IS-LM

Roadmap

1) MARKET I : GOODS MARKET

- goods demand = $C + I + G\ (+NX) = Y$ = goods supply (set by maximizing firms)
- IS curve

2) MARKET II : MONEY MARKET

- money demand = $L_d(Y, r + \pi^e) = M_s/P$ = money supply (set by the Fed)
- LM curve

→ **IS-LM EQUILIBRIUM = EQUILIBRIUM IN BOTH MARKETS I and II**

Goods Market

- **IS curve represents the equilibrium in the goods market:**

(1) $$Y \equiv C + I + G + NX$$

- Recall the definition of **private savings** S (hh) = Y – T – C
- Recall the definition of **national savings** S = S (hh) + T – G
- Combining them

(2) $$S = Y - C - G$$

- From (1) and (2) the demand side of the economy can be written as:

$$\mathbf{S = I + NX}$$

The IS curve is named as it is because it documents the **relationship between Investment and Saving** (holding NX constant).

Demand side : the IS curve

C is a function of PVLR (Y, Y^f, W), tax policy, expectations, etc.

I is a function of r, A^f, K, and investment tax policy.

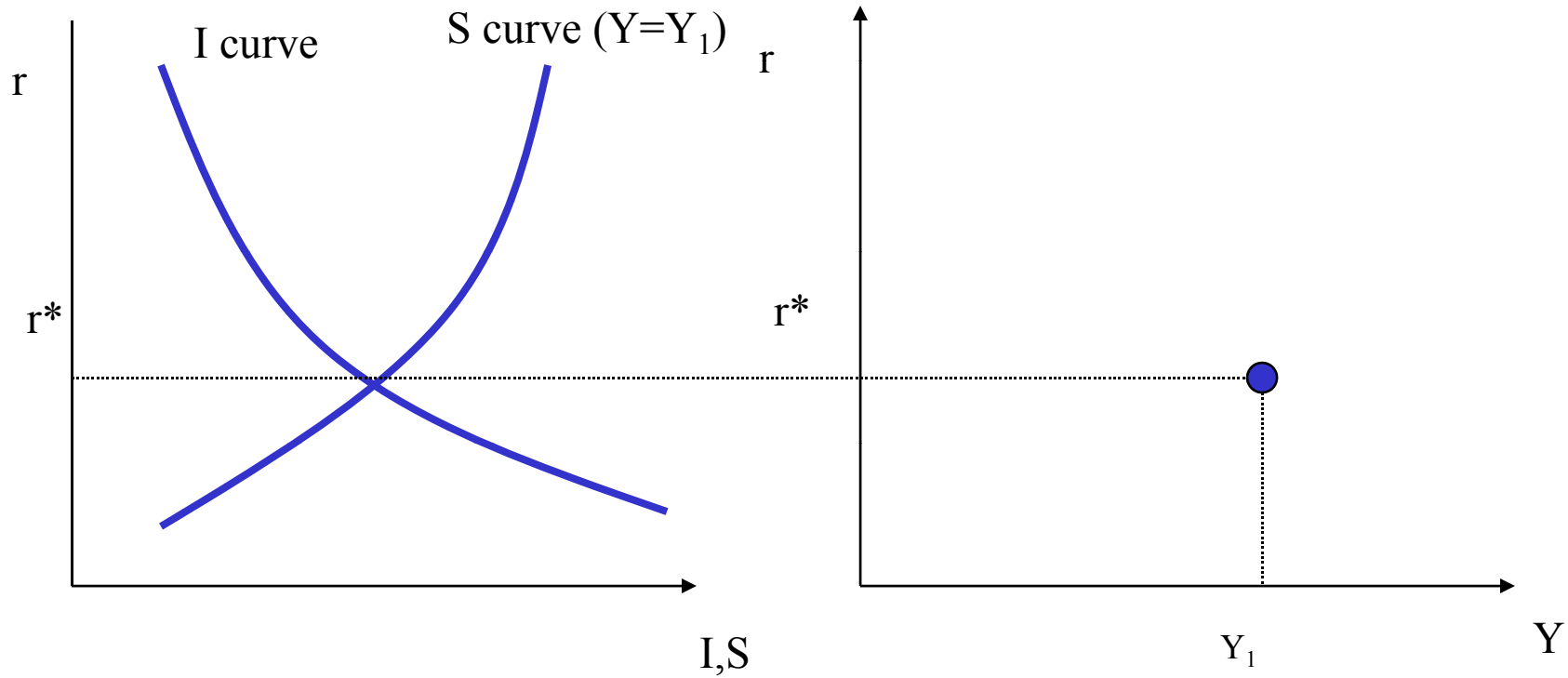
G is a function of government policy (we will discuss this shortly)

NX we will model in the last lecture of the course (for the U.S., NX is small)

