Aggregate Demand I

(chapter 10)

macroeconomics

fifth edition

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PowerPoint® Slides
by Ron Cronovich

Motivation

- The Great Depression caused a rethinking of the Classical Theory of the macroeconomy. It could not explain:
  - Drop in output by 30% from 1929 to 1933
  - Rise in unemployment to 25%
- In 1936, J.M. Keynes developed a theory to explain this phenomenon.
- We will learn a version of this theory, called the 'IS-LM' model.

Context

- Chapter 9 introduced the model of aggregate demand and aggregate supply.
- 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 is negatively related to output

Context

- This chapter develops the *IS-LM* model, the theory that yields the aggregate demand curve.
- We focus on the short run and assume the price level is fixed.

The Keynesian Cross

- A simple closed economy model in which income is determined by expenditure.
  (due to J.M. Keynes)
- Notation:
  $\boldsymbol{I}$ = *planned* investment
  $\boldsymbol{E} = \boldsymbol{C} + \boldsymbol{I} + \boldsymbol{G}$ = planned expenditure
  $\boldsymbol{Y}$ = real GDP = actual expenditure
- Difference between actual & planned expenditure: unplanned inventory investment

Elements of the Keynesian Cross

consumption function: $C = C(Y - T)$

govt policy variables: $G = \bar{G}, \quad T = \bar{T}$

for now,
investment is exogenous: $I = \bar{I}$

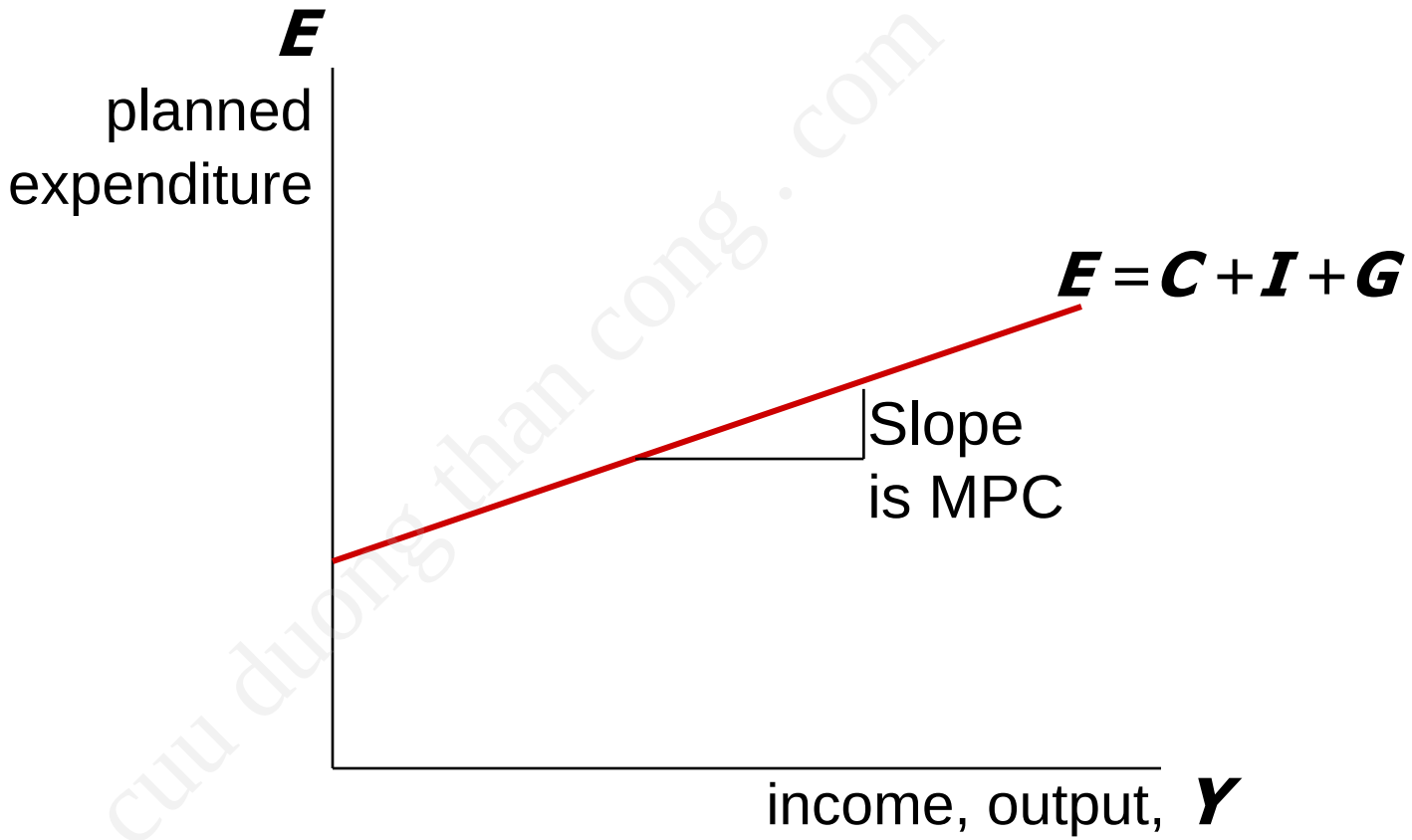
planned expenditure: $E = C(Y - \bar{T}) + \bar{I} + \bar{G}$

Equilibrium condition:

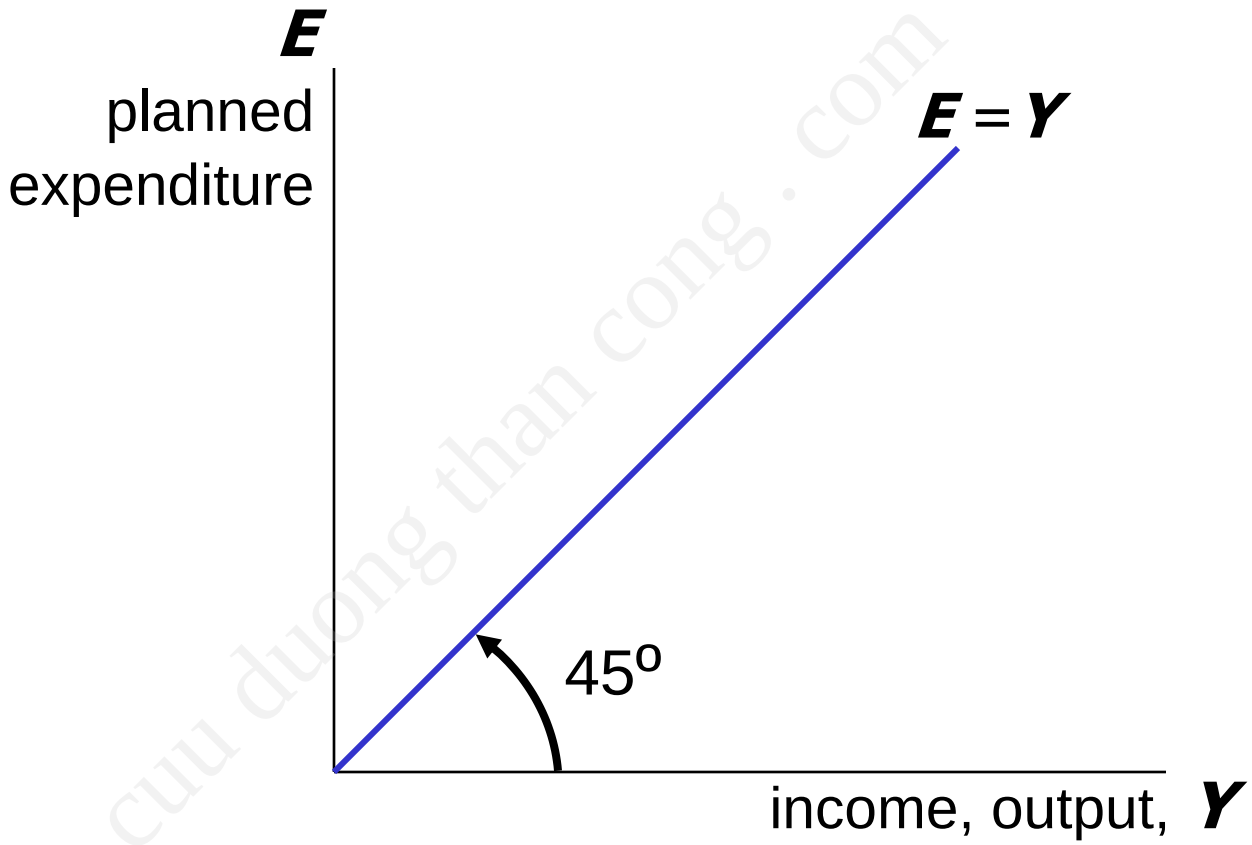
Actual expenditure = Planned expenditure

