ECO 3302 – Intermediate Macroeconomics

Lecture 13: Aggregate Demand—Building the IS-LM model

Luis Pérez
(luisperez@smu.edu)

April 25–28, 2025

Table of Contents

Introduction

Introduction

- The Great Depression of 1930s was an inflection point for economic thought
  - During that time, the US and many countries registered massive unemployment and large reductions in GDP per capita
  - In 1933, 25% of US labor force unemployed and GDP was 30% lower than in 1929
- Classical macroeconomic theory was unable to explain the depression
  - According to classical theory, national income depends on factor supplies and available technology, neither of which changed substantially from 1929 to 1933
- Many economists believed a new theory was needed to explain such episodes

Introduction

- Main proponent of a new theory was British economist *John Maynard Keynes*

  "I shall argue that the postulates of the classical theory are applicable to a special case only and not to the general case...Moreover, the characteristics of the special case assumed by the classical theory happen not to be those of the economic society in which we actually live"

- In 1936, Keynes wrote *The General Theory of Employment, Interest and Money*
  - He argued that depressions resulted from insufficient aggregate demand
  - And criticized the classical theory for assuming that aggregate supply alone determines national income

- Today, economists' thinking is consistent with these two views:
  - In the long run, prices are flexible, and aggregate supply determines income
  - In the short run, prices are sticky, and aggregate demand influences income

Introduction

- **Today, we look more closely at aggregate demand and try to understand**:
  - What variables cause shifts in AD and fluctuations in income and employment
  - What policymakers can do to influence AD
- Previously, we saw that monetary policy is non-neutral in the short run
  (ie, it can shift aggregate demand curve)
- Today, we also study how the government can influence AD with fiscal policy
- **To do so, we build the IS-LM model** (the leading interpretation of Keynes theory)

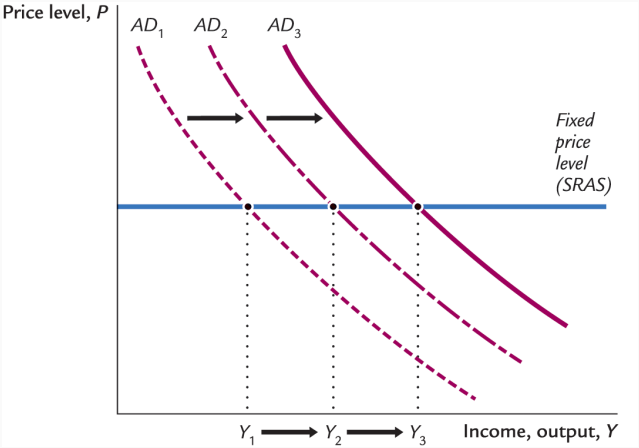
The IS-LM Model

IS-LM model

- The IS-LM model is useful to *qualitatively* understand short-run economic fluctuations and appropriate policy responses
  - Goal of the model is to show what determines income for given price level

- IS-LM model shows what causes income to change in the short run when the price level is fixed (because all underlying prices are sticky)

In the short run, when prices are fixed, shifts in the aggregate demand curve lead to changes in the equilibrium level of output



IS-LM model

- IS-LM model has two components:
  - IS curve, which captures what's going on in market for goods and services
    - IS stands for Investment and Savings
  - LM curve, which captures what's happening to supply and demand of money
    - LM stands for Liquidity and Money
- The interest rate r is the key variable linking the IS and LM curves
  - The interest rate influences both desired investment and money demand
- IS-LM model shows how interactions between goods and money markets determine the position and slope of AD curve and, hence, national income

The Goods Market and the IS Curve

The Goods Market and the IS Curve

- **IS curve** plots the relationship between income and the interest rate
  - To understand this relationship we build the *Keynesian cross* model
- **Two types of expenditure**:
  - **Actual expenditure (GDP)**: amount of money households, firms and government *spend* on goods and services
  - **Planned expenditure**: amount of money households, firms and government *would like to spend* on goods and services
- Actual and planned expenditures differ because firms can't perfectly predict demand, so unpredicted inventory changes cause actual $\neq$ planned expend.

