

THE IS-LM FRAMEWORK

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EE212
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THIS SECTION

- To introduce *a macroeconomic framework* that allows for the *joint* determination of **income and interest rate**
 - **Income = output = real GDP** (Interchangeably used from now on)
- Having a model usable for **impact analysis**, including **policy interventions**

THIS SECTION

- Didn't we actually see this already.
 - Interest rate / income in Keynesian cross model
 - Interest rate / income in Liquidity preference model
- **Yes, but we haven't seen the interconnection yet**
- The existing knowledge must be combined to create an integrated framework

HOW DO WE DO THIS?

- Combining your knowledge from **Keynesian cross model** with **Liquidity preference model**
- The integrated framework is known as **the IS-LM model**
 - **IS** : equilibrium in product market (real sector)
 - **LM**: equilibrium in money market (financial sector)

AGENDA

- **IS relation**
 - **Derivation of IS curve**
 - **Slope of IS curve**
 - **Shifts of IS curve**
- LM relation
 - Derivation of LM curve
 - Slope of LM curve
 - Shifts of LM curve
- IS-LM combined
- Changes in Equilibrium under IS-LM

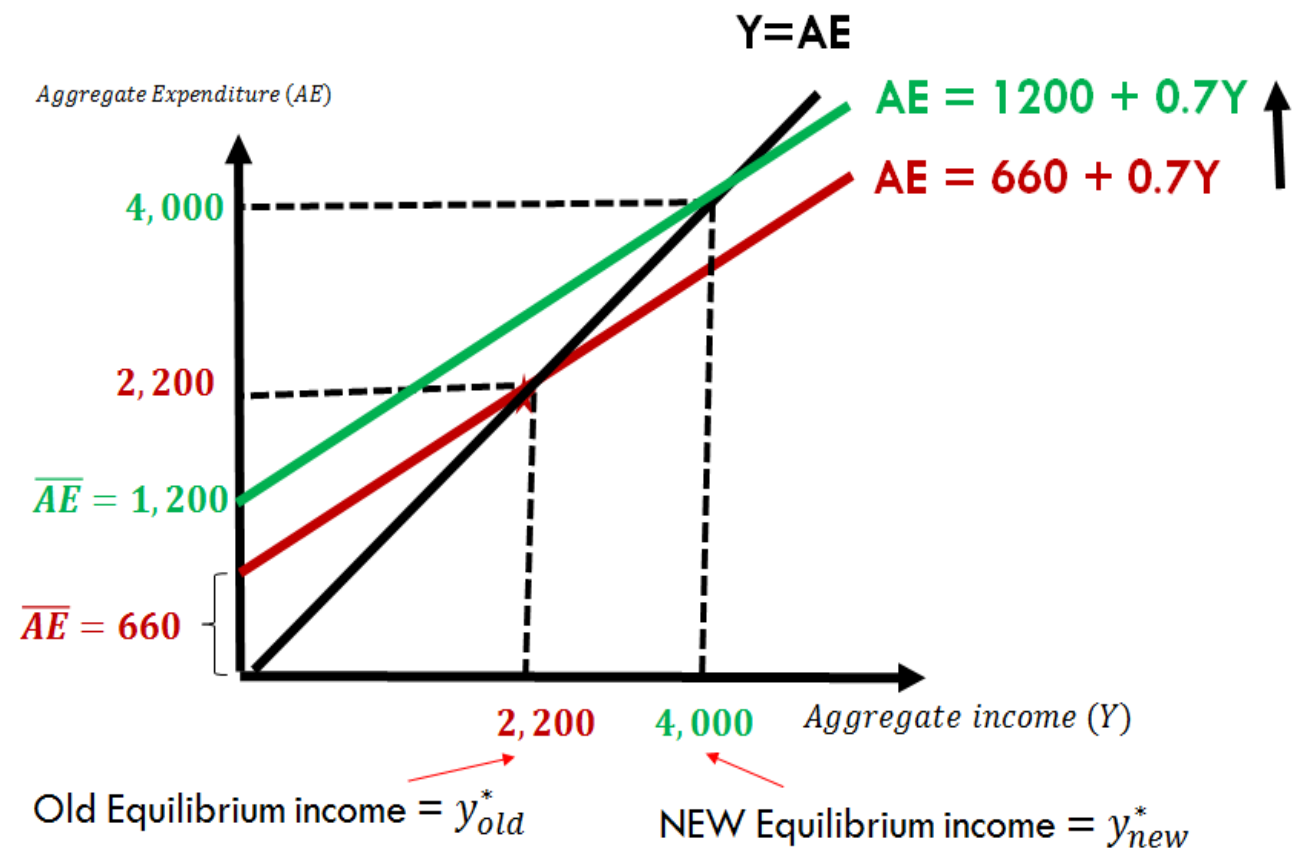
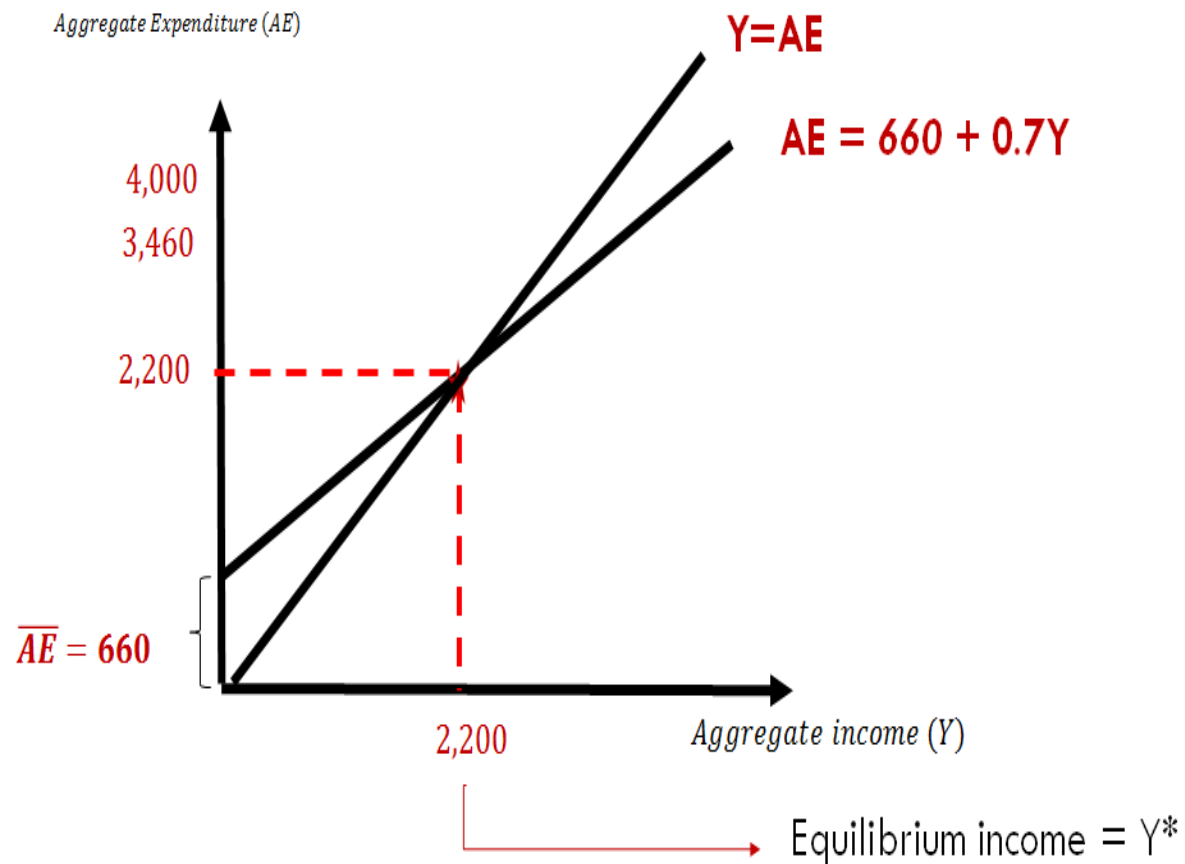
PRODUCT MARKET AND IS RELATION

- Back to part before midterm exam
- We studied about the **determination of income**
- Income is determined in **product market, i.e. the real sector**
 - Product market: **a market where business/consumers/governments buy products from firms/producers**
 - Total value of output = Total value of income

PRODUCT MARKET AND IS RELATION: KEYNESIAN CROSS

- Back to part before midterm exam
 - Based on the concept of **Keynesian cross**, equilibrium income (Y^*) is determined by **autonomous expenditure**
 - The sum of components of autonomous spending; those with “bar” notation!
 - We knew that
 - Autonomous expenditure is driven by **various factors** that we assume **fixed**
 - Changes in those factors affect the autonomous expenditure, and hence the equilibrium income

PRODUCT MARKET AND IS RELATION: AGGREGATE EXPENDITURE AND EQUILIBRIUM INCOME



INTEREST RATE, AUTONOMOUS EXPENDITURE AND INCOME

- Notice that **interest rate (r) is one of the factors** that determines the autonomous expenditure
- Change in the interest rate “ r ” will affect
 - Private consumption spending (C) and Private investment spending (I)
- **As a result, change in the interest rate can affect the size of aggregate expenditure, and hence equilibrium income**

PRODUCT MARKET AND IS RELATION: DEFINITION OF IS RELATION

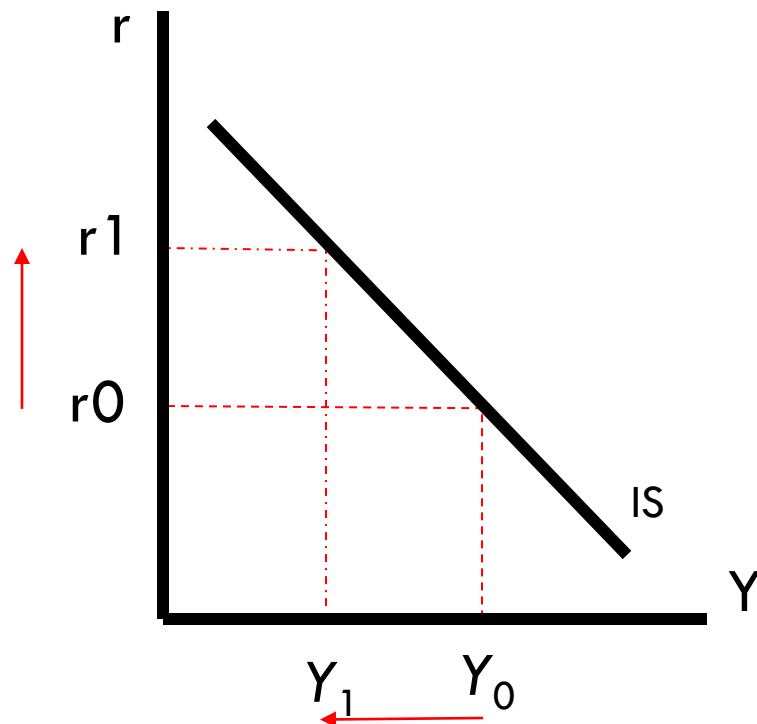
- Economists define the **relation between “r” and “y”** that put the product market under equilibrium as **the IS relation**
 - Equilibrium = income is exactly matched by expenditure
- The IS relation represents the **negative relation between “r” and “y” (Why is it so?)**

PRODUCT MARKET AND IS RELATION: WHY NEGATIVE RELATION?

- Why negative relation?
 - Suppose we start from r_0 , the level of autonomous consumption and investment is determined.
 - Given the level of autonomous expenditure, equilibrium income can be determined, i.e. y_0
 - **An increase in the interest rate from $r_0 \rightarrow r_1$** will lower the level of autonomous consumption and investment
 - Aggregate expenditure drops for every level of income
 - In the equilibrium, **income will fall from y_0 to y_1**

GRAPHICAL ILLUSTRATION OF IS RELATION: THE IS CURVE

- IS curve is the graphical version of IS relation
 - Plotting “ r ” on vertical and “ y ” on the horizontal



- An increase in the interest rate from r_0 ($=3$ percent) to r_1 ($=6$ percent) lowers aggregate expenditure (consumption/investment) and thus reduces equilibrium income from Y_0 to Y_1 .

