

ECON 3010

Intermediate Macroeconomics

Chapter 11

Aggregate Demand I:
Building the IS-LM Model

Context

- Chapter 10 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 negatively related to output

Context

- This chapter develops the *IS-LM* model, the basis of the aggregate demand curve.
- We focus on the short run and assume the price level is fixed (so the *SRAS* curve is horizontal).

The Keynesian cross

- A simple closed-economy model in which income is determined by expenditure.

- Notation:

I = planned investment

$PE = C + I + G$ = planned expenditure

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: $G = \bar{G}, \quad T = \bar{T}$

planned investment: $I = \bar{I}$

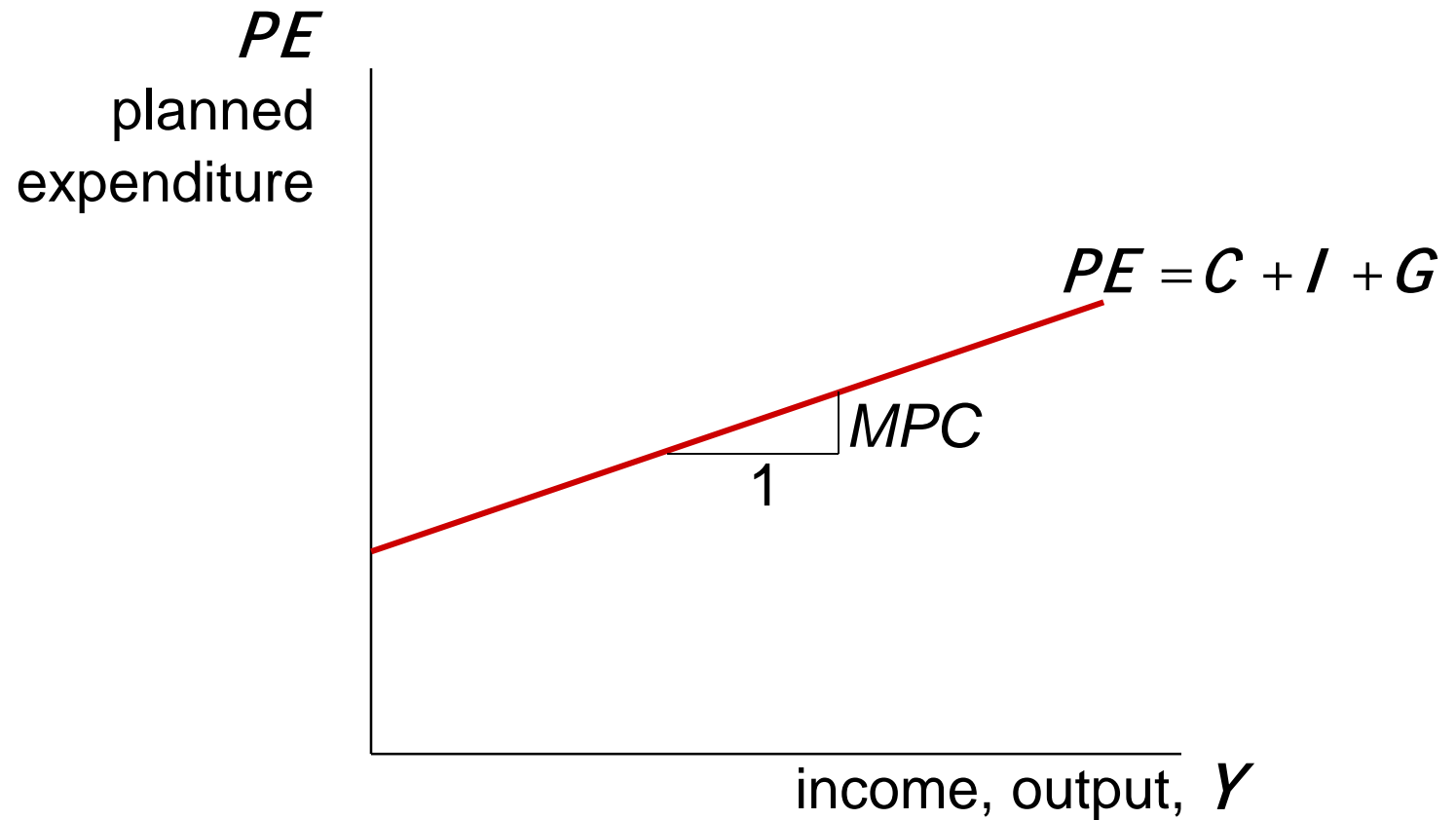
planned expenditure: $PE = C(Y - \bar{T}) + \bar{I} + \bar{G}$

equilibrium condition:

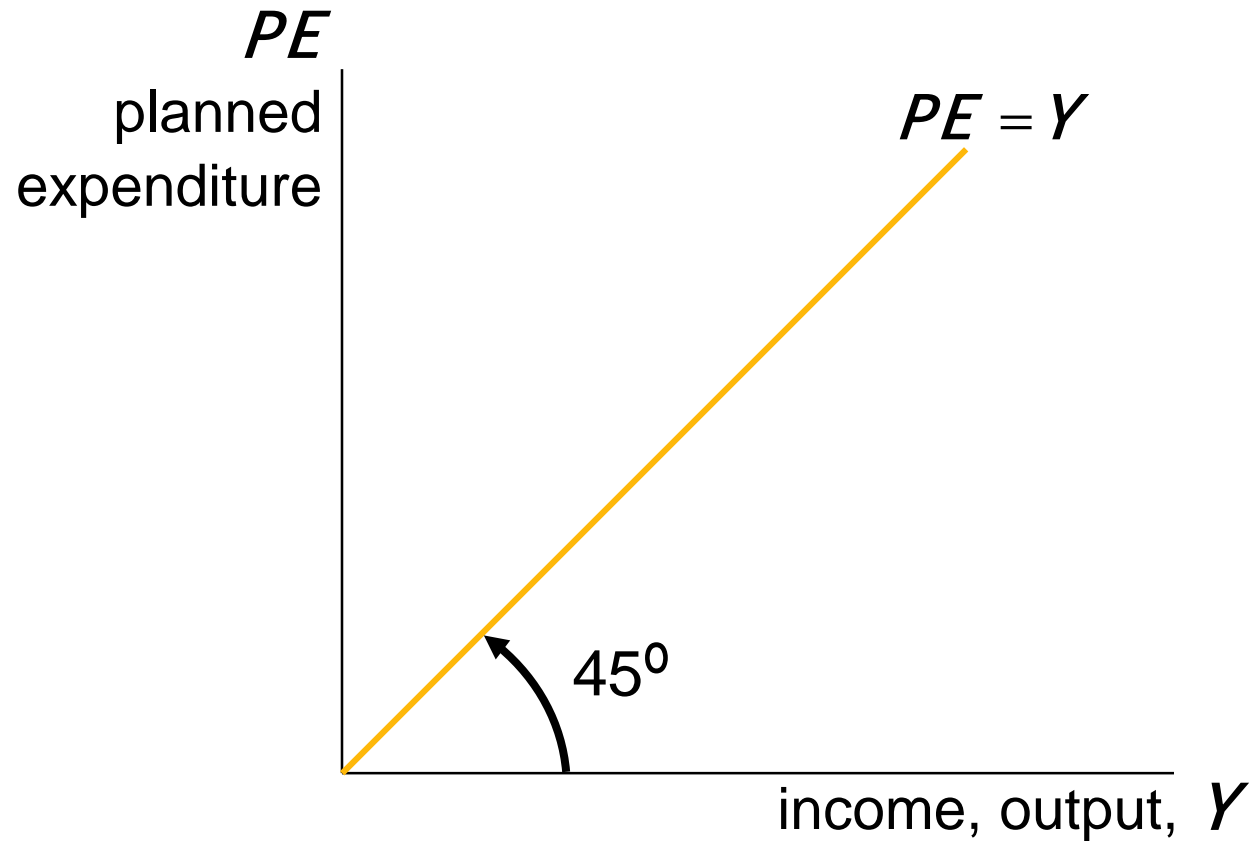
actual expenditure = planned expenditure