- **Planned expenditures** (in closed economy):

$$
\begin{aligned}
PE &= C + I + G \\
C &= C(Y - T) && \text{(Consumption function)} \\
I &= \overline{I} && \text{(Exogenous planned investment)} \\
G &= \overline{G} = T = \overline{T} && \text{(Fixed fiscal policy)}
\end{aligned}
$$

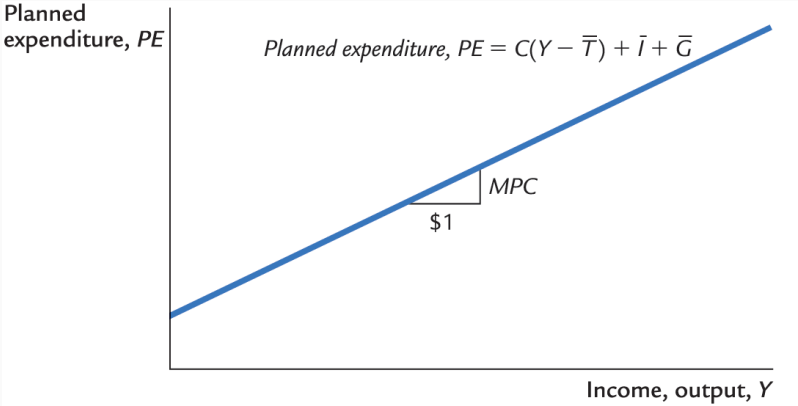
- Putting these equations together:

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

Planned expenditure is a function of income Y, planned investment $\overline{I}$, and fiscal policy $(\overline{G}, \overline{T})$

Planned-expenditure function

- Planned-expenditure function is the first piece of the Keynesian cross
  - It slopes upward because higher income leads to higher consumption
  - MPC shows how much planned expenditures increase when income rises by $1



Equilibrium expenditures

- Crucial for the Keynesian cross is the assumption that in equilibrium actual expenditures equal planned expenditures:

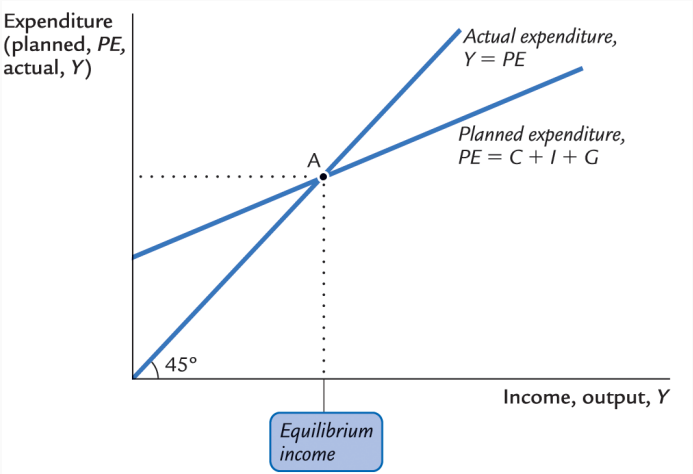
$$\underbrace{Y}_{\text{actual expenditures}} = \underbrace{PE}_{\text{planned expenditures}}$$

- This equilibrium assumption is the second piece of the Keynesian cross
  - Graphically, it is represented via a 45-degree line

- The Keynesian cross obtains when we put together the planned-expenditure function with this 45-degree line

The Keynesian cross

Planned-expenditure function is flatter than 45-degree line because MPC < 1

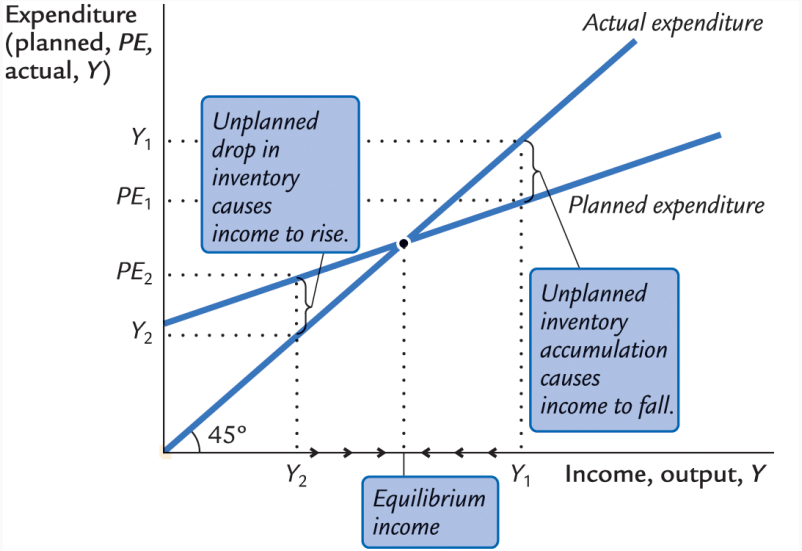


Equilibrium and the role of inventories

How does the economy reach equilibrium?