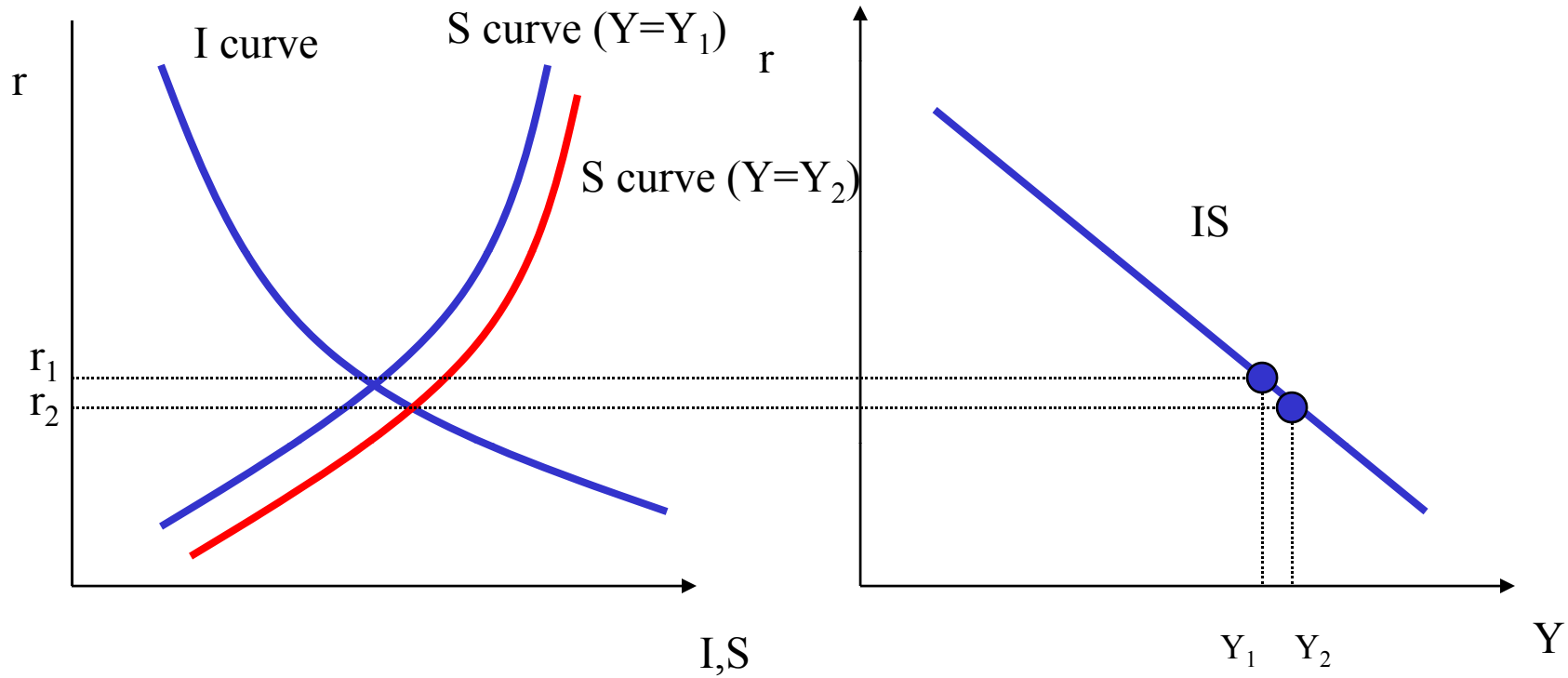
- **The IS curve relates Y to r**. How do interest rates affect Y?
- **As r falls, Investment increases** (due to firm profit maximization behavior).
- **Also Consumption increases** (substitution effect dominates)

IS curve is downward sloping in {r, Y} space.

