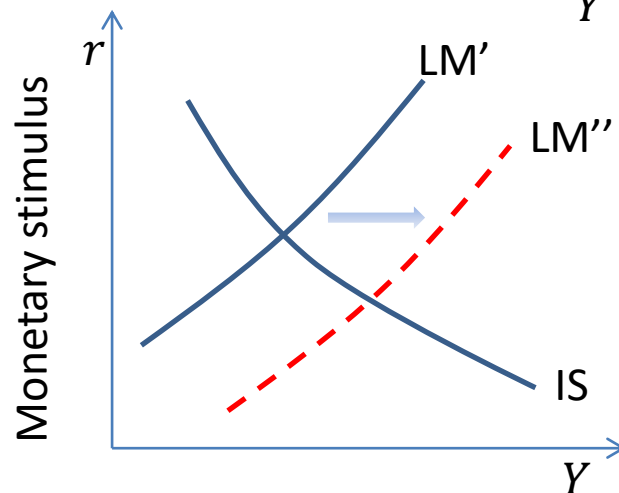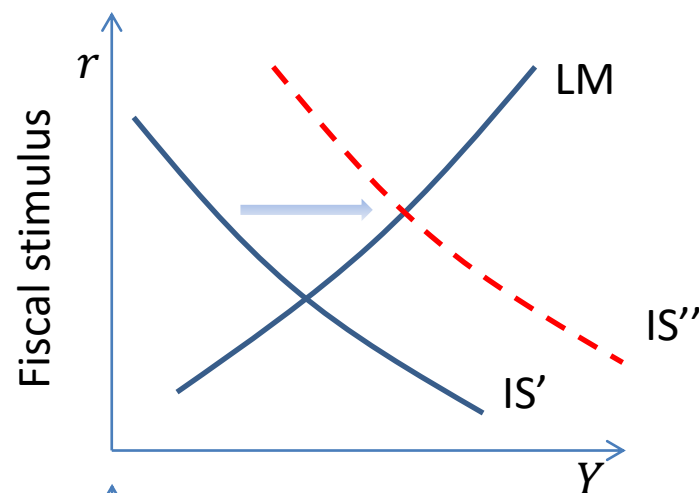 - The effect of tax on interest rate: $\frac{dr}{dT} = \frac{L_2C'}{L_1(1-C')+I'L_2} < 0$

The Effect of Monetary Policies

- Similarly, holding G and T fixed, we obtain

$$\frac{dY}{dM} = \frac{I'}{P(L_1(1 - C') + I'L_2)} > 0$$

$$\frac{dr}{dM} = \frac{(1 - C')}{P(L_1(1 - C') + I'L_2)} < 0$$

- Expansionary monetary policy (e.g., QE) would result in lower interest rate and higher output (income).

The Effect of Expansionary Fiscal and Monetary Policies

Intermediate Macroeconomics

# When Monetary Policy Becomes Ineffective: Liquidity Trap

- Liquidity trap refers to the situation that increase in money supply fails to lower interest rate.
  - When nominal interest rate reaches zero.
  - When $L_1 \equiv \frac{\delta L(r,Y)}{\delta r} = \infty$ (The LM curve is horizontal)

- In a liquidity trap, monetary policy is ineffective $\left(\frac{dY}{dM} = 0\right)$. This was the position Keynesians took during the Great Depression, the Japanese "Lost Decade", and to a lesser degree, the recent global financial crisis.

- In contrast, fiscal policy is effective and exhibits the multiplier effects in the Keynesian Cross model:

$$\frac{dY}{dG} = \frac{1}{1-C'} \quad \text{and} \quad \frac{dY}{dT} = -\frac{C'}{1-C'}.$$

When Fiscal Policy Becomes Ineffective

- When $L_1 \equiv \frac{\delta L(r,Y)}{\delta r} = 0$ (classical quantity theory of money), the LM curve is vertical, fiscal policies become ineffective.

- Only monetary policy matters in this case. This was the position that the Monetarists took (e.g., Milton Friedman) during the "stagflation" in the 1970s.

Where Do Economists Stand

Quantity theory of money

IS'

Normal case

LM

Liquidity trap

IS

IS''

r

Y

Intermediate Macroeconomics
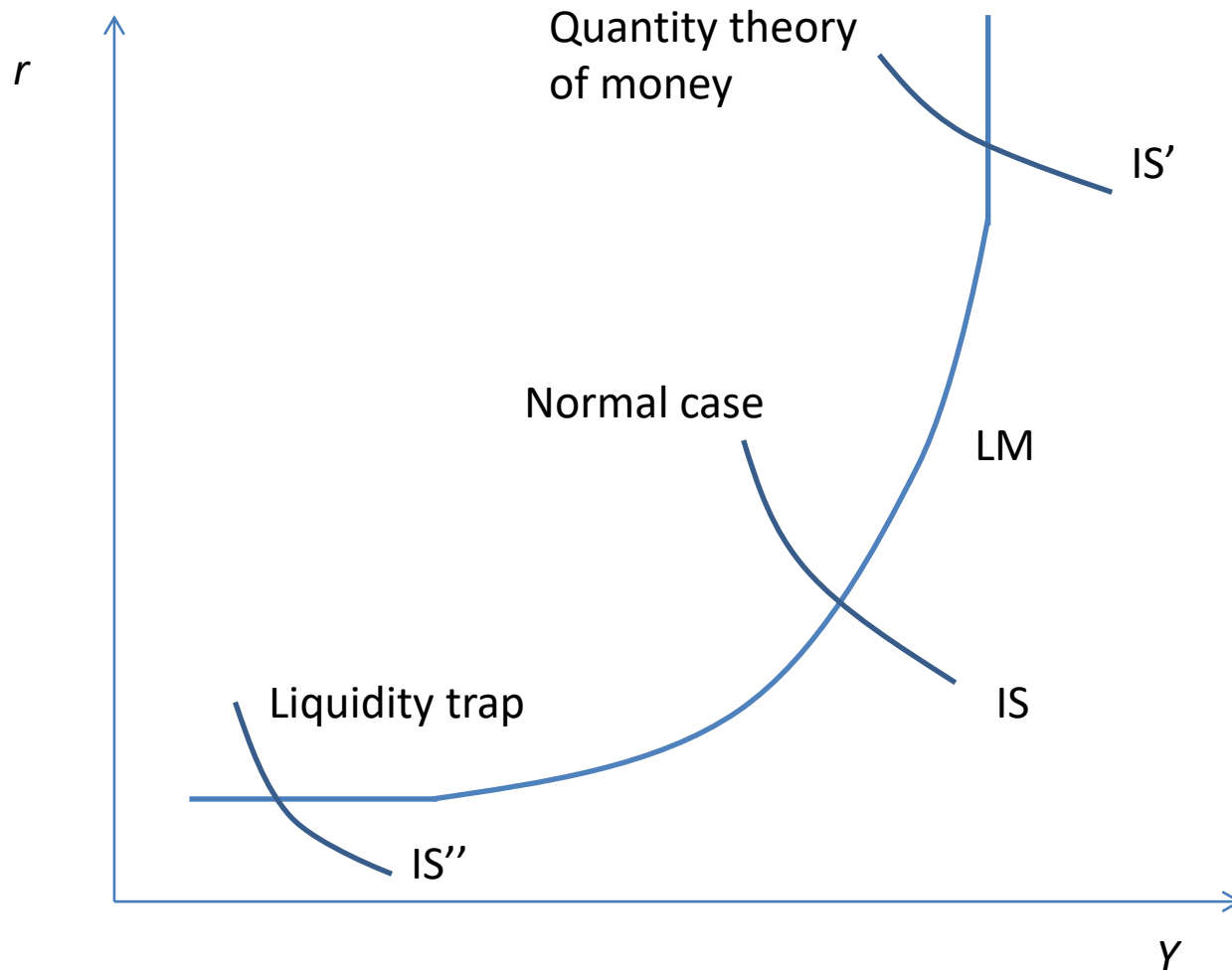
The Role of Interest Rate

- Interest rate plays a central role in the IS-LM analysis of the economy.
- In the normal case,
  - Expansionary monetary policy lowers interest rate, which encourages investment.
  - Fiscal stimulus drives up interest rate. This discourages investment and partly offsets the direct increase in output (income).
- In a liquidity trap,
  - Expansionary monetary policy fails to lower interest rate. Hence no effect on output.
- In the classical world,
  - Fiscal stimulus only drives up interest rate and completely "crowds out" investment.

The Interest-Rate Channel of Monetary Policy Transmission

- The IS–LM model characterizes an *interest−rate channel* of monetary policy transmission:

$$M \uparrow \implies i \downarrow \implies r \downarrow \implies I(r) \uparrow \implies Y \uparrow.$$

  – The direct effect of monetary stimulus (e.g., a massive liquidity injection) is to lower the nominal interest rate i.

  – Under the sticky−price assumption, a lower nominal interest rate translates into a lower real interest rate, which businesses and households really care.

Interest Rate Policy

- Central banks in the real world have a dominant influence on short-term interest rates without targeting any level of money supply.

- The monetary authority manipulate one or more *monetary instruments* to steer short-term money-market interest rate (intermediate target variable) toward a desired level.
    - The federal funds rate in the US
    - The overnight market rates in the Euro zone

Modeling Interest Rate Policy

- We may modify the IS-LM as follows,
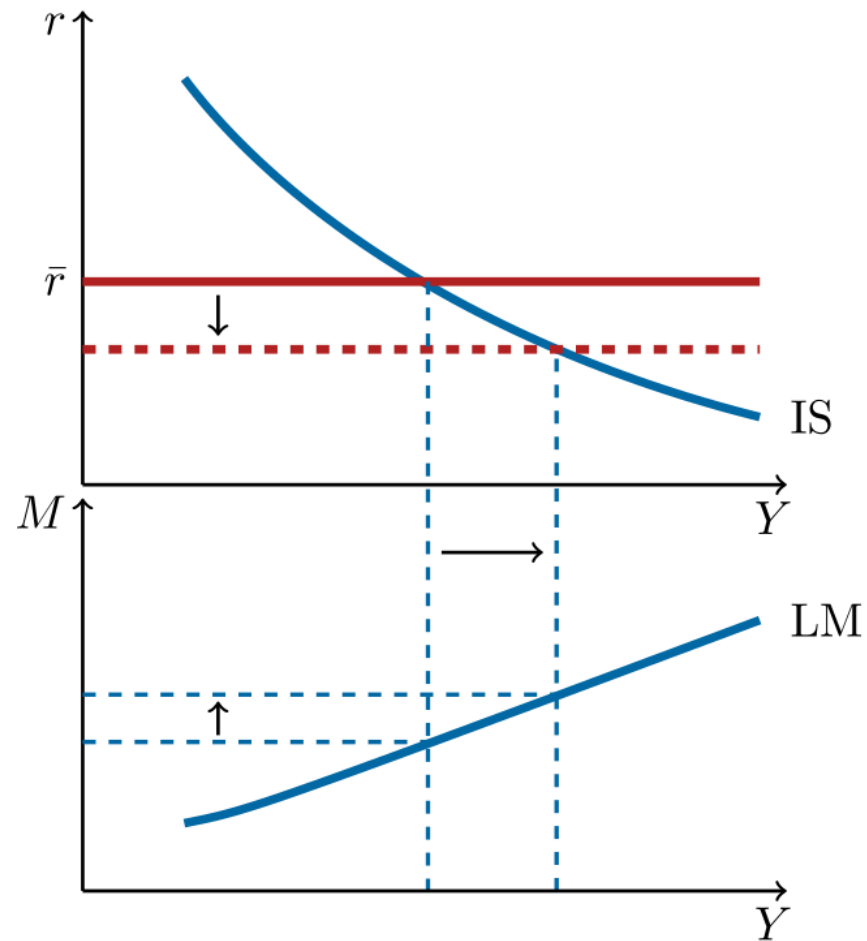$$Y = C(Y - T) + I(r) + G$$
$$r = \bar{r}$$
$$\frac{M}{P} = L(r, Y) \, ,$$

 where $\bar{r}$ is the policy rate.

- Which of the above variables are endogenous, and which are exogenous?

A Rate Cut

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    - III. Small open economy with fixed exchange rate
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Overview

- We now consider open economies that trade with each other.

- We shall study the effects of various shocks to exchange rate, money supply, interest rate, and output.

- We assume that prices are sticky. Hence changes in real exchange rate is the same as nominal exchange rate.

Key Assumptions

- The open economy, which allows trade and international finance.

- Perfect capital mobility, which implies <u>a common interest rate</u> for the world.

- Small economy, whose saving and investment <u>does not</u> affect the world interest rate.

- Large economy, whose saving and investment <u>does</u> affect the world interest rate.

Fixed Exchange Rate

- In a typical fixed exchange rate regime (e.g., China from 1995 to 2005), the monetary authority stands ready to buy or sell the domestic currency at pre-determined price (exchange rate). There are several other forms of exchange rate pegging:
  - Gold or silver standard (e.g., Bretton Woods)
  - Monetary union (e.g., Euro area)
  - "Dollarization" and currency boards (e.g., Hong Kong, Argentina in 1990s)
- Advantages of fixed exchange rate
  - Exchange rate stability
  - The "import" of responsible monetary policy from the advanced countries.
- Disadvantages of fixed exchange rate
  - Non-independence of monetary policy
  - To defend fixed rate against speculative attacks, the country has to accumulate a substantial amount of foreign exchange reserve.
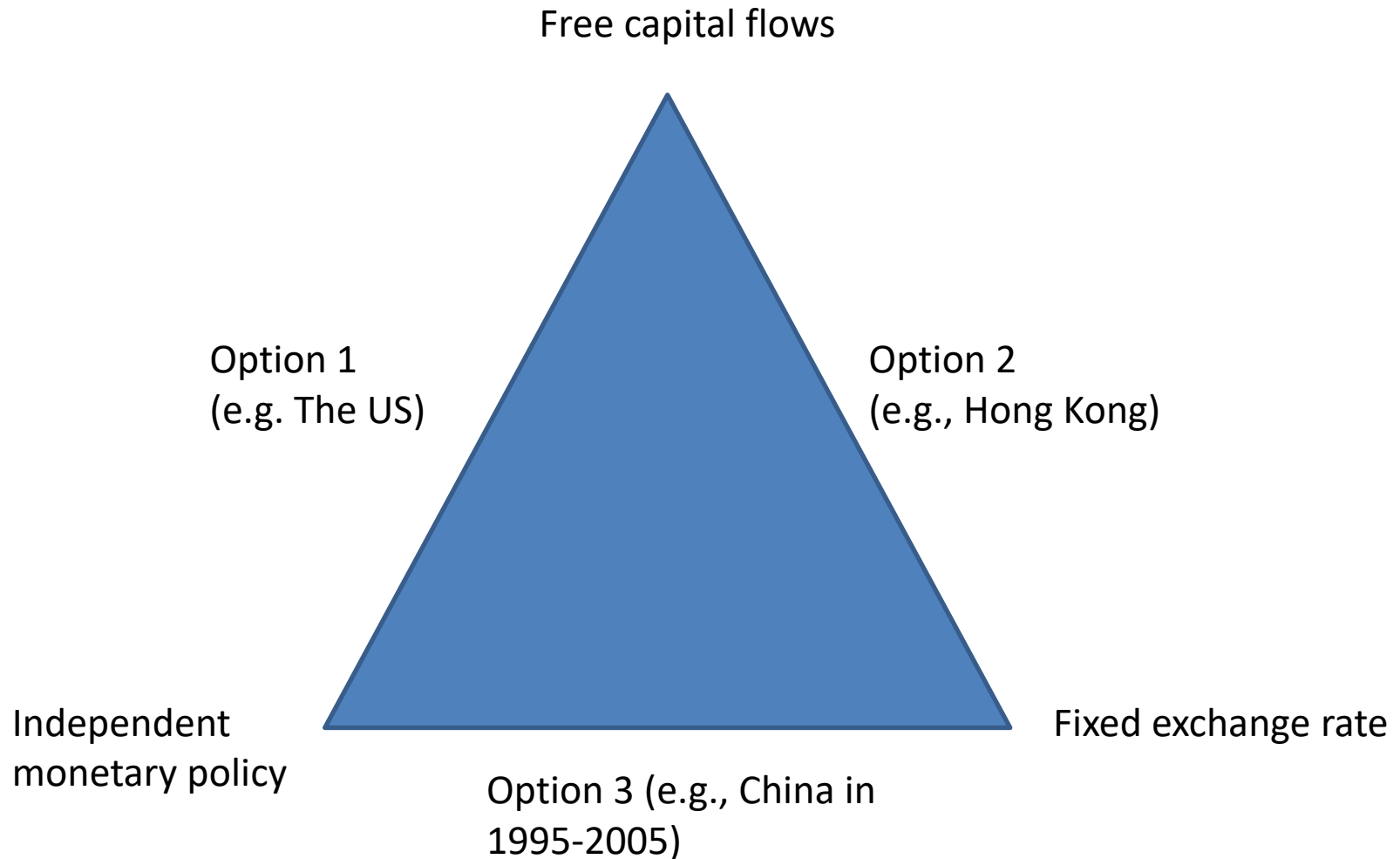
China's Foreign Reserve