IS relation	LM relation	IS-LM combined	Change in equilibrium
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GRAPHICAL APPROACH TO THE DERIVATION OF IS CURVE

AE

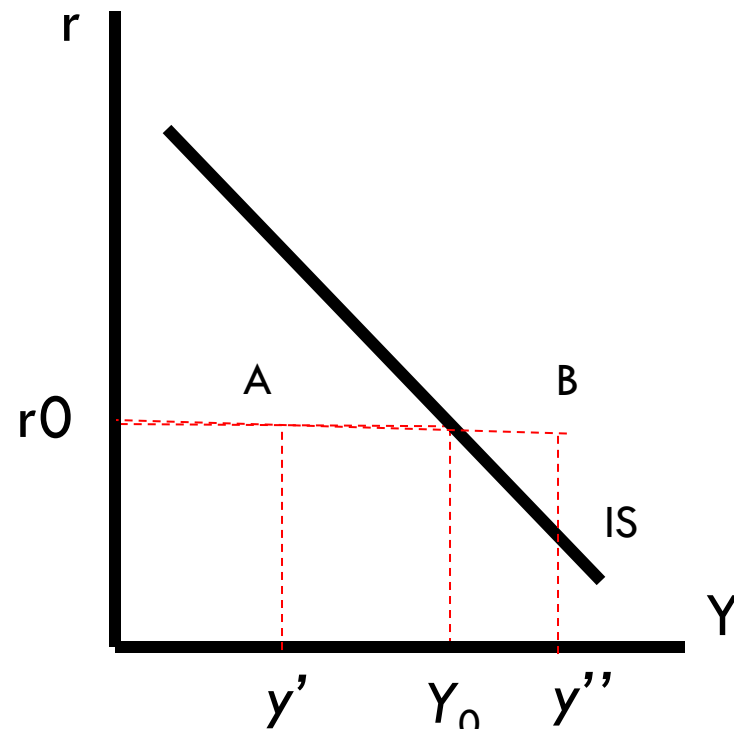


r



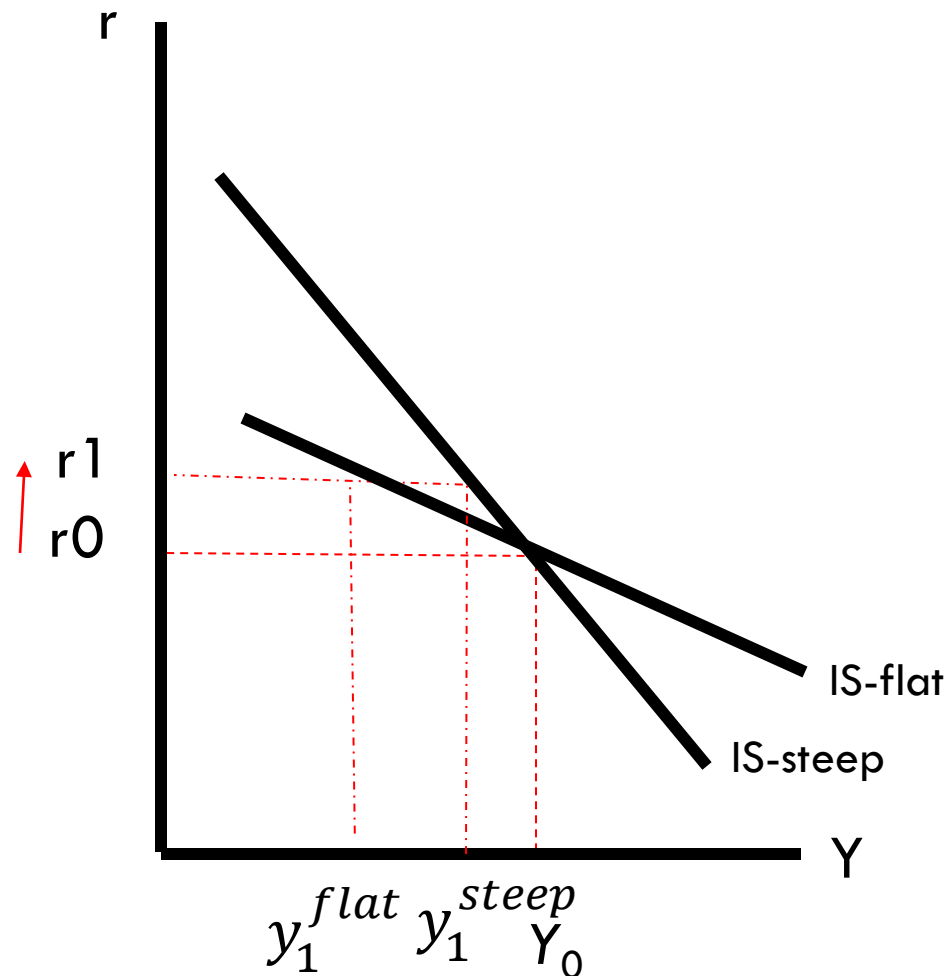
IS CURVE AND DISEQUILIBRIUM

- Combination of “ r ” and “ y ” on the IS curve represents the equilibrium situation in product market
 - Off the IS curve $\rightarrow$ disequilibrium



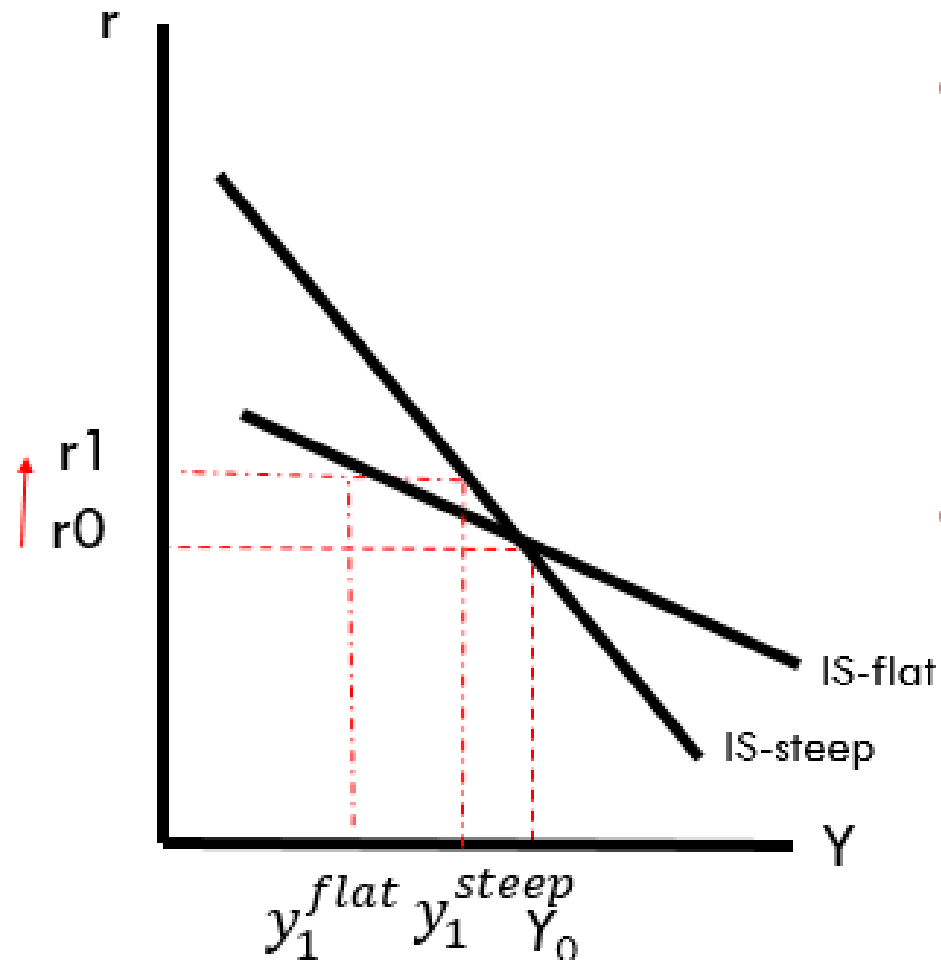
- $E(r_0, y_0) = \text{Equilibrium}$
 - Income is exactly matched by expenditure
- $A(r_0, y')$ = disequilibrium
 - Income is too low $\rightarrow$ **Excess demand for goods**
- $B(r_0, y'')$ = disequilibrium
 - Income is too high $\rightarrow$ **Excess supply of goods**

FACTORS DETERMINES OF IS CURVE



- Steep IS curve:
 - Income changes little when there is a change in the interest rate
 - **Income is insensitive to interest rate**
- Flat IS curve:
 - Income changes a lot when there is a change in the interest rate
 - **Income is sensitive to interest rate**

FACTORS DETERMINES OF IS CURVE



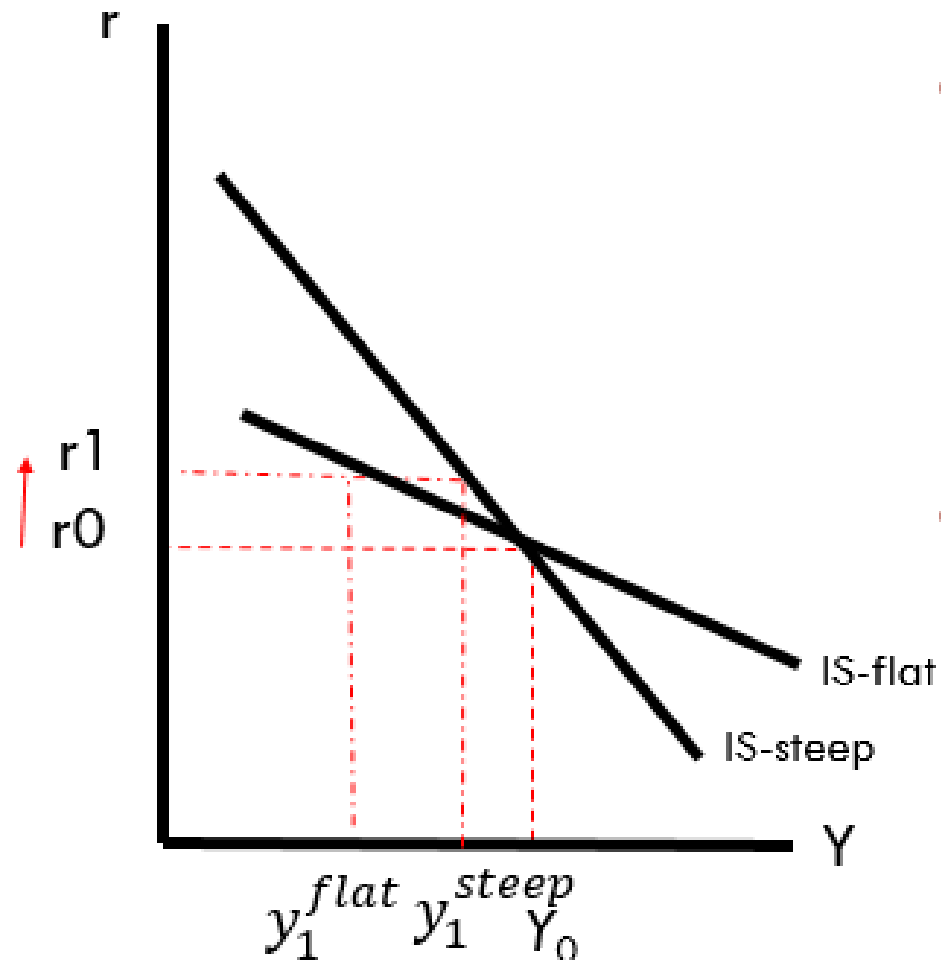
- Recall that downward sloping IS curve is due to the following mechanism

$$r \uparrow \rightarrow \bar{C} \downarrow \text{ and } \bar{I} \downarrow \rightarrow \bar{AE} \downarrow \rightarrow Y \downarrow$$

- Drop in income is large because of two possibilities:

1. Large decline in $\bar{C} \downarrow$ and $\bar{I} \downarrow$
2. Big response of income to change in autonomous expenditure

FACTORS DETERMINES OF IS CURVE



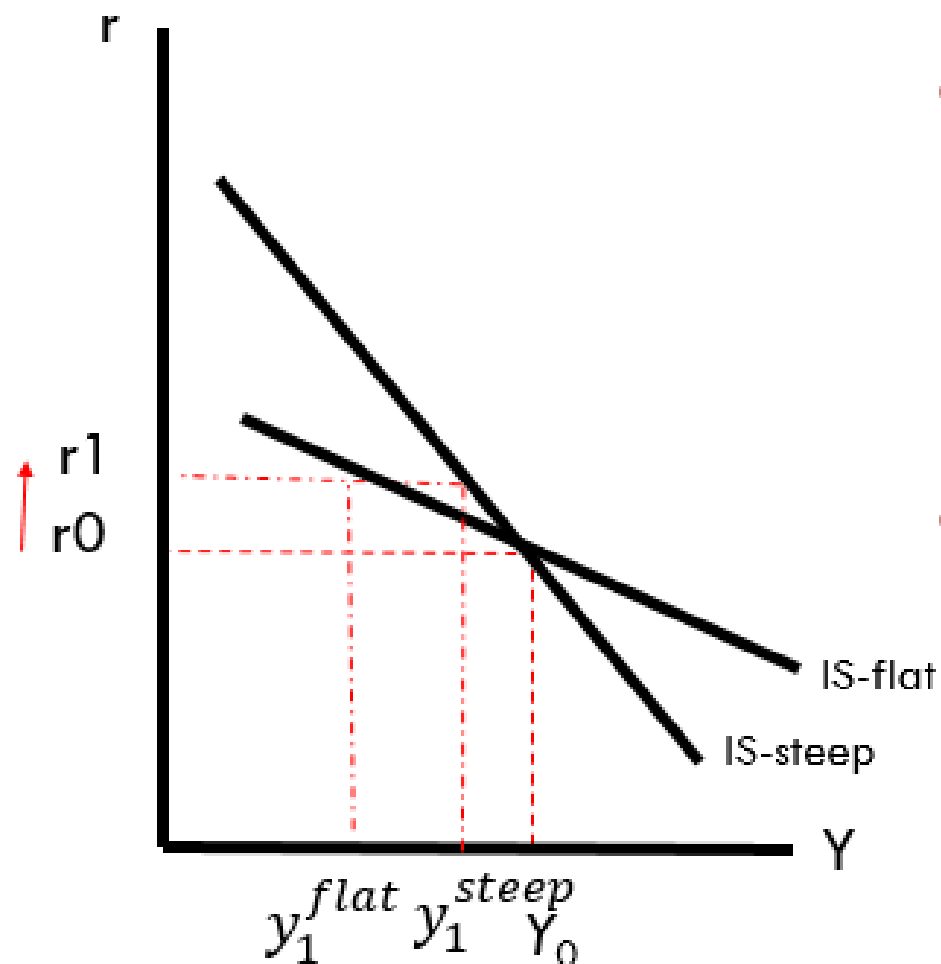
- Recall that downward sloping IS curve is due to the following mechanism

$$r \uparrow \rightarrow \bar{C} \downarrow \text{ and } \bar{I} \downarrow \rightarrow \bar{AE} \downarrow \rightarrow Y \downarrow$$

Large decline in $\bar{C} \downarrow$ and $\bar{I} \downarrow$:

Consumption and investment is sensitive to interest rate $\rightarrow$ IS curve is flat!