$Y = E$

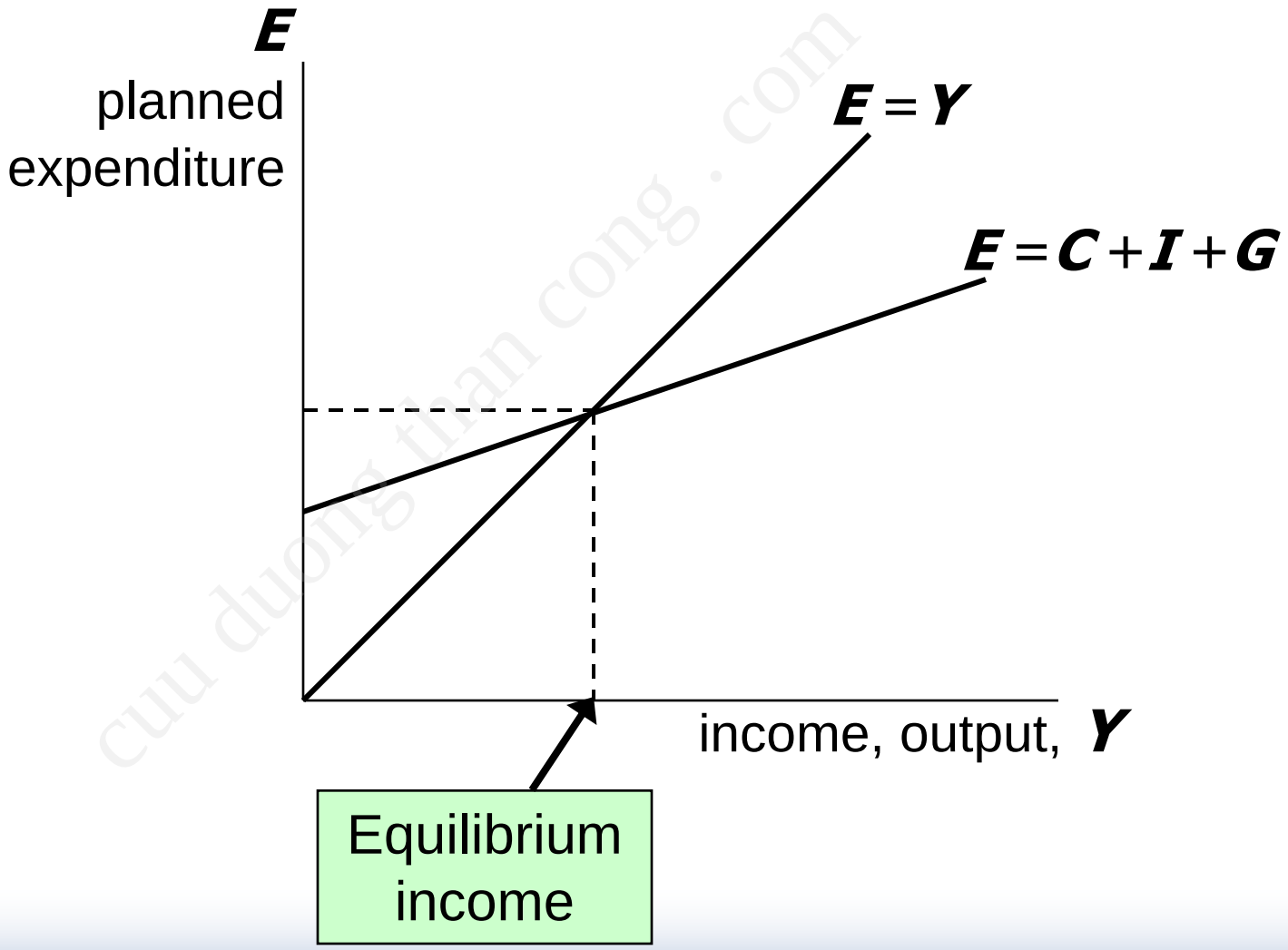
Graphing planned expenditure



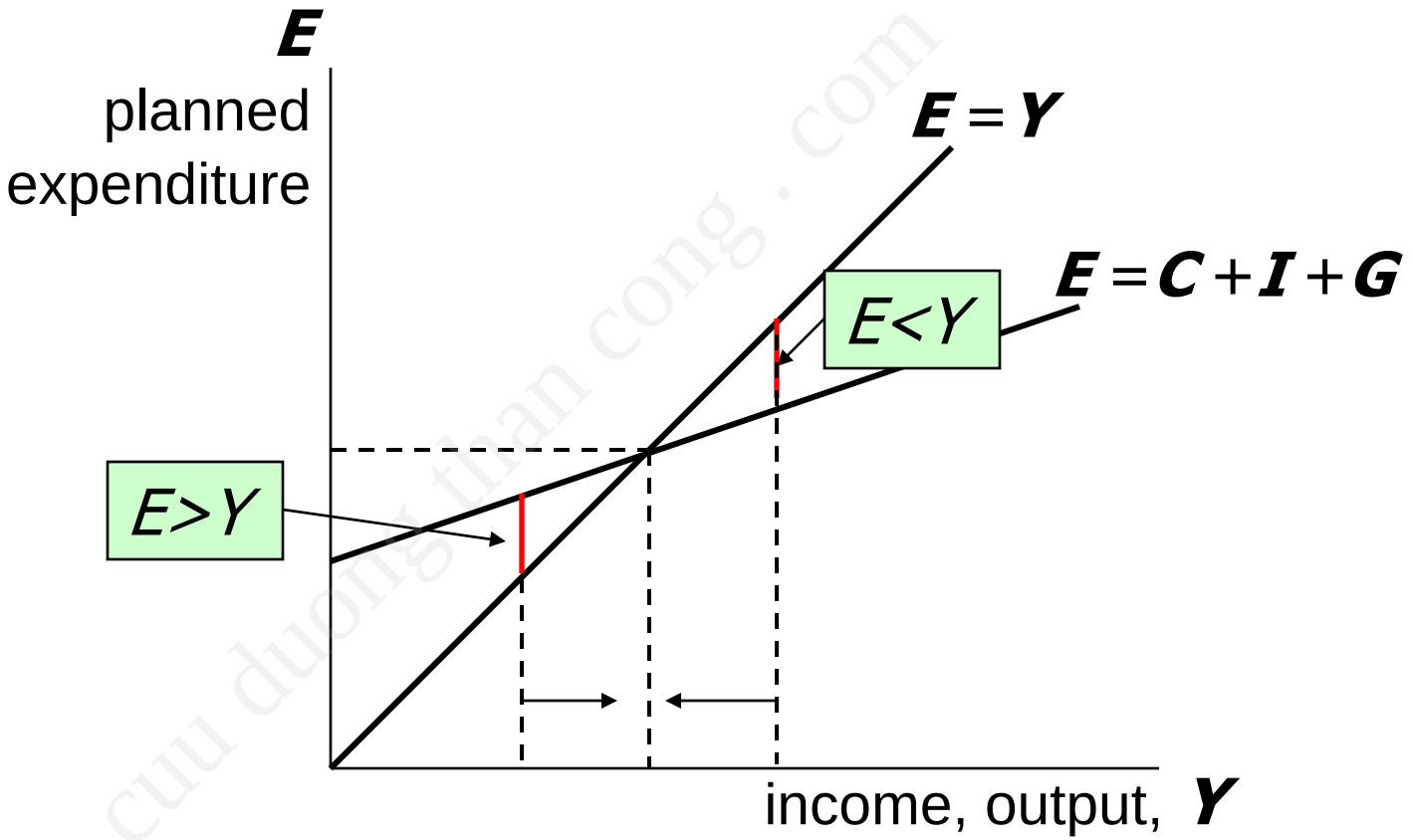
Graphing the equilibrium condition



The equilibrium value of income



The equilibrium value of income



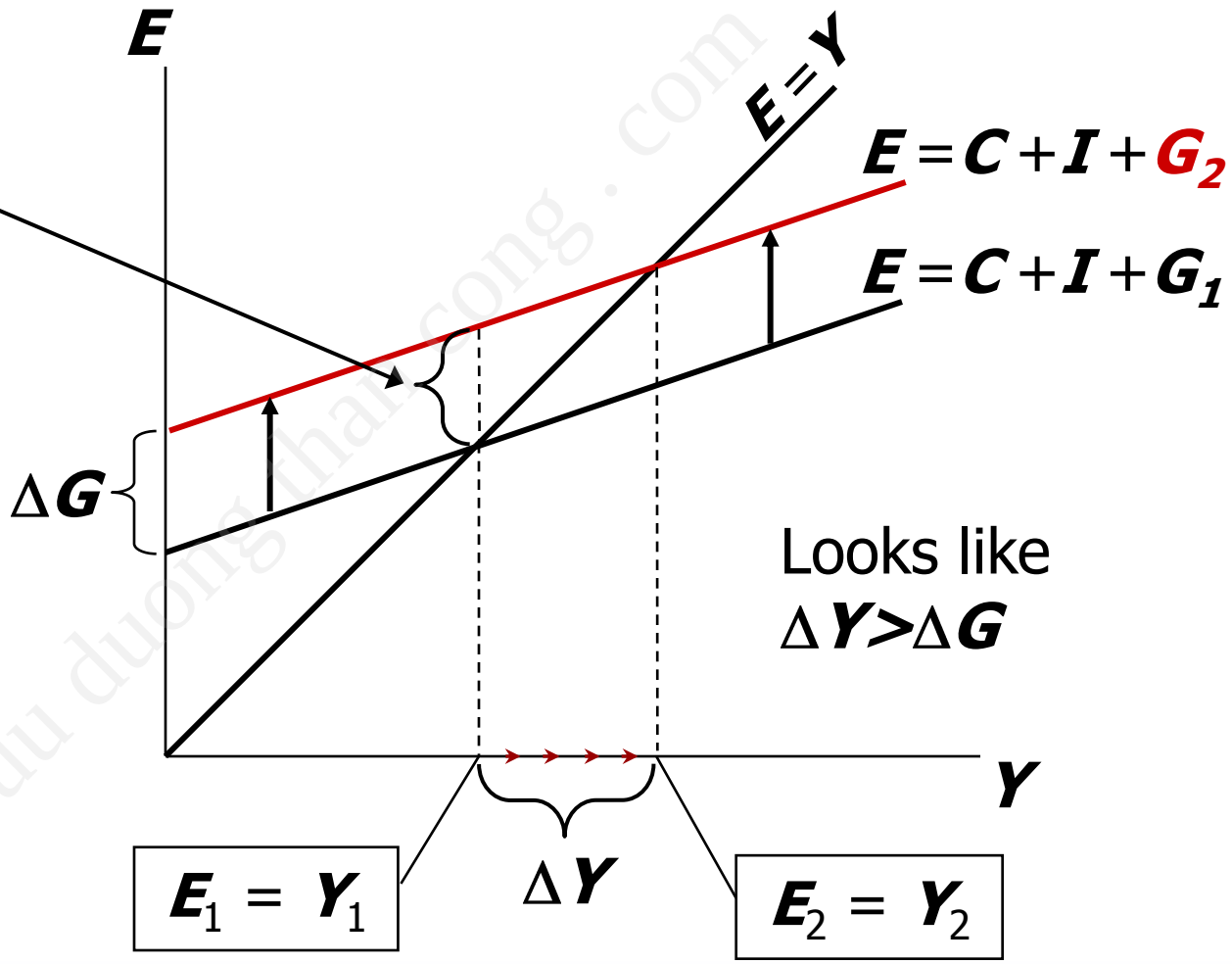
E>Y: depleting inventories: must produce more.