- **Inventories play key role in adjustment process**: whenever economy is not in equilibrium, inventories move, inducing firms to alter production levels
- Changes in production influence total income and expenditure moving economy toward equilibrium
- **Example**:
  1. Economy starts at $Y_1 > Y^*$ so that $PE_1 < Y_1$ (firms sell less than what they produce)
  2. Firms add unsold goods to inventories
  3. Rise in inventories leads firms to lay off workers & cut production, reducing GDP
     This process continues until income falls to equilibrium level Y^*

Equilibrium and the role of inventories



Equilibrium and the role of inventories

How does the economy reach equilibrium?

- **Another example**:
  1. Economy starts at $Y_2 < Y^*$ so $PE_2 > Y_2$ (firms sell more than what they produce)
  2. Firms draw down to inventories
  3. Fall in inventories leads firms to hire more workers & expand production, ↑ GDP
     This process continues until income rises to equilibrium level Y^*

- Keynesian cross shows how income Y is determined for given levels of planned investment I and fiscal policy (G, T)

Fiscal policy and the income multiplier

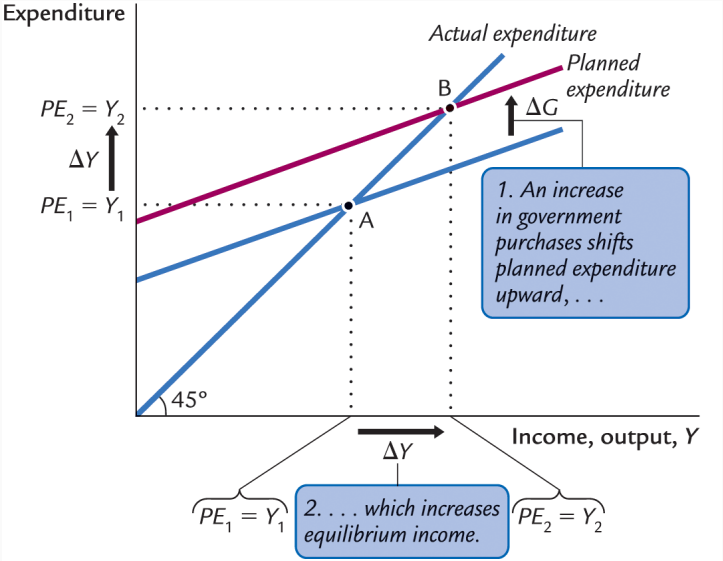
- **We now consider how changes in government spending affect the economy**:
  - Higher gvt spending results in higher planned expenditure
    (If gvt purchases rise by ΔG, then planned expenditures also rise by ΔG)
  - This moves the economy to an equilibrium with higher income $(A \to B)$
  - The increase in income is larger than the increase in gvt spending: $\Delta Y > \Delta G$
  - We can asses how much larger the rise in income is compared to the rise in gvt spending by looking at **the government-spending multiplier**

$$\frac{\Delta Y}{\Delta G} > 1$$

    It tells us how much income rises in response to \$1 increase in government purchases

- **An implictation of the Keynesian cross is that fiscal policy has a multiplier effect on income**: income rises more than by the increase in gvt spending

Fiscal policy and the income multiplier: government spending



Fiscal policy and the income multiplier

- **Why does fiscal policy have a multiplied effect on income?**
  (ie, why does income rise more than by the increase in gvt spending?)
  - Because higher income causes higher consumption: $C = C(Y - T)$
  - Higher consumption further raises income
  - Further raises in income further raises consumption, and so on...

Fiscal policy and the income multiplier

- How large is the multiplier?
  (ie, by how much does income rise in comparison to gvt spending?)