FACTORS DETERMINES OF IS CURVE



- Recall that downward sloping IS curve is due to the following mechanism

$$r \uparrow \rightarrow \bar{C} \downarrow \text{ and } \bar{I} \downarrow \rightarrow \overline{AE} \downarrow \rightarrow Y \downarrow$$

- Big response of income to change in autonomous expenditure**

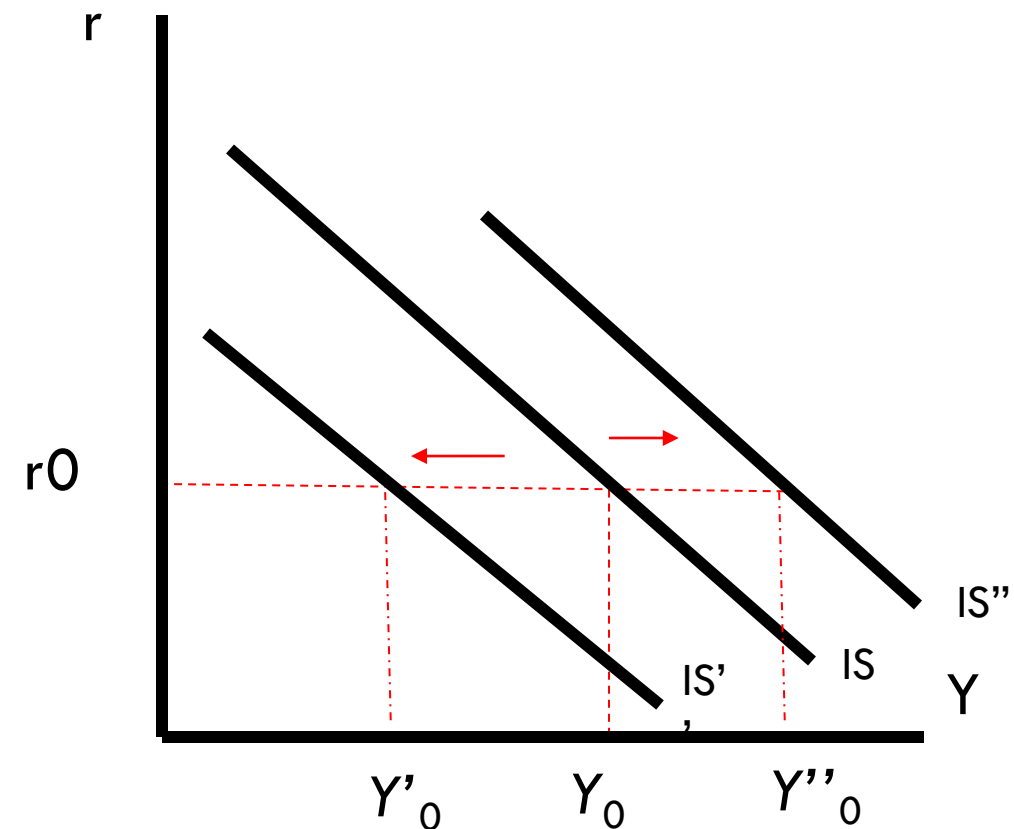
Recall the multiplier concept!

Large multiplier generates flatter IS curve

SHIFTS OF THE IS CURVE

- IS curve shifts left: $IS \rightarrow IS'$
 - Income decreases at every level of interest rate
- IS curve shifts right: $IS \rightarrow IS''$
 - Income increases at every level of interest rate

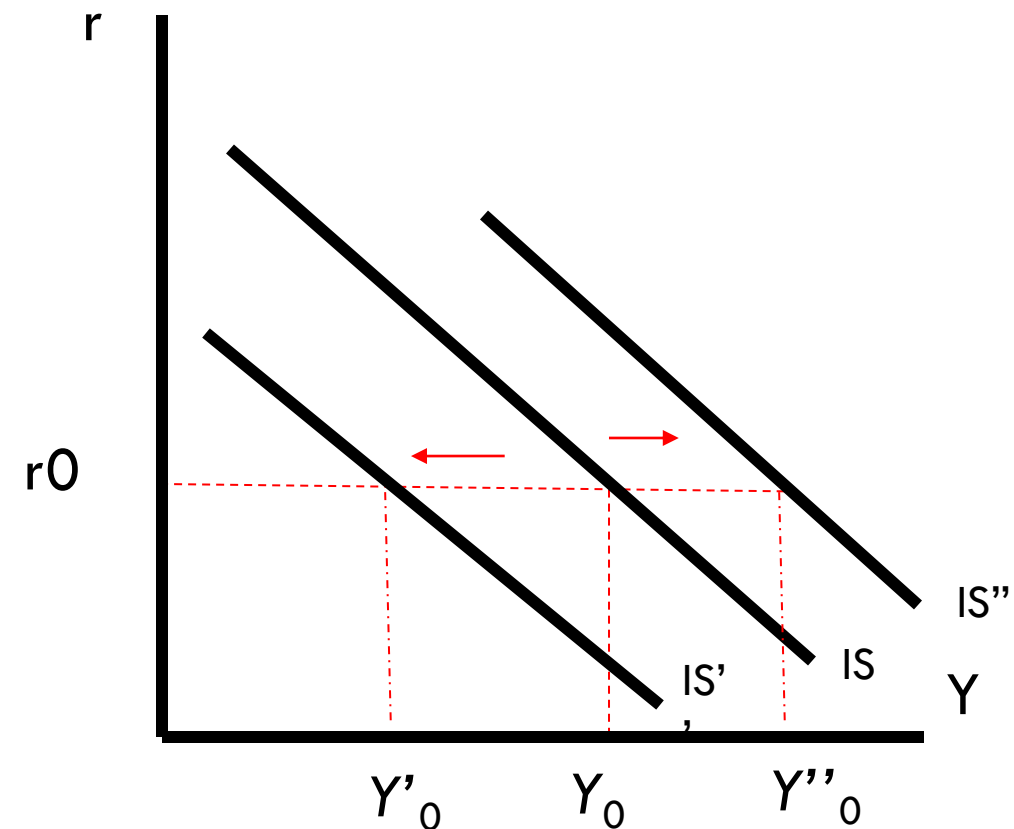
- Shifts of the IS curve



SHIFTS OF THE IS CURVE

- The shift of IS curve occurs because of **the change in autonomous expenditure that is not due to the interest rate**
- What are those factors affecting autonomous expenditure

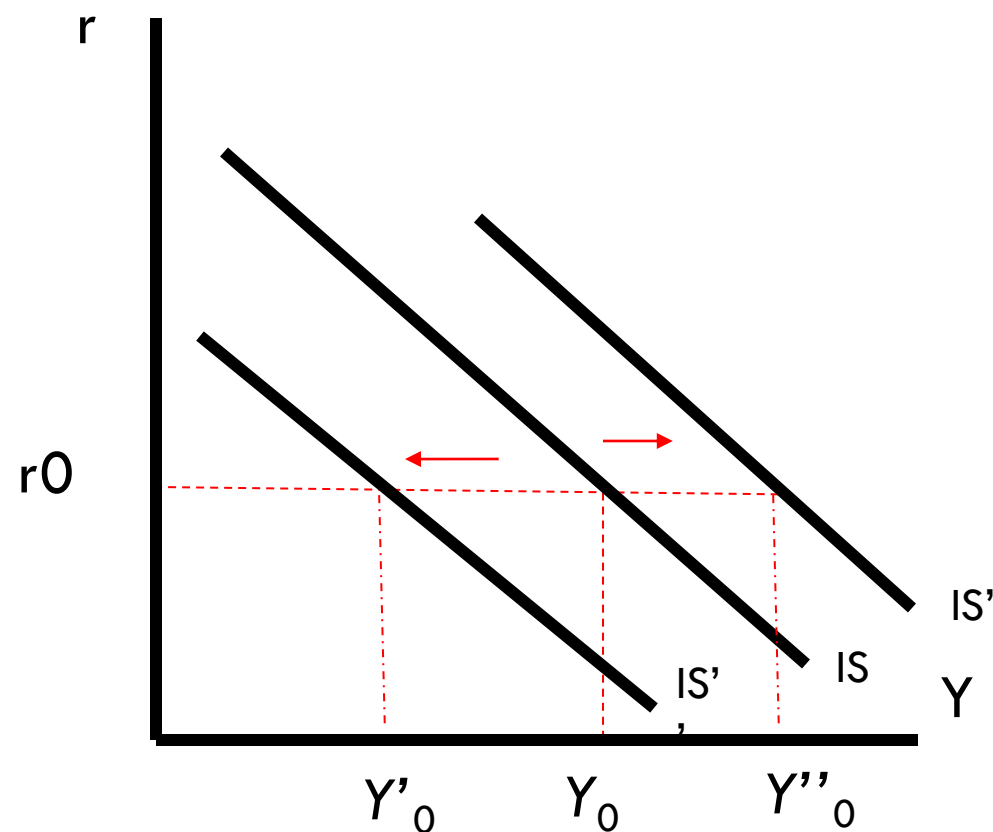
- Shifts of the IS curve



SHIFTS OF THE IS CURVE

- Autonomous consumption
 - Consumer confidence
- Autonomous investment
 - Business sentiments
- Autonomous government spending
- Autonomous tax
- Autonomous net exports
 - Exchange rate / Trade barriers

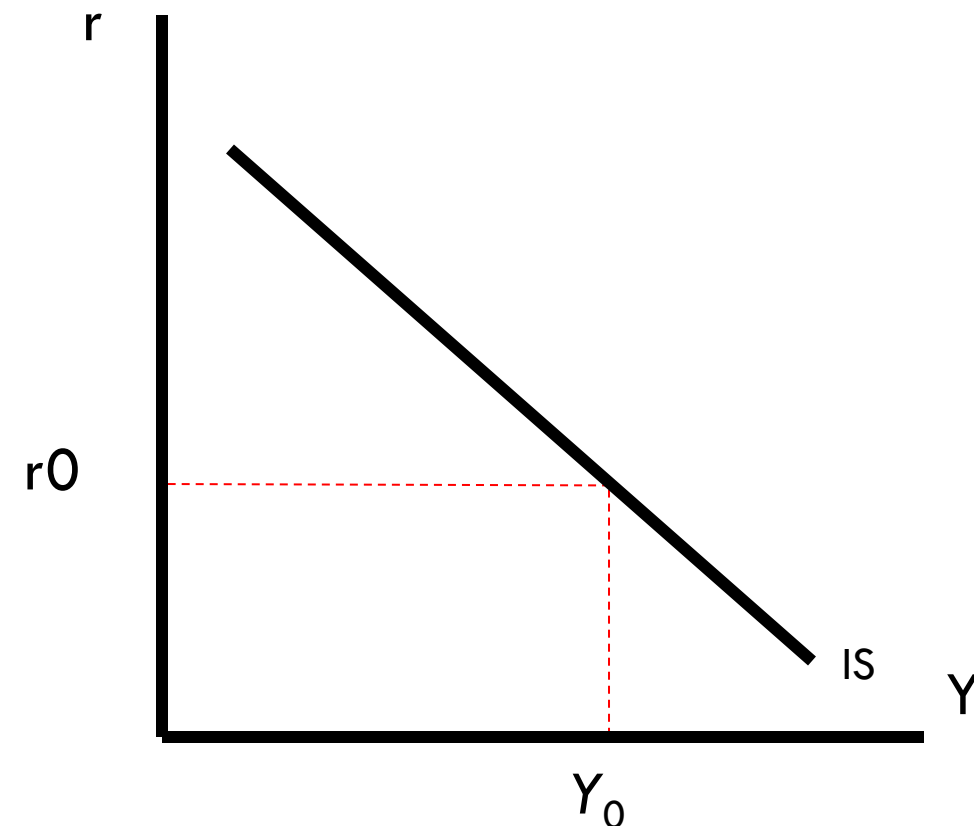
- Shifts of the IS curve



SHIFTS OF THE IS CURVE

- Examples
 - A drop in business sentiments
 - An increase in government spending
 - A decrease in net-exports due to an appreciation in Thai baht
 - A tax cut by government
 - A negative outlook by households

- Shifts of the IS curve



AGENDA

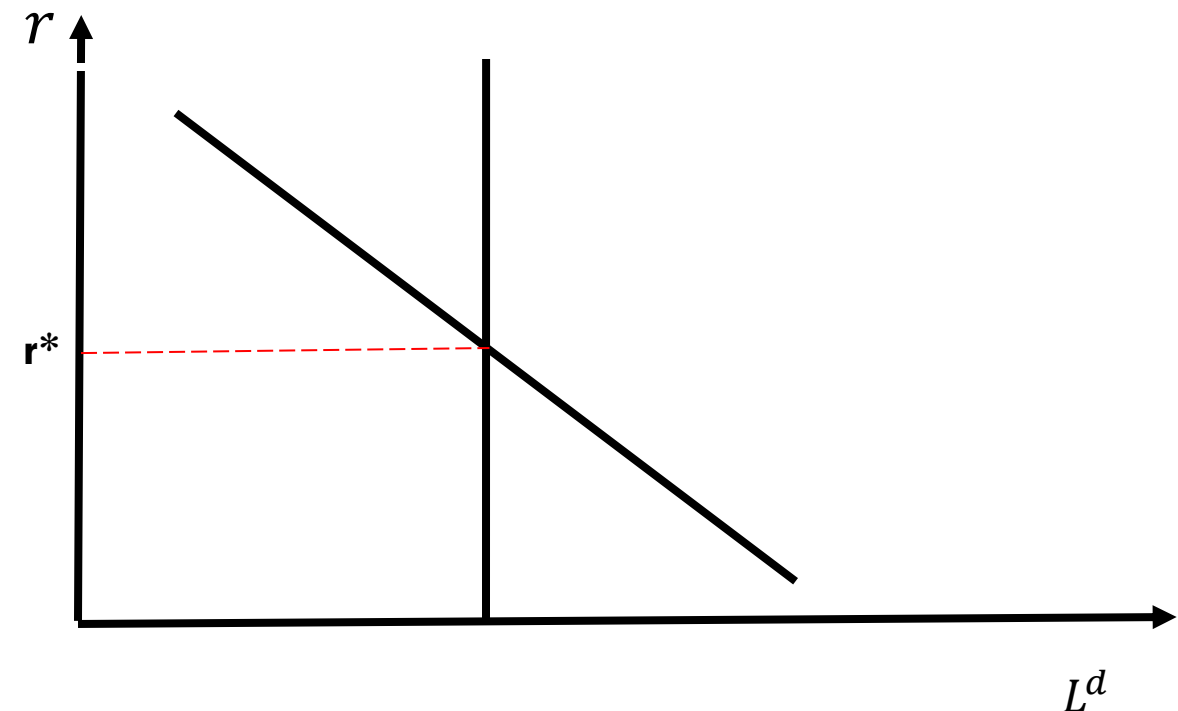
- IS relation
 - Derivation of IS curve
 - Slope of IS curve
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- **LM relation**
 - **Derivation of LM curve**
 - **Slope of LM curve**
 - **Shifts of LM curve**
- IS-LM combined
- Changes in Equilibrium under IS-LM