E<Y: accumulating inventories: must produce less.

An increase in government purchases

At Y_1,
there is now an unplanned drop in inventory…

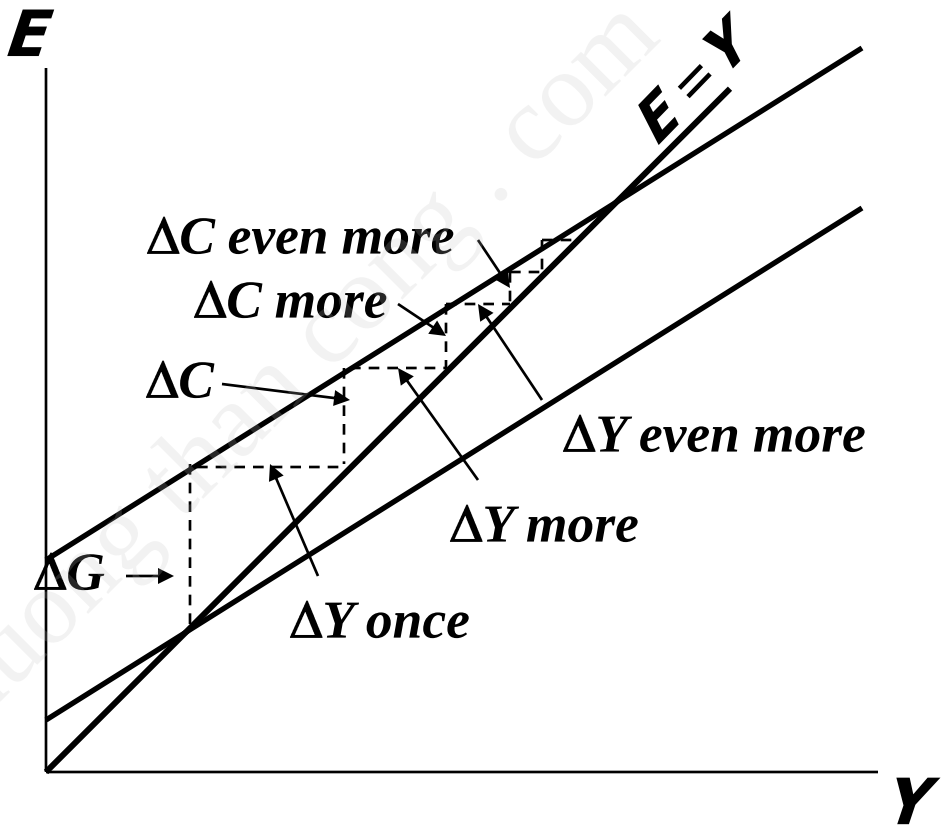
…so firms increase output, and income rises toward a new equilibrium



Why the multiplier is greater than 1

- Def: Government purchases multiplier: $\Delta Y / \Delta G$
- Initially, the increase in G causes an equal increase in Y: $\Delta Y = \Delta G$.
- But $\uparrow Y \Rightarrow \uparrow C$
  $\Rightarrow$ further $\uparrow Y$
  $\Rightarrow$ further $\uparrow C$
  $\Rightarrow$ further $\uparrow Y$
- So the government purchases multiplier will be greater than one.

An increase in government purchases



Sum up changes in expenditure

$$\Delta Y = \Delta G + MPC \bullet \Delta G + MPC\ MPC \bullet \Delta G$$

$$+ MPC\ MPC\ MPC \bullet \Delta G + \ldots$$

$$= \Delta G + MPC^{1}\Delta G + MPC^{2}\Delta G + MPC^{3}\Delta G \ldots$$

This is a standard geometric series from algebra:

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

So the multiplier is:

$$\frac{\Delta Y}{\Delta G} = \frac{1}{1 - MPC} > 1 \text{ for } 0 < MPC < 1$$

Solving for ΔY

$$Y = C + I + G$$ equilibrium condition

$$\Delta Y = \Delta C + \Delta I + \Delta G$$ in changes

$$= \Delta C + \Delta G$$ because I exogenous

$$= MPC \times \Delta Y + \Delta G$$ because $\Delta C = MPC\ \Delta Y$

Collect terms with ΔY on the left side of the equals sign:

$$(1 - MPC) \times \Delta Y = \Delta G$$

Finally, solve for ΔY:

$$\Delta Y = \left(\frac{1}{1 - MPC} \right) \times \Delta G$$

Algebra example

Suppose consumption function: $C = a + b(Y - T)$

where a and b are some numbers (MPC $= b$)

and other variables exogenous:

$$I = \overline{I}, T = \overline{T}, G = \overline{G}$$

Use Goods market equilibrium condition:

$$Y = C + I + G$$

Algebra example

$$Y = C + I + G$$

$$Y = a + b(Y - \overline{T}) + \overline{I} + \overline{G}$$

Solve for Y: $Y - bY = a - b\overline{T} + \overline{I} + \overline{G}$

$$(1 - b)Y = a - b\overline{T} + \overline{I} + \overline{G}$$

$$Y = \frac{1}{1-b}\overline{G} + \frac{1}{1-b}\overline{I} + \frac{a}{1-b} - \frac{b}{1-b}\overline{T}$$

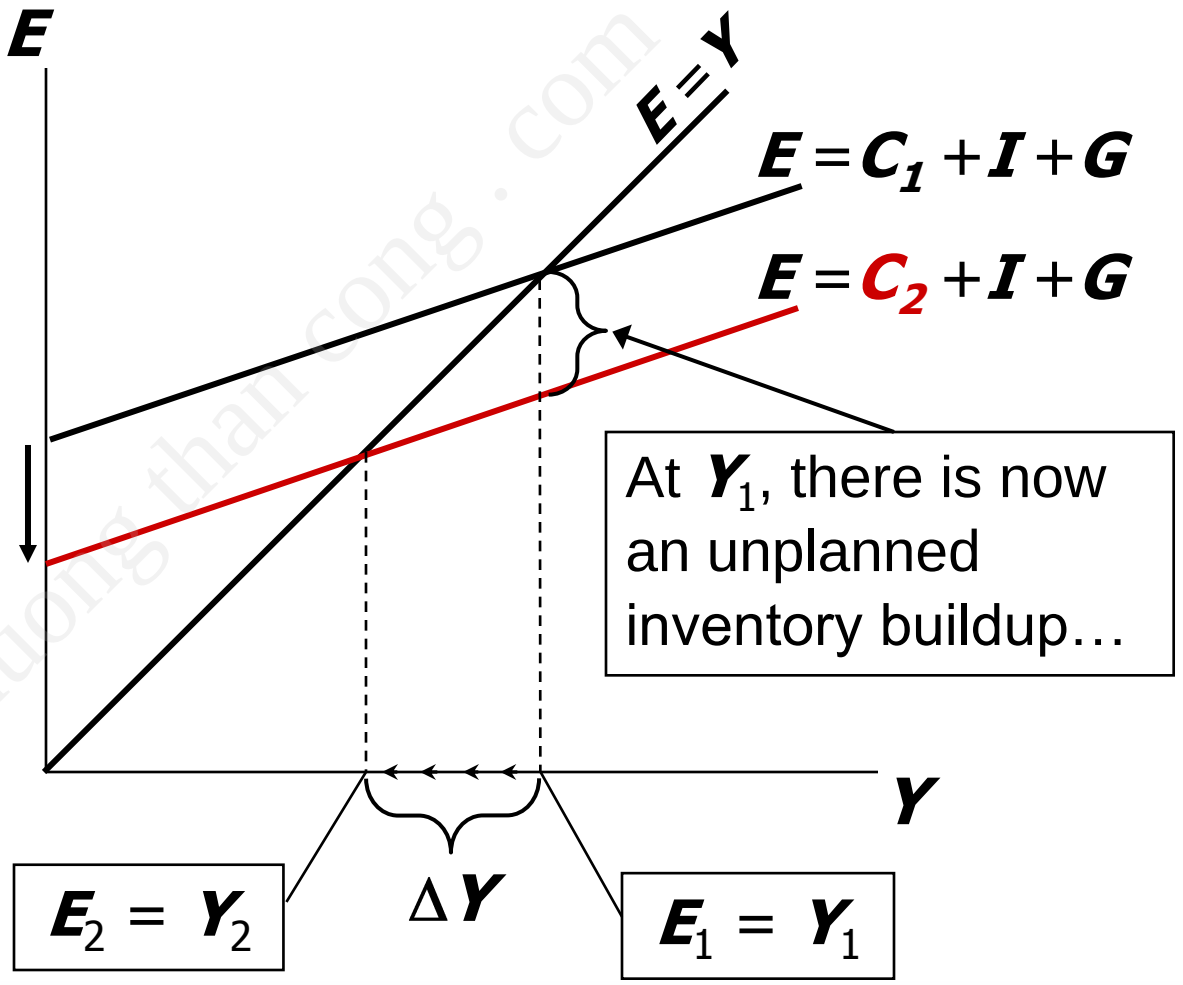
So if b=MPC=0.75, multiplier = 1/(1 - 0.75) = 4.

An increase in taxes

Initially, the tax increase reduces consumption, and therefore E:

$\Delta C = -\text{MPC}\,\Delta T$

…so firms reduce output, and income falls toward a new equilibrium



Tax multiplier

Define tax multiplier: how much does output fall for a unit rise in taxes: $\Delta Y / \Delta T$

Can read the tax multiplier from the algebraic solution above:

$$Y = \frac{1}{1-b}\bar{G} + \frac{1}{1-b}\bar{I} + \frac{a}{1-b} - \frac{b}{1-b}\bar{T}$$

So: $\Delta Y = \left(\frac{-b}{1-b}\right) \cdot \Delta T$ where b is the MPC.