Share of GDP (left,%) — Reserve (right, USD 100million)

Intermediate Macroeconomics
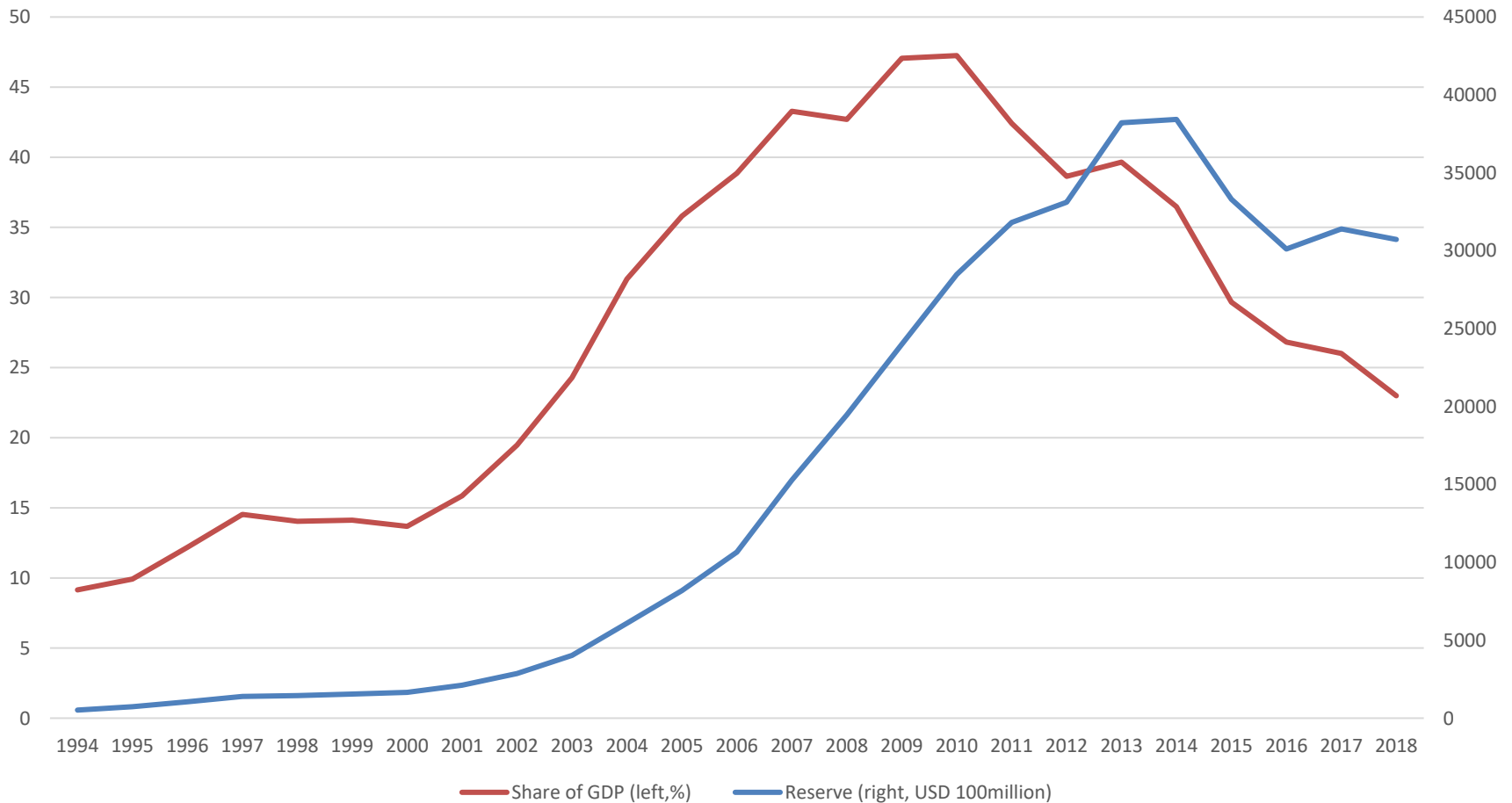
Floating Exchange Rate

- In a floating exchange rate regime, the exchange rate is allowed to fluctuate according to the foreign exchange market.

- The monetary authority may or may not intervene the foreign exchange market.

- Advantages of floating exchange rate
  - Independent monetary policy (The monetary authority may pursue objectives other than the defending of a fixed exchange rate.)

- Disadvantages of floating exchange rate
  - Volatile exchange rate

The Impossible Trinity

Free capital flows

Option 1
(e.g. The US)

Option 2
(e.g., Hong Kong)

Independent
monetary policy

Fixed exchange rate

Option 3 (e.g., China in
1995-2005)

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Small Open Economy with Floating Exchange Rate

- The Mundell-Fleming model is a close relative to IS-LM, consisting of two equations characterizing goods and money markets, respectively,
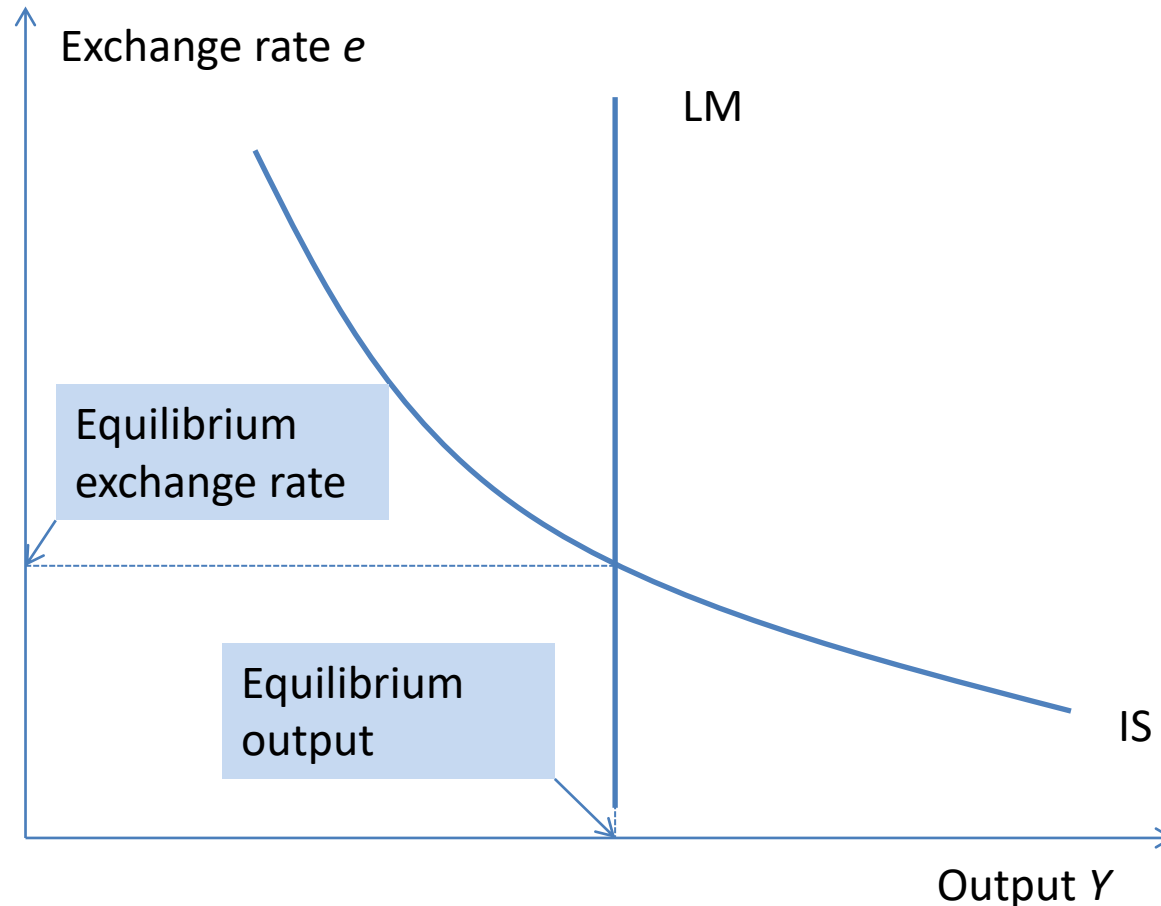
$$Y = C(Y - T) + I(r^*) + G + X(e)$$

$$\frac{M}{P} = L(r^*, Y),$$

where r^* is the world interest rate and $X(e)$ is the net export, which is a decreasing function of exchange rate e.

- The two endogenous variables are: Y and e. We can draw IS-LM curves about these two variables.

IS-LM Curves of The Small Open Economy with Floating Exchange Rate

Exercises (i)

- What are the effects of the following events?
  - Fiscal stimulus (raising G or lower T)
  - Monetary stimulus
  - A rise in the country's risk premium (due, for example, to political instability)

A Summary of Exercises (i)

- The exchange rate e plays a similar role in the standard IS-LM model.

- Fiscal stimulus leads to appreciation of the domestic currency, which "crowds out" the net export. Output does not change.

- Monetary stimulus leads to depreciation of the domestic currency, which leads further to increase in net export.

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Small Open Economy with Fixed Exchange Rate

- Under the fixed exchange regime, the monetary authority stands ready to buy or sell the domestic currency at pre-determined price (exchange rate).

- When the monetary authority buys the domestic currency with a foreign currency, the monetary authority <u>tightens</u> the money supply.

- When the monetary authority sells the domestic currency for a foreign currency, the monetary authority <u>expands</u> the money supply.

- If the exchange rate is fixed, the money supply is <u>endogenous</u>.

The Role of Foreign Exchange Reserve

- To conduct the intervention, the monetary authority needs a solid foreign currency reserve for the defense of the fixed exchange rate.

- Under the fixed exchange rate regime,

net capital outflow = net private capital outflow + increase in foreign reserve.

- The increase in foreign reserve corresponds to increase in domestic money supply.

The IS-LM Model of The Small Open Economy with Fixed Exchange Rate
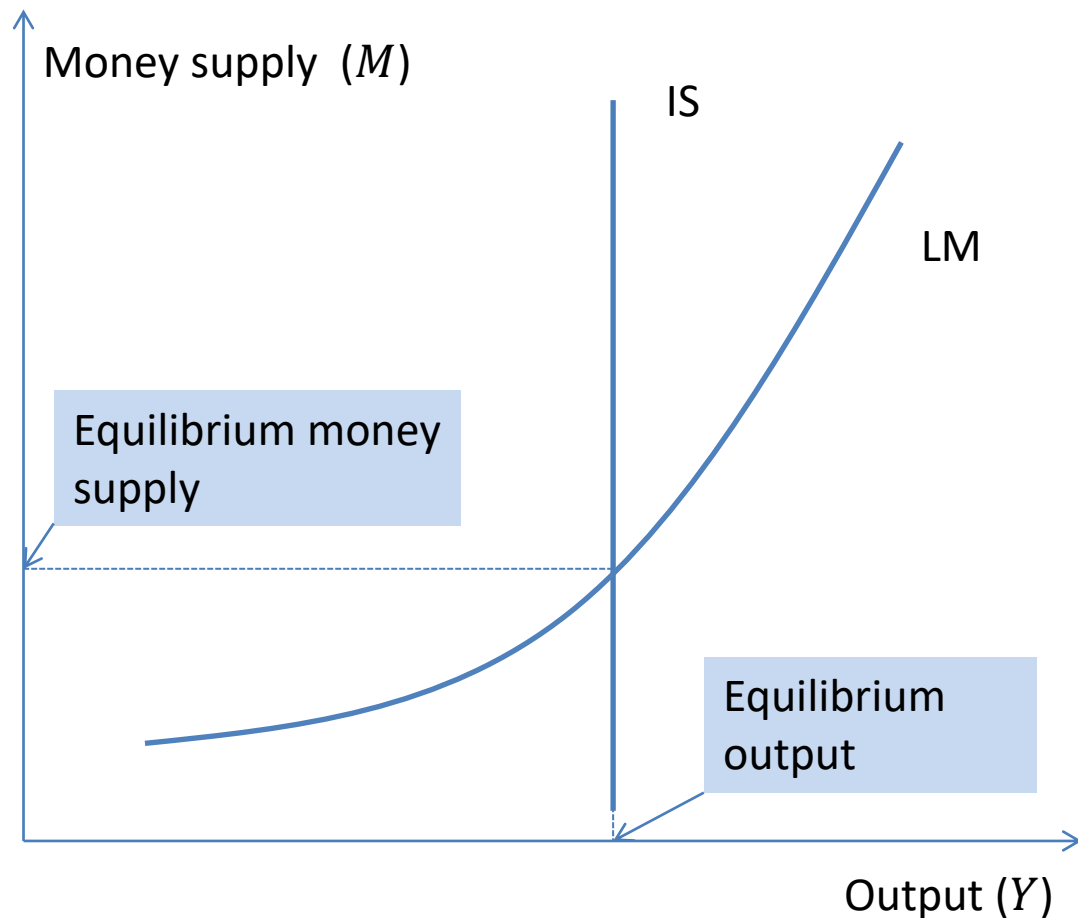
- Under the fixed exchange rate regime,
$$Y = C(Y - T) + I(r^*) + G + X(e^*)$$
$$\frac{M}{P} = L(r^*, Y),$$

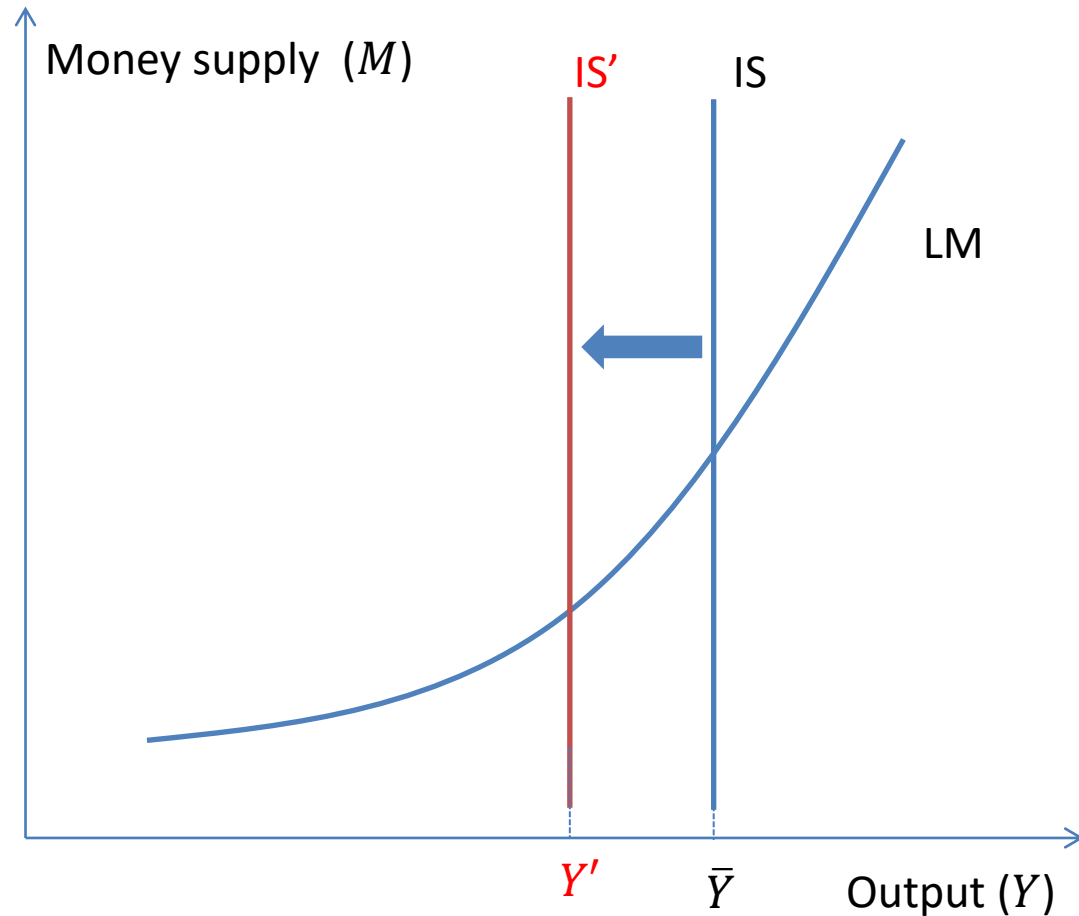where r^* is the world interest rate and e^* is the fixed exchange rate.