MONEY MARKET AND LM RELATION

- We have seen that interest rate relates to income in the product market
 - Higher interest rate $\rightarrow$ Lower income
- How is the interest rate determined?
 - Based on the liquidity preference model, we have seen that interest rate is determined by the demand and supply for real money balance, **i.e. equilibrium in the money market**

MONEY MARKET AND LM RELATION

- From the analysis, it turns out that **income is one of the factors that determines the interest rate**
 - For a given level of income, transaction and precautionary demand is determined, and hence the money demand curve
 - For a fixed level of real money supply, the equilibrium interest rate is determined



MONEY MARKET AND LM RELATION

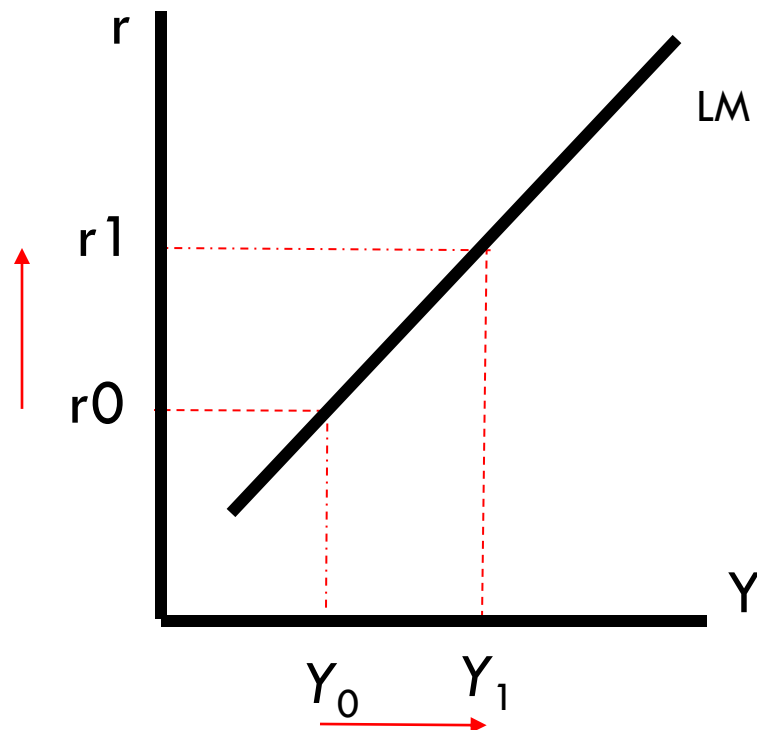
- Similar to the IS relation, economists consider the relation between “ r ” and “ y ” that put the money market in equilibrium as the LM relation
- The LM relation represents **the positive relation between “ r ” and “ y ”** (Why is it so?)

MONEY MARKET AND LM RELATION: LINKAGE

- Why positive relation?
 - Suppose we start from y_0 , the level of transaction and precautionary demand for money is determined.
 - Given the two, the level of money demand can be determined, and hence the equilibrium interest rate, i.e. r_0
 - **An increase in the income from $y_0 \rightarrow y_1$** will increase the level transaction and precautionary demand for money
 - Given the change, the new level of money demand is higher than before, for every level of interest rate
 - In the equilibrium, **interest rate will rise from r_0 to r_1**

GRAPHICAL ILLUSTRATION OF LM RELATION: THE LM CURVE

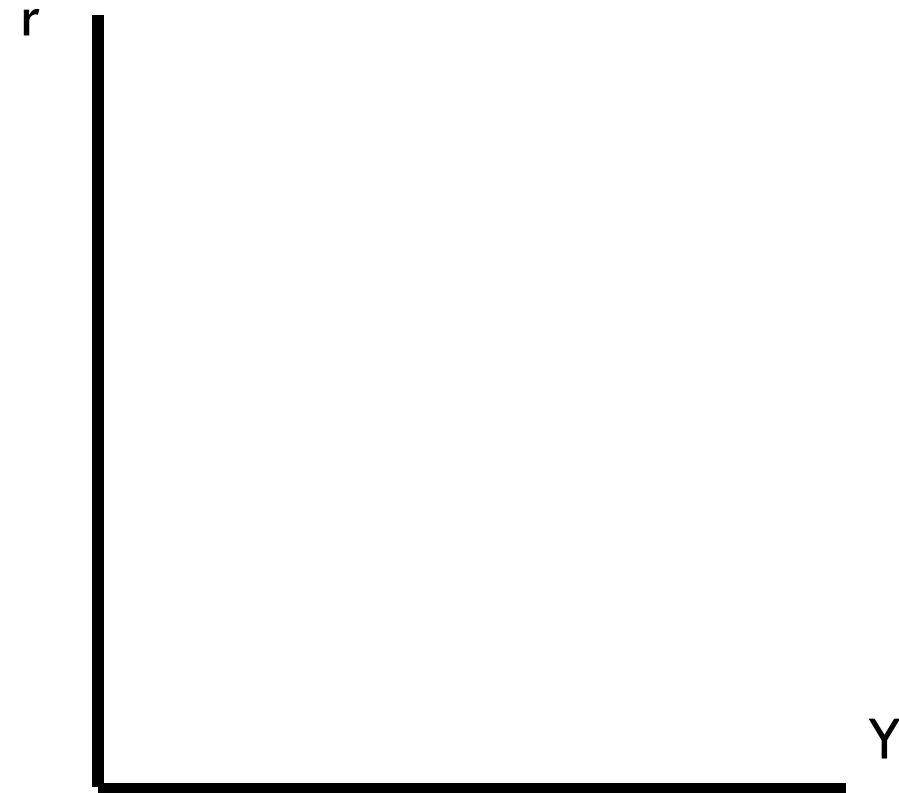
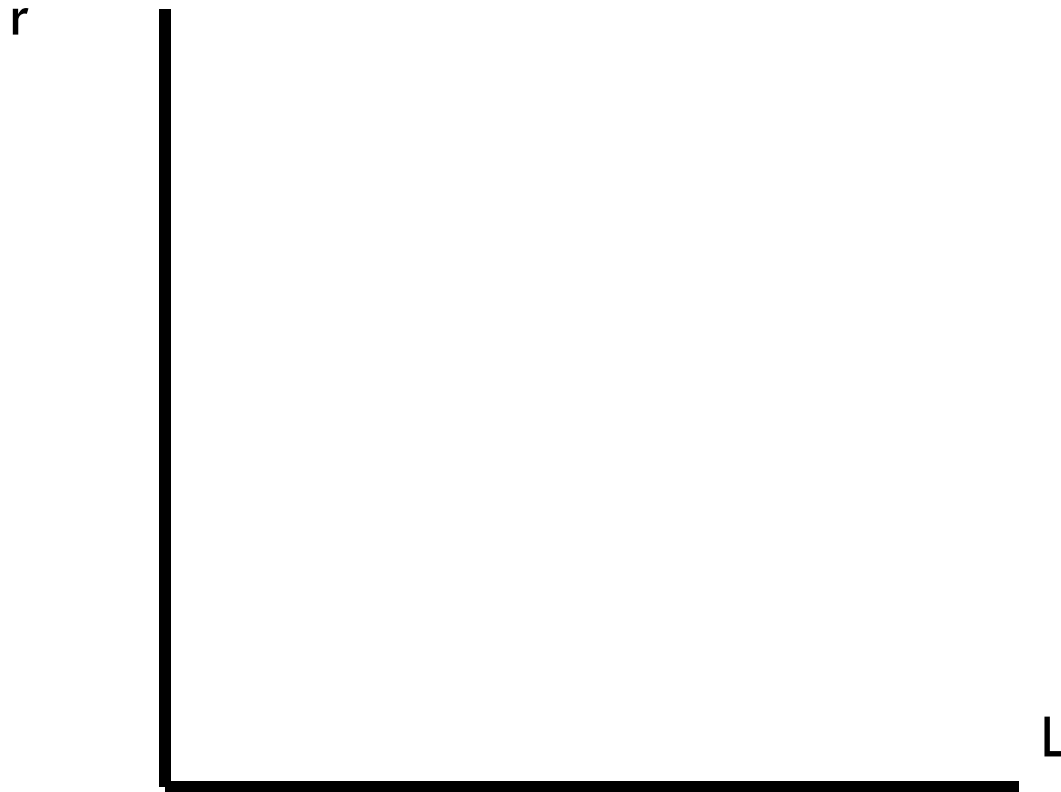
- LM curve is the graphical version of LM relation
 - Plotting “ r ” on vertical and “ y ” on the horizontal



- An increase in the income from y_0 ($=100$) to y_1 ($=200$) increases the level of money demand, and thus increase the equilibrium interest rate from r_0 to r_1 .

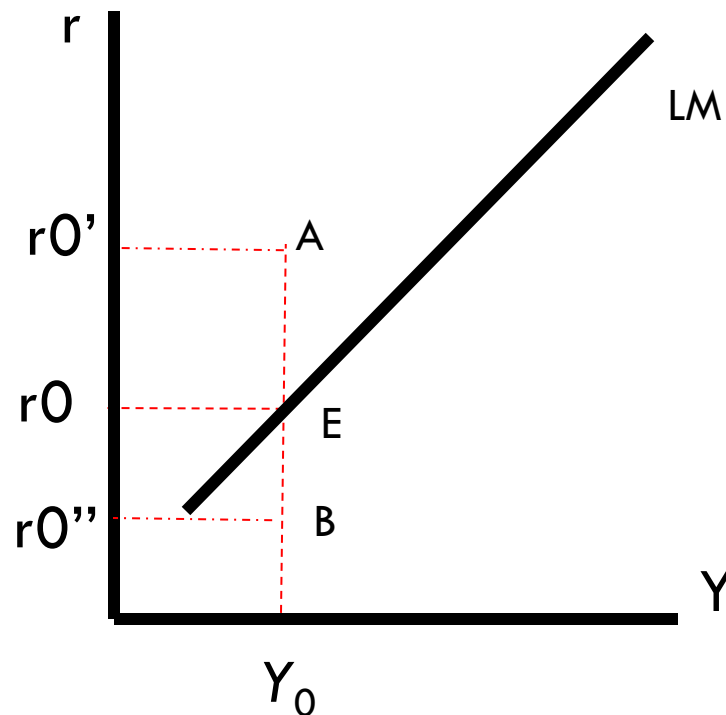
IS relation	LM relation	IS-LM combined	Change in equilibrium
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GRAPHICAL APPROACH TO THE DERIVATION OF LM CURVE



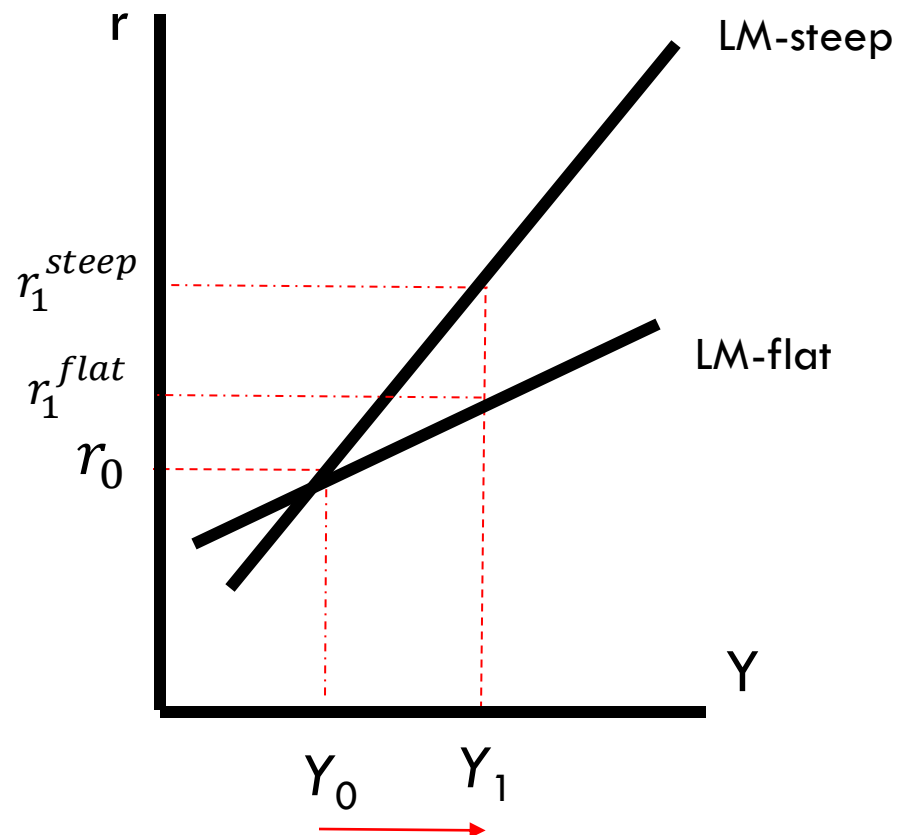
LM CURVE AND DISEQUILIBRIUM

- Combination of “ r ” and “ y ” on the LM curve represents the equilibrium situation in money market
 - Off the LM curve $\rightarrow$ disequilibrium