If b=0.75, tax multiplier = -0.75/(1 - 0.75) = -3.

Solving for ΔY

$$\Delta Y = \Delta C + \Delta I + \Delta G$$

eq'm condition in changes

$$= \Delta C$$

I and G exogenous

$$= MPC \times \Delta Y - \Delta T$$

Solving for ΔY: $(1 - MPC) \times \Delta Y = -MPC \times \Delta T$

Final result:

$$\Delta Y = \left(\frac{-MPC}{1 - MPC} \right) \times \Delta T$$

The Tax Multiplier

Question: how is this different from the government spending multiplier considered previously?

The tax multiplier:

…is *negative:*
An increase in taxes reduces consumer spending, which reduces equilibrium income.

…is *smaller than the govt spending multiplier:*
(in absolute value) Consumers save the fraction (1-MPC) of a tax cut, so the initial boost in spending from a tax cut is smaller than from an equal increase in ***G***.

A question to consider:

- Using the Keynesian Cross, what would be the effect of an increase in investment on the equilibrium level of income/output.

Building the *IS* curve

def: a graph of all combinations of ***r*** and ***Y*** that result in goods market equilibrium,

i.e. actual expenditure (output)
= planned expenditure

The equation for the *IS* curve is:

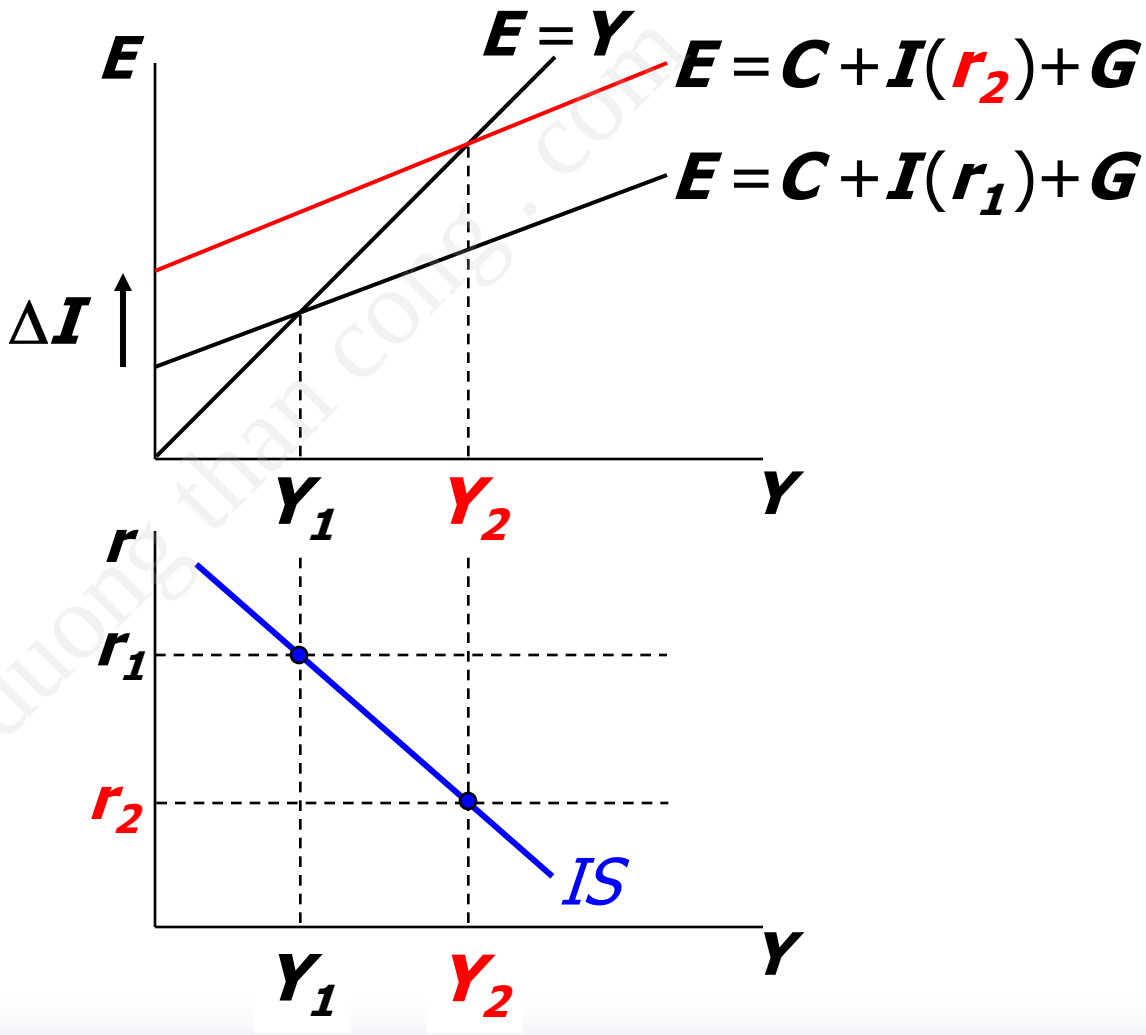
$$Y = C(Y - \overline{T}) + I(r) + \overline{G}$$

Deriving the *IS* curve

$\downarrow r \Rightarrow \uparrow I$

$\Rightarrow \uparrow E$

$\Rightarrow \uparrow Y$



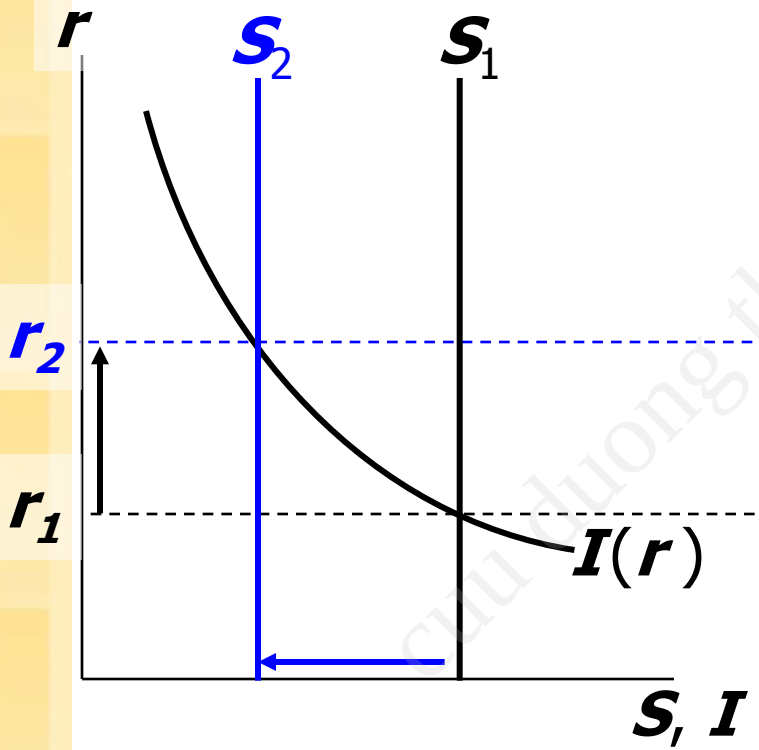
Understanding the *IS* curve's slope

- The *IS* curve is negatively sloped.
- Intuition:
  A fall in the interest rate motivates firms to increase investment spending, which drives up total planned spending (***E***).

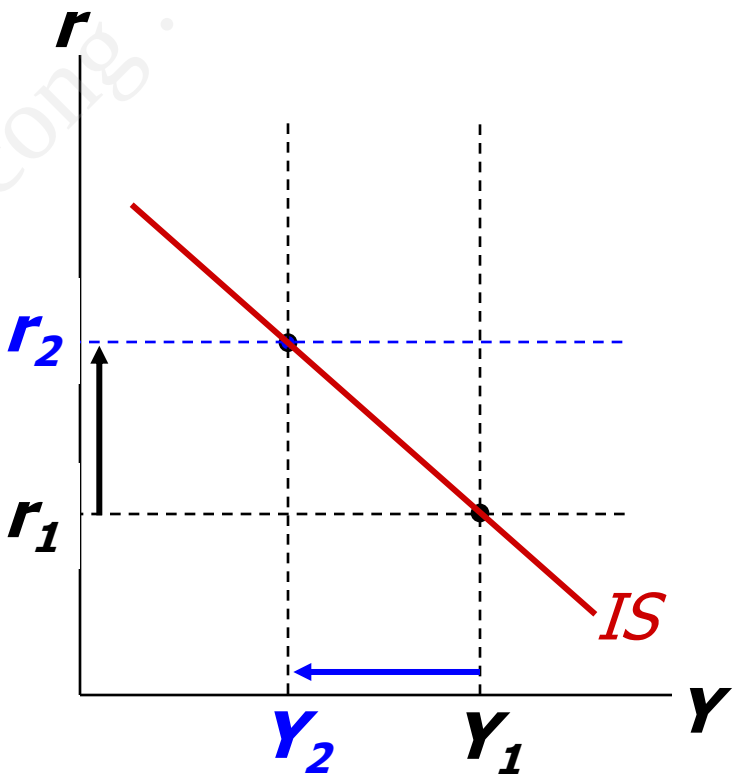
  To restore equilibrium in the goods market, output (a.k.a. actual expenditure, ***Y***) must increase.