$$Y = PE$$

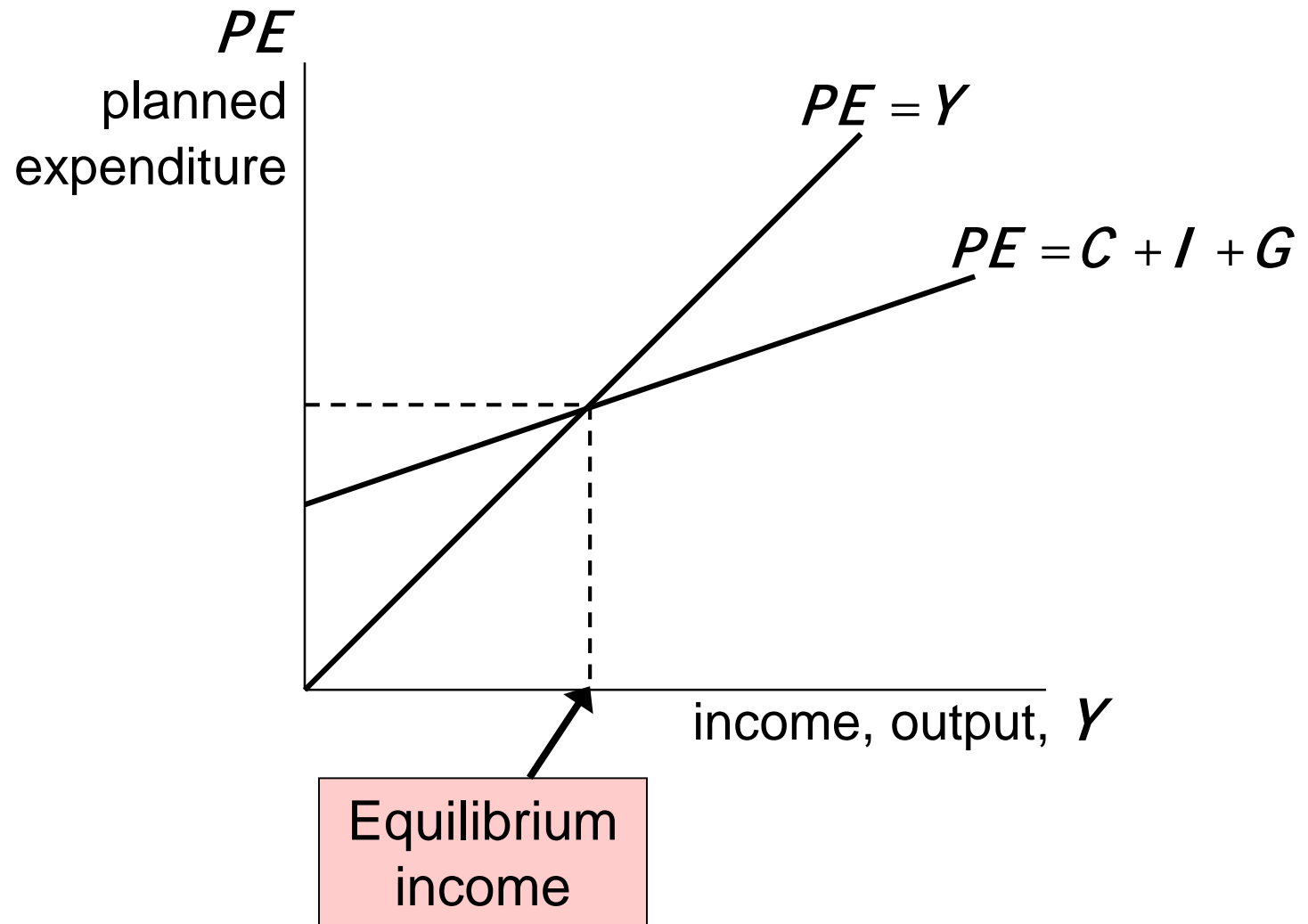
Graphing planned expenditure



Graphing the equilibrium condition



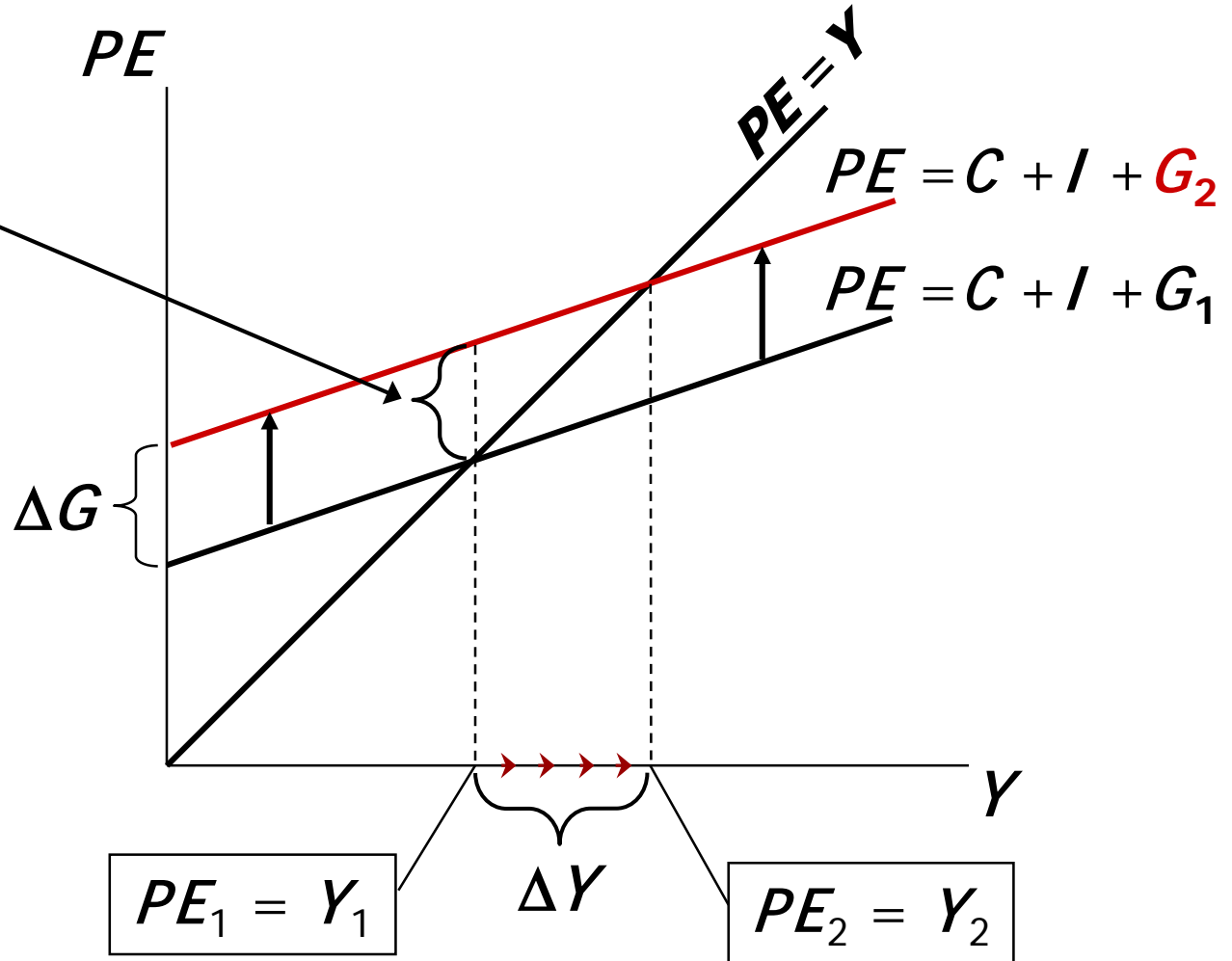
The equilibrium value of income



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.



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

$$= \text{MPC} \times \Delta Y + \Delta G$$

because $\Delta C = \text{MPC} \Delta Y$

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

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

Solve for ΔY :

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

The government spending multiplier

Definition: the increase in income resulting from a \$1 increase in **G**.

In this model, the government purchases multiplier equals

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