IS Curve: Graphical Derivation

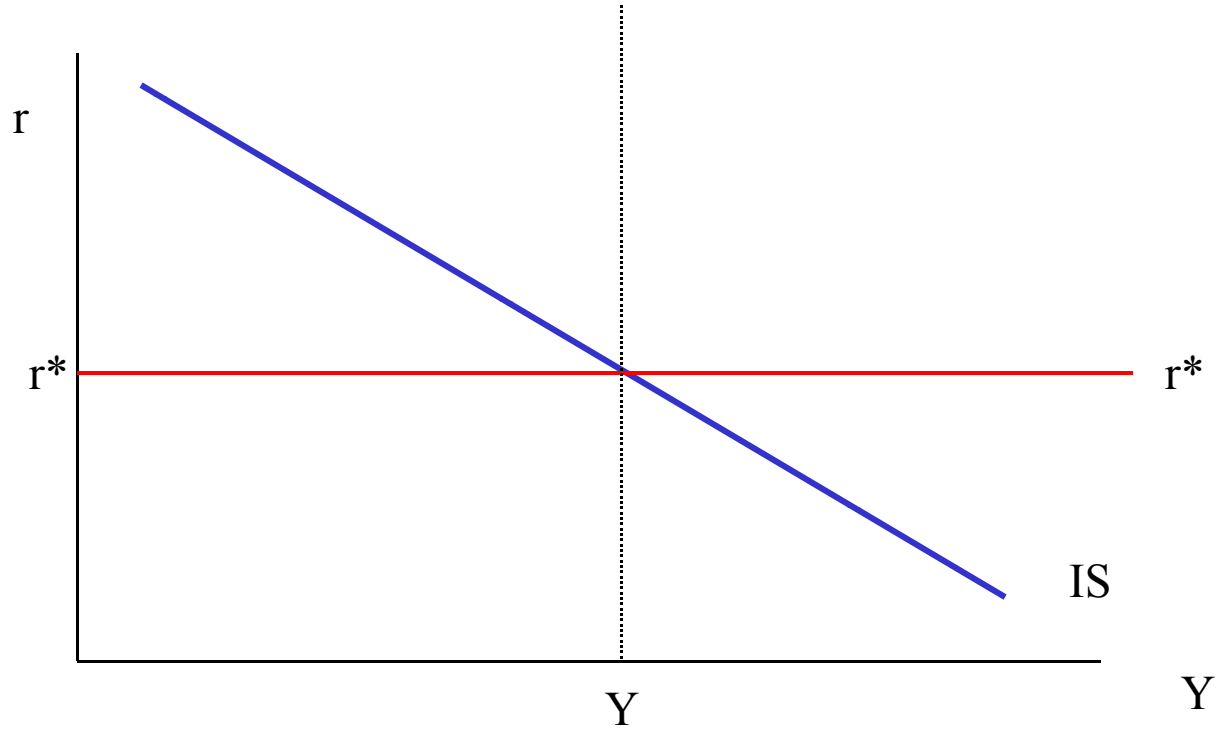


IS Curve: Graphical Derivation



An increase in current Y leads to more desired S,
hence the equilibrium r needs to be lower!

IS curve



Suppose r is set by the Fed at the level of r* (we will explore this in depth later in the course). For a given r, we can solve for the level of **output desired by the demand side of the economy.**

We represent the demand side of the economy, drawn in {r,Y} space as the I-S curve. Why IS? Because the demand side of the economy can be boiled down to **I = S** (when NX is zero)

What shifts the IS curve

What shifts the IS curve to the right?

Anything that increases **C, I or G** (or NX when we model it):

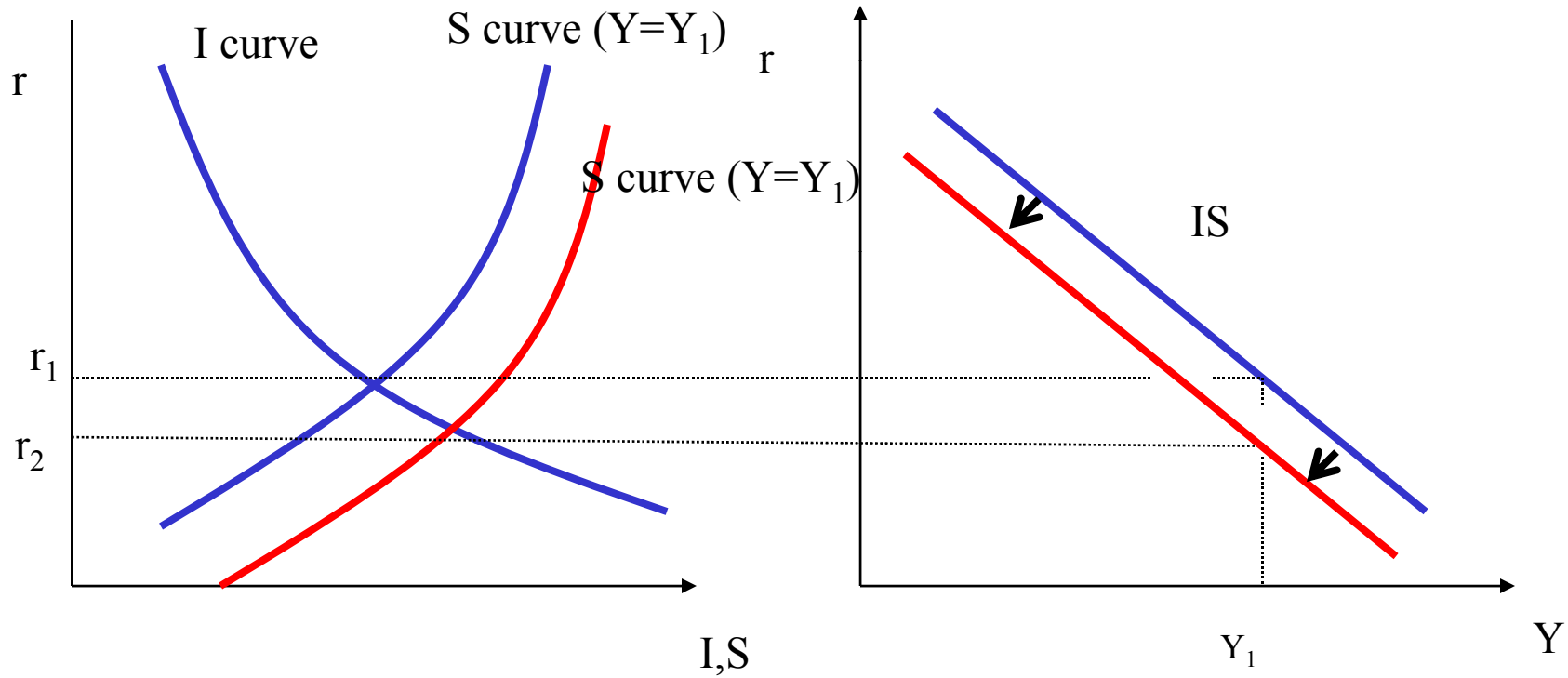
- higher expected income or wealth $\longrightarrow$ higher PVLR $\longrightarrow$ higher C
- higher conusmer confidence $\longrightarrow$ higher PVLR $\longrightarrow$ higher C
- higher Tr or lower T (if the Ricardian equivalence fails) $\longrightarrow$ higher C
- higher expectations about A^f $\longrightarrow$ higher MPK^f $\longrightarrow$ higher I
- higher business confidence $\longrightarrow$ higher MPK^f $\longrightarrow$ higher I
- lower δ or mm, or lower t_K $\longrightarrow$ lower adjusted user cost of K $\longrightarrow$ higher I
- higher G