- The two endogenous variables: Y and M.

IS-LM Curves of The Small Open Economy with Fixed Exchange Rate

Intermediate Macroeconomics

Foreign-Demand-Shock Recession

China's Slowdown in 2008-2009

- China's GDP in 2007 was about 26% of the US GDP.

- The "crawling peg" of RMB to USD: although the RMB exchange rate was no longer pegged to USD, it was still rigid and was allowed to appreciate very slowly.

- As the financial crisis hit the US, the US demand for Chinese goods took a nosedive, resulting in China's slowdown.

Intermediate Macroeconomics

China's Slowdown in 2008-2009

Quarter	RGDP (Y2Y growth,%)	Export to the US (Y2Y growth,%)
2008Q1	11.5	5.4
2008Q2	10.9	12.0
2008Q3	9.5	15.3
2008Q4	7.1	0.7
2009Q1	6.4	-14.8
2009Q2	8.2	-18.5
2009Q3	10.6	-16.7
2009Q4	11.9	0.6

Intermediate Macroeconomics

The Effect of Fiscal Stimulus

- The fiscal stimulus shifts the IS curve to the right, raising both output and money supply.
  - The fiscal stimulus exerts appreciation pressure on the domestic currency. To defend the fixed exchange rate, the monetary authority sells the domestic currency, resulting in the expansion of the money supply.
- China's massive "Four-Trillion Stimulus" at the end of 2008 quickly puts a stop on the slowdown.

The Effect of Global Monetary Tightening

- Suppose that the world real interest rate rises, due to policy changes in the US Fed.
- This would shift the IS curve to the left and the LM curve to the right, resulting in lower output and money supply.
  - To understand why the money supply has to be tightened, note that the rise in the world interest rate puts depreciation pressure on the domestic.
  - Defending the fixed exchange rate, the monetary authority has to buy the domestic currency, which is to withdraw money from the economy.

The Asian Financial Crisis

	Fed Funds Rate (%)	Dollar Index	Exchange Rates (per Dollar)		
			Baht	Won	Rupiah
1993	3.02	89.9	25.3	805.8	2110
1994	4.20	88.4	25.2	806.9	2200
1995	5.84	83.4	24.9	772.7	2308
1996	5.30	87.2	25.4	805.0	2383
1997	5.46	93.9	31.1	953.2	4650
1998	5.35	98.5	41.3	1400.4	8025
1999	4.97	97.0	37.9	1189.8	7085
2000	6.24	101.8	40.2	1130.9	9595

Intermediate Macroeconomics

The Asian Financial Crisis

|	RGDP Growth (local currency)			GDP Growth (in Dollar)		
	Thailand	S. Korea	Indonesia	Thailand	S. Korea	Indonesia
1994	8	9.2	7.5	13.8	13.3	17.9
1995	8.1	9.6	8.2	15.4	14.0	22.1
1996	5.7	7.6	7.8	8.1	12.8	7.5
1997	-2.8	5.9	4.7	-18.0	-5.3	-6.8
1998	-7.6	-5.5	-13.1	-24.3	-57.0	-32.9
1999	4.6	11.3	0.8	11.4	43.6	29.7
2000	4.5	8.9	4.9	-0.2	19.1	15.7

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A Model of Large Open Economy with Flexible Exchange Rate

- The capital outflow of a large open economy would have an impact on the world interest rate.
- Consider the following model,
  - $Y - C(Y - T) - G = I(r) + F(r)$, -- market for loanable funds (or equivalently, market for goods and services)
  - $\frac{M}{P} = L(r, Y)$, -- money market
  - $F(r) = X(e)$, -- foreign exchange market,
    a) Demand for foreign currency equals the supply
    b) We assume $X' < 0, F' < 0$.
- What are the endogenous variables in this model?

The IS-LM Curves of the Large Open Economy
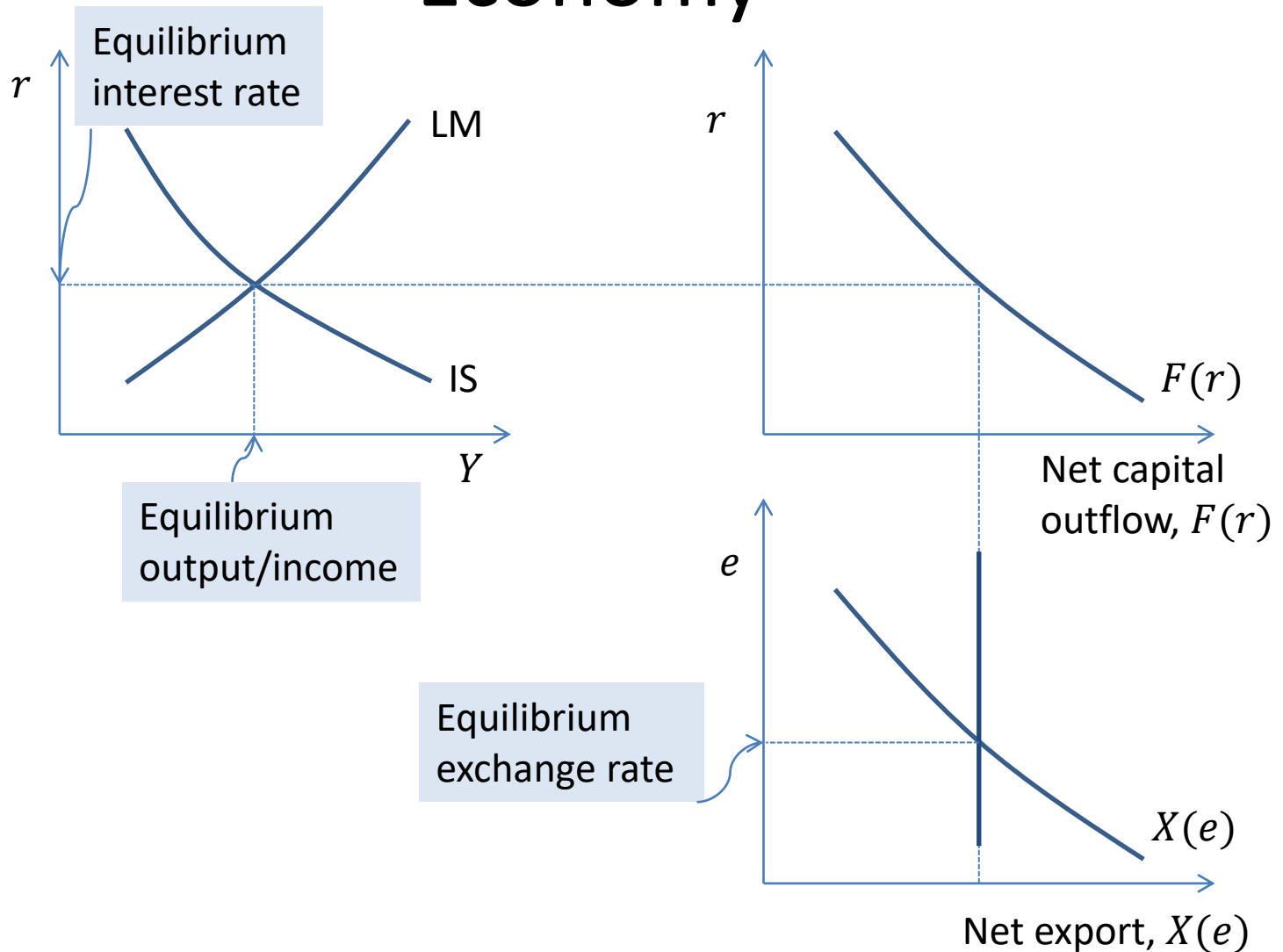
Exercises (iii)

- What would be the effects of the following changes?
  - Fiscal stimulus
  - Monetary stimulus
  - A protectionist policy shock (e.g., an import tax)

Summary of Exercises (iii)

- Fiscal stimulus leads to higher output, higher interest rate, appreciation of the domestic currency, and lower net export.

- Monetary stimulus leads to lower interest rate, depreciation of the domestic currency, higher output, and higher net export.

- A protectionist policy shock would lead to appreciation of the domestic currency.

Summary of Policy Effects

	Policy	Floating				Fixed			
		Y	r	e	NX	Y	r	e	NX
closed	fiscal expansion	+	+	N/A	N/A	+	+	N/A	N/A
	monetary expansion	+	-	N/A	N/A	+	-	N/A	N/A
small open	fiscal expansion	0	0	+	-	+	0	0	0
	monetary expansion	+	0	-	+	N/A	N/A	N/A	N/A
large open	fiscal expansion	+	+	+	-				
	monetary expansion	+	-	-	+				

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Endogenizing the Price

- To analyze inflation, we must allow price to change, possibly slowly in response to external shocks.

- Hence price should be treated as endogenous.

- We may reinterpret the IS-LM model as a special Keynesian AD-AS model:

$$Y = C(Y - T) + I(r) + G$$

Demand side

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

Supply side

$$P = \bar{P}$$

The Aggregate Demand

- The IS and LM equations define an implicit function $Y(P, T, G, M)$, which characterizing the aggregate demand.

- To obtain $Y(P, T, G, M)$, we can simply "eliminate" r from the IS-LM equations.

  – It would be easier if we take total differential and eliminate dr.

The Slope of the AD Curve

- Take T, G, and M as given, we examine how a change in price level P affects the total expenditure in the IS-LM model.

- Taking total differentiation of IS-LM and eliminate dr, we obtain

$$\frac{dY}{dP} = -\frac{L(r,Y)I'}{P(L_1(1 - C') + I'L_2)} < 0,$$

since $I' < 0, L_1 < 0, I' < 0, 0 < C' < 1.$

The Graphical Derivation

- A decline in price increases the real balance of money supply, shifting the LM curve <u>to the right</u>. Hence lower equilibrium interest rate and higher income/output.

- So the aggregate demand curve is downward-sloping.
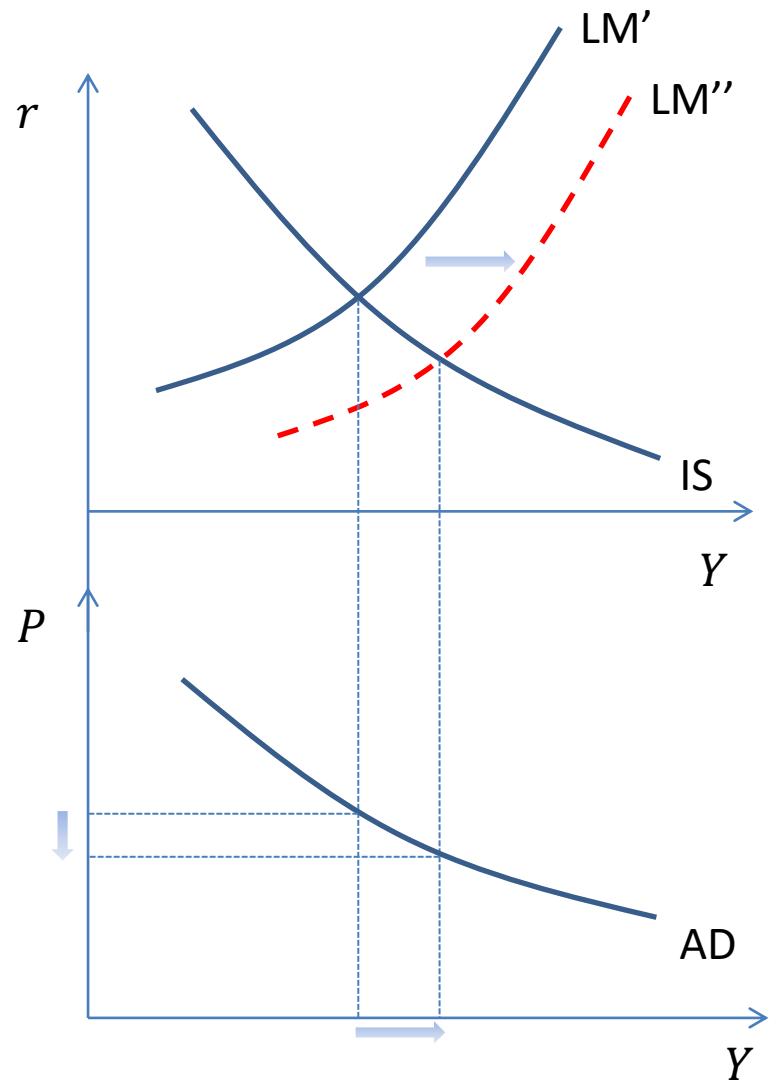
# The Effect of Expansionary Fiscal and Monetary Policies

- To see how policies shift the AD curve, we fix P and examine the effects of the changes in exogenous variables (G, T, M) on Y.

- We know that in the IS-LM model,

$$\frac{\partial Y}{\partial G} > 0, \frac{\partial Y}{\partial T} < 0, \text{ and } \frac{\partial Y}{\partial M} > 0.$$

- Increased government expenditure, a tax cut, and monetary expansion would all shift the AD curve to the right.

  - At every price level P, the aggregate demand Y increases.