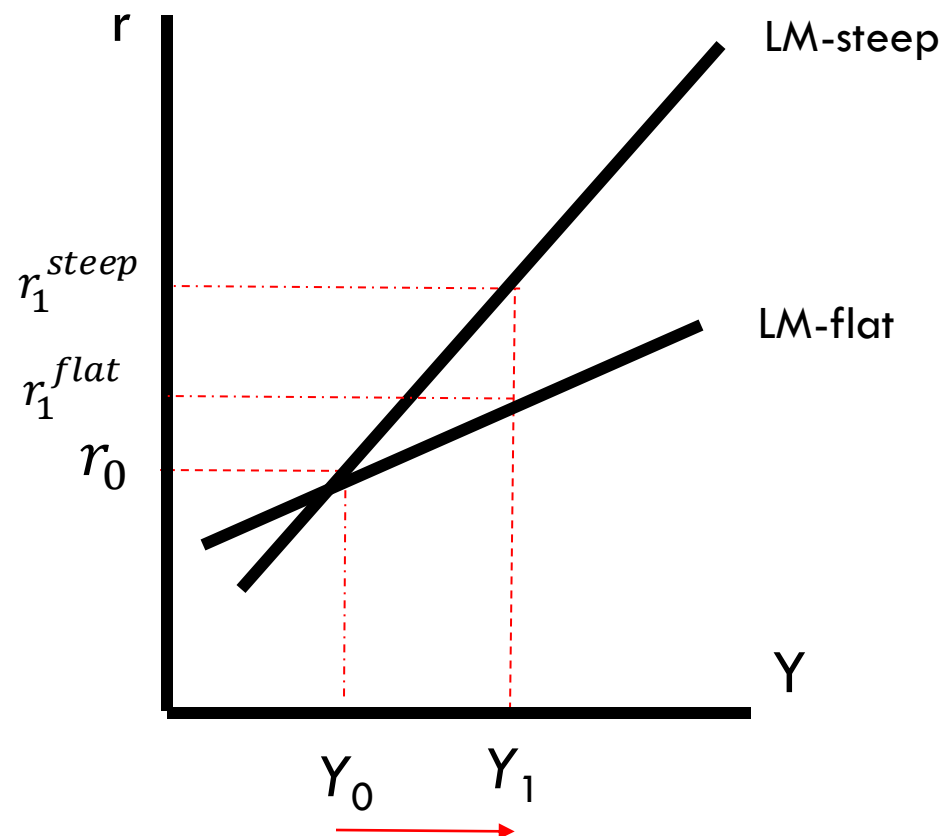
- $E(r_0, y_0) = \text{Equilibrium}$
 - Real money demand = real money supply
- $A(r_0', y_0) = \text{disequilibrium}$
 - Interest rate is too high $\rightarrow$ Excess real money supply
- $B(r_0'', y_0) = \text{disequilibrium}$
 - Interest rate is too low $\rightarrow$ Excess real money demand

FACTORS DETERMINES OF IS CURVE



- Steep LM curve:
 - Interest rate changes a lot for a unit change in income
 - Interest rate sensitively responds to income
- Flat LM curve:
 - Interest rate changes a lot for a unit change in income
 - Interest rate has limited response to income

FACTORS DETERMINES OF IS CURVE



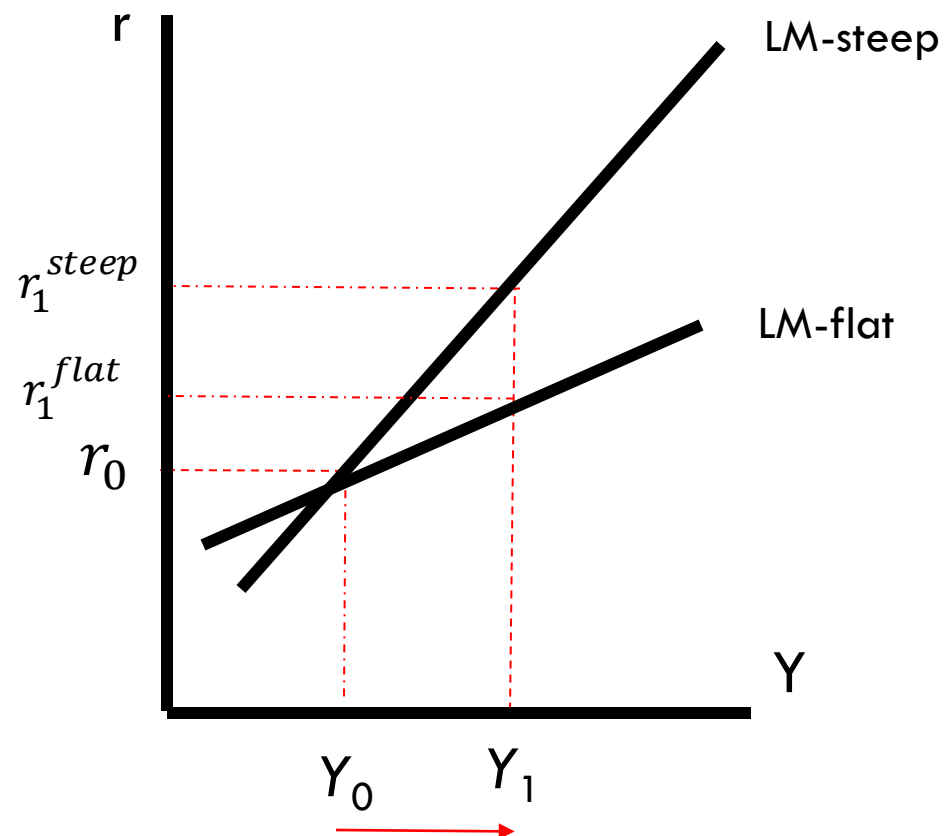
- Recall the mechanism

$$y \uparrow \rightarrow L^d \uparrow \rightarrow r \uparrow$$

A big change in “ r ” can occur because of two possibilities

1. Demand for money is sensitive to income change
2. Demand for money is insensitive to interest rate

FACTORS DETERMINES OF IS CURVE



- Recall the mechanism

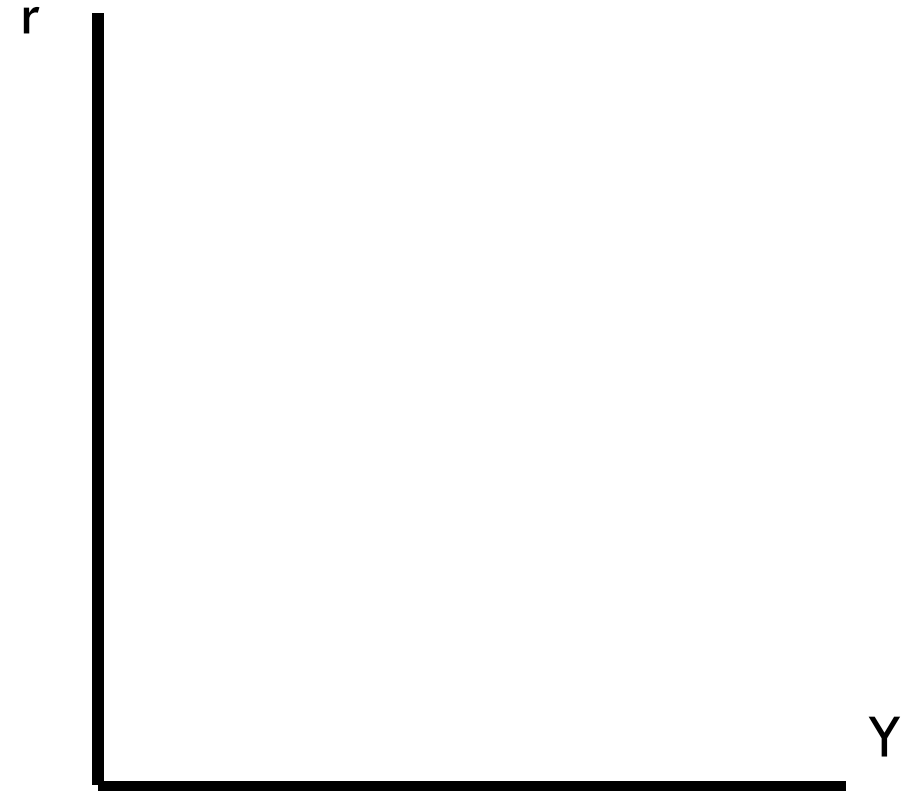
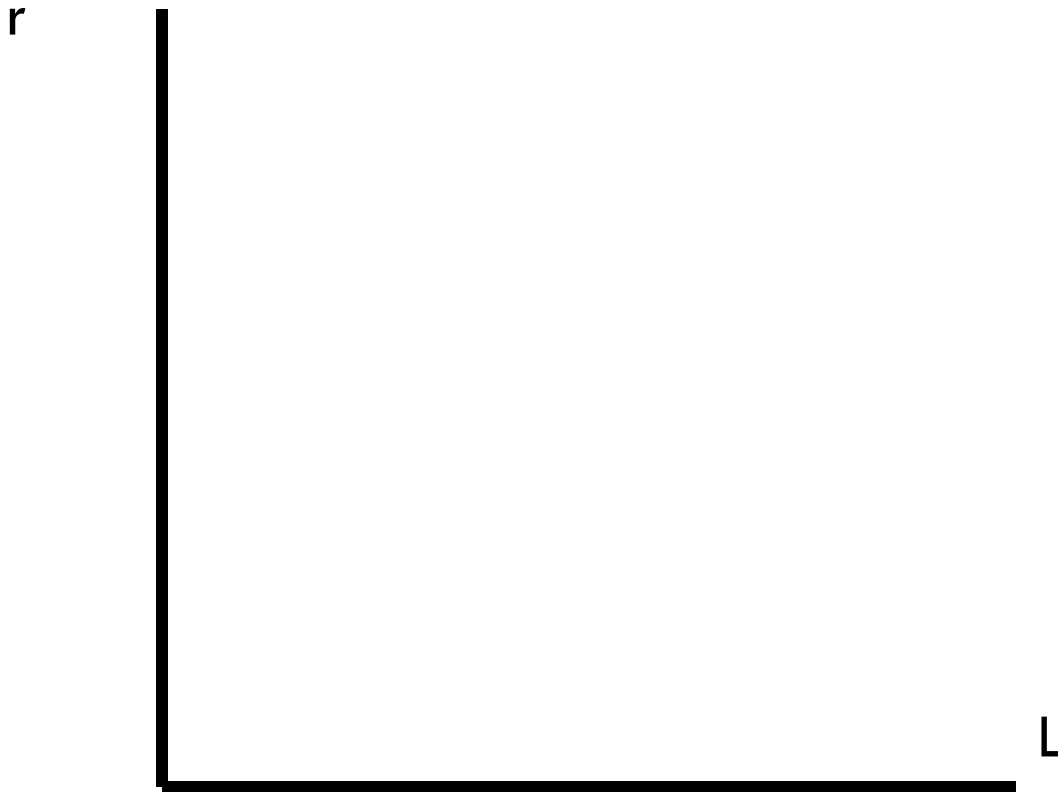
$$y \uparrow \rightarrow L^d \uparrow \rightarrow r \uparrow$$

A big change in “ r ” can occur because of two possibilities

1. Demand for money is sensitive to income change
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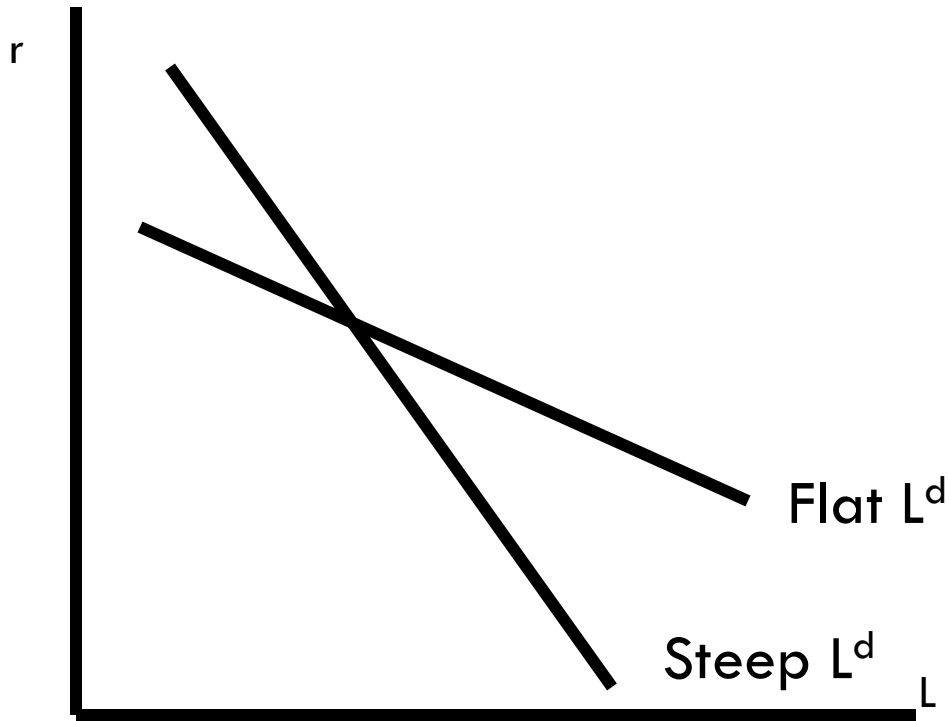
FACTORS DETERMINES OF IS CURVE

Sensitivity of money demand to income $y \uparrow \rightarrow L^d \uparrow \rightarrow r \uparrow$