The IS curve and the Loanable Funds model

(a) The L.F. model



(b) The *IS* curve



Fiscal Policy and the *IS* curve

- We can use the *IS-LM* model to see how fiscal policy (***G*** and ***T***) can affect aggregate demand and output.
- Let's start by using the Keynesian Cross to see how fiscal policy shifts the *IS* curve…

Shifting the *IS* curve: ΔG

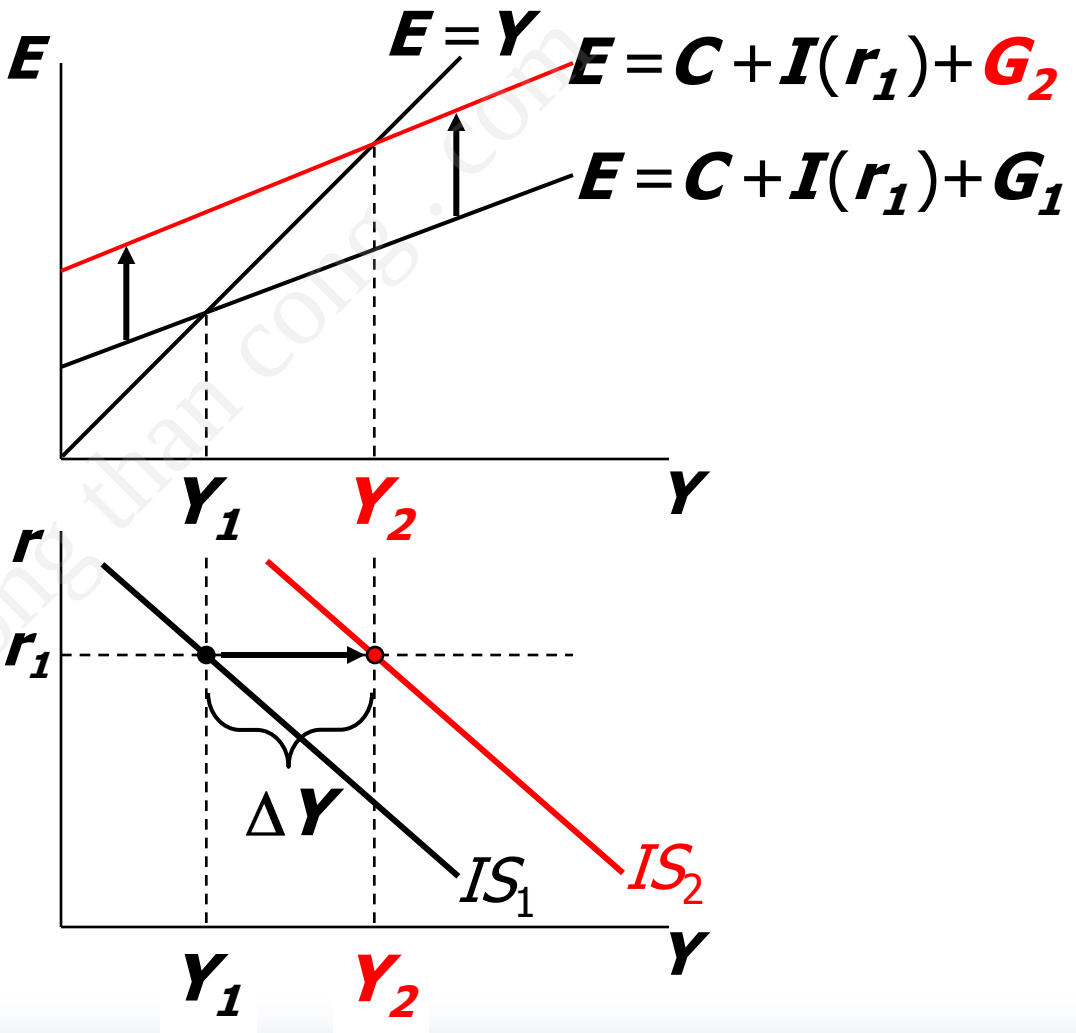
At any value of r,

$\uparrow G \Rightarrow \uparrow E \Rightarrow \uparrow Y$

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

The horizontal distance of the IS shift equals

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



Algebra example for IS curve

Suppose the expenditure side of the economy is characterized by:

$$C = 95 + 0.75(Y-T)$$
$$I = 100 - 100r$$
$$G = 20, \quad T = 20$$

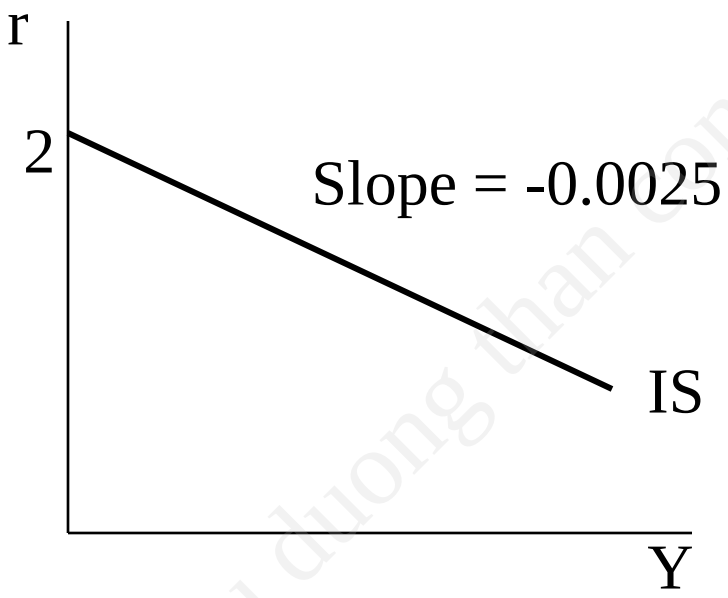
Use the goods market equilibrium condition

$$Y = C + I + G$$
$$Y = 215 + 0.75\,(Y-20) - 100r$$
$$0.25Y = 200 - 100r$$

IS: $Y = 800 - 400r$ or write as

IS: $r = 2 - 0.0025Y$

Graph the IS curve



IS: ***r = 2 - 0.0025Y***

Slope of IS curve

Suppose that investment expenditure is "more responsive" to the interest rate:

$$I = 100 - \cancel{100}r \; 200r$$

Use the goods market equilibrium condition

$$Y = C + I + G$$

$$Y = 215 + 0.75\,(Y-20) - 200r$$

$$0.25Y = 200 - 200r$$

IS: $Y = 800 - 800r$ or write as

IS: $r = 1 - 0.00125Y$ (slope is lower)

So this makes the IS curve flatter: A fall in r raises I more, which raises Y more.

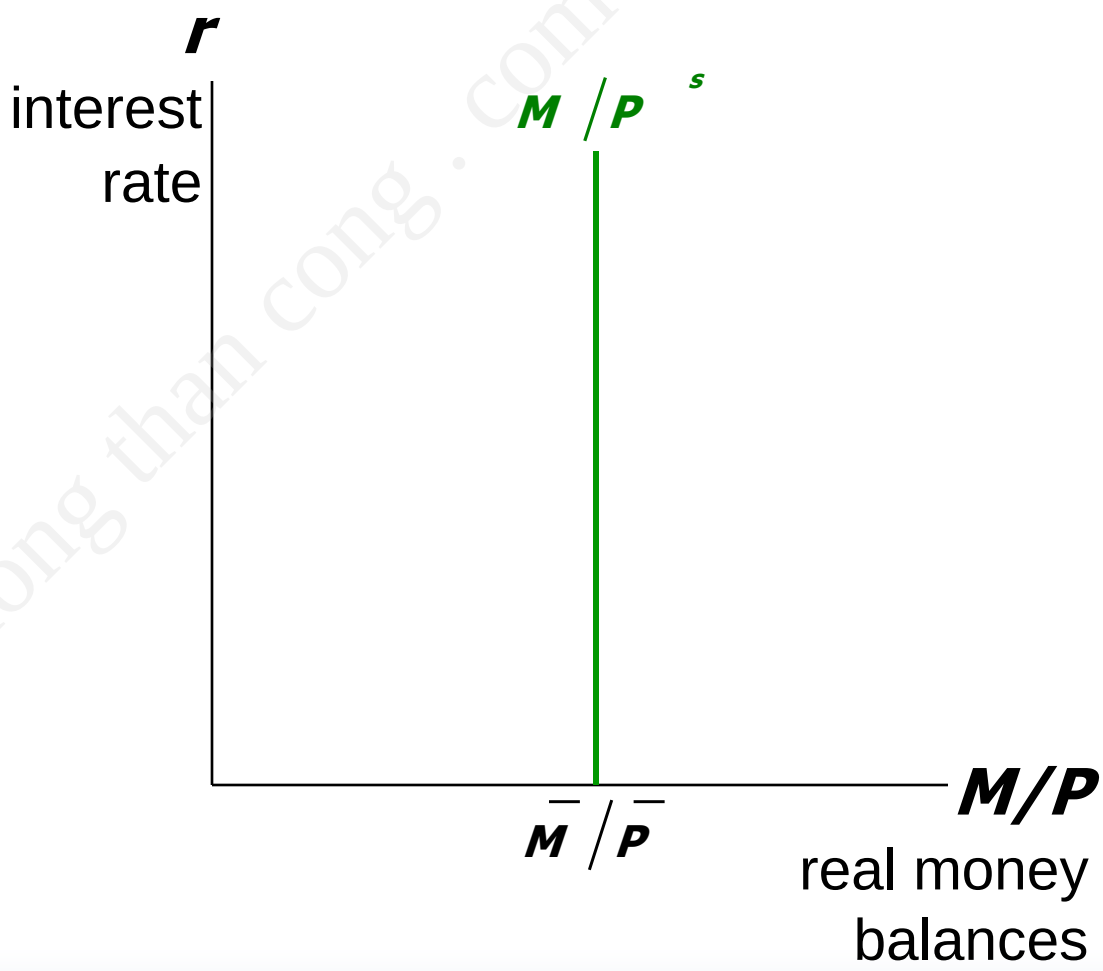
Building the LM Curve: The Theory of Liquidity Preference

- due to John Maynard Keynes.
- A simple theory in which the interest rate is determined by money supply and money demand.