Example: If $MPC = 0.8$, then

$$\frac{\Delta Y}{\Delta G} = \frac{1}{1 - 0.8} = 5$$

An increase in **G** causes income to increase 5 times as much!

Why the multiplier is greater than one?

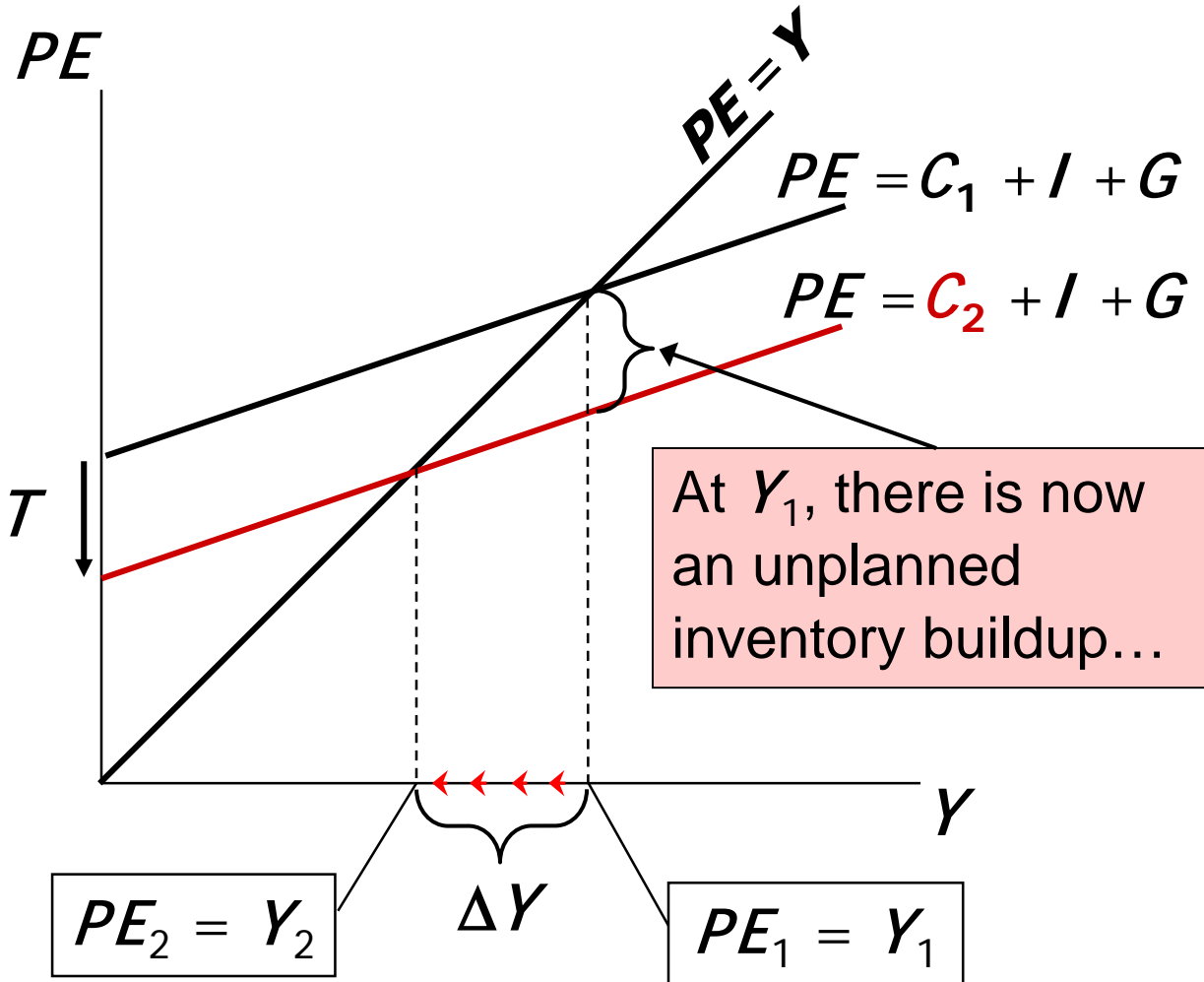
- Initially, the increase in **G** causes an equal increase in **Y**:
 $\Delta Y = \Delta G$.
- But $\uparrow Y \Rightarrow \uparrow C$
 \Rightarrow further $\uparrow Y$
 \Rightarrow further $\uparrow C$
 \Rightarrow further $\uparrow Y$
- So the final impact on income is much bigger than the initial ΔG .

An increase in taxes

Initially, the tax increase reduces consumption and therefore **PE**:

$$\Delta C = -MPC \Delta T$$

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



At Y_1 , there is now an unplanned inventory buildup...