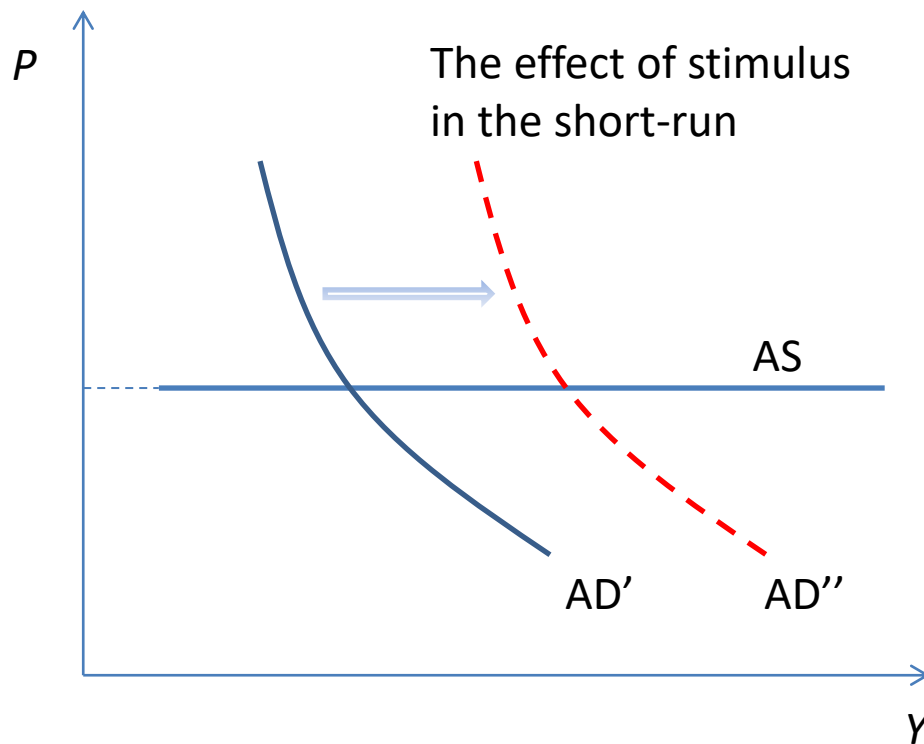# The Effect of Expansionary Fiscal and Monetary Policies

Intermediate Macroeconomics
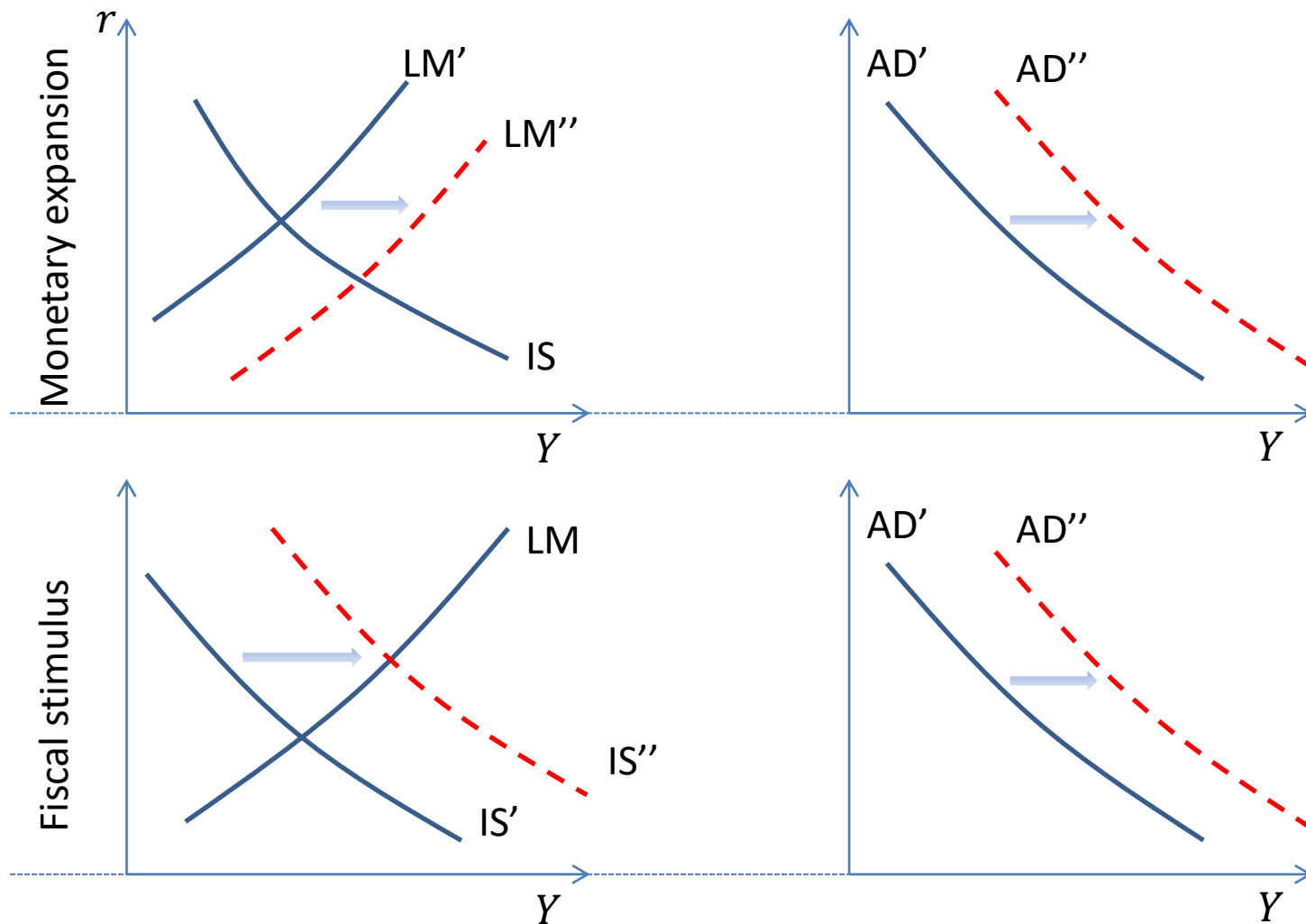
The Short-Run Supply Curve

- In the short run, price is sticky, implying a horizontal supply curve.

P

$\bar{P}$

Y

The Keynesian Analysis

P

The effect of stimulus in the short-run

AS

AD'   AD''
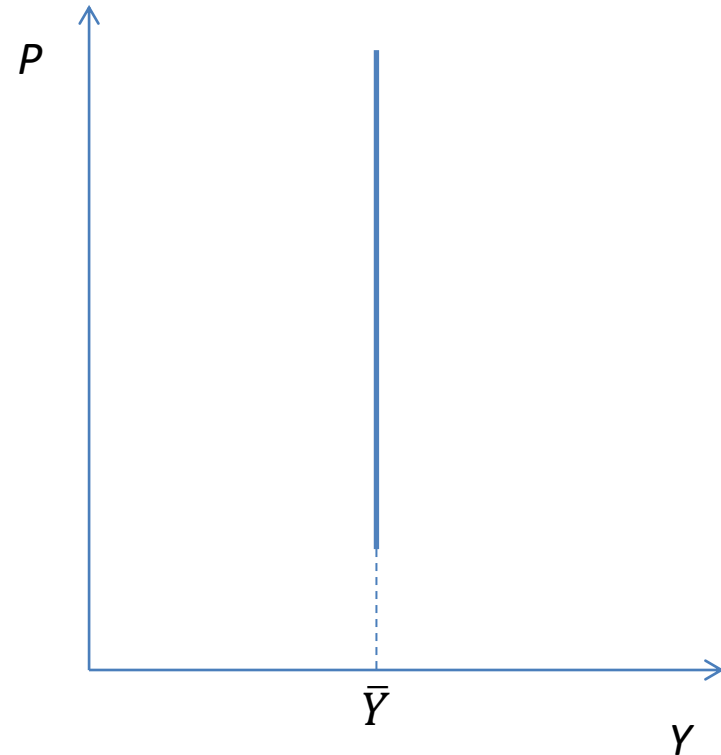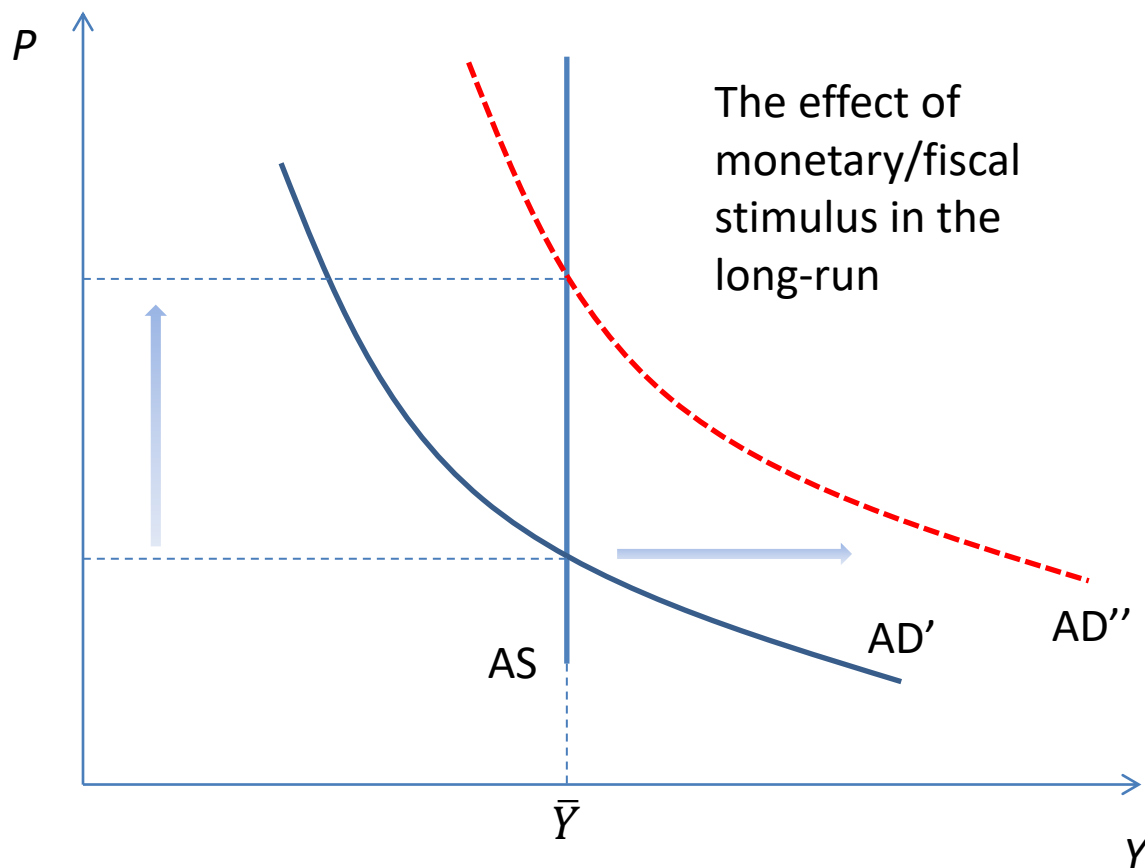
Y
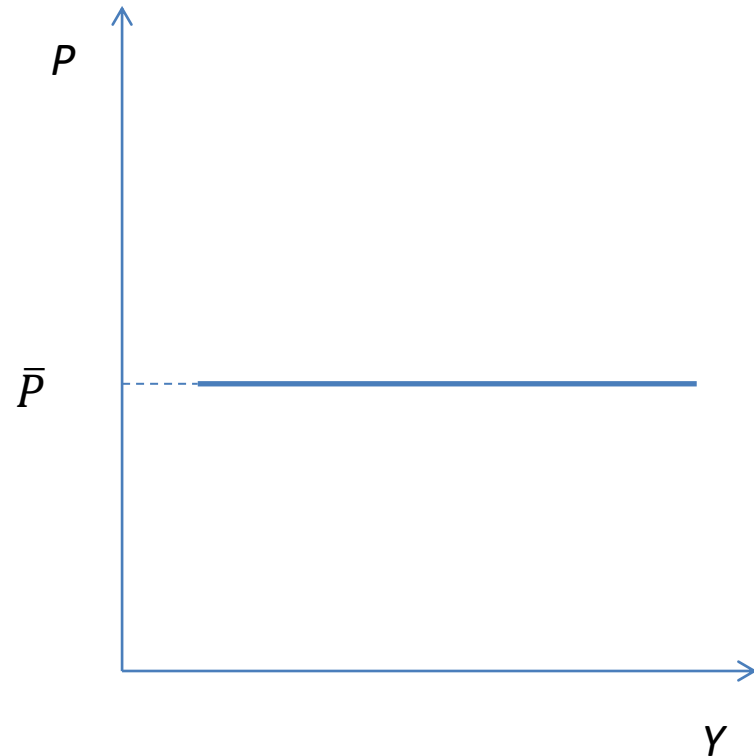
The Long-Run Supply Curve

- In the long run, price is flexible and the economy produces the natural level, $\bar{Y}$.

P

$\bar{Y}$

Y

The Long-Run (Classical) Analysis

The effect of monetary/fiscal stimulus in the long-run

P

AS

AD'

AD''

$\bar{Y}$

Y

From Short-Run To Long-Run

The long-run equilibrium

The short-run equilibrium
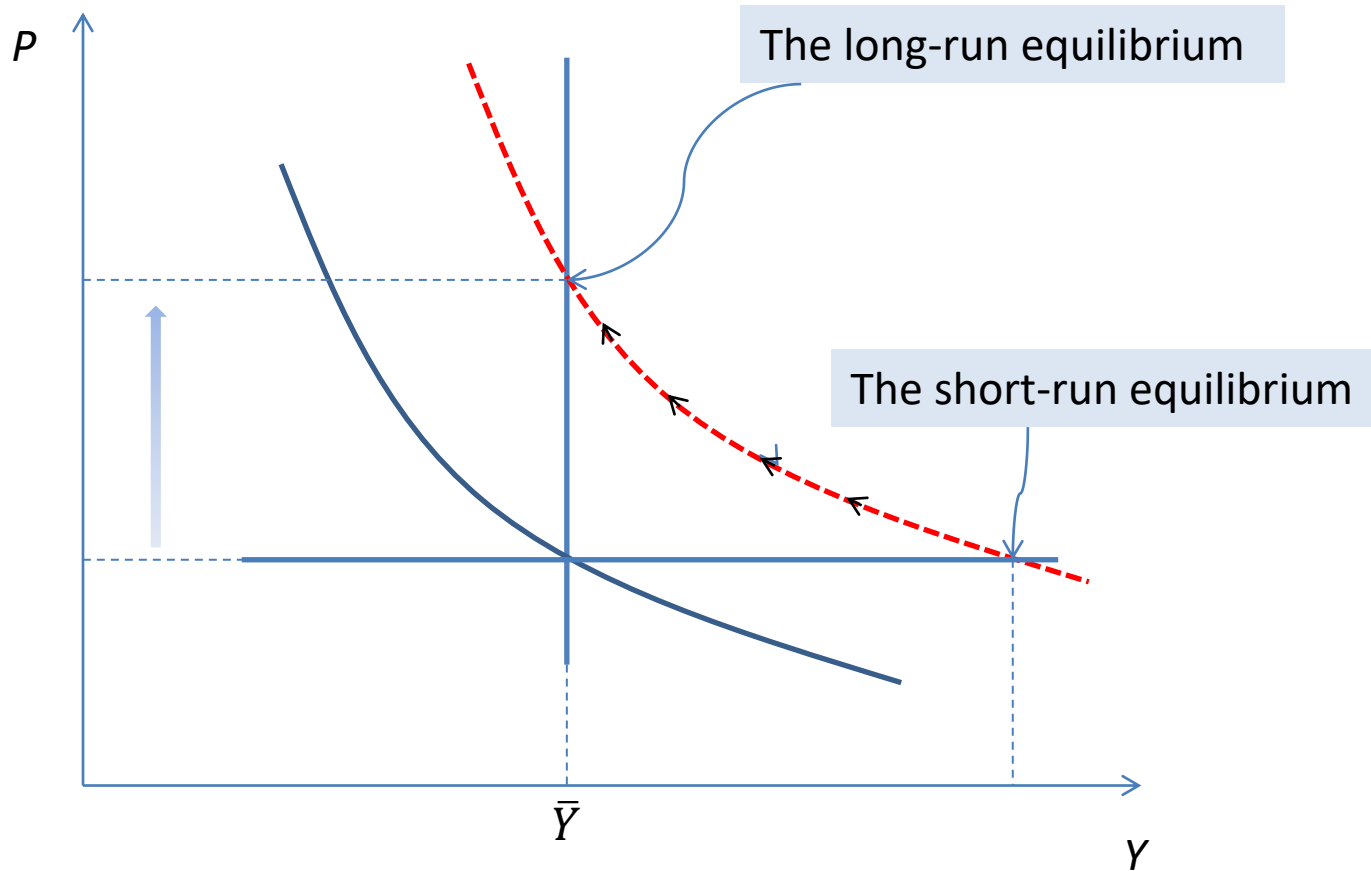
Stabilization Policy

- The government, as either <u>the monetary authority</u> or <u>the biggest spender</u>, is able to stabilize an economy that, under constant shocks, deviate from long-run natural levels of output and employment.