Changes in r WILL NOT cause IS curve to shift

(causes movement along IS curve)

IS shift: Fall in Consumer Confidence

Imagine S decreases



An increase in desired S requires r to decrease if Y is unchanged!

Money Market

LM curve represents the equilibrium in the money market

The Money Market is in Equilibrium when

$$M_s/P = L_d(Y, r + \pi^e)$$

M_s/P = Real Money Supply

$L_d(Y, r + \pi^e)$= Real Money Demand

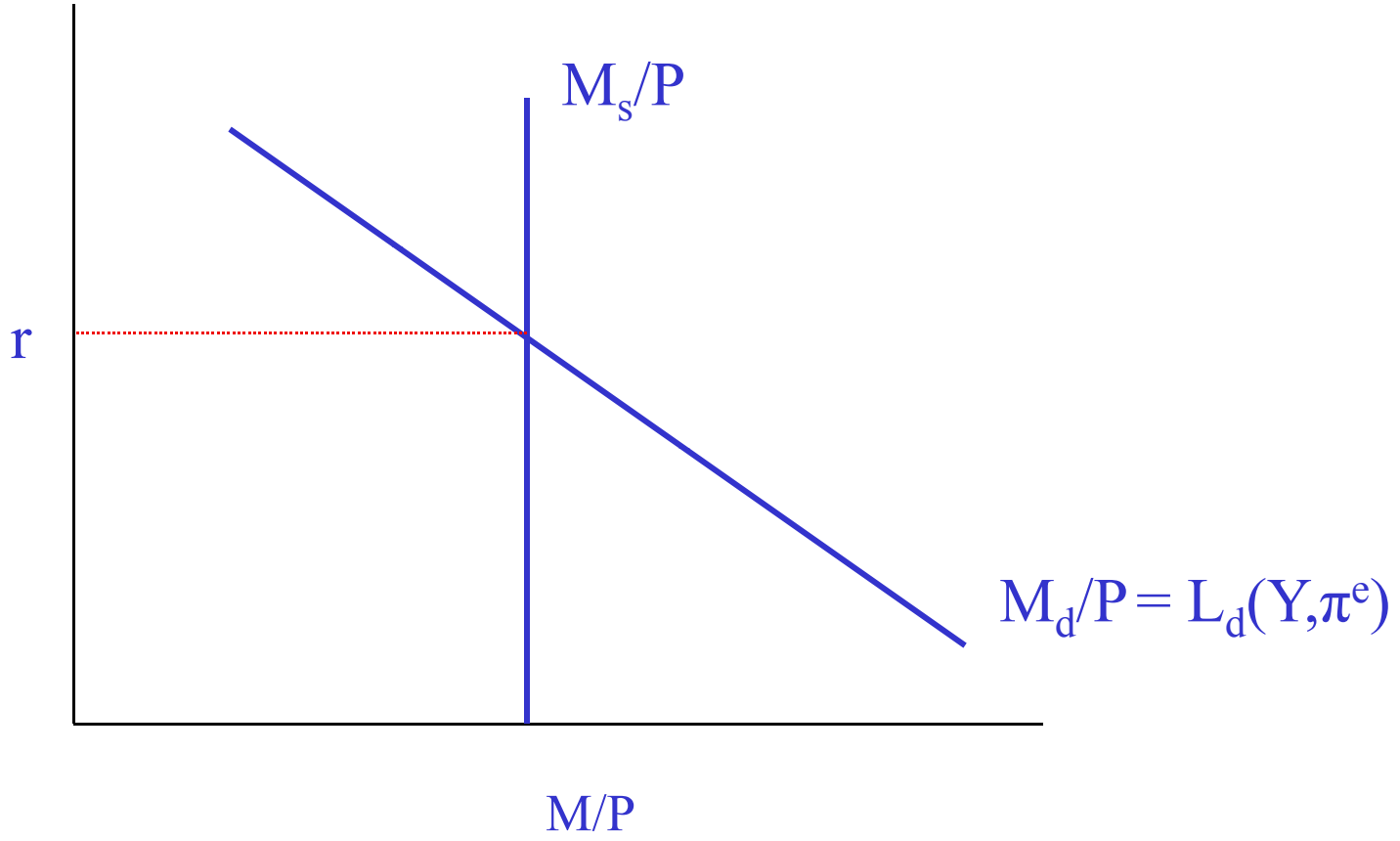
The money supply is decided by the Fed and does not change with interest rates