Solving for ΔY

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

eq'm condition in
changes

$$= \Delta C$$

I and G exogenous

$$= \text{MPC} \times (\Delta Y - \Delta T)$$

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

Final result:

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

The tax multiplier

Definition: the change in income resulting from a \$1 increase in T :

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

If $MPC = 0.8$, then the tax multiplier equals

$$\frac{\Delta Y}{\Delta T} = \frac{-0.8}{1 - 0.8} = \frac{-0.8}{0.2} = -4$$

The tax multiplier

...is *negative*:

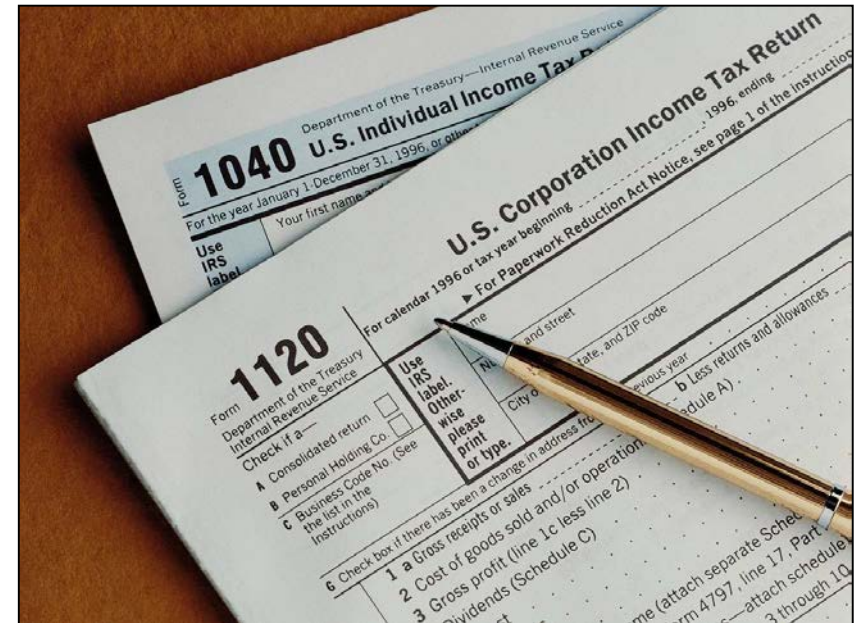
A tax increase reduces **C**,
which reduces income.

...is *greater than one*
(in absolute value):

A change in taxes has a
multiplier effect on income.

...is *smaller than the government spending multiplier*:

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**.



The *IS* curve

Definition: 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:

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

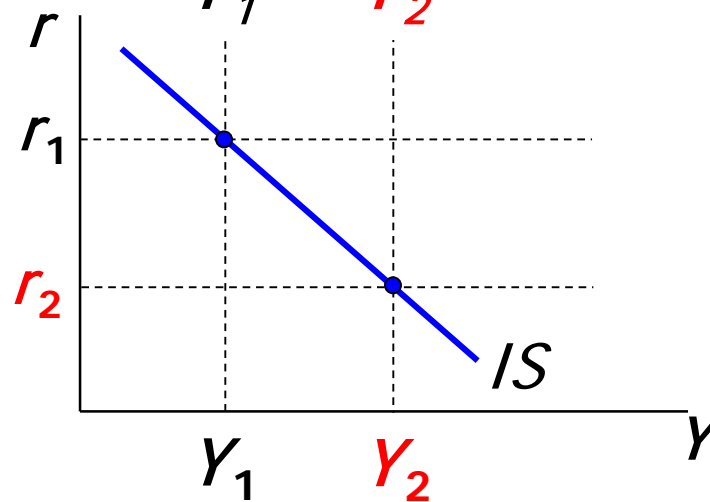
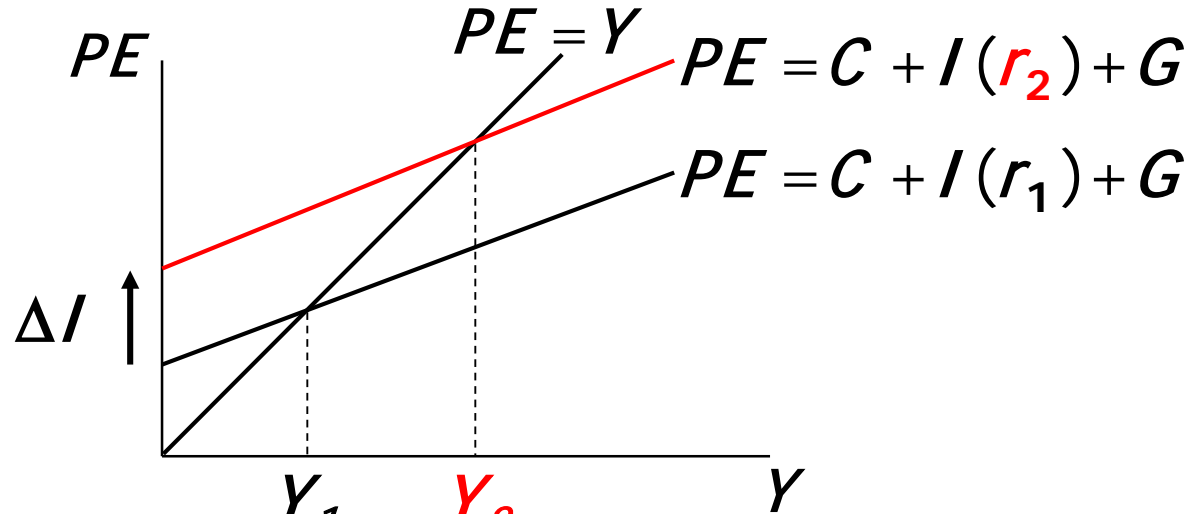
Deriving the IS curve

$\downarrow r$

$\Rightarrow \uparrow I$

$\Rightarrow \uparrow PE$

$\Rightarrow \uparrow Y$



Why the *IS* curve is negatively sloped?

- A fall in the interest rate (r) motivates firms to increase investment spending, which drives up total planned spending (PE).
- To restore equilibrium in the goods market, output (Y) must increase.

Fiscal Policy and the *IS* curve

- We can use the *IS-LM* model to see how fiscal policy (***G*** and ***T***) affects 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