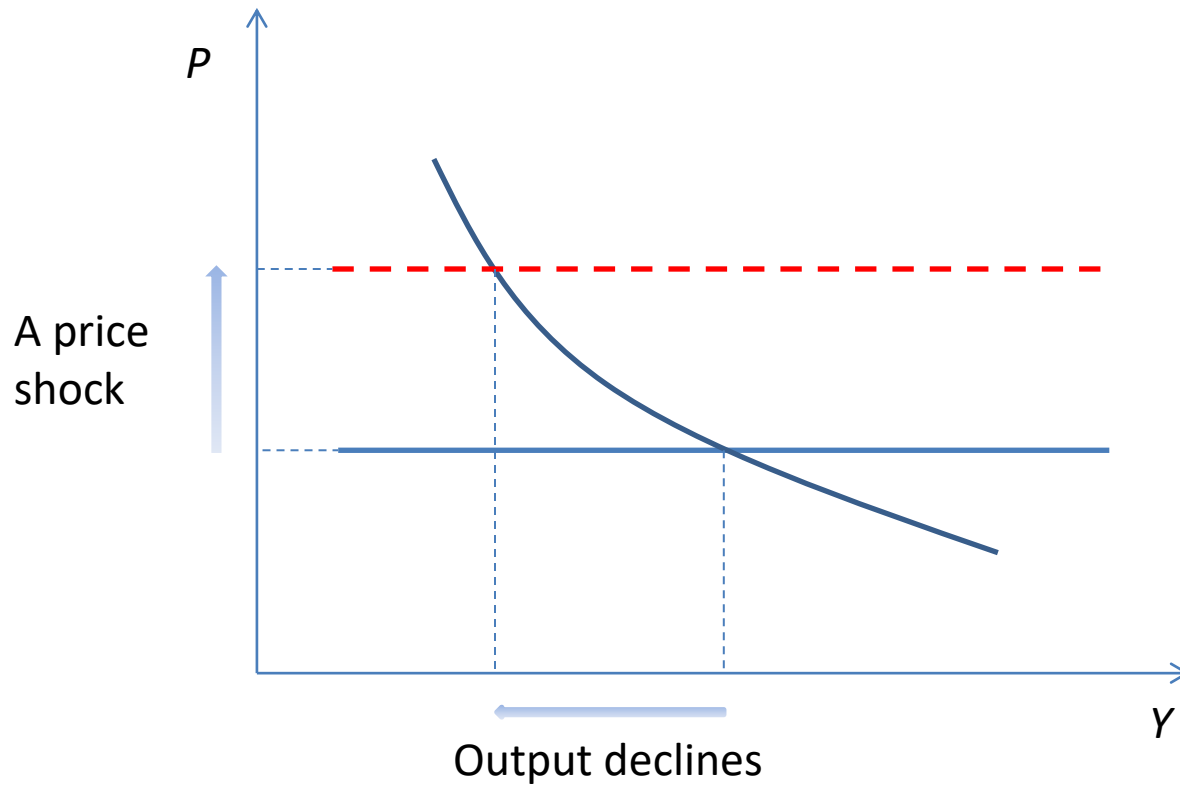- A shock to the economy may come from the <u>demand side</u> or the <u>supply side</u>.

Shocks to Aggregate Demand

- Examples of positive shocks to AD include:
    a) An asset price bubble (stocks, property)
    b) A credit boom
    c) A surge in foreign demand
- To dampen the booms resulted from the positive shocks, the government may tighten monetary/fiscal policy.
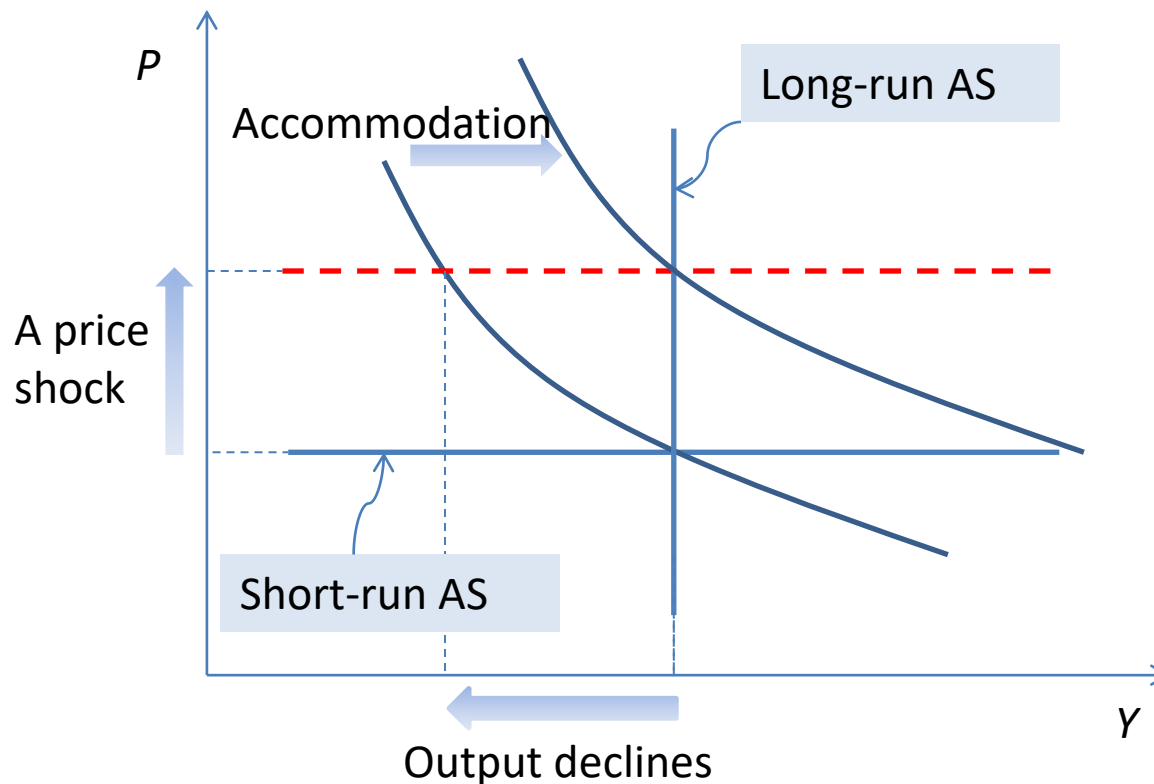
Shocks to Aggregate Supply

- A supply shock changes the factor prices or the technology.

- A supply shock is invariably associated with a change in price. Hence we often call it <u>price shock</u>.

- Examples of adverse supply shocks:
  - A severe drought
  - A new environmental protection law
  - An increase in labor unrest or union aggressiveness
  - The formation of an international oil cartel

Stagflation

P

A price shock

Output declines

Y

Intermediate Macroeconomics

Accommodate An Adverse Supply Shock

Case Study: The Oil Shocks in 1970s and 1980s
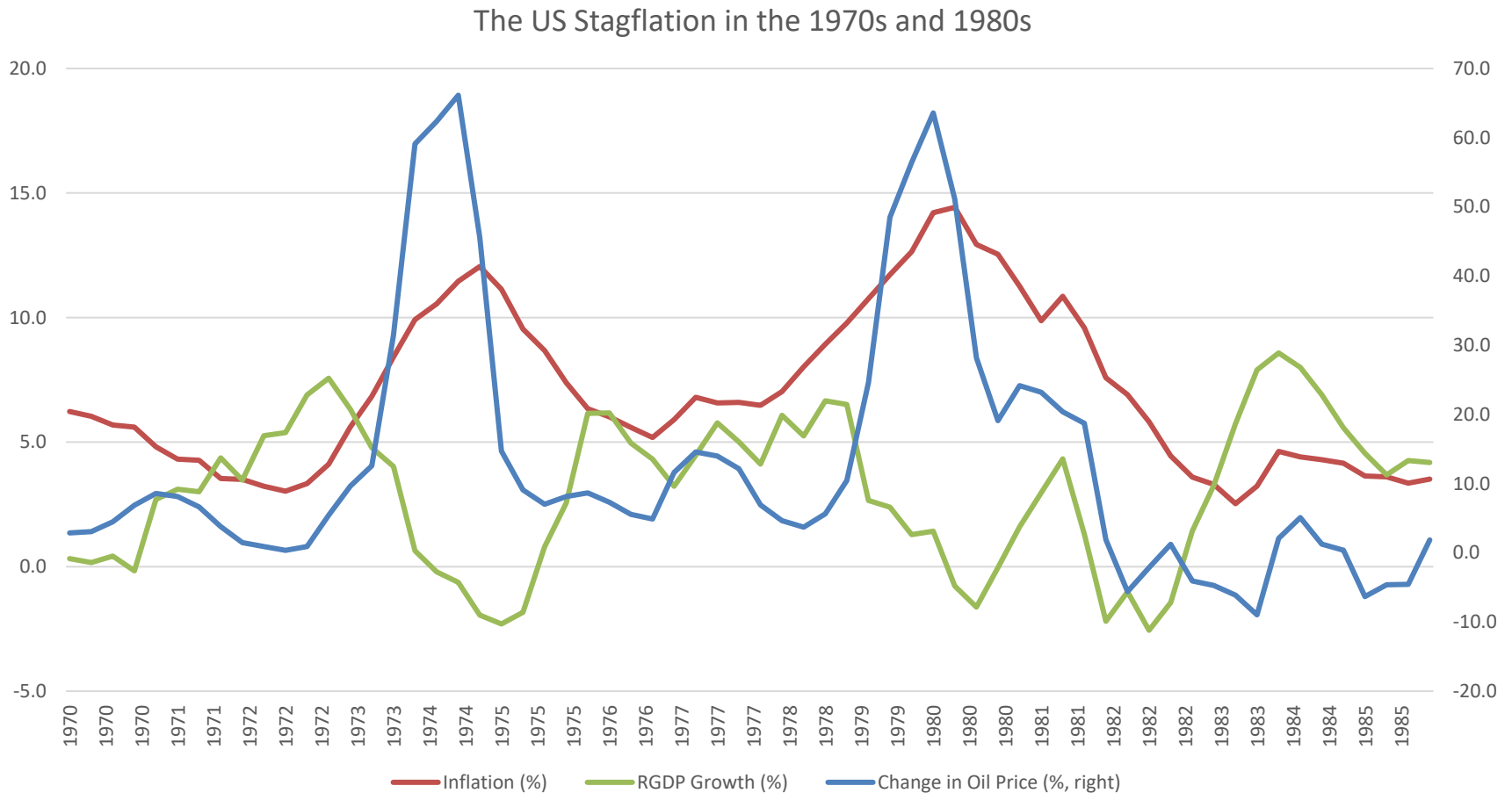
The US Stagflation in the 1970s and 1980s

Legend: Inflation (%) — RGDP Growth (%) — Change in Oil Price (%, right)

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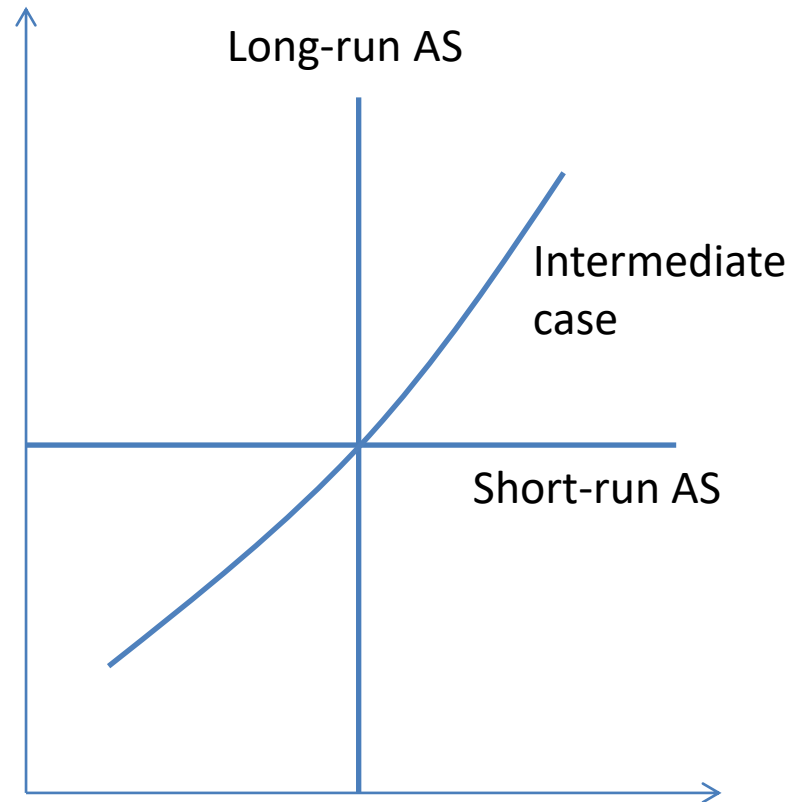# Aggregate Supply

- Previously we assume that the aggregate supply curve is either vertical (the classical long-run case), or horizontal (the short-run sticky price case).

- These are two extreme cases of a general theory of aggregate supply, a subject we study in this section.
  - Basic theory
  - Phillips curve
  - Policy implications

Long-run AS

Intermediate case

Short-run AS

A General AS Curve

- The AS curve is the relationship between the general price level P and the total real output that the firms are willing to supply.

- We may characterize the AS curve by the following function,

$$P(Y, Z),$$

where Z is a vector of exogenous variables that may shift the AS curve, and $\frac{\partial P}{\partial Y} > 0$. That is, the AS curve is upward-sloping.

The Imperfect-Information Argument

- We assume that each firm in the economy produces a single good and there are many goods in the market.

- Furthermore, we assume that firms have an imperfect information on the overall price level. In other words, they may mistake an <u>overall price</u> rise as a rise in the <u>relative price</u> of the good they produce.

- As the overall price level rises, many firms make more efforts to produce more. Hence the upward-sloping AS.

# A Linear Aggregate Supply Equation

- We assume that the short-run aggregate supply (AS) is characterized by

$$P = EP + \phi(Y - \bar{Y}), \, \phi > 0,$$

where Y is output, $\bar{Y}$ is the <u>output potential</u>, P is the price level, EP is <u>the expected price level</u>, and ϕ is a parameter that measures the sensitivity of price to deviation of output from the potential level.

The Short-Run AS Curve

- The Short-Run AS curve is upward sloping, with ϕ being the slope.
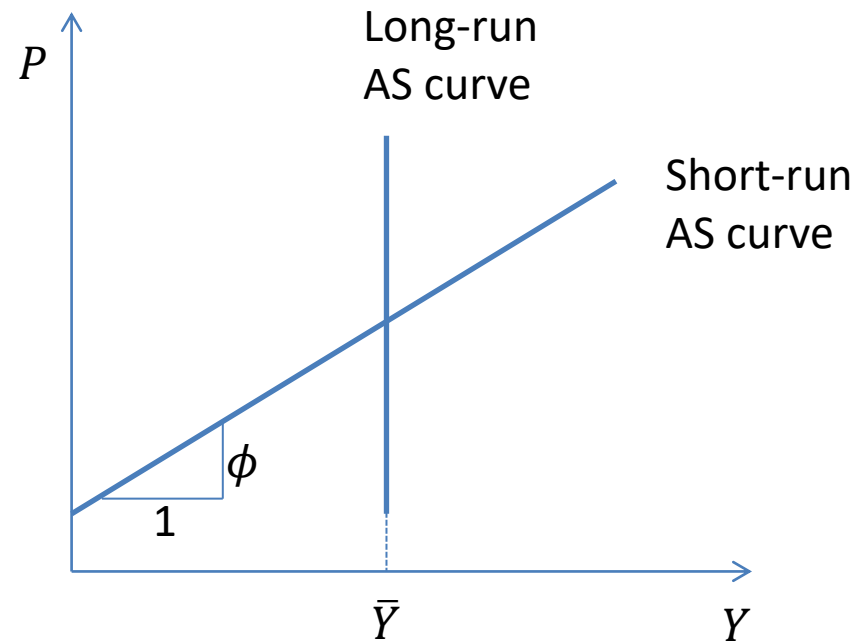
The Sticky-Price Argument

- We assume that there are two types of firms:
  - Flexible-price firms, which set price according to
  $$P_f = P + \gamma(Y - \bar{Y}).$$
  - Sticky-price firms, which set the price by
  $$P_s = EP.$$
- Let s be the fraction of sticky-price firms, the overall price level would be
  $$P = sP_s + (1 - s)P_f =$$
  $$sEP + (1 - s)\big(P + \gamma(Y - \bar{Y})\big).$$
- Re-arranging the terms, we obtain
  $$P = EP + \frac{(1 - s)\gamma}{s}(Y - \bar{Y}).$$

Intermediate Macroeconomics

The Determinants of ϕ

- The AS curve is steeper for those economies with volatile aggregate price level. (This is implied by the imperfect-information model.)

- The AS curve is also steeper for those economies with higher average level of inflation. (This is implied by the sticky-price model.)