Money Supply

The supply of real money balances is fixed:

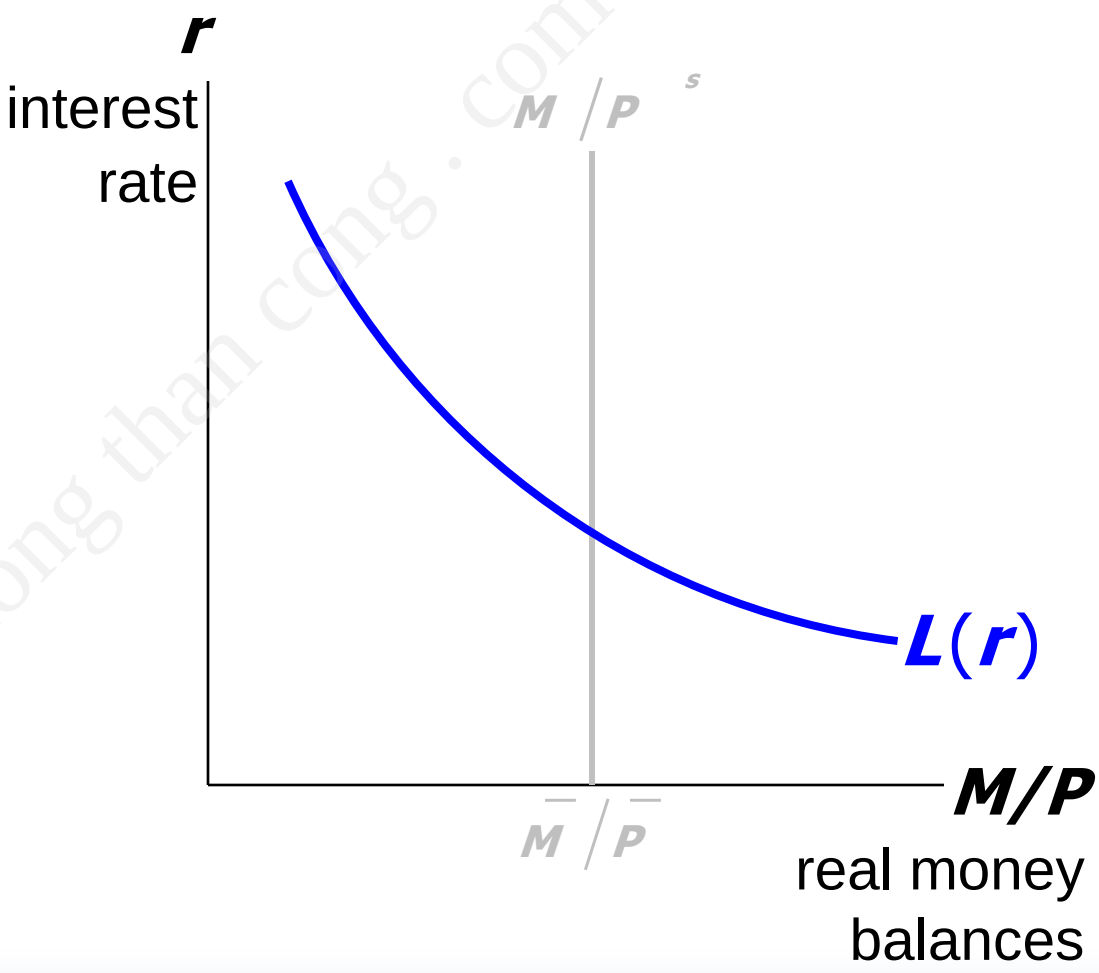
$$M/P^{s} = \bar{M}/\bar{P}$$



Money Demand

Demand for real money balances:

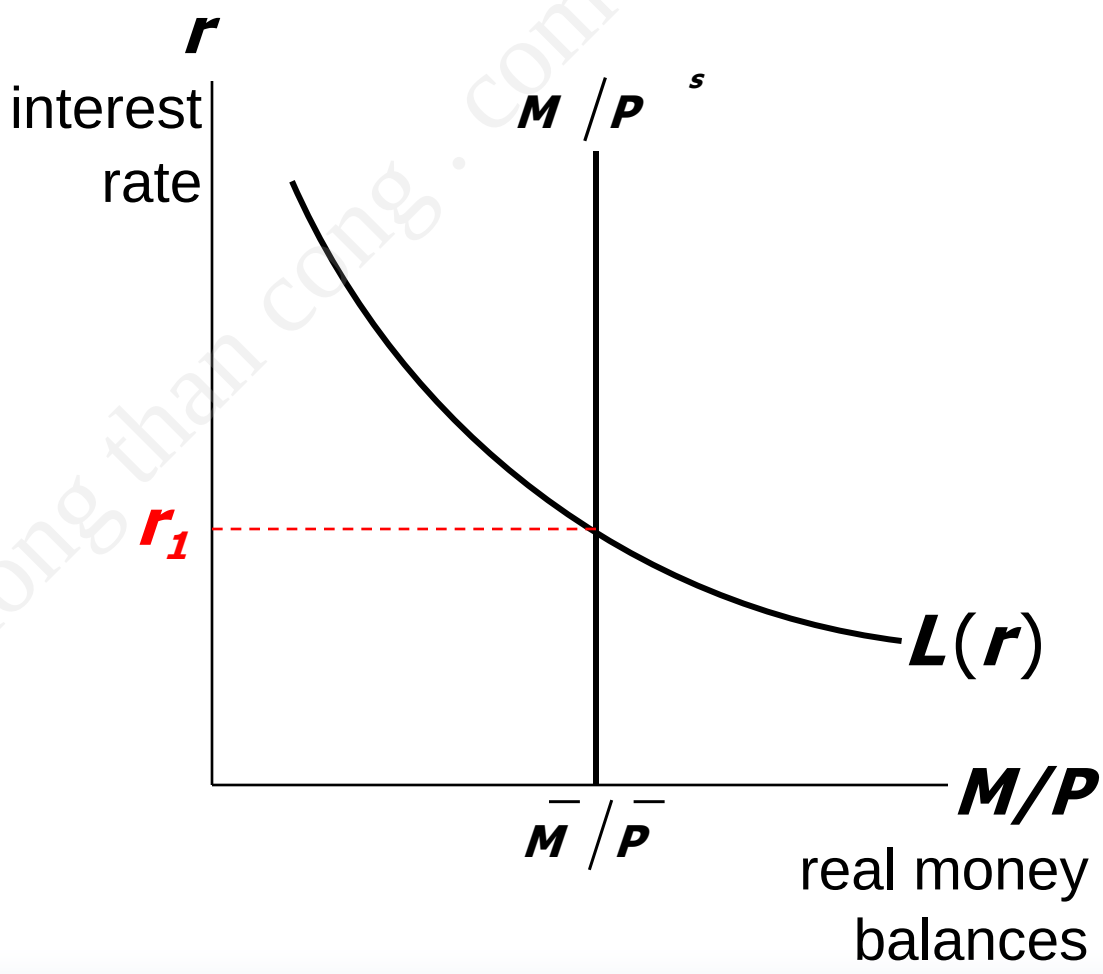
$$M/P^{d} = L(r)$$



Equilibrium

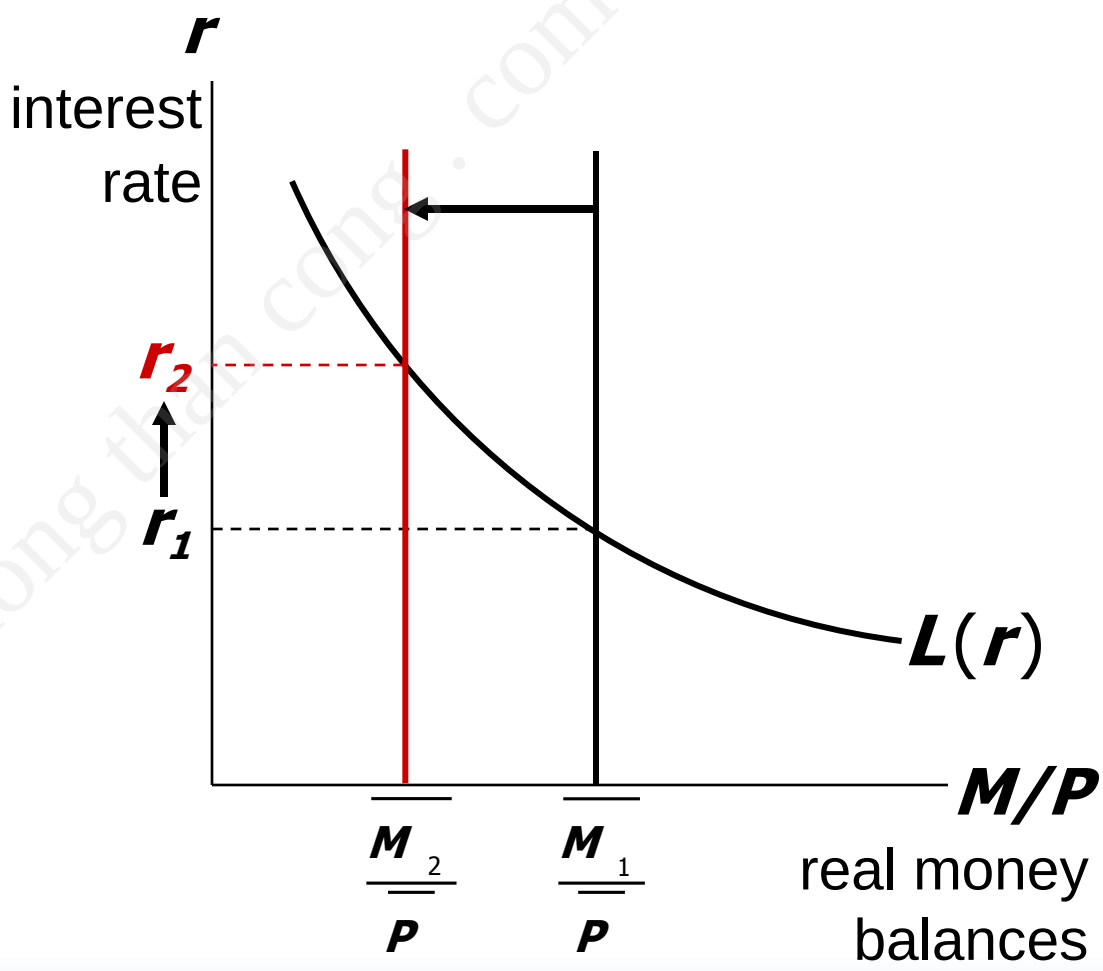
The interest rate adjusts to equate the supply and demand for money:

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



How the Fed raises the interest rate

To increase *r*,
Fed reduces *M*



CASE STUDY

Volcker's Monetary Tightening

- Late 1970s: $\pi > 10\%$
- Oct 1979: Fed Chairman Paul Volcker announced that monetary policy would aim to reduce inflation.
- Aug 1979-April 1980: Fed reduces ***M/P*** 8.0%
- Jan 1983: $\pi = 3.7\%$

How do you think this policy change would affect interest rates?