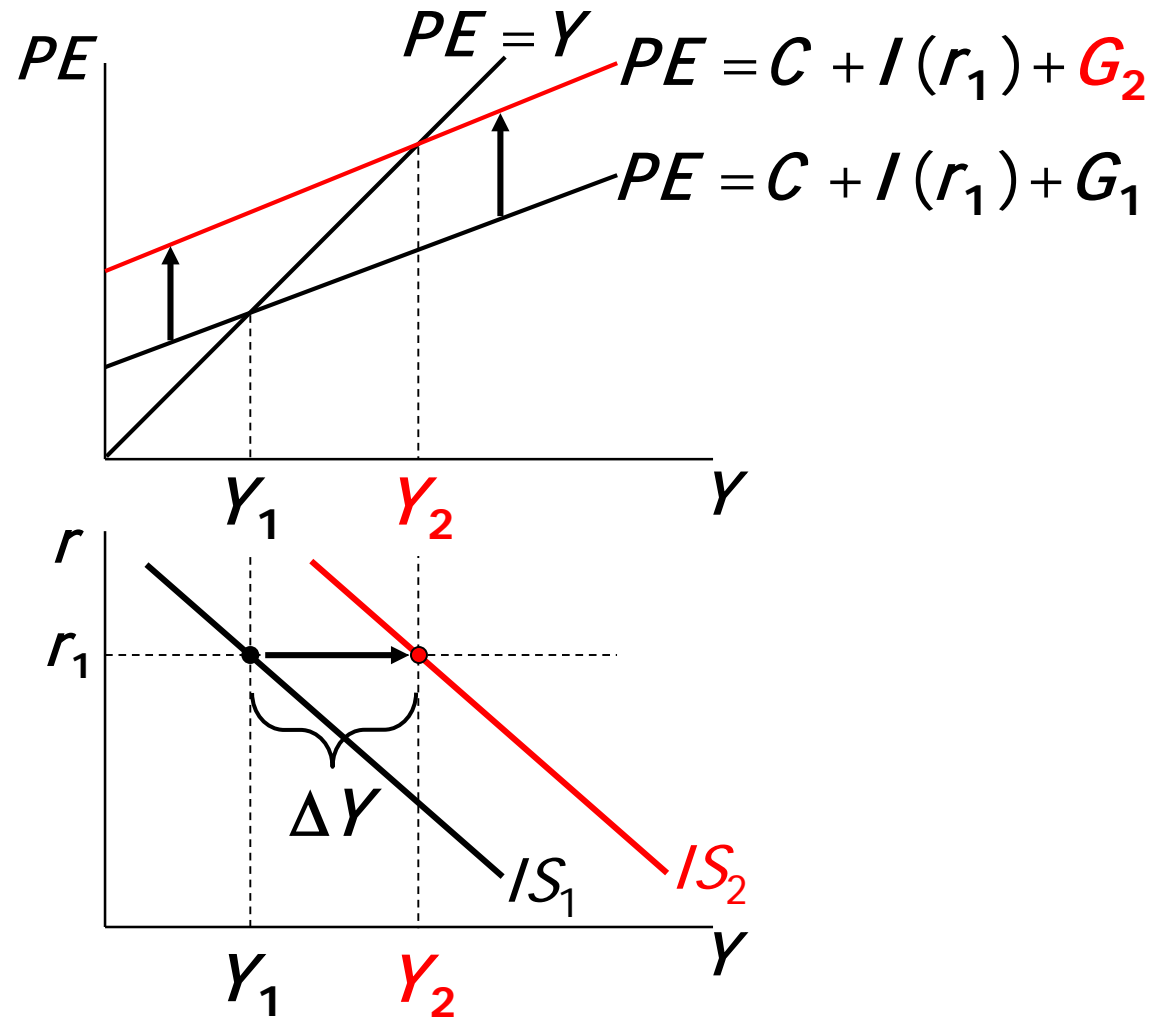
At any value of r , $\uparrow G$

$\Rightarrow \uparrow PE \Rightarrow \uparrow Y$

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

The horizontal distance of the *IS* shift equals

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



The *LM* curve

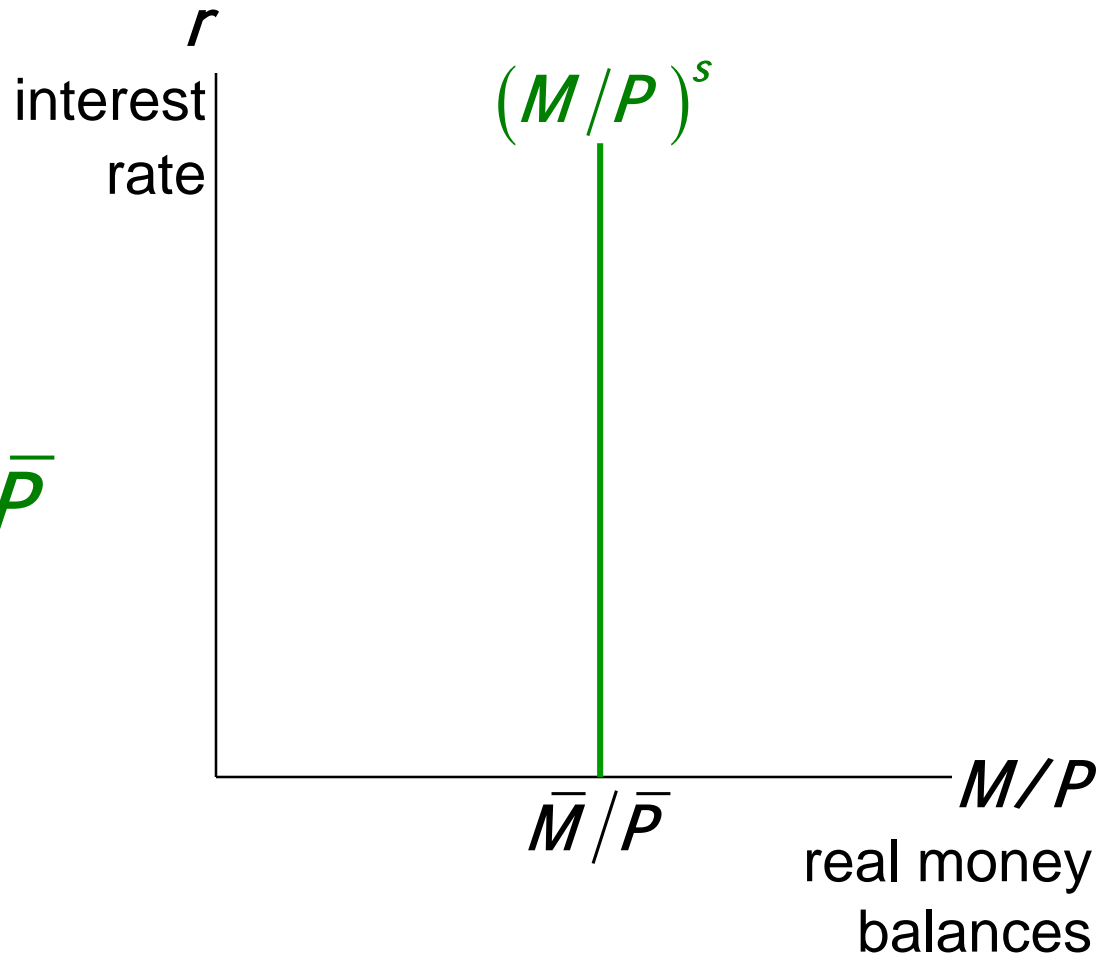
- Definition: Graph of all combinations of r and Y that equate the supply and demand for real money balances.
- Theory of liquidity (L) preference.
- The equation for the *LM* curve is:

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

Money supply

The supply of
real money
balances
is fixed:

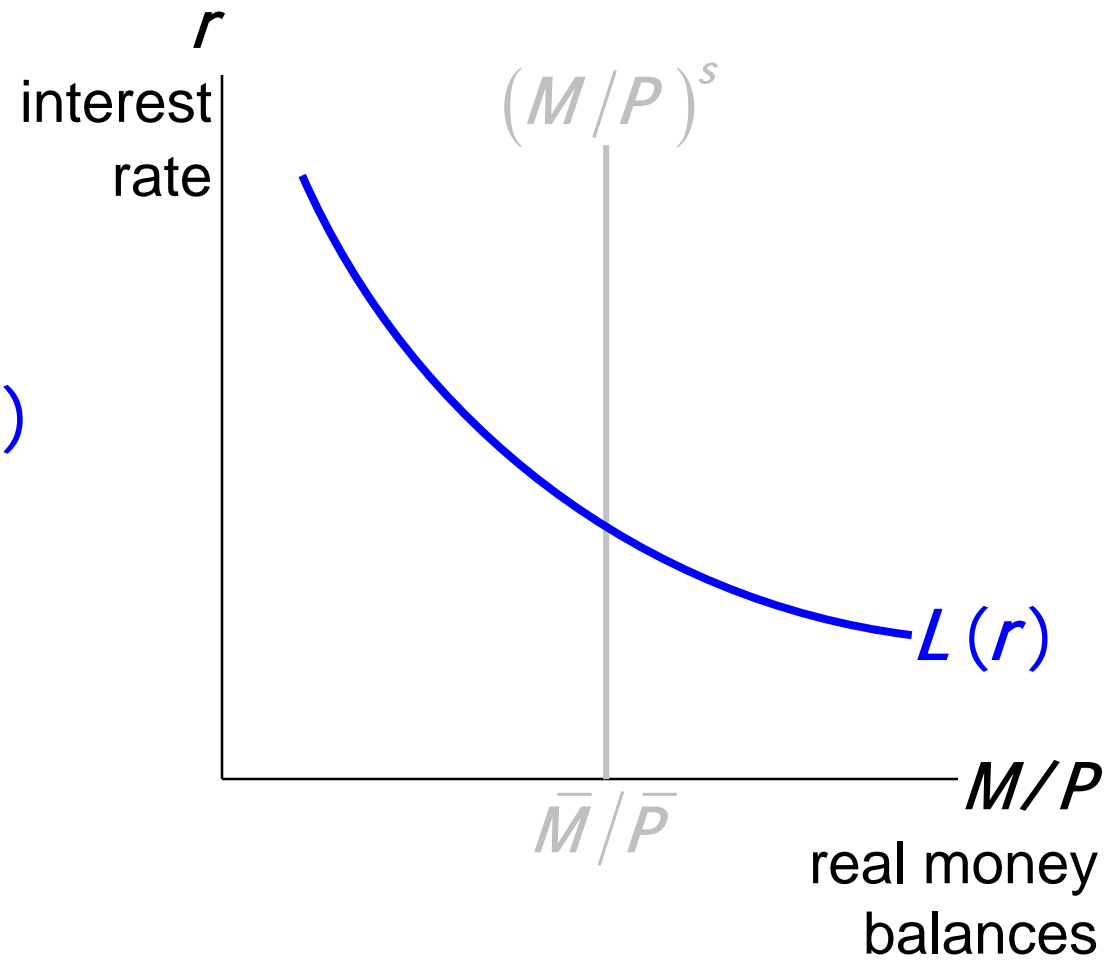
$$(M/P)^s = \bar{M}/\bar{P}$$



Money demand

Demand for real money balances:

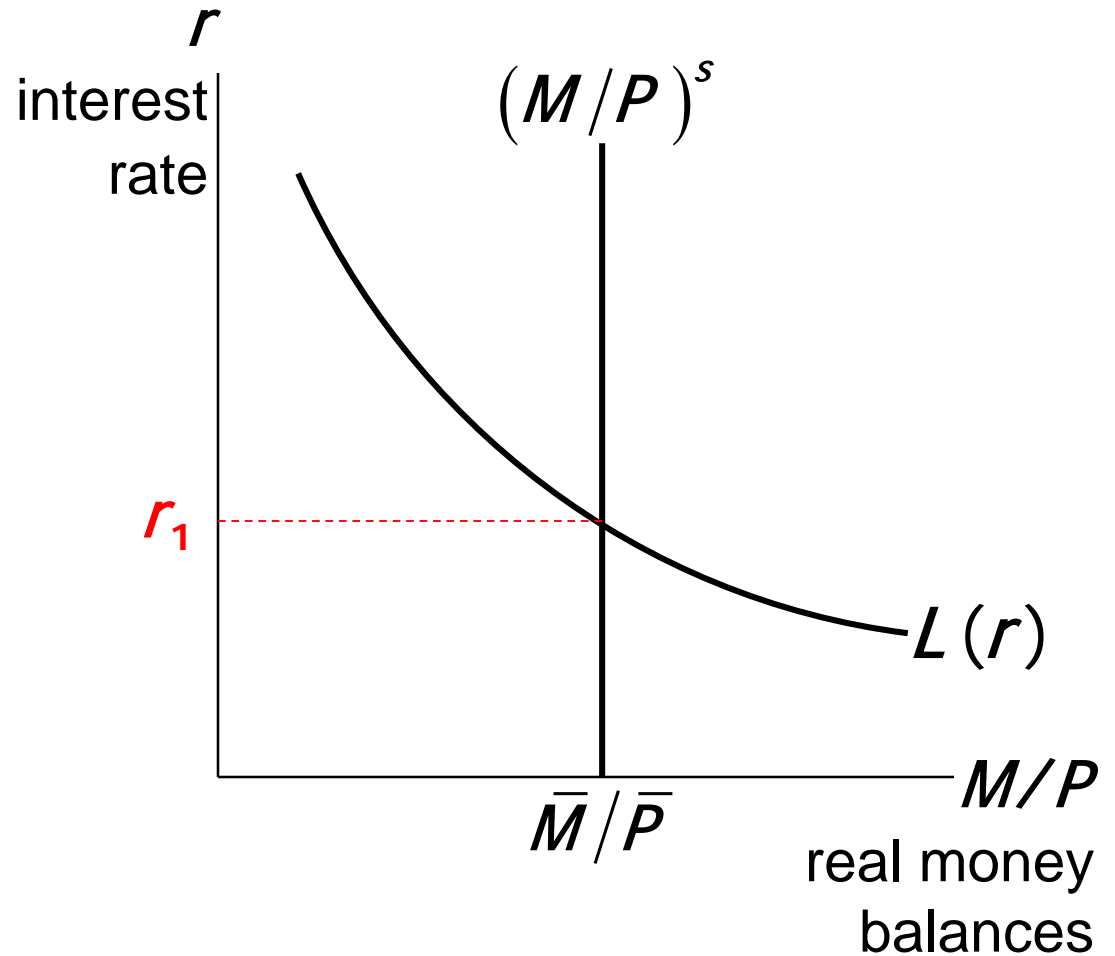
$$(M/P)^d = L(r)$$



Equilibrium

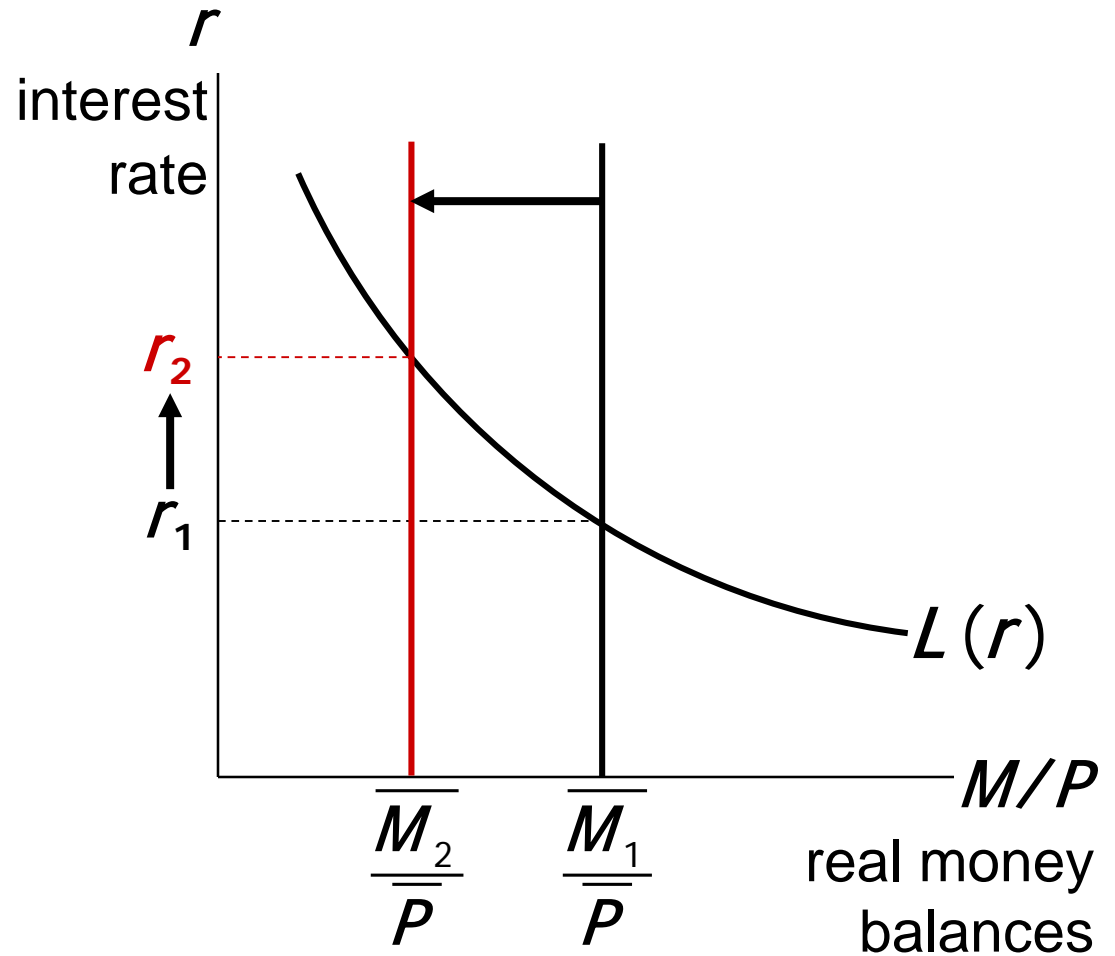
The interest rate adjusts to equate the supply and demand for money:

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



How the Fed raises the interest rate

To increase r ,
Fed reduces M



The *LM* curve

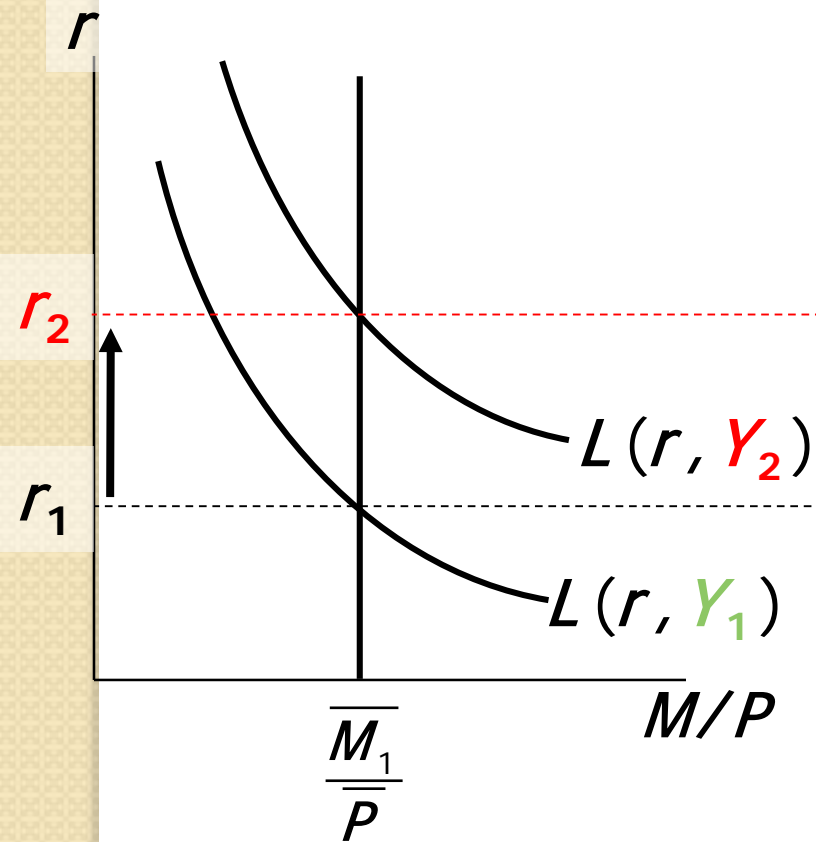
Now let's put Y back into the money demand function:

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

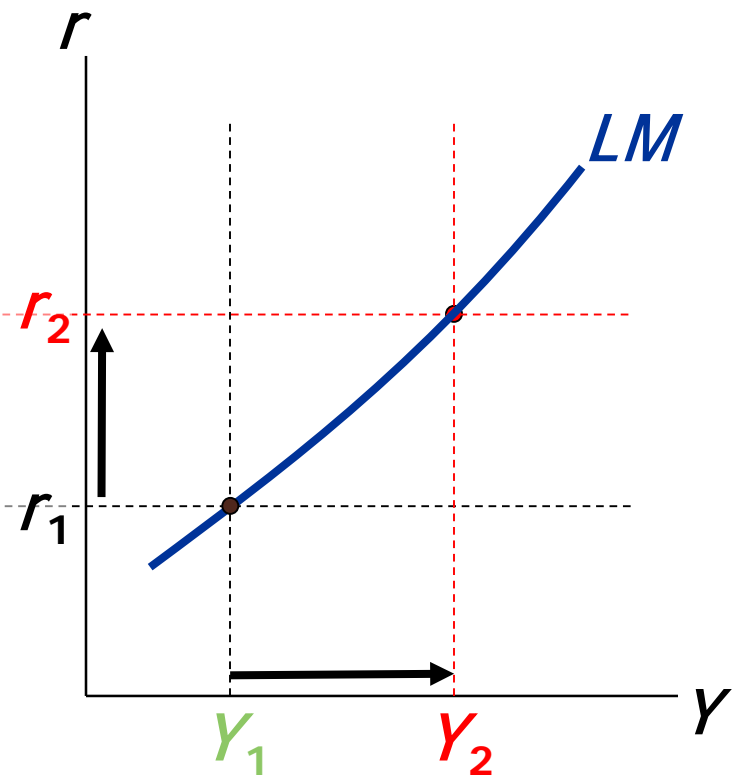
and derive the *LM* curve.