  Initial change in gvt purchases $= \Delta G$

  First change in consumption $= MPC \times \Delta G$

  Second change in consumption $= MPC^2 \times \Delta G$

  $\vdots$

  Total change in income : $\Delta Y = (1 + MPC + MPC^2 + \cdots)\Delta G$

- Government-spending multiplier:

$$\frac{\Delta Y}{\Delta G} = 1 + MPC + MPC^2 + \cdots = \frac{1}{1 - MPC}$$

If $MPC = 0.75$, \$1 increase in gvt spending raises equilibrium income by \$4

Fiscal policy and the income multiplier

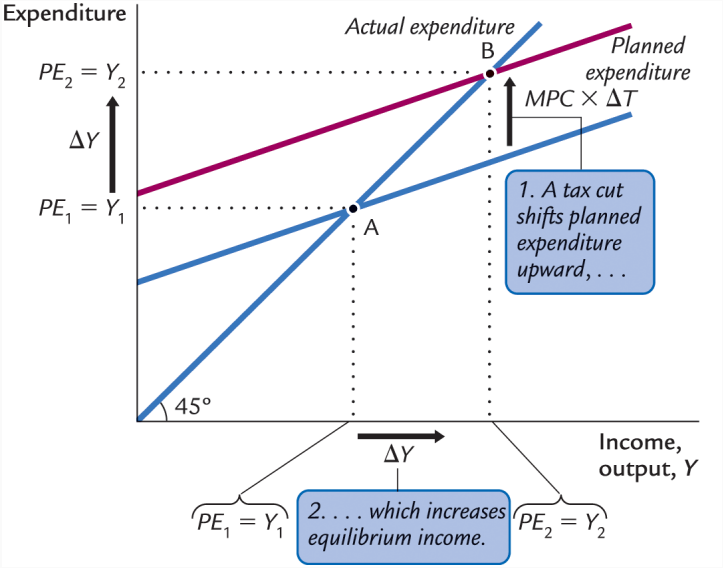
- **We now consider how changes in government taxes affect the economy**:
  - Lower taxes result in higher planned expenditure b/c disposable income raises
    (If taxes fall by ΔT, planned expenditures rise by $MPC \times \Delta T$)
  - This moves the economy to an equilibrium with higher income $(A \rightarrow B)$
  - The increase in income is larger than the cut in gvt taxes: $\Delta Y > \Delta T$
  - We can asses how much larger the rise in income is compared to the cut in gvt taxes by looking at **the tax multiplier**

$$\frac{\Delta Y}{\Delta T} = -\frac{MPC}{1 - MPC} > 1$$

    It tells us how much income changes in response to \$1 change in taxes

  - Eg, if the MPC is 0.75, the tax multiplier is -3: A \$1 cut in taxes raises income by \$3

Fiscal policy and the income multiplier: taxes



The interest rate and the IS curve

- The Keynesian cross is useful to understand how the spending plans of HHs, firms, and the gvt determine the economy's income
- Yet it makes the simplifying assumption that planned investment I is fixed
- In reality, however, planned investment depends on the interest rate

$$I = I(r)$$

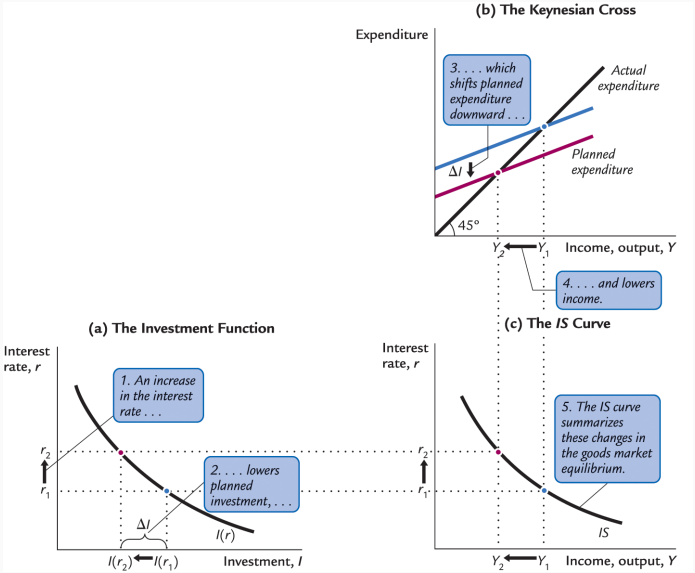
  - An increase in the interest rate lowers planned investment (and viceversa)
  - Hence, the investment function slopes downward