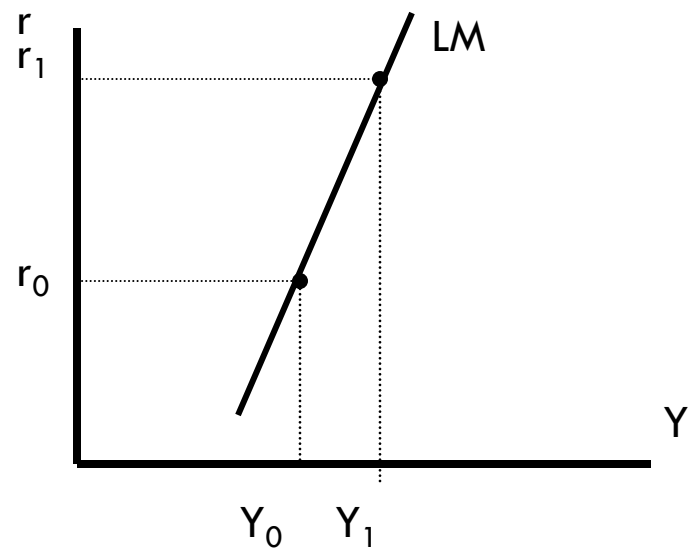
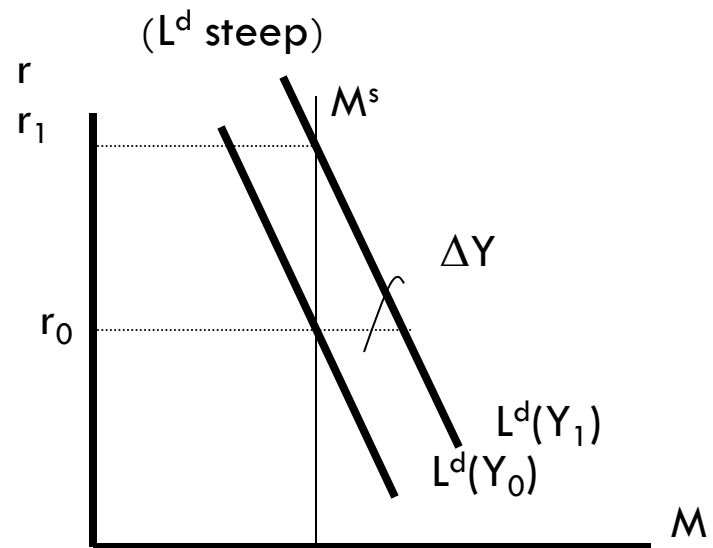
FACTORS DETERMINES OF IS CURVE

Sensitivity of money demand to interest rate

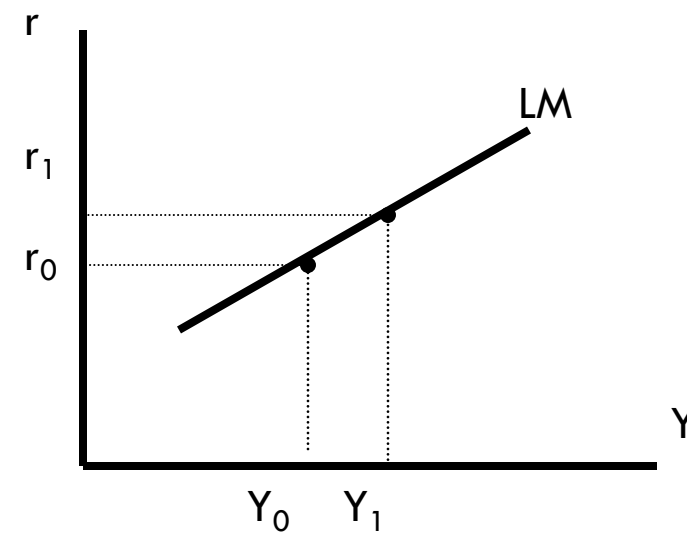
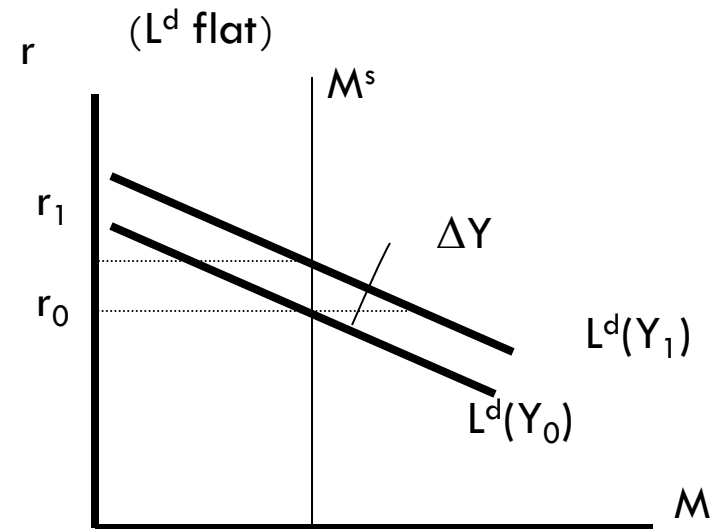


- How does money holding respond to the interest rate?
- High sensitivity
 - Money demand curve is flat
- Low sensitivity
 - Money demand curve is steep

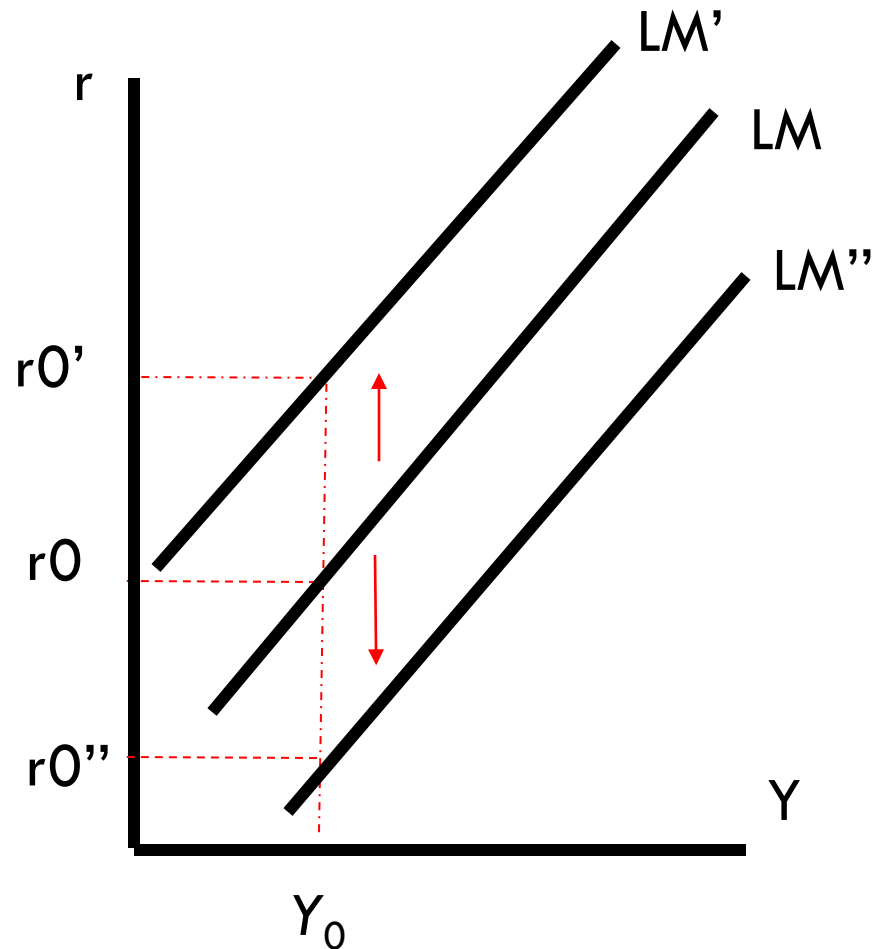
Money demand is Insensitive to interest rate



Money demand is sensitive to interest rate

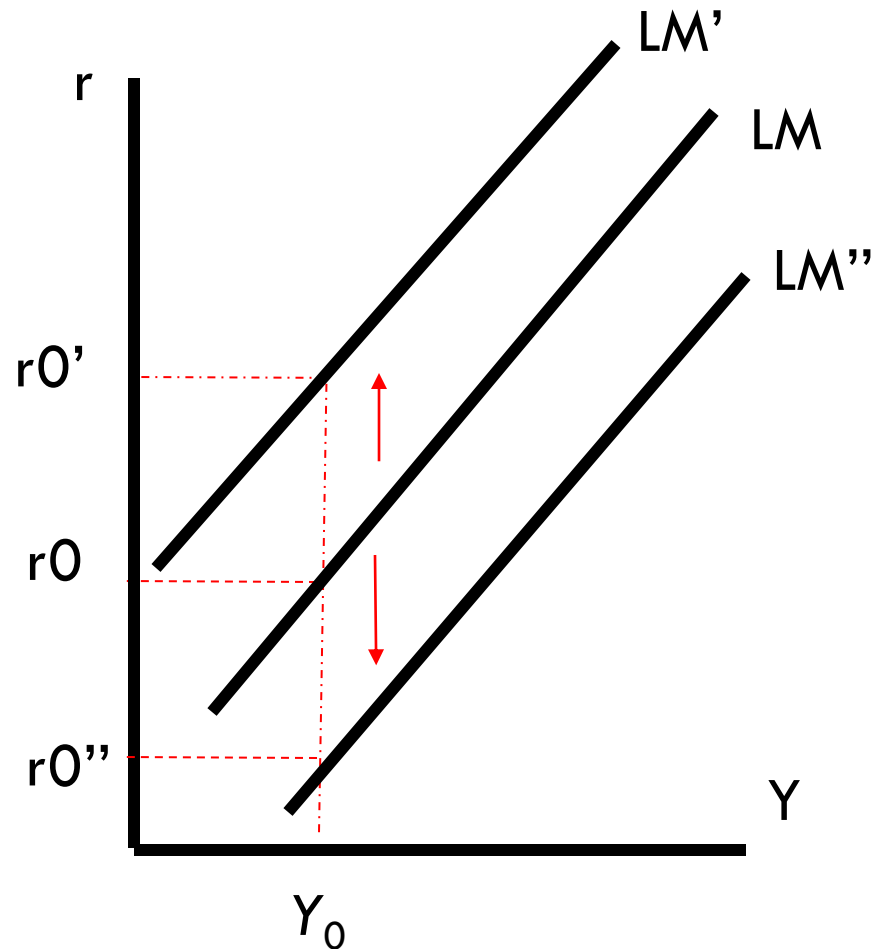


SHIFTS IN LM CURVE



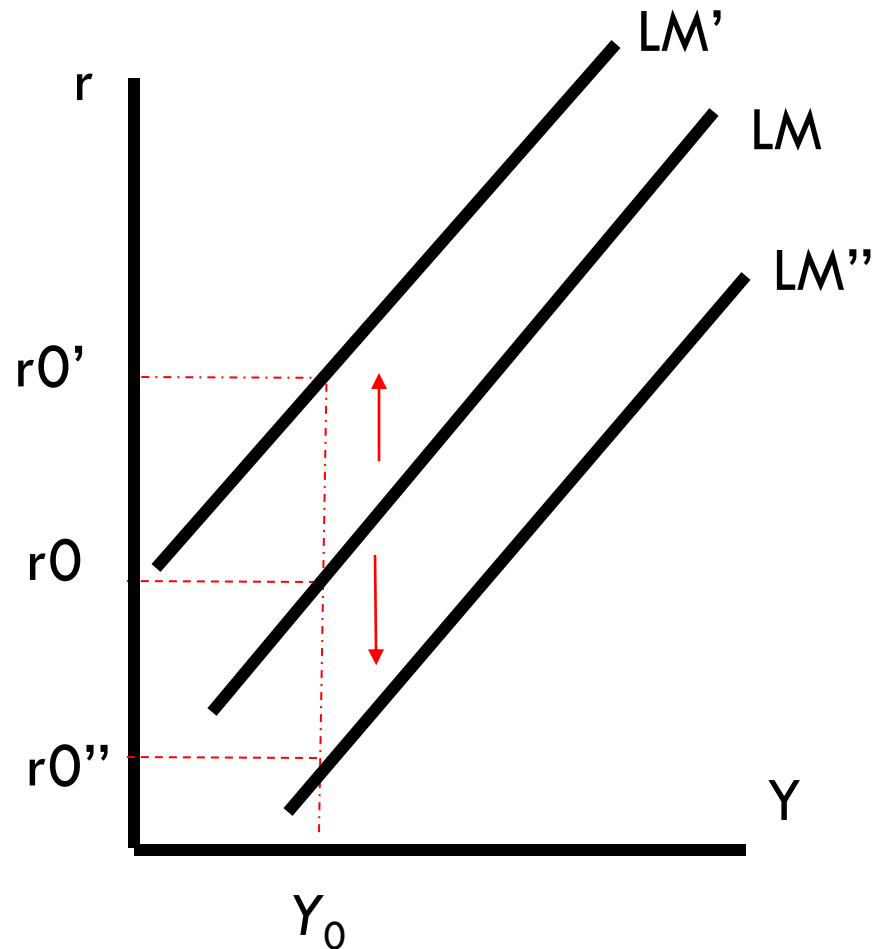
- LM curve shifts up: $LM \rightarrow LM'$
 - Interest rate increases at every level of income
- LM curve shifts down: $LM \rightarrow LM''$
 - Interest rate falls at every level of income

SHIFTS IN LM CURVE



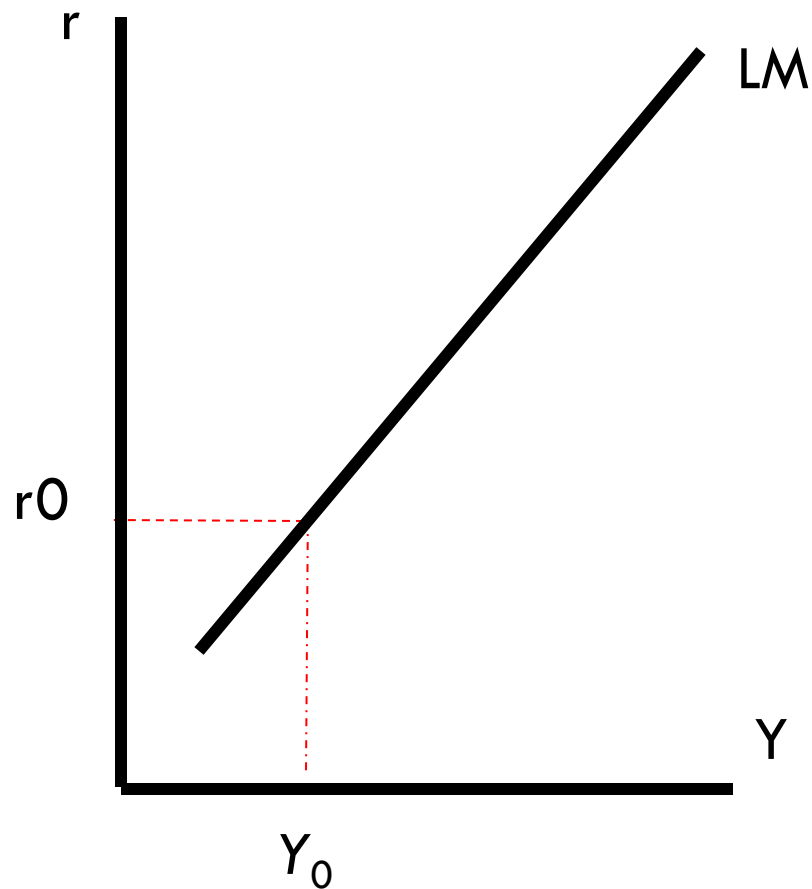
- The shift in LM occurs because of the **non-income factors** that affect the money market, and hence equilibrium interest rate
- What are they?