Deriving the *LM* curve

(a) Market for real money balances



(b) The *LM* curve

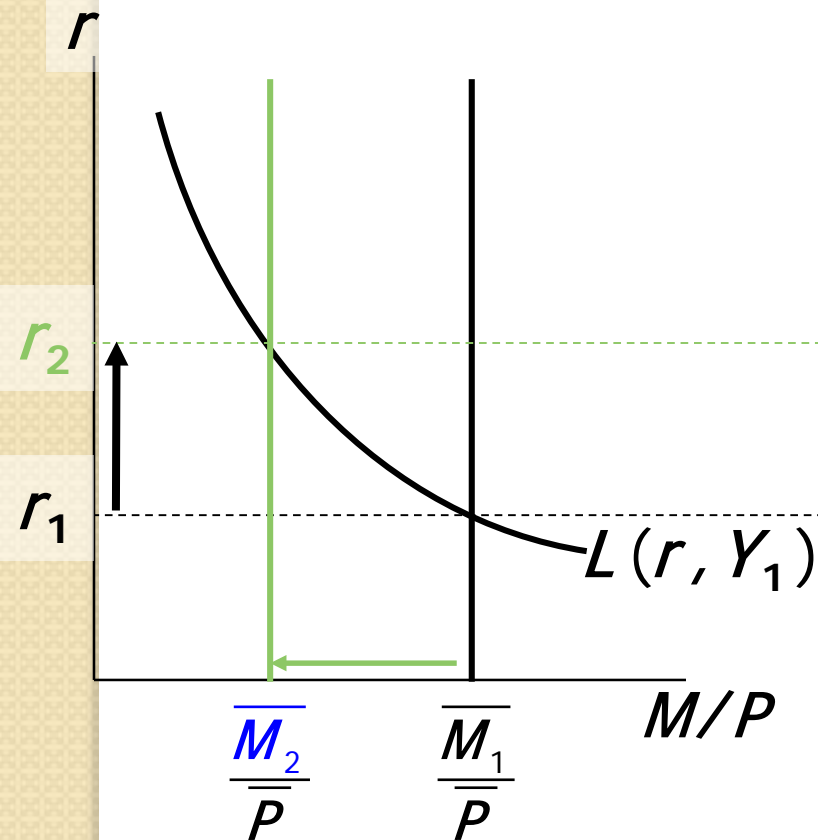


Why the *LM* curve is upward sloping

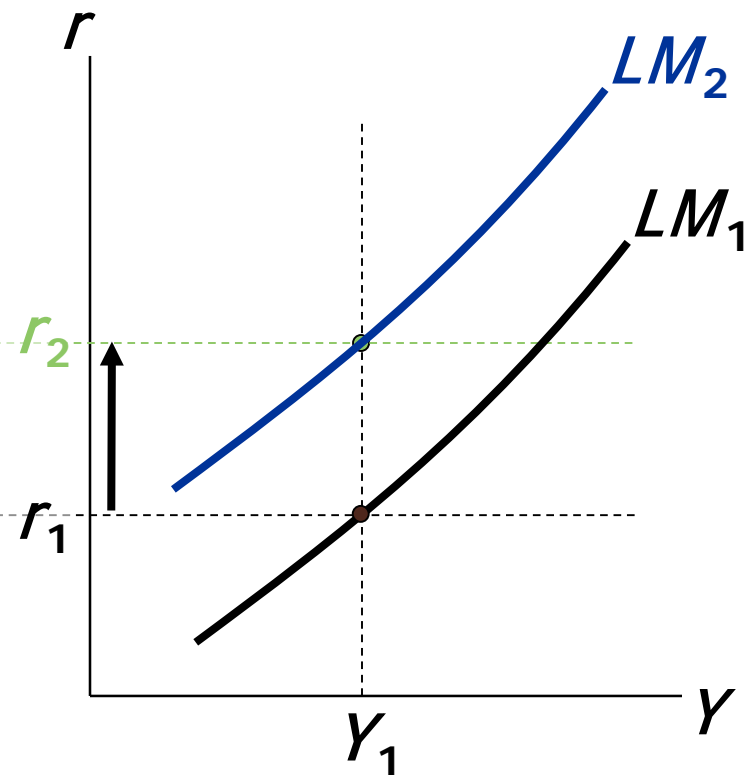
- An increase in income raises money demand.
- Since the supply of real balances is fixed, there is now excess demand in the money market at the initial interest rate.
- The interest rate must rise to restore equilibrium in the money market.

How ΔM shifts the LM curve

(a) Market for real money balances

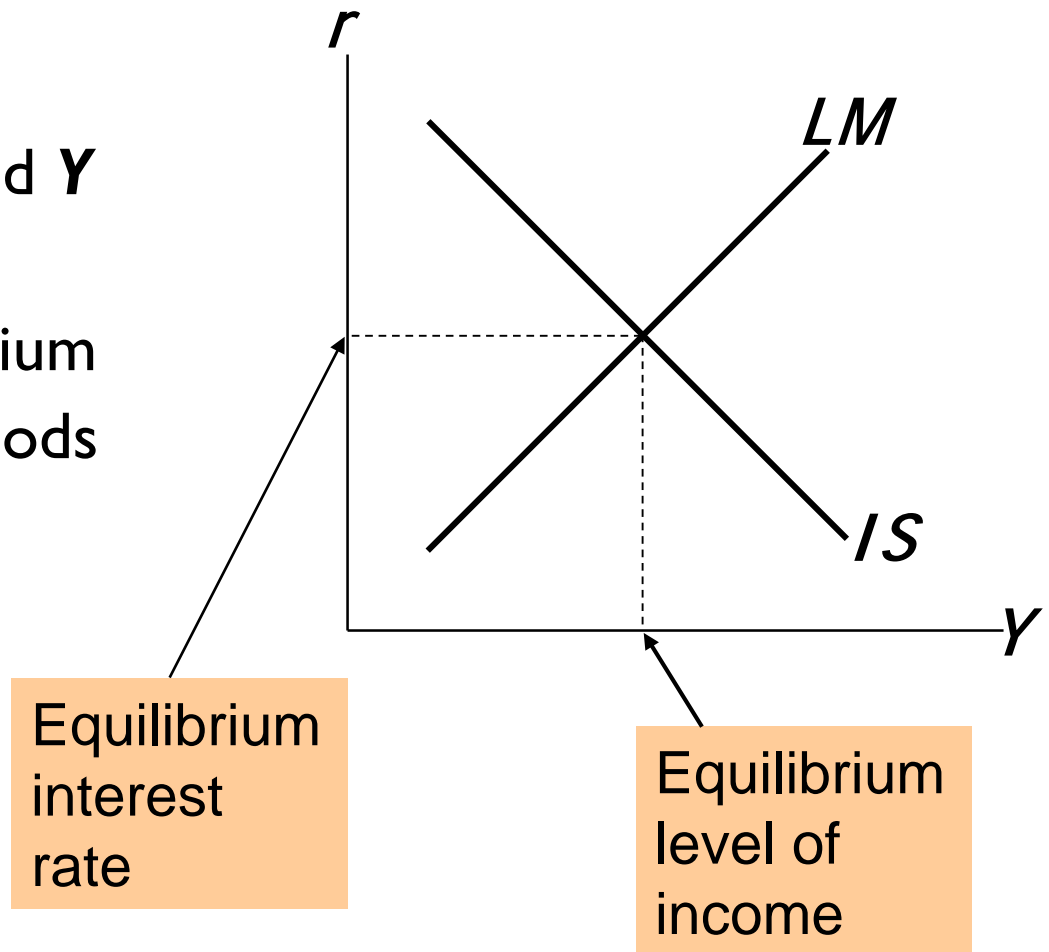


(b) The LM curve



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:



The Big Picture