- We now add this relationship to our model

The interest rate and the IS curve

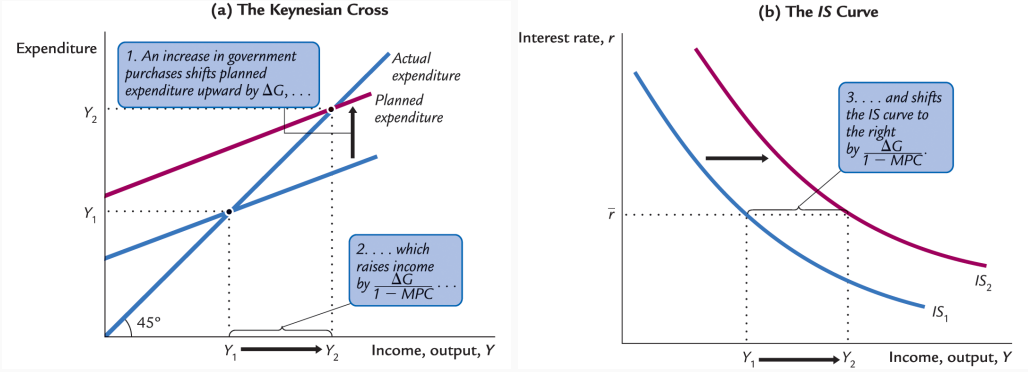
- An increase in the interest rate reduces investment
  (since investment is negatively related to the interest rate)
- Decrease in planned investment shifts downward the planned-expenditure function, leading to a lower income
- Hence, **increase in interest rate lowers income**
- **IS curve summarizes this relationship between the interest rate and income**
  - Each point on the IS curve represents an equilibrium in the goods market
  - IS curve shows how equilibrium income depends on interest rate
  - Because increase in interest rate reduces planned investment and income, IS curve slopes downward

The interest rate and the IS curve



Fiscal policy and the IS curve

- The IS curve is drawn for a given fiscal policy (G, T)
- When fiscal policy changes, so does the IS curve
  - An increase (decrease) in gvt spending shifts the IS curve outward (inward)
  - A decrease (increase) in taxes shifts the IS curve outward (inward)



The Money Market and the LM Curve

Theory of liquidity preference

- LM **curve** plots the relationship between income and the interest rate *in market for money balances*
  - To understand this relationship we turn to the *theory of liquidity preference*

- **Theory of liquidity preference**: in the short run, the interest rate adjusts to balance the supply and demand for money
  - Theory assumes supply of real money balances is fixed:

$$\left(\frac{M}{P}\right)^s = \frac{\overline{M}}{\overline{P}}$$

    Money supply is exogenous (eg, chosen by Fed) and price level is fixed (ie, sticky prices)

  - Assumptions imply supply of real money doesn't depend on interest rate

Theory of liquidity preference

- **Theory of liquidity preference**: in the short run, the interest rate adjusts to balance the supply and demand for money
  - Theory assumes supply of real money balances is fixed:

$$\left(\frac{M}{P}\right)^s = \frac{\overline{M}}{\overline{P}}$$

  - Theory posits interest rate determines how much money people want to hold:

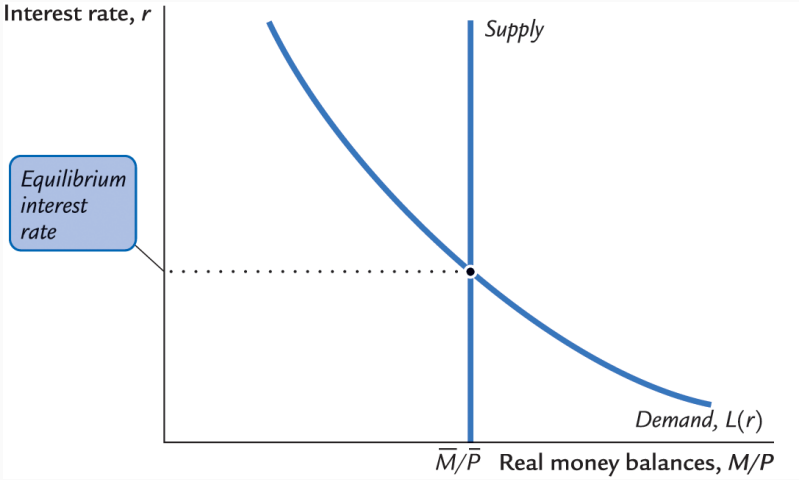
$$\left(\frac{M}{P}\right)^d = L(r)$$

    Demand curve L slopes downward because with higher r, people want to save more

  - Assumptions imply supply of real money doesn't depend on interest rate

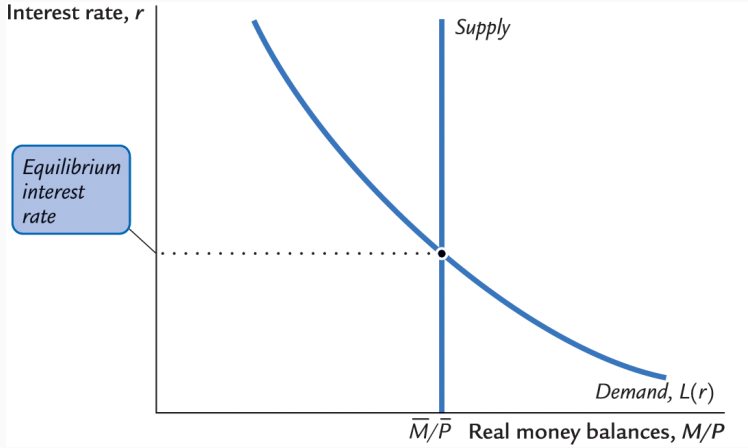
Theory of liquidity preference

Supply curve of real money balances is vertical because it is independent of r



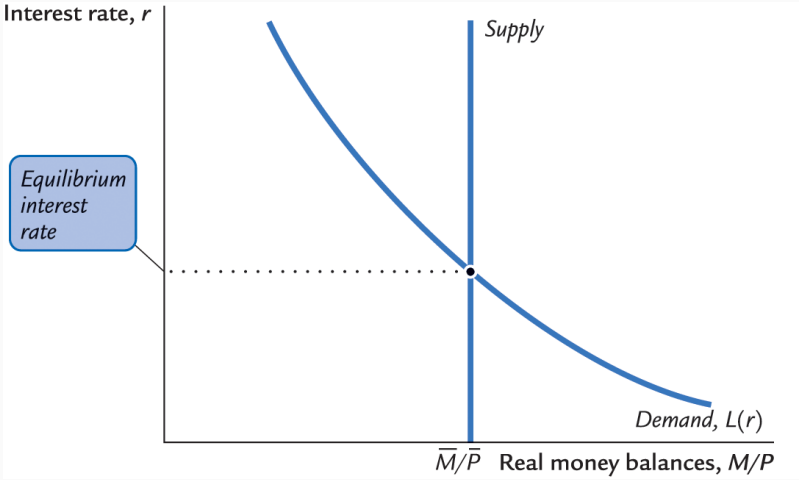
Theory of liquidity preference

Demand curve of real money balances slopes downward because with higher r people want to save more (since there are higher returns on savings)



Theory of liquidity preference

Equilibrium interest rate balances supply and demand of real money balances



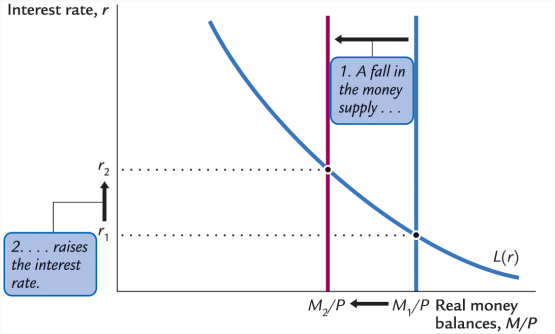
Theory of liquidity preference

How does the interest rate adjust to balance supply and demand of money?

- If interest rate is above its equilibrium level ($r > r^*$):
  - Money supply exceeds money demand, $(M/P)^s > (M/P)^d$
  - Individuals holding excess money want to increase the share in their portfolio of interest-paying assets
  - Suppliers of interest-paying assets respond by lowering offered interest rate
- If interest rate is below its equilibrium level ($r < r^*$):
  - Money demand exceeds money supply, $(M/P)^s < (M/P)^d$
  - Individuals try to sell interest-paying assets to obtain more money
  - Suppliers of interest-paying assets respond by raising offered interest rate

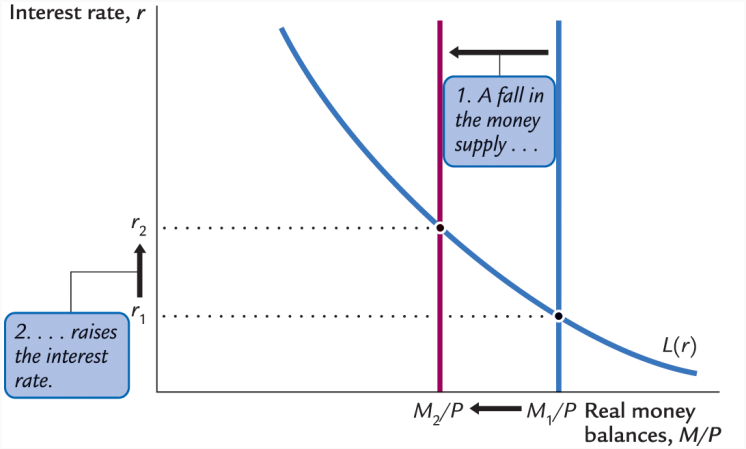
How does the interest rate respond to changes in the money supply?