What shifts real money supply: M, P

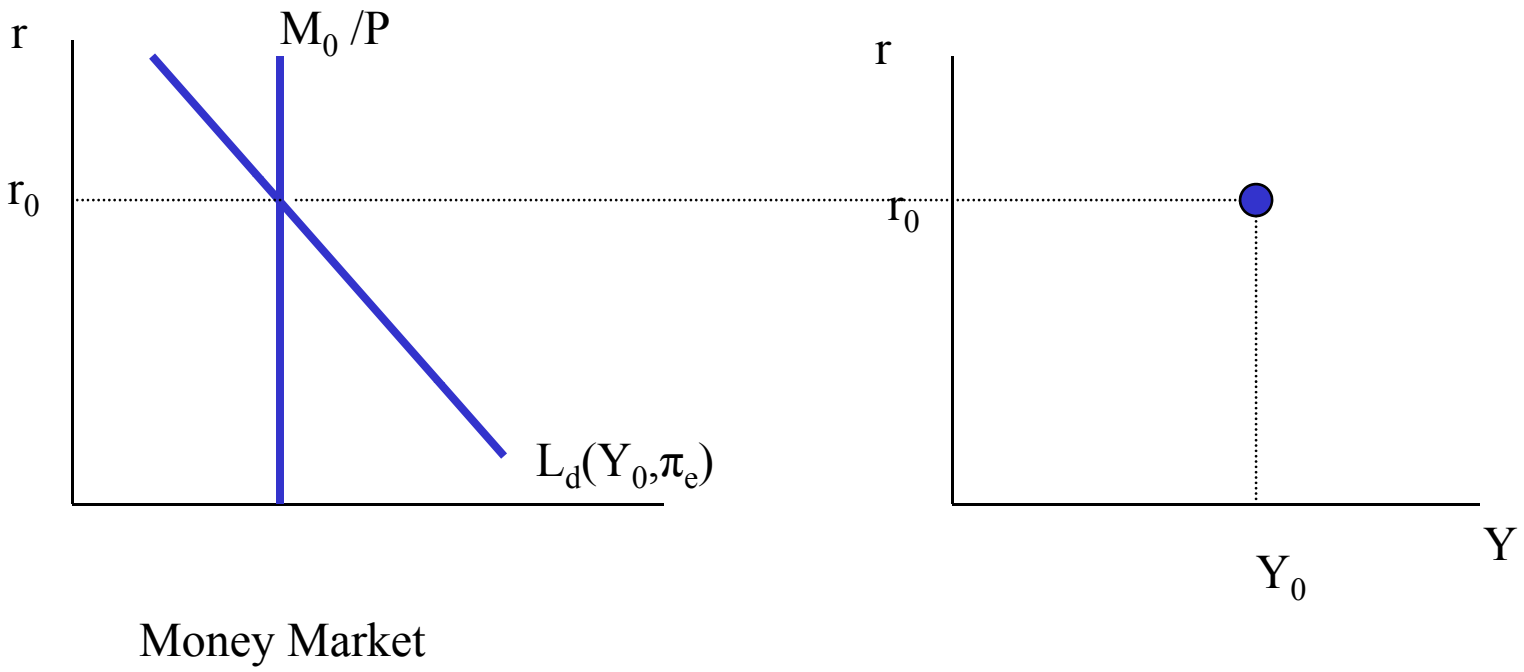
What shifts real money demand: Y, π^e

LM curve is named as it is because it documents the **relationship between Liquidity and Money**