Demand-Shock Recession
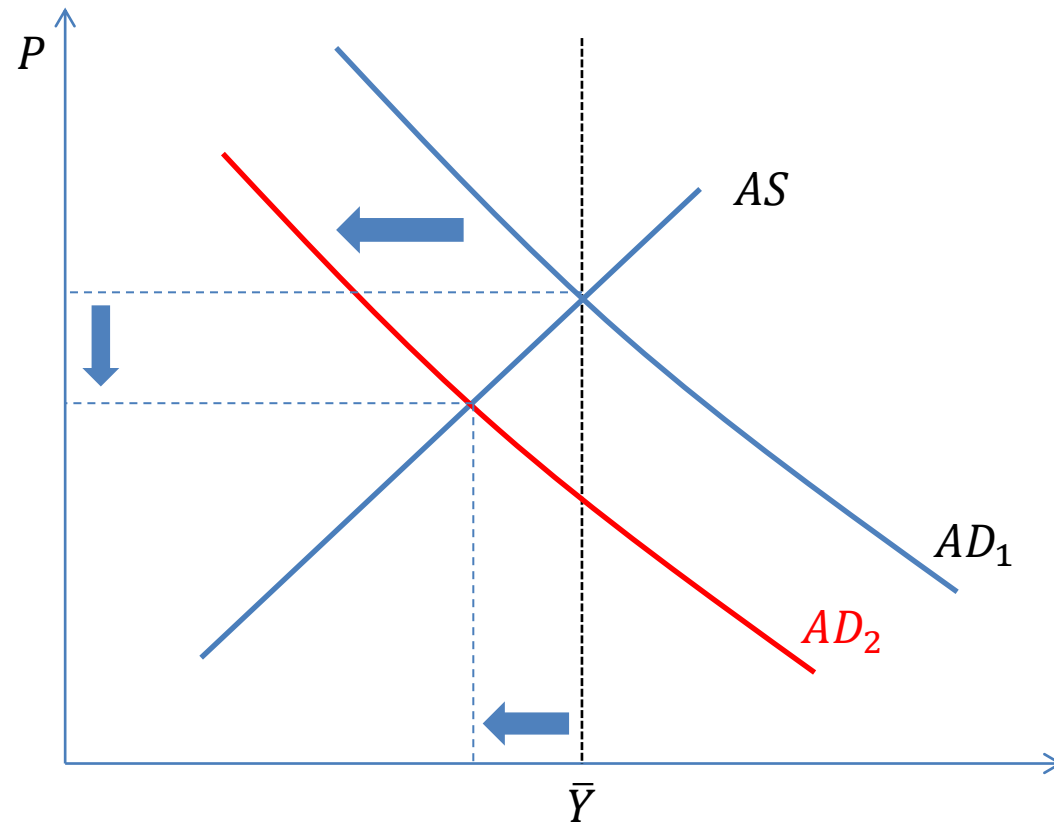
Demand-Shock Recession

- If there is a negative shock to the aggregate demand, e.g., reduced investment sentiment, then the economy would enter a recession.
  - Output declines, unemployment rises, and price declines (deflation).
- Recall that deflation may further reduce aggregate demand.
  - Transfer wealth from debtors to creditors, who generally have less MPC.
  - The deflation expectation raises the real interest rate, further reducing investment.

Policy Response to Demand-Shock Recessions

- In normal cases, both fiscal and monetary policies may be employed to increase aggregate demand.

- However, if the recession is deep and there is widespread panic (e.g., liquidity trap), monetary policy alone may not work.

- Even a tax cut may not work since people may choose to save the extra money.

- Under such circumstances, government expenditure may directly raise income and, perhaps more importantly, restore confidence.

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Negative Correlation between Unemployment and Inflation

- If the AS curve is upward-sloping and fixed, then shifts of the AD curve predict a negative relationship between unemployment and inflation.

  - Suppose that the economy is in a recession and that the government conducts fiscal or monetary stimulus, shifting the AD curve to the right. As a result, the output increases, the unemployment rate declines, and the inflation rate picks up.

- The Phillips curve describes the trade-off between unemployment and inflation.

Phillips Curve

- The modern Phillips curve is characterized by the following equation,

$$\pi = E\pi - \alpha(u - u^n) + v.$$

- The Phillips curve relates inflation to
  - Expected inflation $(E\pi)$
  - Cyclical unemployment ($u - u^n$, deviation of unemployment from the natural level)
  - Supply shocks (v)

Derivation of The Phillips Curve

- Let $p_t = \log(P_t)$. Note that $\pi_t = p_t - p_{t-1}$. Rewrite the short-run AS equation,
$$p_t = E p_t + \phi(Y_t - \bar{Y}) + v_t$$
where we add the supply shock v.

- Subtract p_{t-1} from the equation,
$$\pi_t = E \pi_t + \phi(Y_t - \bar{Y}) + v_t.$$

- Using the Okun's law, $(Y_t - \bar{Y}) = -\gamma(u_t - u^n)$, we obtain
$$\pi_t = E \pi_t - \alpha(u_t - u^n) + v_t, \text{ with } \alpha = \phi\gamma.$$

How Inflation Changes

- From the Phillips curve equation,
$$\pi_t = E\pi_t - \alpha(u_t - u^n) + v_t,$$
we can infer that there are three factors that may change inflation:
  - The cyclical unemployment $(u_t - u^n)$, leading to "demand-pull inflation".
  - Supply shock (v_t), leading to "cost-push inflation".
  - Change in expectation
  - Change in natural rate of unemployment (u^n)

Adaptive Expectation of Inflation
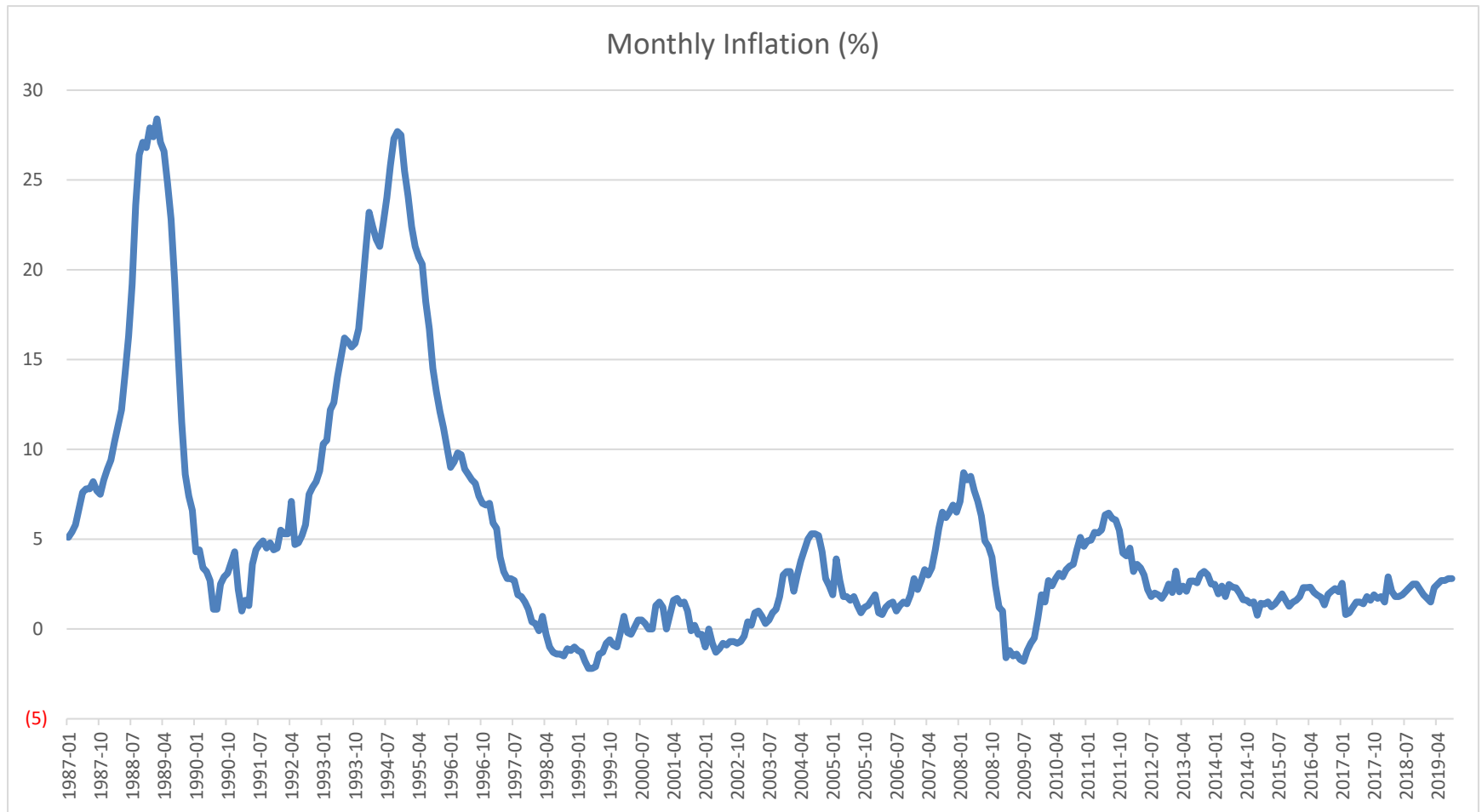
- A more concrete form of the Phillips curve is
$$\pi_t = \pi_{t-1} - \alpha(u_t - u^n) + v_t.$$
where we make the assumption that
$$E\pi_t = \pi_{t-1}.$$

- The above assumption is called the adaptive expectation of inflation.

- The adaptive expectation implies that inflation is inert.
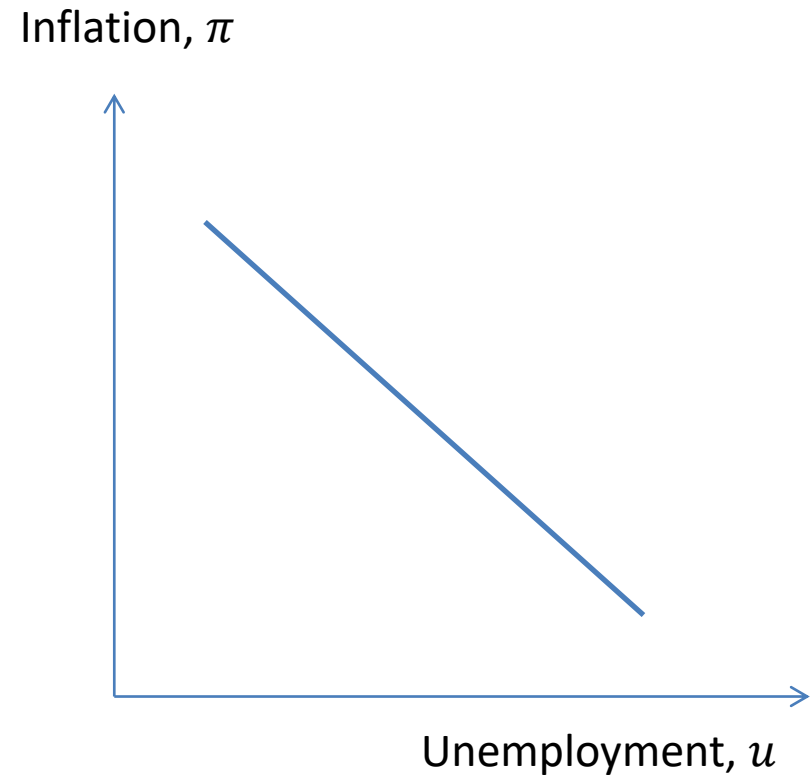
Inflation Inertia

Monthly Inflation (%)

Intermediate Macroeconomics

The Trade-Off Between Inflation and Unemployment

- The Phillips curve indicates a trade-off between inflation and unemployment.

- The trade-off is not stable, however, because people adjust their expectation of inflation.

Inflation, π

Unemployment, u

"Sacrifice Ratio"

- The trade-off between inflation and output (employment) can be summarized by the "sacrifice ratio", which is defined by the percentage of a year's real GDP growth that must be forgone to reduce inflation by 1 percentage point.

- In the U.S., a typical estimate of the sacrifice ratio is about 5: for every percentage point that inflation is to fall, 5 percent of one year's GDP must be sacrificed.

- If the policy of monetary tightening is highly credible, the sacrifice ratio can be much smaller.

Rational Expectation

- Rational expectation is a hypothesis that people form their expectations using all relevant information, and their expectations are correct in average.

- Under the rational expectation, there may not be a trade-off between inflation and unemployment.
  - Bad: it would be futile to combat unemployment with inflation.
  - Good: it may be painless to combat inflation. In other words, inflation may be brought down without causing any increase in unemployment.
    - It is important that policies are credible.

Trade-off under Rational Expectation
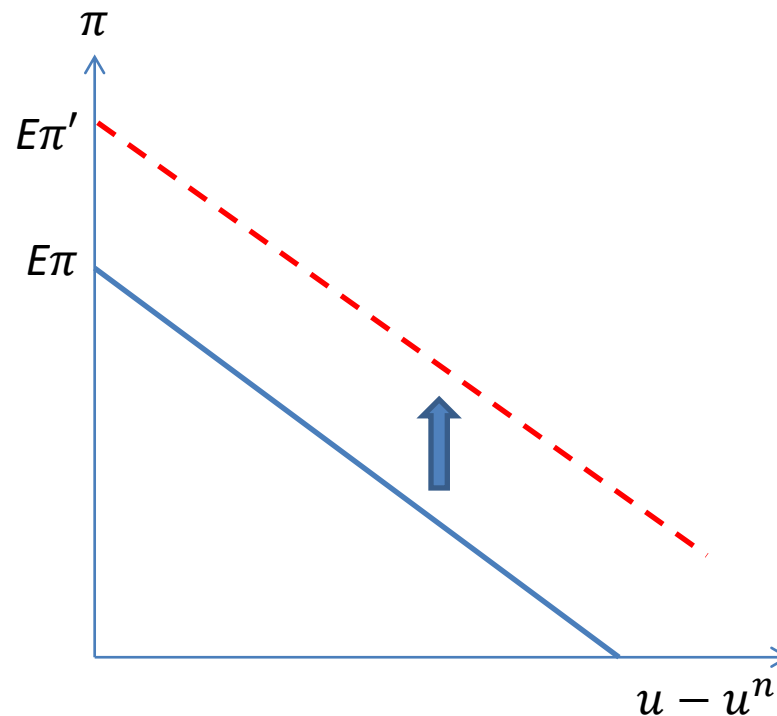
Natural Rate of Unemployment

- It is a hypothesis that there exists a natural rate of unemployment, which is called "natural-rate hypothesis".
- An alternative hypothesis is "hysteresis", which states that the natural rate of unemployment may be time-varying and the level of unemployment rate depends not only the current state of economy, but also the historical path.
  - A recession may permanently change an unemployed worker.
  - A recession may change the balance of "insiders" and "outsiders" in the labor force.

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- The AD-AS Model
  - Aggregate Demand
  - Aggregate Supply
  - Phillips Curve
  - **Dynamic AD-AS Model**
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- Concluding Remarks

Static v.s. Dynamic

- A static model specifies a set of <u>simultaneous</u> relations among variables, which is often assumed to hold in an equilibrium or steady state.
  - For example, the Keynesian cross model, $Y_t = C(Y_t - T_t) + I_t + G_t$. The subscript t can be omitted.
  - Most models considered in this course are static.
- A dynamic model specifies a set of time-dependent relations, which necessarily involves lags of endogenous variables.
  - For example, if we assume adaptive expectation, the Phillips curve becomes $\pi_t = \pi_{t-1} - \beta(u_t - u^n) + v_t$, which is a dynamic model.

A Simple Example

- Consider the linear AD-AS model,
$$Y_t = 100 + 0.4P_t + u_t,$$
$$Y_t = 400 - 0.6P_t + v_t,$$
where u and v denote shocks to the supply and the demand, respectively. Solving the model, we obtain $P_t = 300 + (v_t - u_t)$.

- In a static model, exogenous shocks have <u>instantaneous</u> impact on endogenous variables. In the example, a unit negative shock to u would result in a unit <u>instantaneous</u> price increase.

- Now we change the supply equation to
$$Y_t = 100 + 0.4P_{t-1} + u_t.$$
The model becomes a dynamic model.

- In a dynamic model, an exogenous shock leads to <u>a series of changes</u> to endogenous variables. See the next slide for the impact of a supply shock on the price level.