- **Suppose the Fed engages in contractionary monetary policy**:
  - If Fed decreases money supply M, supply of real money balances shifts left
  - Equilibrium interest rate rises, making people want to hold less money



Theory of liquidity preference

According to the theory of liquidity preference, a decrease in the money supply raises the interest rate (and an increase in M lowers it)



Income, money demand, and the LM curve

- How does a change in income affect the market for real money balances?
  - When income is high, expenditure is high, so people demand more money:

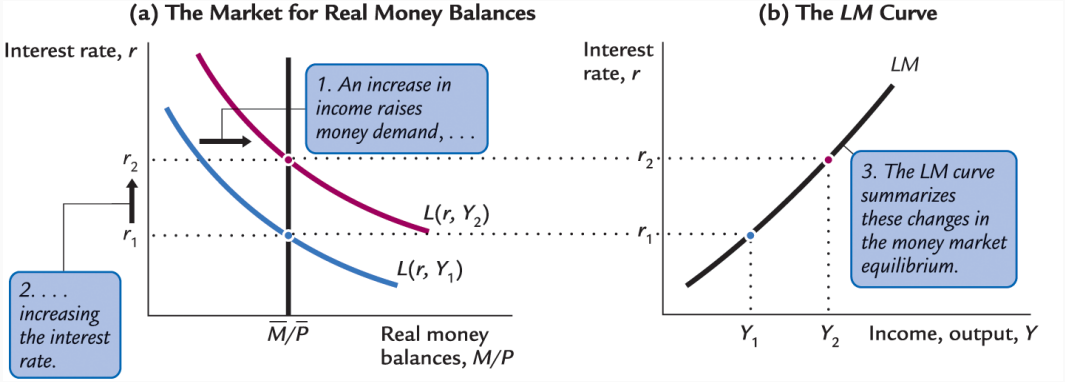
$$\left(\frac{M}{P}\right)^d = L(r, Y)$$

    Quantity of real money demanded is negatively related to the interest rate r and positively related to income Y

  - When income increases, money demand curve shifts to the right
    (for given interest rate, people demand more money)
  - Since supply of real money is fixed, equilibrium interest rate rises
  - According to theory of liquidity preference, a rise (decrease) in income leads to a higher (lower) interest rate

Income, money demand, and the LM curve

According to theory of liquidity preference, a rise in income leads to a higher interest rate (left panel), which is captured by the LM curve (right panel)