Money Market Equilibrium

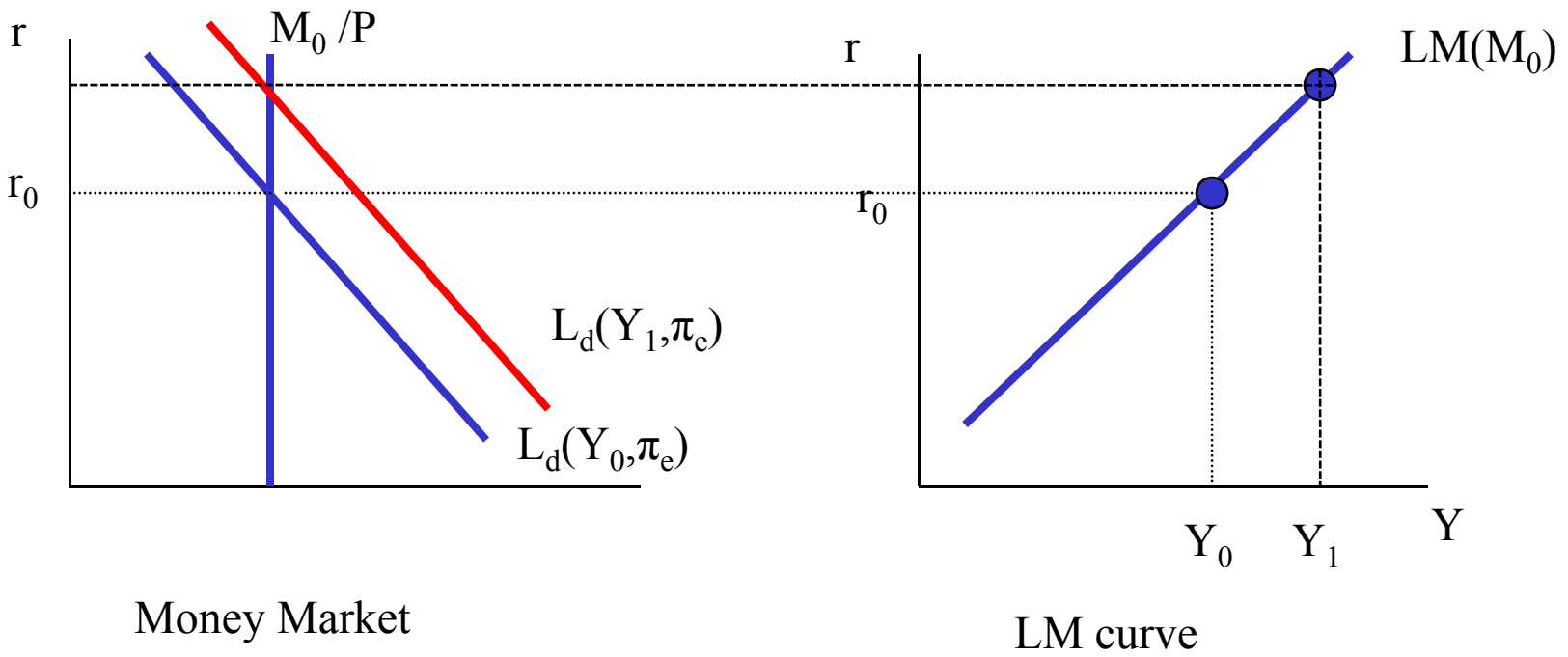


LM Curve: Graphical Derivation



Money Market

LM Curve: Graphical Derivation



An increase in the level of transaction will increase the interest rate (for given money supply)!

What shifts the LM Curve

LM Curve: represents the relationship of Y and r through the money market

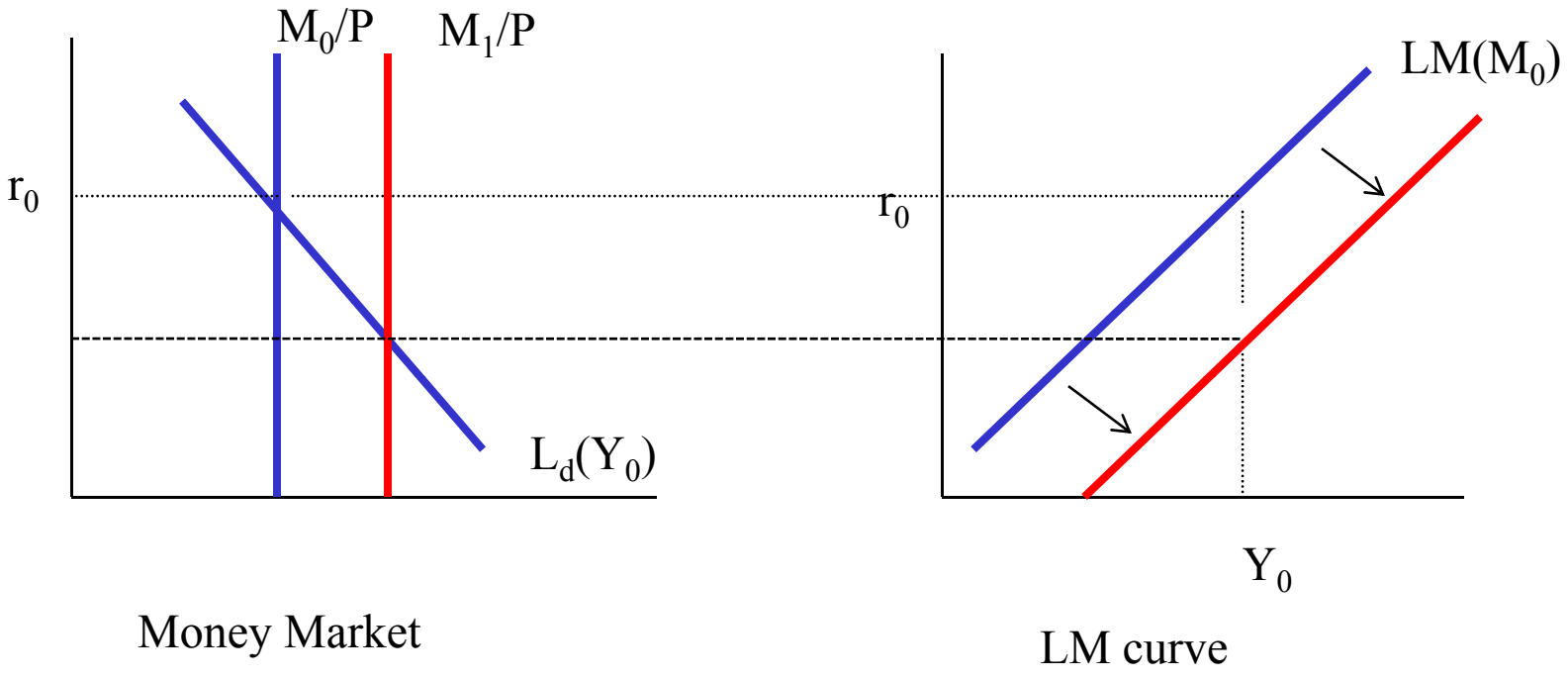
As Y increases - L_d shifts upwards - causing real interest rates to rise (increase in transactions demand increases the demand for money).