SHIFTS IN LM CURVE



- Non-income factors that affect money demand curve
 - Transaction technology
- Factors affecting real money supply
 - The level of nominal money supply
 - Price level

SHIFTS IN LM CURVE



- Example
 - Better transaction technology
 - Lower risk of other assets
 - Increase in nominal money supply
 - Increase in the price

AGENDA

- IS relation
 - Derivation of IS curve
 - Slope of IS curve
 - Shifts of IS curve
- LM relation
 - Derivation of LM curve
 - Slope of LM curve
 - Shifts of LM curve
- **IS-LM combined**
- Changes in Equilibrium under IS-LM

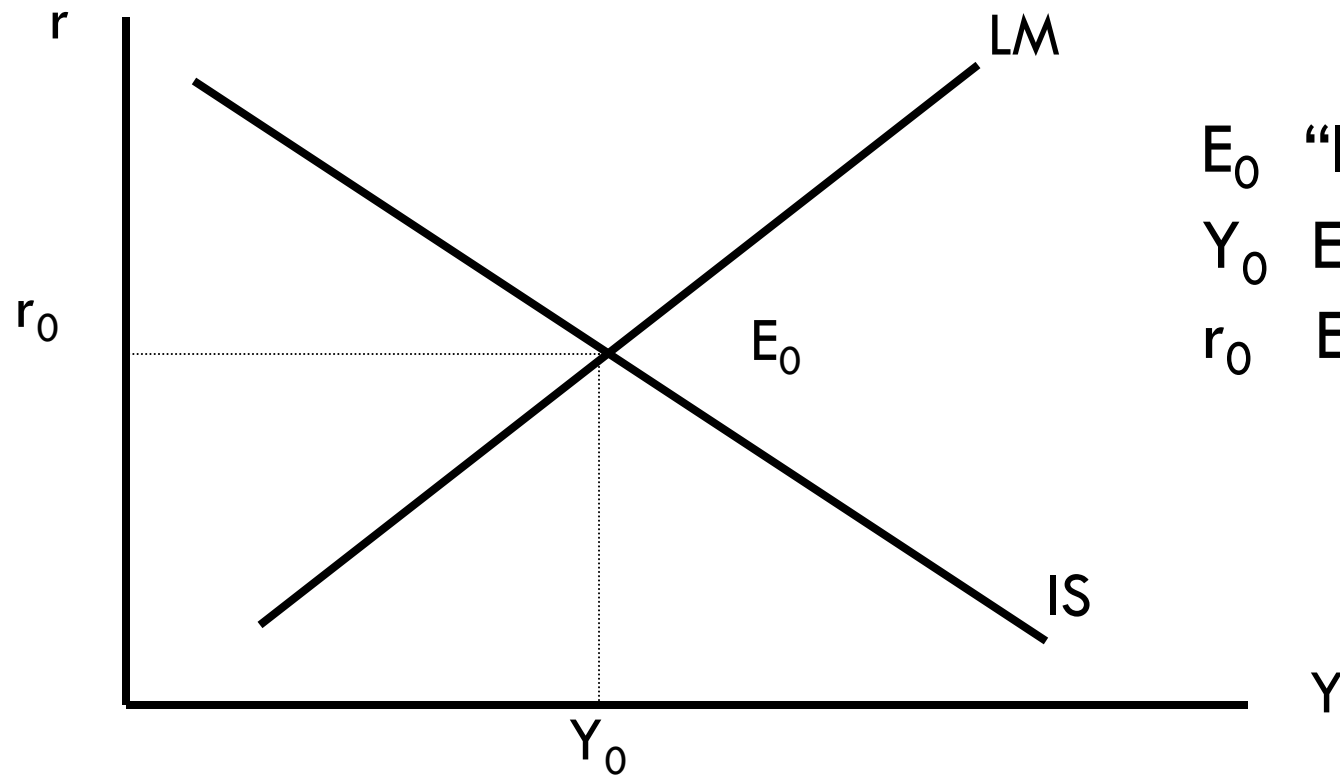
IS-LM EQUILIBRIUM

- Up to this point, we have seen that
 - Interest rate determines income in the product market
 - However, income determines interest rate in the money market
- This circularity implies that both are jointly determined
- Economists capture this idea using the concept of IS-LM equilibrium

IS-LM EQUILIBRIUM

- IS-LM equilibrium is the **equilibrium “ r ” and “ y ” where both product and money market are under equilibrium**
- Graphically, the equilibrium is **the intersection point between IS curve and LM curve**

IS-LM EQUILIBRIUM

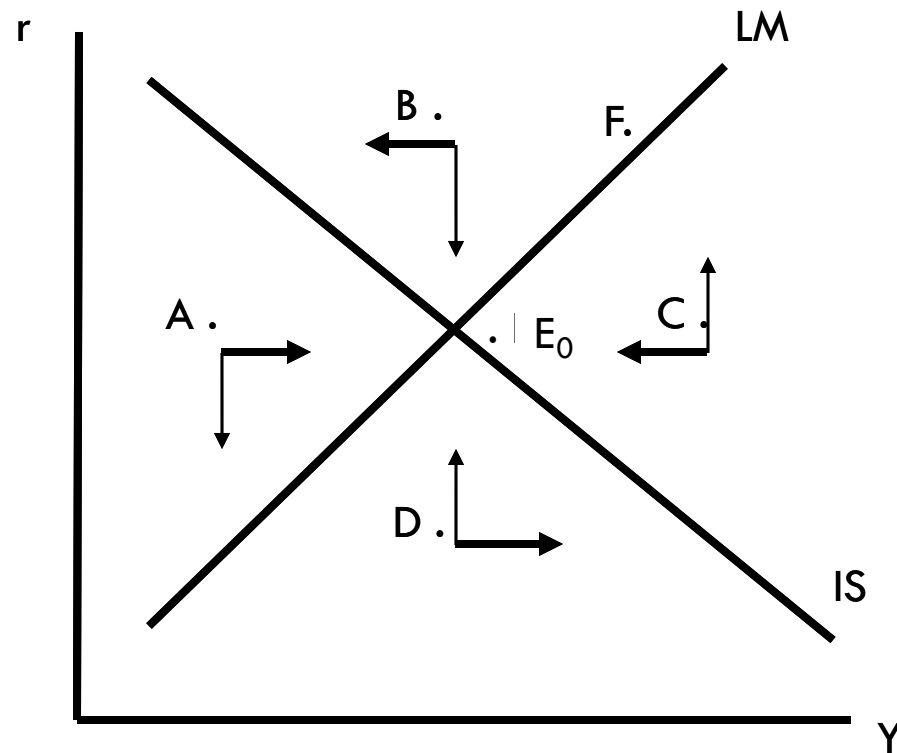


E_0 “IS-LM equilibrium”

Y_0 Equilibrium income

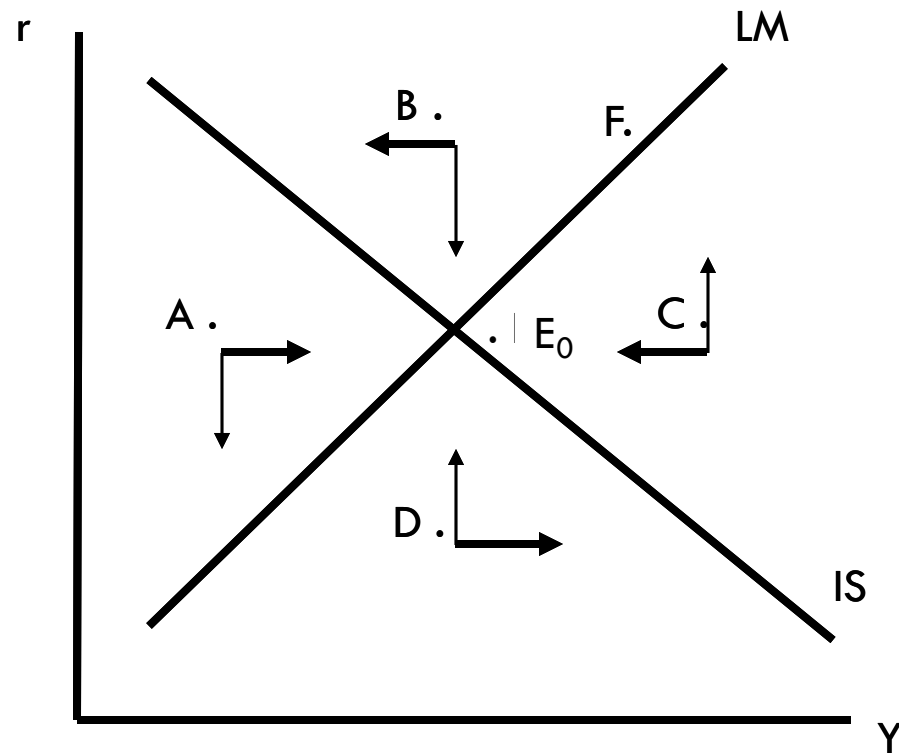
r_0 Equilibrium interest rate

IS-LM EQUILIBRIUM: DISEQUILIBRIUM



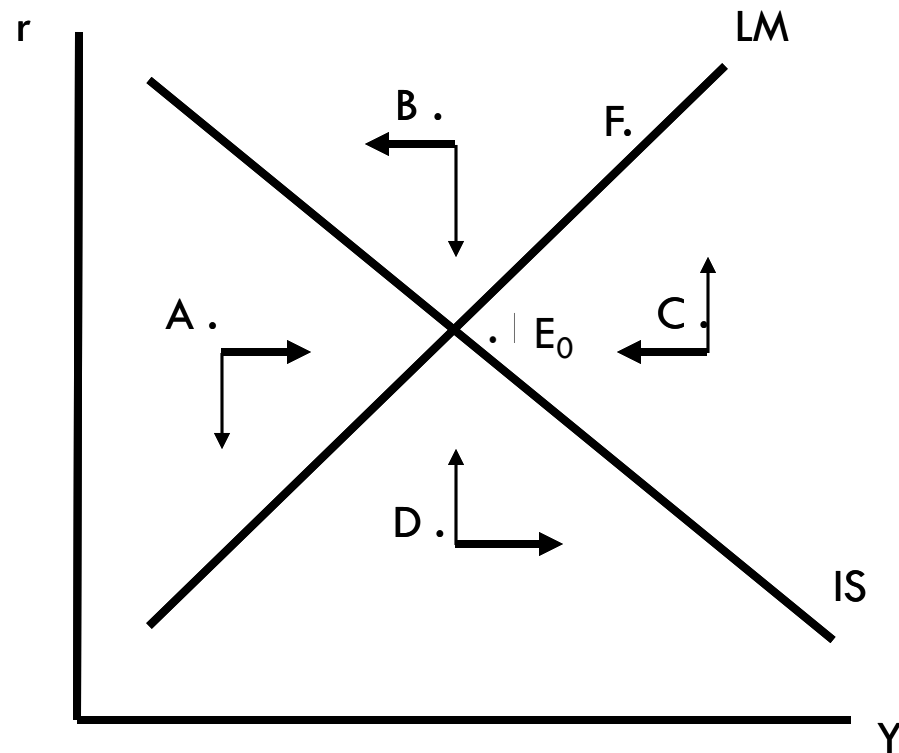
- Each point (off the intersection) represents disequilibrium
- Economy will find its way to adjust towards E_0
- Mechanism?