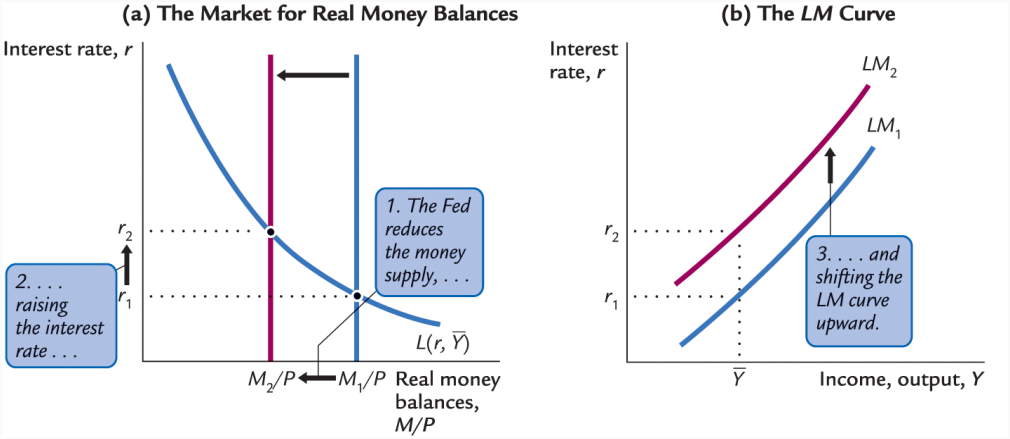


Monetary policy and the LM curve

- LM curve shows interest rate equilibrates money market for any income lvel
- But equilibrium interest rate also depends on supply of real money, $(M/P)^s$
- This means LM curve is drawn for given supply of real money balances, $(M/P)^s = \overline{M}/\overline{P}$
- Hence, if real money balances change, the LM curve shifts
- How does monetary policy affect the LM curve?
  - If Fed reduces money supply ($\downarrow M$), supply of real money falls ($\downarrow M/\overline{P}$), equilibrium interest rate rises ($\uparrow r$) and the LM curve shifts upward
  - If Fed increases money supply ($\uparrow M$), supply of real money increases ($\uparrow M/\overline{P}$), equilibrium interest rate falls ($\downarrow r$) and the LM curve shifts downward

Monetary policy and the LM curve

If the Fed reduces the money supply, the supply of real money falls, the equilibrium interest rate rises and the LM curve shifts upward



Taking Stock

Putting it all together: IS-LM model

- Two key equations:

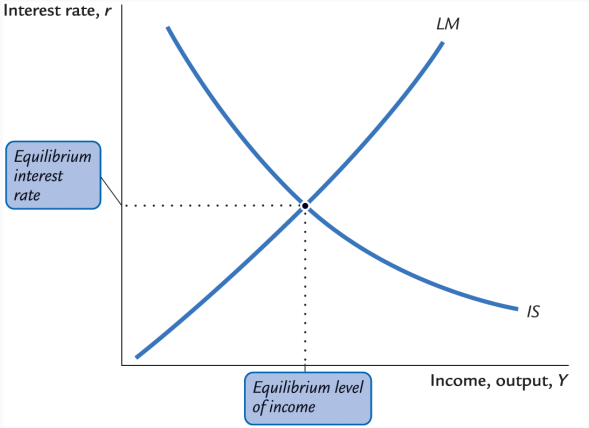
$$Y = C(Y - T) + I(r) + G \qquad (IS \text{ curve})$$

$$\frac{M}{P} = L(r, Y) \qquad (LM \text{ curve})$$

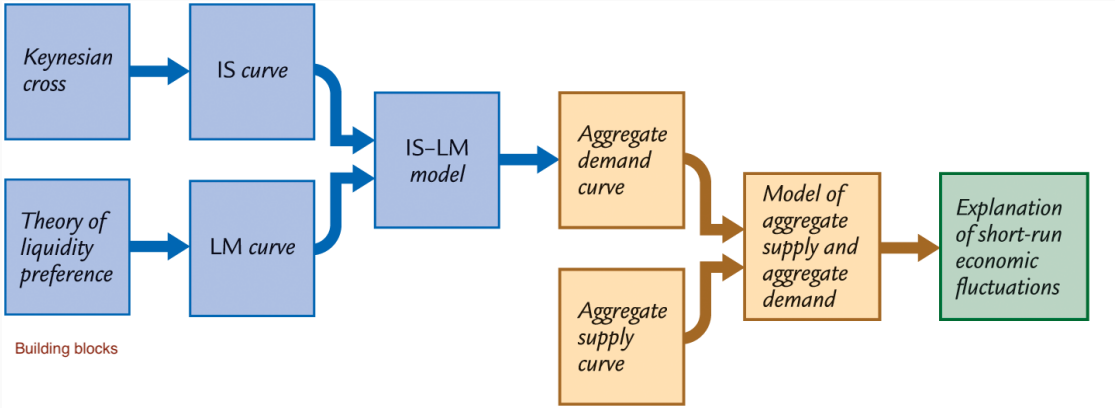
- Exogenous: fiscal (G, T) and monetary policy (M) variables + sticky prices P
- Given exogenous variables:
  - IS curve gives combinations of interest rate r and income Y that satisfy the equation representing the goods market
  - LM curve gives combinations of interest rate r and income Y that satisfy the equation representing the money market
- Short-run equilibrium of economy given by intersection of IS & LM curves

Putting it all together: IS-LM model

In the short-run equilibrium, actual expenditures equal planned expenditures (Keynesian cross) and demand for real money equals its supply (theory of liquidity pref.)



Putting it all together: IS-LM model



Questions?

Thank You!

(Email: luisperez@smu.edu)

(Website: `https://luisperezecon.com`)