What shifts the LM curve to the right?

- Higher nominal money supply $\longrightarrow$ higher M_s/P
- Lower prices $\longrightarrow$ gher M_s/P
- higher π^e $\longrightarrow$ hi higher I and hence lower money demand

LM Shift: Increase in Ms

Thought experiment: Suppose M increases. What would happen to r if Y was held constant?



An increase in the nominal money supply will cause the LM curve to shift to the right.

Summing Up

1) MARKET I : GOODS MARKET

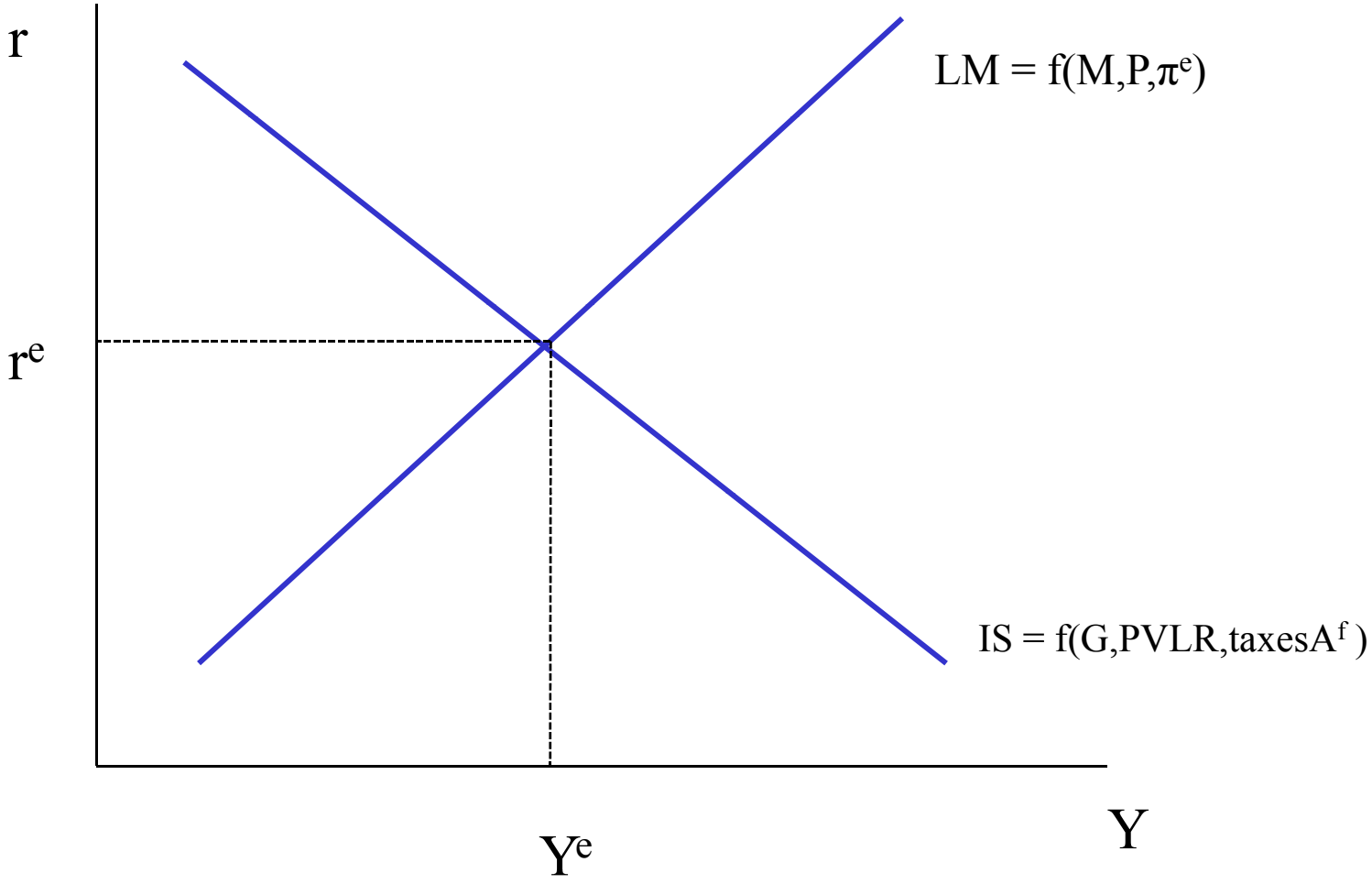
- goods demand = $C + I + G\ (+NX) = Y$ = goods supply (set by maximizing firms)
- as the interest rate increases, I and C fall and the demand for goods falls
- IS curve is downward sloping

2) MARKET II : MONEY MARKET

- money demand = $L_d(Y, r + \pi^e) = M_s/P$ = money supply (set by the Fed)
- as output increases, money demand increases and the interest rate has to increase to bring the demand back to the supply
- LM curve is upward sloping

→ **IS-LM EQUILIBRIUM = EQUILIBRIUM IN BOTH MARKETS I and II**

IS-LM Equilibrium



Short Run

- **SHORT RUN**: equilibrium given by intersection of IS and LM
- When aggregate demand for goods rises, assume that firms are willing to hire more workers in the short run to produce the extra output and meet the expanded demand
- **LONG RUN**: also labor market is in equilibrium and full employment:

$$Y^* = f(N^*, K, A)$$

- In the long run, if there is higher demand, firms will increase prices until they hire the optimal amount of workers and produce the potential level of output.