IS-LM EQUILIBRIUM: ADJUSTMENT



- Suppose we start from A

IS-LM EQUILIBRIUM: ADJUSTMENT



- Suppose we start from C

AGENDA

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 - Derivation of IS curve
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- IS-LM combined
- **Changes in Equilibrium under IS-LM**

CHANGE IN EQUILIBRIUM

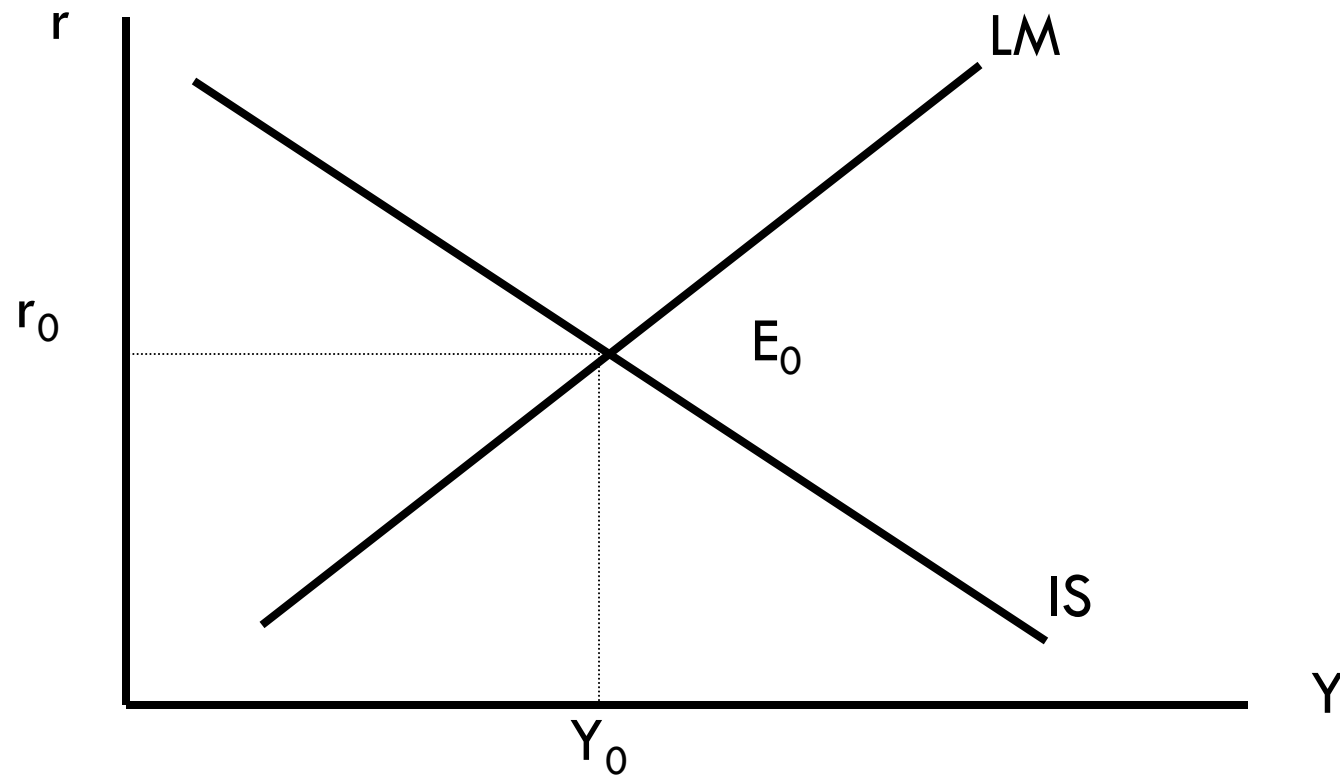
- Our economy will remain at the IS-LM equilibrium as long as everything stays fixed
- The equilibrium will be changing when the factors affecting IS and LM curve change

CHANGES IN EQUILIBRIUM

- Factors affect IS curve
 - What causes the IS curve to shift is the change in autonomous expenditure
 - Whatsoever affects that autonomous expenditure move the whole IS curve then
- Factors affect LM curve
 - Non-income factors that affect money demand
 - Factors affecting real money supply

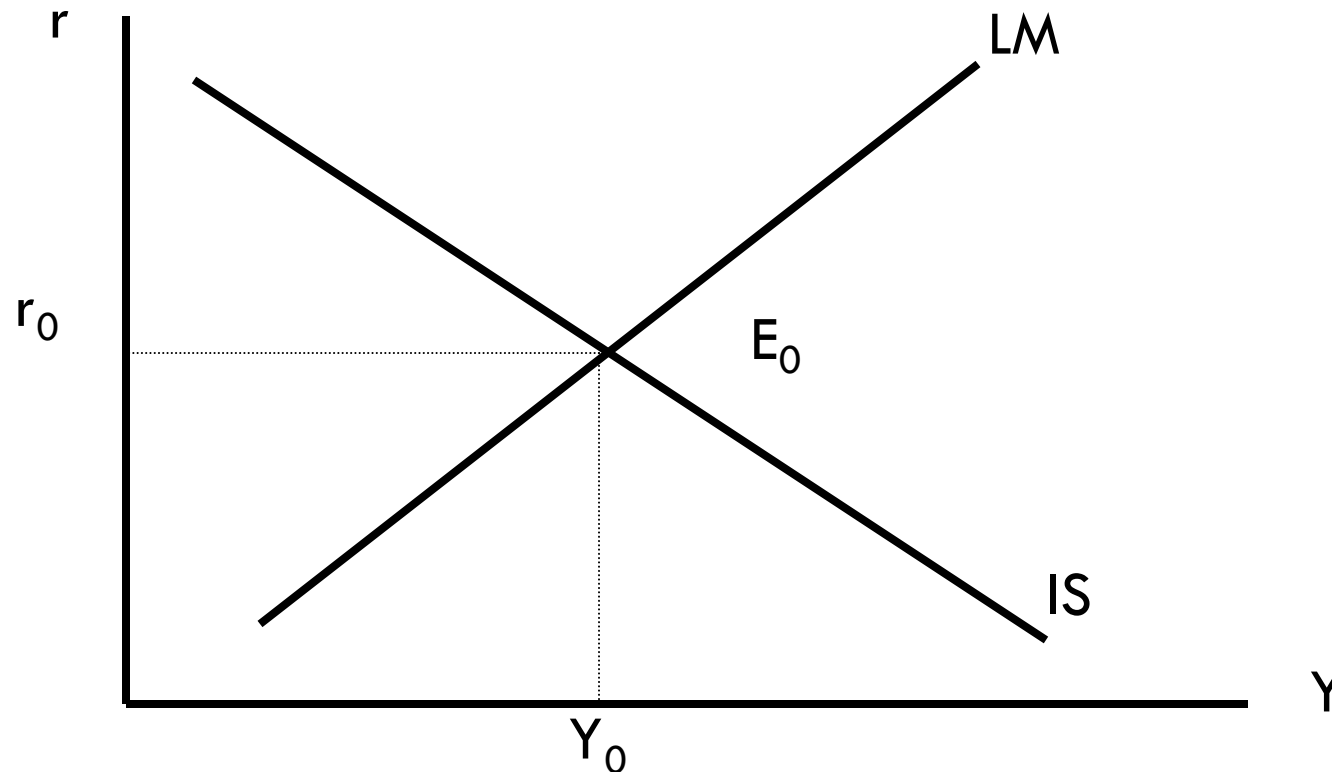
CHANGES IN EQUILIBRIUM

- Consider a drop in the autonomous consumption



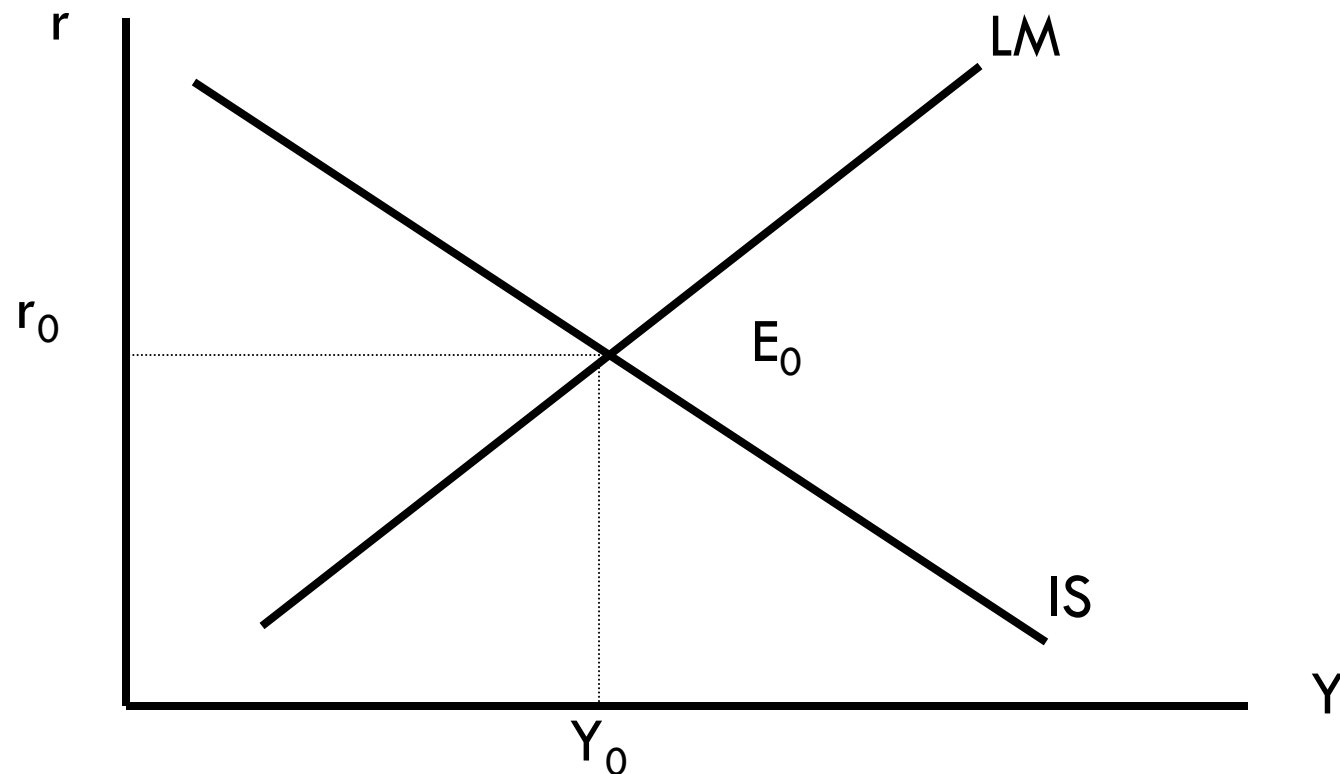
CHANGES IN EQUILIBRIUM

- Consider the increase in government spending (consumption/investment)



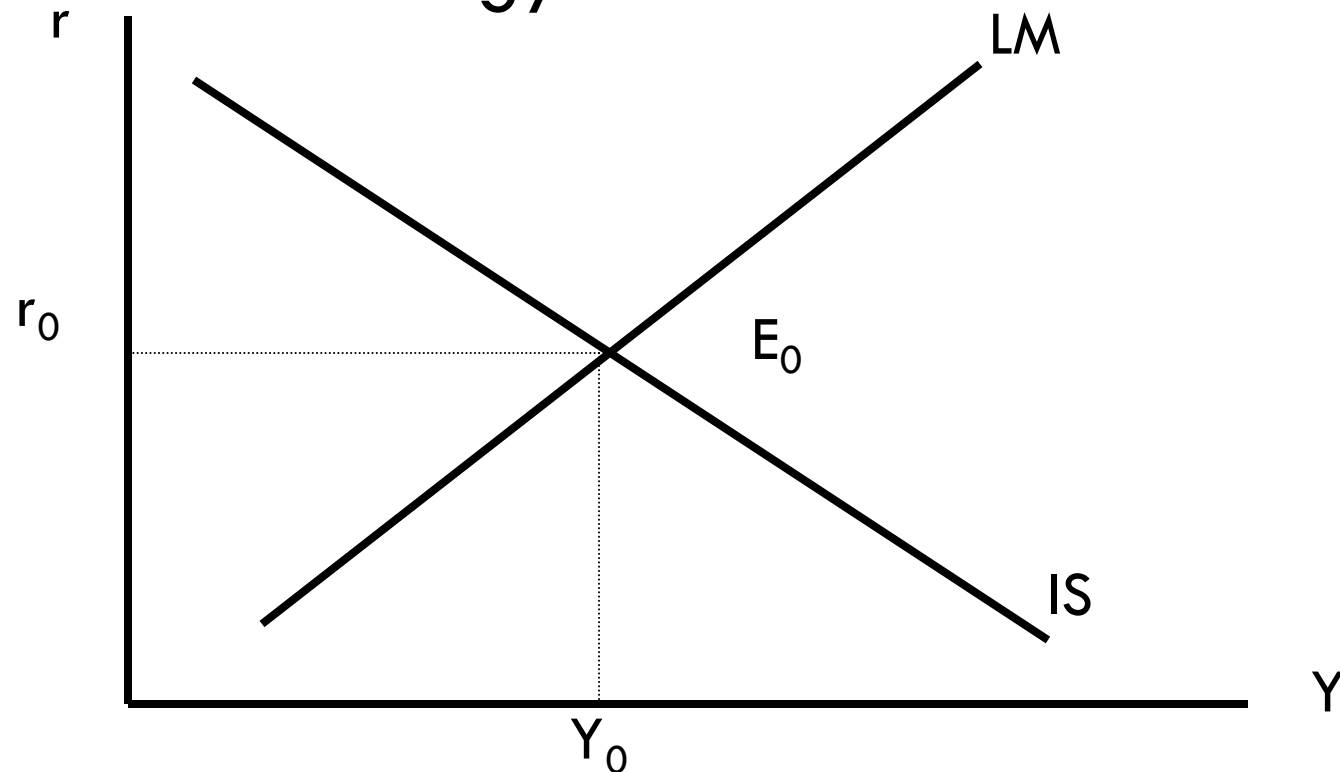
CHANGES IN EQUILIBRIUM

- Consider an appreciation in the Thai baht



CHANGES IN EQUILIBRIUM

- Consider the impact of an improvement of transaction technology



CHANGES IN EQUILIBRIUM

- Consider the impact of a drop in nominal money supply