Volcker's Monetary Tightening, *cont.*

The effects of a monetary tightening on nominal interest rates		
model	short run	long run
	Liquidity Preference *(Keynesian)*	Quantity Theory, Fisher Effect *(Classical)*
prices	sticky	flexible
prediction	$\Delta i > 0$	$\Delta i < 0$
actual outcome	8/1979: $i = 10.4\%$ 4/1980: $i = 15.8\%$	1/1983: $i = 8.2\%$

The LM curve

Now let's put Y back into the money demand function:

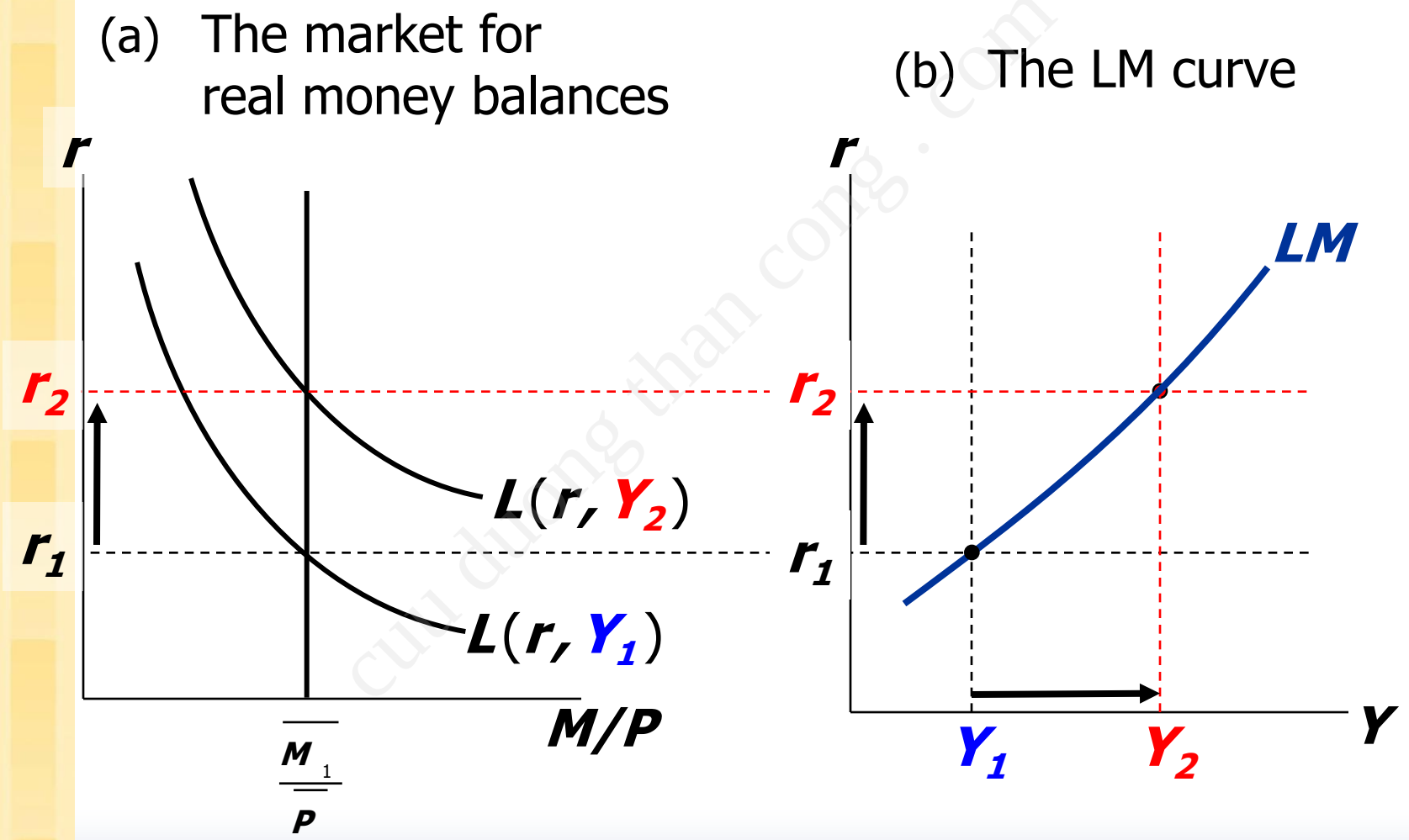
$$M/P^{d} = L(r, Y)$$

The ***LM* curve** is a graph of all combinations of r and Y that equate the supply and demand for real money balances.

The equation for the *LM* curve is:

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

Deriving the LM curve



Understanding the *LM* curve's slope

- The *LM* curve is positively sloped.
- Intuition:
  An increase in income raises money demand.

  Since the supply of real balances is fixed, there is now excess demand in the money market at the initial interest rate.

  The interest rate must rise to restore equilibrium in the money market.

Deriving LM curve with algebra

Suppose a money demand: $M/P^d = eY - fr$

- Where e describes the responsiveness of money demand to changes in income.
- And f describes responsiveness to interest rate.

Suppose money supply: $M/P^s = \overline{M}/\overline{P}$

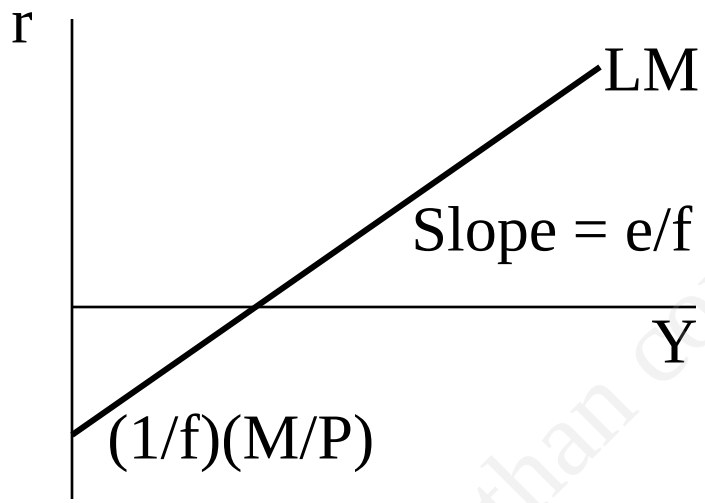
Use money market equilibrium condition:

$$M/P^s = M/P^d$$

So: $\overline{M}/\overline{P} = eY - fr$

or write as: $r = \left(\frac{e}{f}\right)Y - \left(\frac{1}{f}\right)\frac{\overline{M}}{\overline{P}}$

Graph the LM curve



$$r = \left(\frac{e}{f}\right)Y - \left(\frac{1}{f}\right)\frac{\overline{M}}{\overline{P}}$$

A steep LM curve (e/f large) means that a rise in output implies a big rise in interest rate to maintain equilibrium.

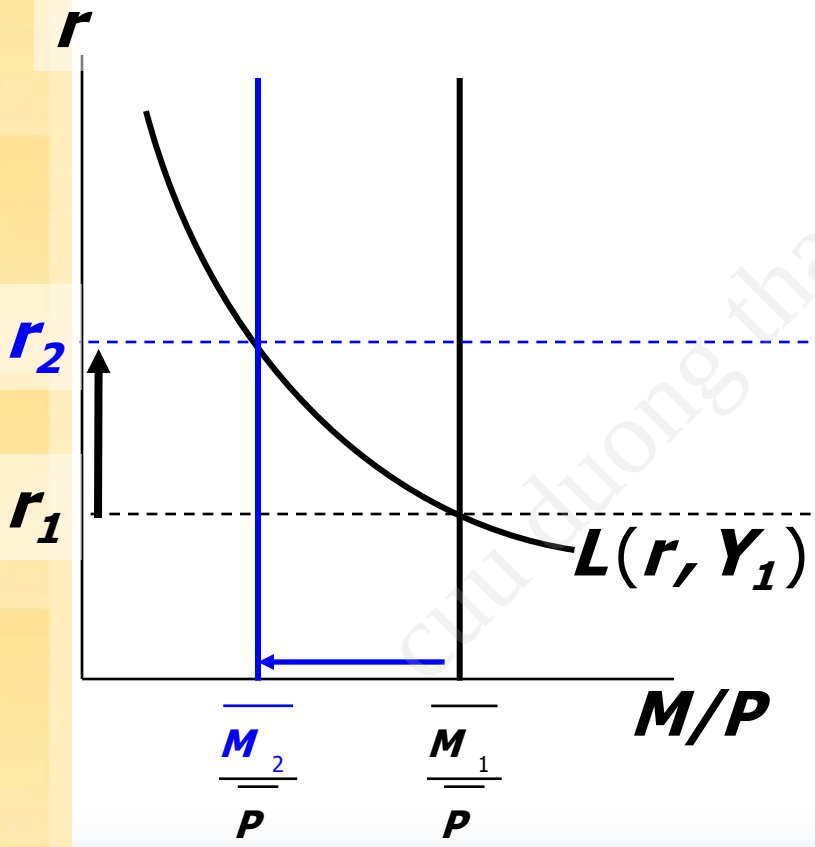
Causes of this:

Money demand is not very responsive to interest rate (f is small)

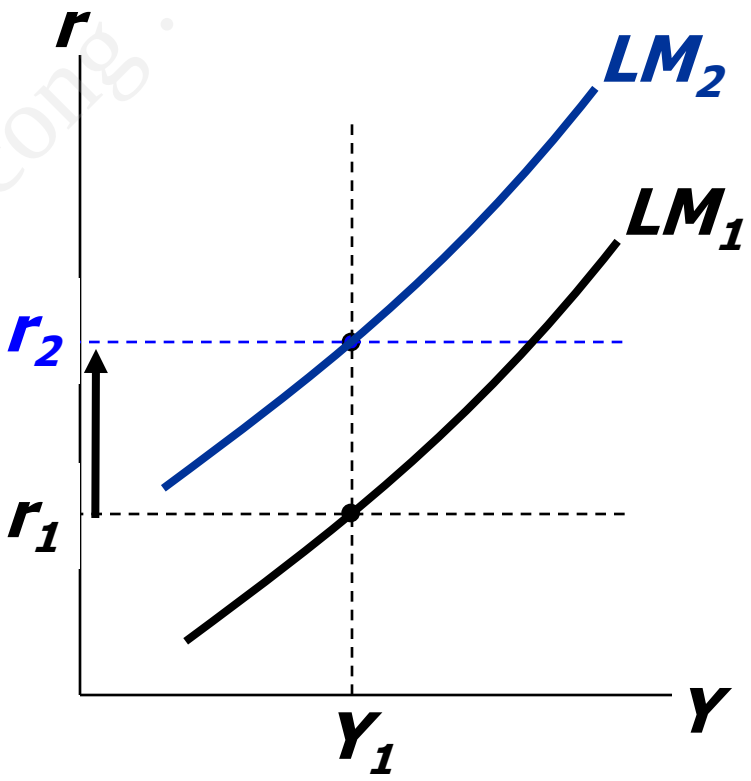
Money demand is very responsive to output (e large)

How ΔM shifts the LM curve

(a) The market for real money balances



(b) The LM curve

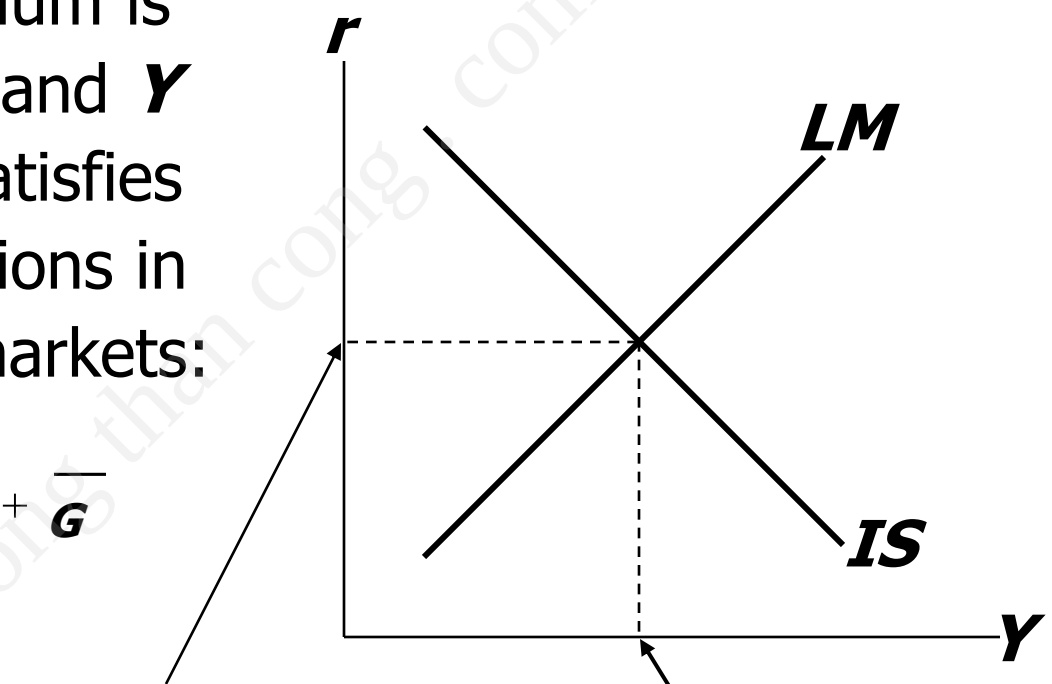


The short-run equilibrium

The short-run equilibrium is the combination of r and Y that simultaneously satisfies the equilibrium conditions in the goods & money markets:

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

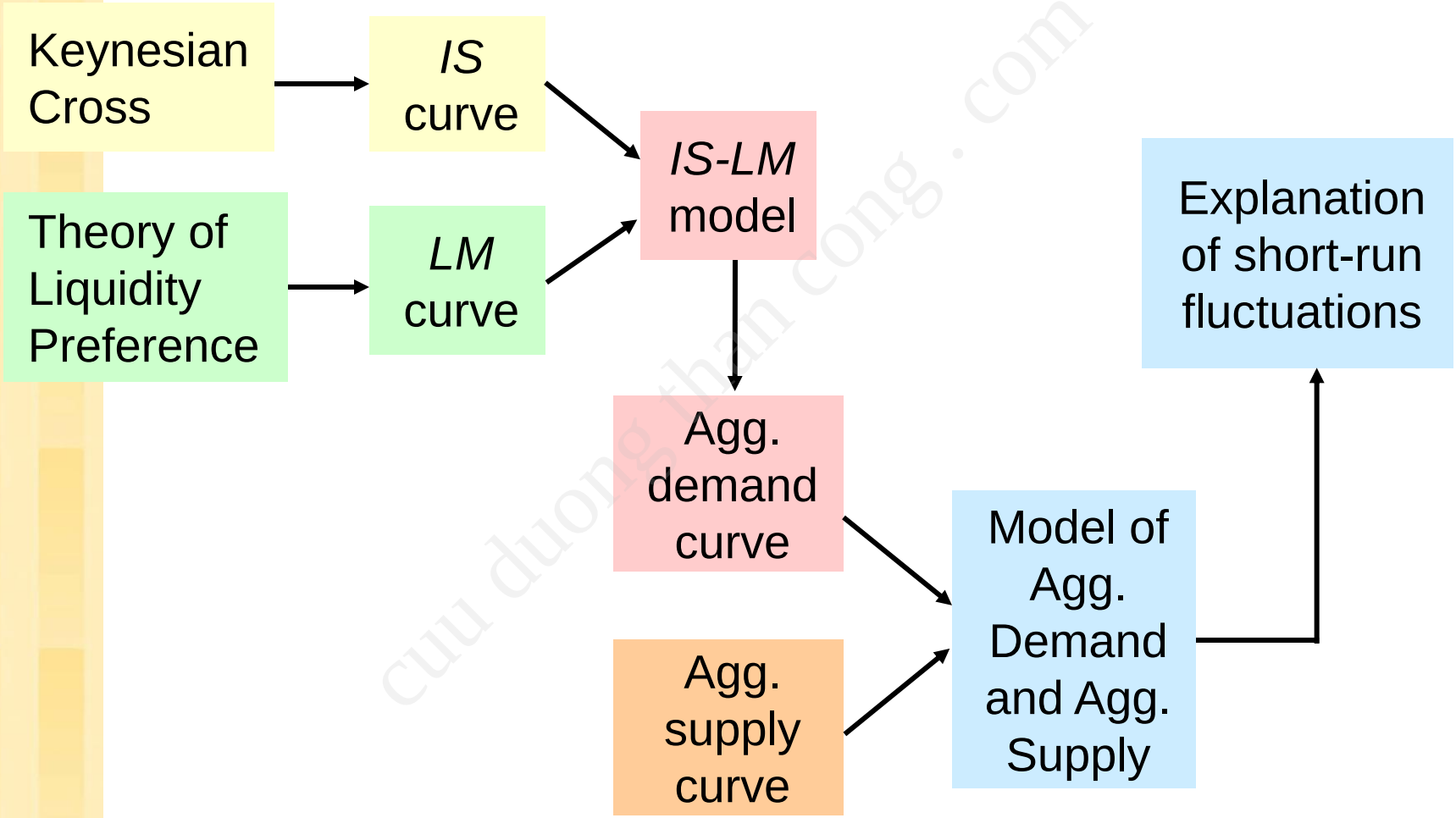
$$\bar{M}/\bar{P} = L(r, Y)$$



Equilibrium interest rate

Equilibrium level of income

The Big Picture



Chapter summary

1. Keynesian Cross
   - basic model of income determination
   - takes fiscal policy & investment as exogenous
   - fiscal policy has a multiplied impact on income.
2. *IS* curve
   - comes from Keynesian Cross when planned investment depends negatively on interest rate
   - shows all combinations of ***r*** and ***Y*** that equate planned expenditure with actual expenditure on goods & services

Chapter summary

3. Theory of Liquidity Preference
   - basic model of interest rate determination
   - takes money supply & price level as exogenous
   - an increase in the money supply lowers the interest rate
4. *LM* curve
   - comes from Liquidity Preference Theory when money demand depends positively on income
   - shows all combinations of ***r*** and ***Y*** that equate demand for real money balances with supply

Chapter summary

5. *IS-LM* model
   - Intersection of *IS* and *LM* curves shows the unique point (***Y***, ***r***) that satisfies equilibrium in both the goods and money markets.

Preview of Chapter 11

In Chapter 11, we will

- use the *IS-LM* model to analyze the impact of policies and shocks
- learn how the aggregate demand curve comes from *IS-LM*
- use the *IS-LM* and *AD-AS* models together to analyze the short-run and long-run effects of shocks
- learn about the Great Depression using our models