A Numerical Illustration

t	Y	P	u	v		a	b	
0	220	300	0	0	Supply: Y(t) = 100+a*P(t-1)+u(t)	0.4	-0.6	
1	219	301.6667	-1	0	Demand: Y(t) = 400+b*P(t)+v(t)			
2	220.6667	298.8889	0	0				
3	219.5556	300.7407	0	0				
4	220.2963	299.5062	0	0				
5	219.8025	300.3292	0	0				
6	220.1317	299.7805	0	0				
7	219.9122	300.1463	0	0				
8	220.0585	299.9025	0	0				
9	219.961	300.065	0	0				
10	220.026	299.9566	0	0				
11	219.9827	300.0289	0	0				
12	220.0116	299.9807	0	0				
13	219.9923	300.0128	0	0				
14	220.0051	299.9914	0	0				
15	219.9966	300.0057	0	0				
16	220.0023	299.9962	0	0				
17	219.9985	300.0025	0	0				
18	220.001	299.9983	0	0				
19	219.9993	300.0011	0	0				
20	220.0005	299.9992	0	0				

P
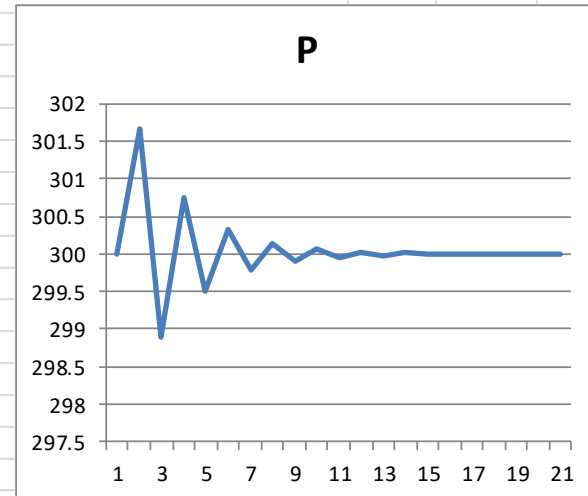
A More Useful Dynamic AD-AS Model

- Model specifications
  - The IS equation
  - The "Phillips-curve" equation
  - A monetary policy rule
- Solving the model
- Applications

The IS Equation

- We specify the IS equation by
$$y_t = \bar{y} - \alpha(r_t - \rho) + u_t,$$
where $y_t = \log(Y_t)$, $\bar{y} = \log(\bar{Y})$, r_t is real interest rate, u_t is the demand-side shock, α is a constant measuring how demand respond to changes in r_t, and ρ is a constant called "the natural rate of interest".

- We further specify r_t as the ex ante real interest rate,
$$r_t = i_t - E_t \pi_{t+1},$$
where i_t is the nominal interest rate and $E_t \pi_{t+1}$ is the expected next-period inflation at period t.

The "Phillips-Curve" Equation

- We specify a Phillips-curve-like equation for the dynamics of inflation,

$$\pi_t = E_{t-1}\pi_t + \phi(y_t - \bar{y}) + v_t,$$

where $(y_t - \bar{y})$ is called the <u>output gap</u>, v_t is the <u>supply-side shock</u>, and ϕ is a constant measuring how inflation responds to the output gap.

- The above equation characterizes the trade-off between inflation and output (unemployment). Hence we call it the Phillips curve equation.

The Monetary Policy Rule

- We assume that the monetary authority determines the nominal interest rate by the following rule

$$i_t = \pi_t + \rho + \theta_\pi(\pi_t - \pi^*) + \theta_y(y_t - \bar{y}),$$

where π^* is inflation target, θ_π and θ_y are constants measuring how the monetary authority would respond to inflation and output gap, respectively.

- The famous Taylor rule for the Fed is given by

$$\text{federal fund rate} = \text{inflation} + 2$$
$$+0.5(\text{inflation} - 2) + 0.5(\text{GDP gap})$$

- The above monetary policy rule implies that the monetary authority has two objectives:
  - To keep a moderate inflation
  - To promote a "maximum" sustainable output and employment

Putting Together

- To make the conditional expectation $E_{t-1}\pi_t$ operational, we assume adaptive expectation (i.e., $E_{t-1}\pi_t = \pi_{t-1}$). We have

$$y_t = \bar{y} - \alpha(i_t - \pi_t - \rho) + u_t,$$
$$\pi_t = \pi_{t-1} + \phi(y_t - \bar{y}) + v_t,$$
$$i_t = \pi_t + \rho + \theta_\pi(\pi_t - \pi^*) + \theta_y(y_t - \bar{y}).$$

- Endogenous variables: y_t, π_t, i_t

- Predetermined variable: π_{t-1}

- Exogenous variables: $\bar{y}, \pi^*, u_t, v_t$

Steady State

- We define the steady state as the state where inflation is constant and there are no shocks $u_t = v_t = 0$.

- It is easy to see that in the steady state, $y_t = \bar{y}$, $\pi_t = \pi^*$, $i_t = \pi^* + \rho$, and $r_t = \rho$.

- In the steady state, real variables (y_t, r_t) do not depend on monetary policy, and monetary policy only influences the inflation (π_t) and nominal variables (i_t). (Recall the concepts: the classical dichotomy and monetary neutrality.)

Solution

- There are three equations and three unknowns (endogenous variables). We may solve the system of equations and obtain

$$\pi_t = a_1(\pi_{t-1} + v_t) + a_2\pi^* + a_3 u_t,$$

$$y_t = \bar{y} + a_4(\pi^* - \pi_{t-1} - v_t) + a_5 u_t,$$

where $a_1 = \left(1 + \frac{\phi\alpha\theta_\pi}{1+\alpha\theta_y}\right)^{-1}$, $a_2 = \frac{\phi\alpha\theta_\pi}{1+\alpha\theta_y+\phi\alpha\theta_\pi}$, $a_3 = \frac{\phi}{1+\alpha\theta_y+\phi\alpha\theta_\pi}$, $a_4 = \frac{\alpha\theta_\pi}{1+\alpha\theta_y+\phi\alpha\theta_\pi}$, and $a_5 = \frac{1}{1+\alpha\theta_y+\phi\alpha\theta_\pi}$.

- Similarly we may represent i_t as linear functions of exogenous and predetermined variables.

- These solutions are called the <u>reduced-form model</u>.

Calibration

- Calibration is an approach for assigning values to the parameters in the model. Often these values are taken from empirical and experimental studies. We assume:

Parameters	Value
α	1
ρ	2
ϕ	0.25
θ_π	0.5
θ_y	0.5

- Furthermore, we assume $\bar{y} = 100$ and $\pi^* = 2$.

Simulation of A Demand Shock

| y bar | 100 | | alpha | 1 | | a1 | 0.923077 | |
pi star	2		rho	2		a2	0.076923	
			phi	0.25		a3	0.153846	
			theta_pi	0.5		a4	0.307692	
			theta_y	0.5		a5	0.615385	
t	pi	y	i	r	u	v		
0	2	100	4	2	0	0		
1	2.154	100.615	4.538	2.385	1	0		
2	2.296	100.568	4.728	2.432	1	0		
3	2.427	100.524	4.903	2.476	1	0		
4	2.548	100.484	5.064	2.516	1	0		
5	2.506	99.831	4.674	2.169	0	0		
6	2.467	99.844	4.623	2.156	0	0		
7	2.431	99.856	4.575	2.144	0	0		
8	2.398	99.867	4.530	2.133	0	0		
9	2.367	99.878	4.490	2.122	0	0		
10	2.339	99.887	4.452	2.113	0	0		
11	2.313	99.896	4.417	2.104	0	0		
12	2.289	99.904	4.385	2.096	0	0		
13	2.267	99.911	4.355	2.089	0	0		
14	2.246	99.918	4.328	2.082	0	0		
15	2.227	99.924	4.303	2.076	0	0		

A Demand Shock
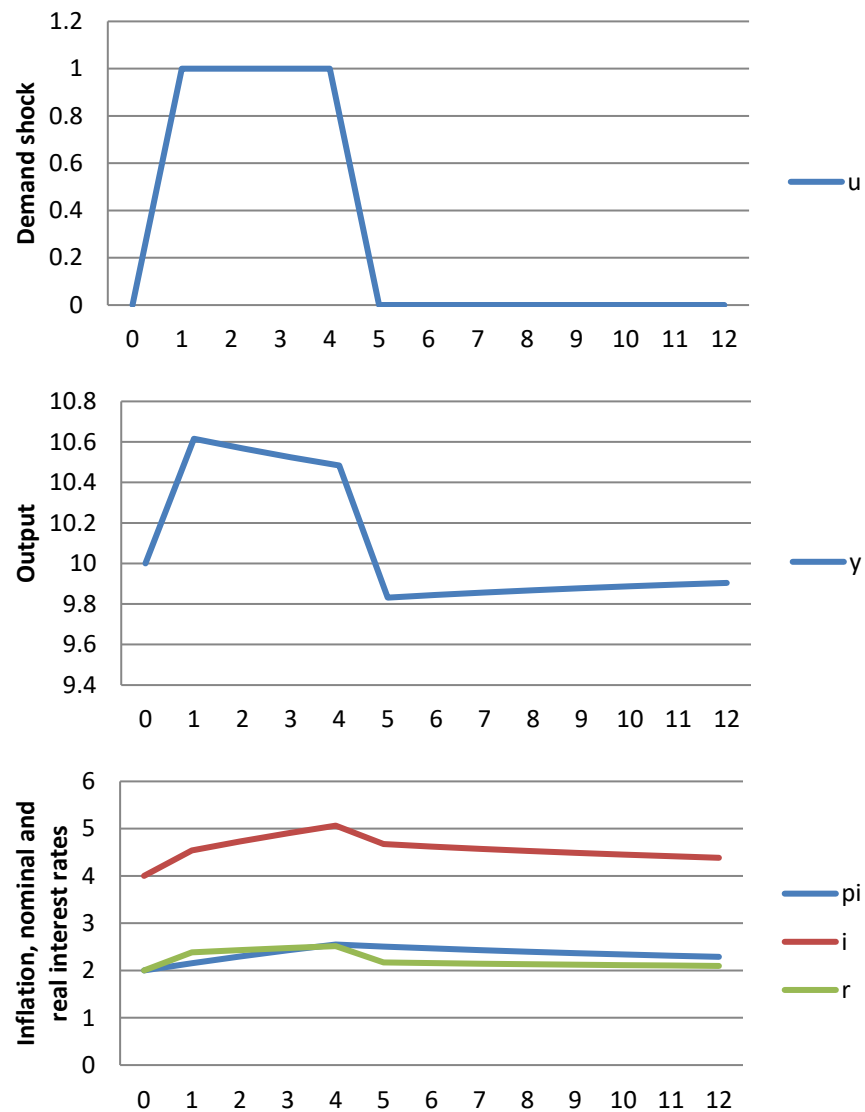
The Economy After A Demand Shock

- The demand shock causes output, inflation, and expected inflation to rise.

- The central bank reacts by raising nominal interest rate more rapidly than the inflation, so that real interest rate also rises, partly offsetting the effect of the demand shock.

- When the demand shock stops, due to the elevated expected inflation, the output would first drop below $\bar{Y}$, and then slowly recover.
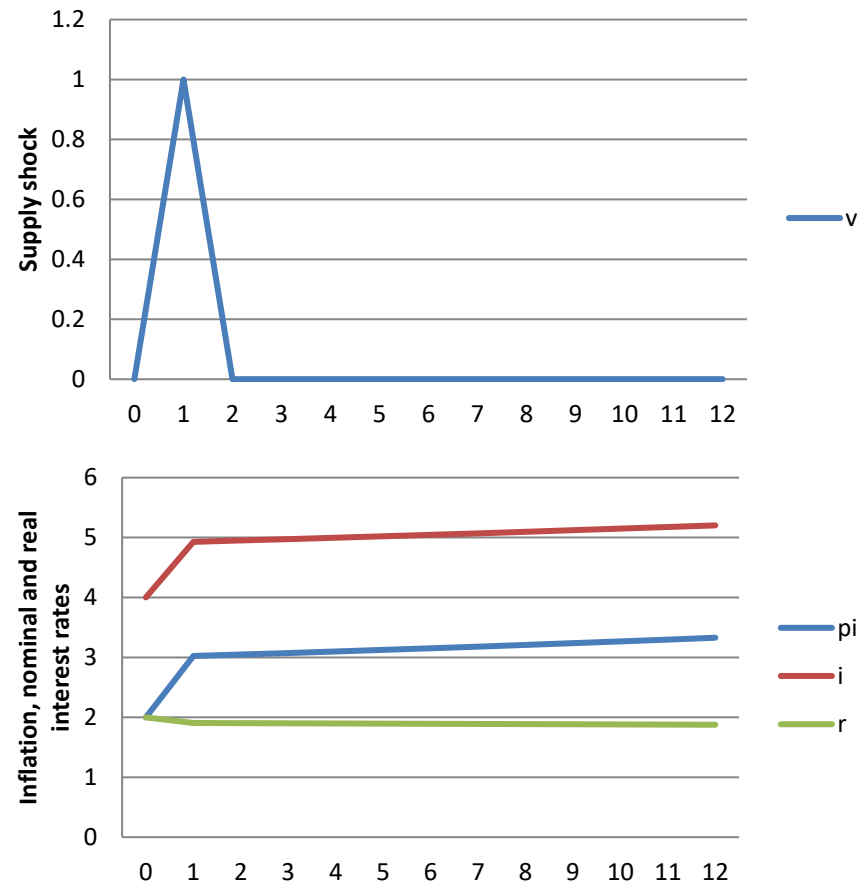
A Supply Shock
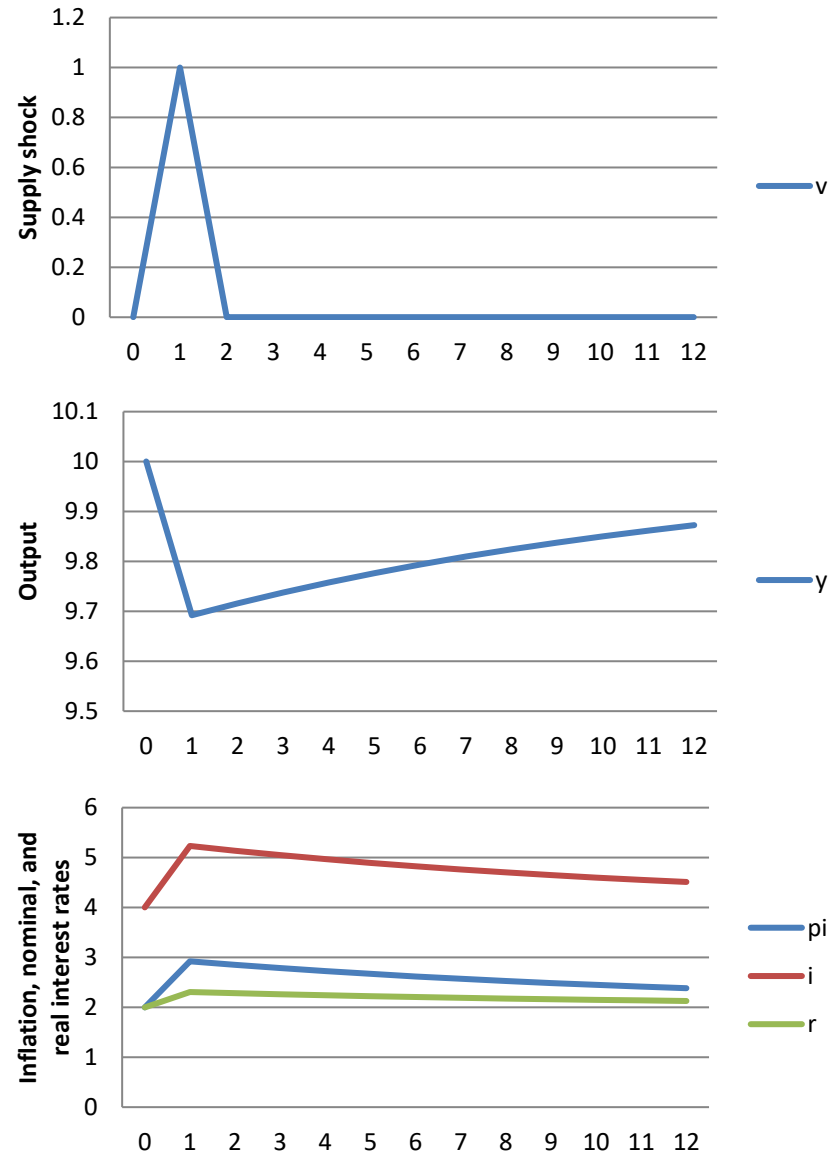
The Economy After A Supply Shock: Stagflation

- The supply shock causes the output to decline, the inflation to rise.

- Although the supply shock lasts only one period, the inertia of expected inflation keeps the supply curve elevated, leading to prolonged periods of stagnation.

- The central bank reacts by raising nominal interest rate more rapidly than inflation. Eventually the central bank would succeed in controlling inflation, but at the cost of a deeper recession.

A supply shock combined with a lenient monetary policy towards inflation $(\theta_\pi = -0.14)$

Explaining The Great Inflation in 1970s

- A supply shock occurred (oil crisis).

- The central bank, for fear of a deep recession, did not raise nominal interest rate aggressively.

- The accommodative attitude of the central bank leads to lower real interest rate, pushing inflation even higher.

A Shift in Monetary Policy
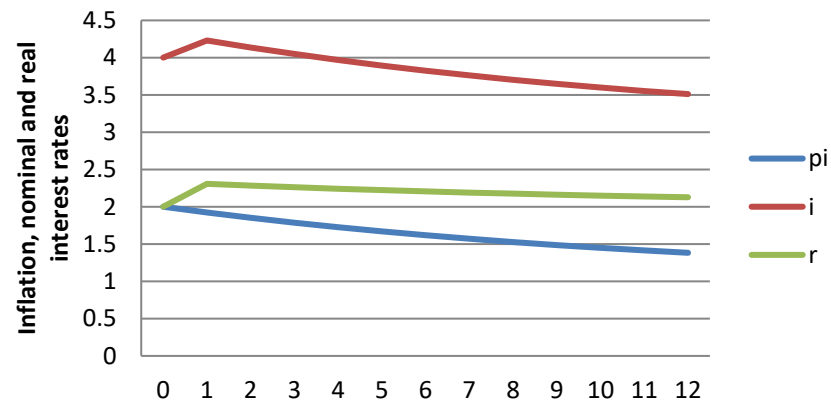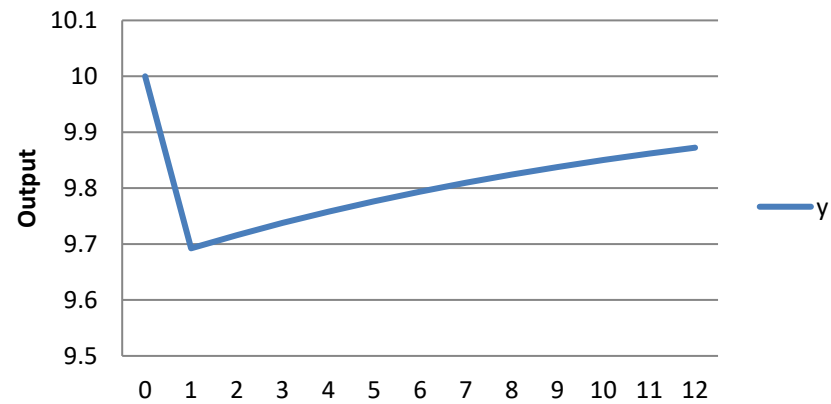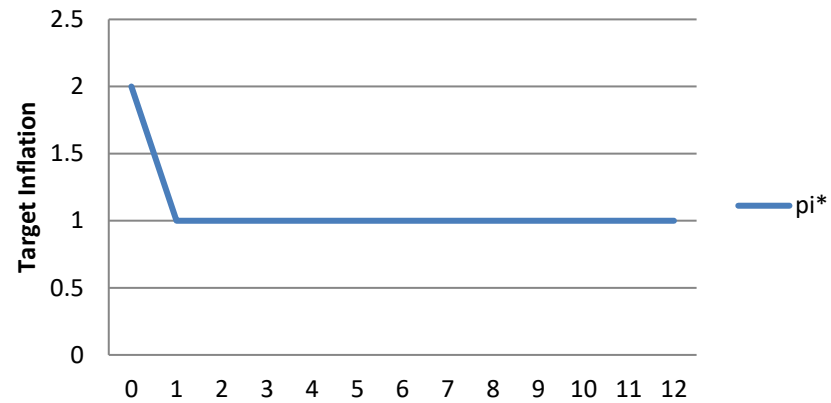
The Economy After A Hawkish Policy Shift on Inflation

- The central bank raises nominal (thus real) interest rate.

- The output immediately drops below $\bar{Y}$, then slowly recovers.

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The need to study Keynes' theory

- The IS-LM and AD-AS models are interpretations of Keynes' theory by the mainstream Keynesian or New Keynesian economists.
- The mathematical models, however, lose some key insights of Keynes.
  - The importance of investment
  - The importance of financial markets

Keynes Aggregate Demand

- Keynes postulates an *aggregate demand function* to characterize the demand side of the economy as a whole,
$$D = f(N),$$
where D is the proceeds (or revenue) which firms expect to receive from the employment of N workers.
  - Keynes uses N to measure the total output.
  - D corresponds to "price," which we may call "aggregate demand price"
- The aggregate demand function should be increasing in N.
  - Higher employment corresponds to higher income, which further corresponds to more consumption (proceeds for firms).

Keynes Aggregate Supply

- Keynes postulates an *aggregate supply function,*
$$Z = \phi(N),$$

where Z is the *aggregate supply price* of the output from employing N workers.

- Keynes defines the AS price as follows,

"…the aggregate supply price of the output of a given amount of employment is the expectation of proceeds which will just make it worth the while of the entrepreneurs to give that employment."

The Aggregation of AS

- For a firm employing N_i workers, the manager may expect a minimum amount of proceeds, D_i.
  - If he expects a revenue lower than D_i, he will reduce employment.

- In aggregation, there is a minimum amount of proceeds that the whole entrepreneur class requires to employ a varying amount of total employment.

The Shape of AS curve

- The AS function should be increasing, too. To induce more employment, the AS price must increase.
  - The aggregate supply price should be higher than the expected factor costs, including wage costs in particular.
 - We may assume that
    $$Z = W \cdot N + R,$$
    where W is the average wage, $W \cdot N$ is the total wage bill, and R represents the sum of economic profits and other factor costs.
  - R may or may not increase as entrepreneurs consider more employment of labor. But it is unlikely that R decreases as entrepreneurs consider increasing labor inputs.

The Relationship between AD and AS curves

- The AS curve has a steeper slope than the AD curve;

- The AS curve is below the AD curve when the employment level N is low.

- Therefore, there exists an equilibrium. The cross-section of AD and AS curves gives the equilibrium employment level and the *effective demand*.

The Keynes AD-AS Model
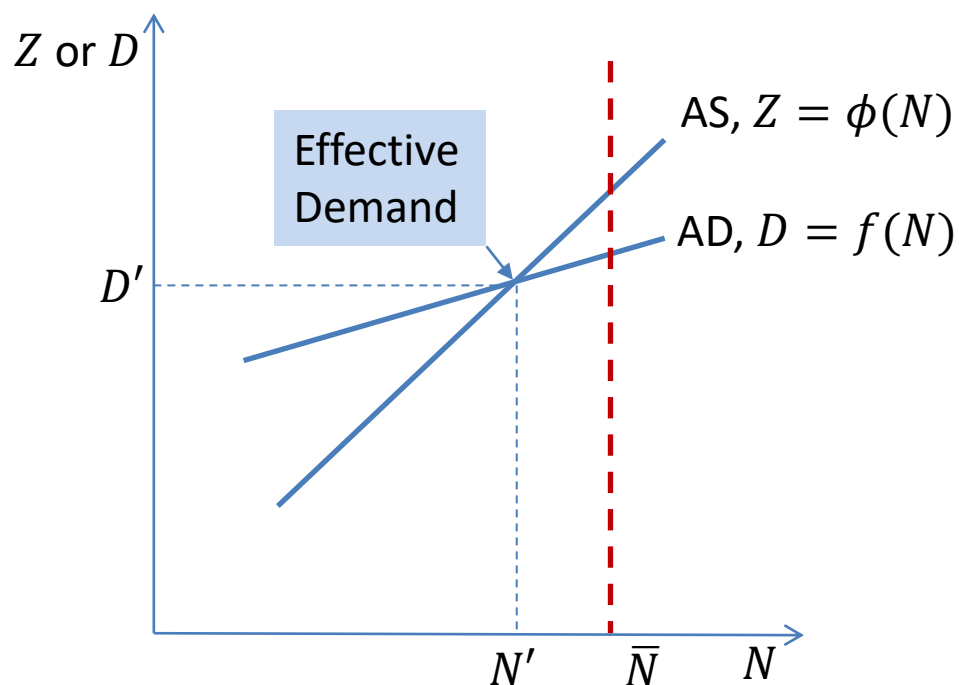
Implications

- The effective demand may not support full employment.

- When AD declines, if AS fails to adjust, then employment may decline.

  - Sticky-price, sticky wage in particular, may prevent AS from adjusting.

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The Importance of Investment

- We may omit the effect of foreign trade and government expenditure and decompose the effective demand Y into two components,
$$Y = C(Y) + I,$$

  - $C(Y)$ denotes an aggregate consumption function, which Keynes calls "propensity to consume." We assume that the effective demand equals the aggregate income.

  - I denotes the demand derived from new investment.

- If there is insufficient *new* investment, the effective demand has to decline and, with it, the volume of employment.

Paradox of Poverty in the Midst of Plenty

- Since the marginal propensity to consume is less than one and it generally declines as income increases, wealthy societies have wider gaps between the aggregate income and the consumption expenditure.

- Investment means not only the possibility of future growth but also the necessity of maintaining the current living standards.

- Once there is a decline of investment, unemployment will follow.

The Determinants of Investment

- *Prospective yield*: future cash flows from an investment or capital asset.

- *Supply price*, or *replacement cost*: the asset price that would just induce the production of an additional unit of such assets.

- Interest rate

Marginal Efficiency of Capital

- Keynes invents the *marginal efficiency of capital* to connect the future to the present. He defines the marginal efficiency of capital as

  "the rate of discount which would make the present value of the series of annuities given by the returns expected from the capital-asset during its life just equal to its supply price."

- In mathematics, we denote the series of *expected* annuities by $Q_1, Q_2, \ldots, Q_n$. The marginal efficiency of capital is a discount rate r_m that solves the following equation,

$$\text{Supply price} = \frac{Q_1}{(1 + r_m)} + \frac{Q_2}{(1 + r_m)^2} + \cdots + \frac{Q_n}{(1 + r_m)^n}.$$

The Demand Price of Capital

- Entrepreneurs as a whole will add new investment until there is no longer any class of capital asset with a marginal efficiency of capital higher than the current interest rate.

- To help understand this, Keynes introduces the demand price of a capital asset,

$$\text{Demand price} = \frac{Q_1}{(1+r)} + \frac{Q_2}{(1+r)^2} + \cdots + \frac{Q_n}{(1+r)^n},$$

  where r is interest rate.

- If the supply price of a capital asset is lower than the demand price or, equivalently, if $r_m > r$, then entrepreneurs will supply such capital assets, that is, add new investment.

Source of Instability

- The supply price of capital is relatively stable.
- But the expectation, especially the long-term expectation, of prospective yields can be volatile.
- Keyes regards the fluctuation in the marginal efficiency of capital as the cause of business cycles.
  - The optimistic evaluation of the marginal efficiency of capital leads to over-investment in the later phase of economic expansion.
  - Sooner or later, the game has to stop since the feverish accumulation of capital would depress the marginal efficiency of capital. When this happens, optimism gives way to pessimism.

When Does a Recession End?

- The recession continues as long as the marginal efficiency of capital is lower than the interest rate. The dismal state of the economy may change for the better when:

  - the monetary authority slashes the interest rate to below the marginal efficiency of capital;

  - the expectation of future yield improves as business confidence restores;

  - the supply price of capital declines by an amount enough for the marginal efficiency of capital to exceed the rate of interest.

The Role of the Stock Market

- For potential entrepreneurs, stocks are alternatives to investment in real assets.
  - When stock market valuation is low, there is little incentive for entrepreneurs to make new investments since they can purchase capital assets in the stock market.
- The stock market provides for entrepreneurs and investors with a *conventional valuation* on almost every type of capital asset.
  - The conventional valuation is imperfect but indispensable.
    - Uncertainty makes it difficult to form expectations about prospective yields.

The Weaknesses of the Stock Market

1. The stock market's overall ability to value assets is dubious.

2. Short-term fluctuations in profits tend to have excessive influence on the market.

3. The conventional valuation of the stock market results from the mass psychology of a large number of ignorant individuals, which may suddenly change due to factors unrelated to the prospective yield.

The Weaknesses of the Stock Market

4. Even professional investors and speculators are concerned not with making superior forecasts of future yields, but with foreseeing changes in the conventional valuation a little ahead of the others.

   – Challenges for *value investors*

      a) Human nature desires quick results.

      b) The value investors must have greater resources for safety and should avoid leverage.

      c) When a committee is in charge of evaluating investment performance, the value investor will face the most criticism.

Summary of Keynes' View

- The conventional valuation offered by the stock market has deep flaws.
- The violent fluctuations in the mass psychology of investors and speculators drive the fluctuations in the conventional valuation of prospective yields, which further drives the fluctuations in new investment, which further drives the business cycles.
- Keynes: *When the capital development of a country becomes a by-product of the activities of a casino, the job is likely to be ill-done.*

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Concluding Remarks on Business Cycles

- The full-employment equilibrium is as "transitory" as the under-employment equilibria.

- Full of inner dynamism, our economy cannot stay quietly anywhere. As soon as it recovers from a recession and reaches the full-employment state, it will move on to overheat.

- The inner dynamism manifests itself most evidently in finance.

Minsky's Financial Instability Hypothesis

- Minsky: A fundamental characteristic of our economy is that the financial system swings between robustness and fragility and these swings are an integral part of the process that generates business cycles.

Minsky's Financial Cycle
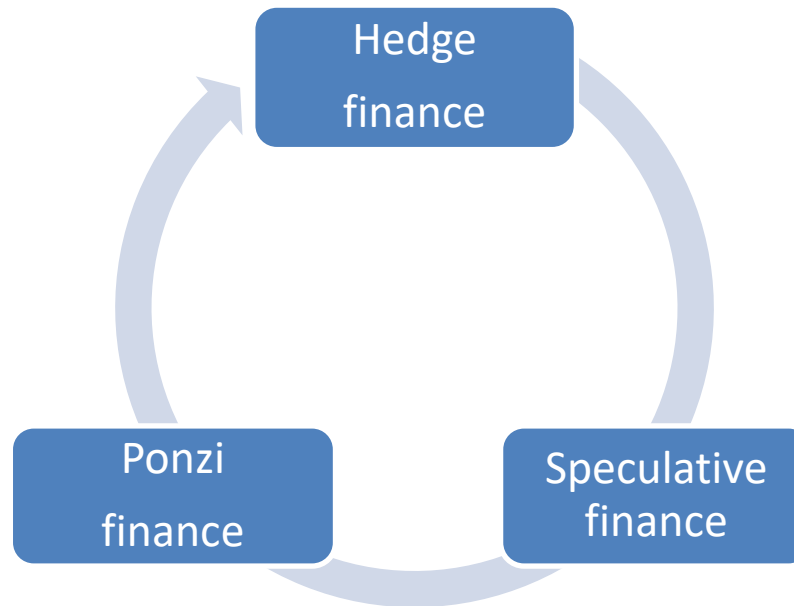
Concluding Remarks on Business Cycles

- The financial cycle does not simply repeat in the same style. Every cycle is different because financial markets are structurally changing over time.
  - The government reaction to busts (and booms): regulation and deregulation.
  - The market reactions: financial innovations, shadow banks.
- Mark Twain: The history ~~of economic fluctuations~~ doesn't repeat itself, but it often rhymes.