Labor Market

FE Curve: the equilibrium in the labor market (Full Employment)

- Factors Affecting Labor Supply
  - The Real Wage (**w/p**)
  - The Household's Present Value of Lifetime Resources (**PVLR**)
  - The Marginal Tax Rate on Labor Income ($\mathbf{t_n}$)
  - The Marginal Tax Rate on Consumption ($\mathbf{t_c}$)
  - Value of Leisure (reservation wage) - non-'work' status (**VL**)
  - The Working Age Population (**pop**)

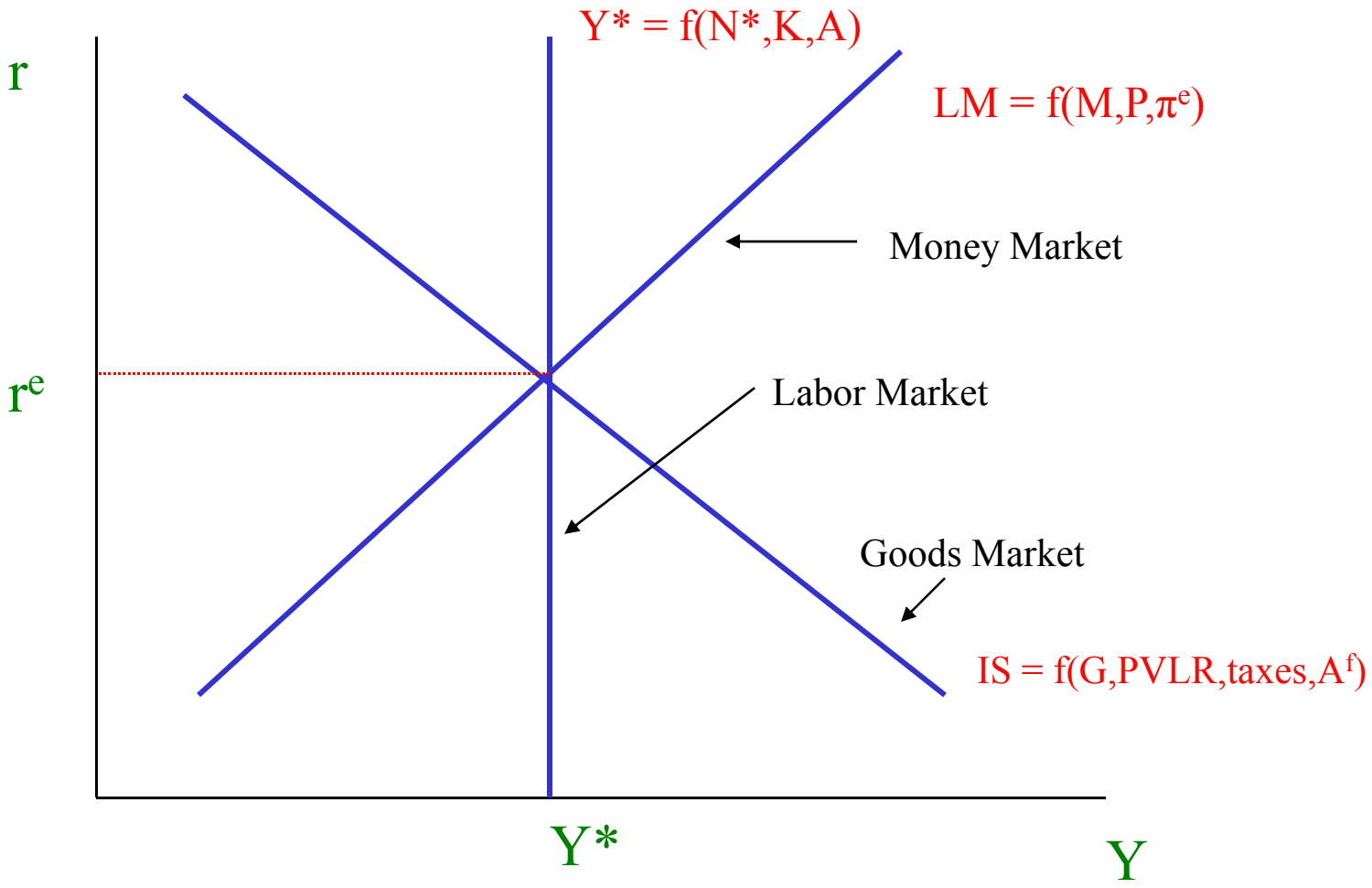
- Factors affecting Labor Demand:
  - TFP (**A**)
  - Capital (**K**)

Y* is not sensitive to r!

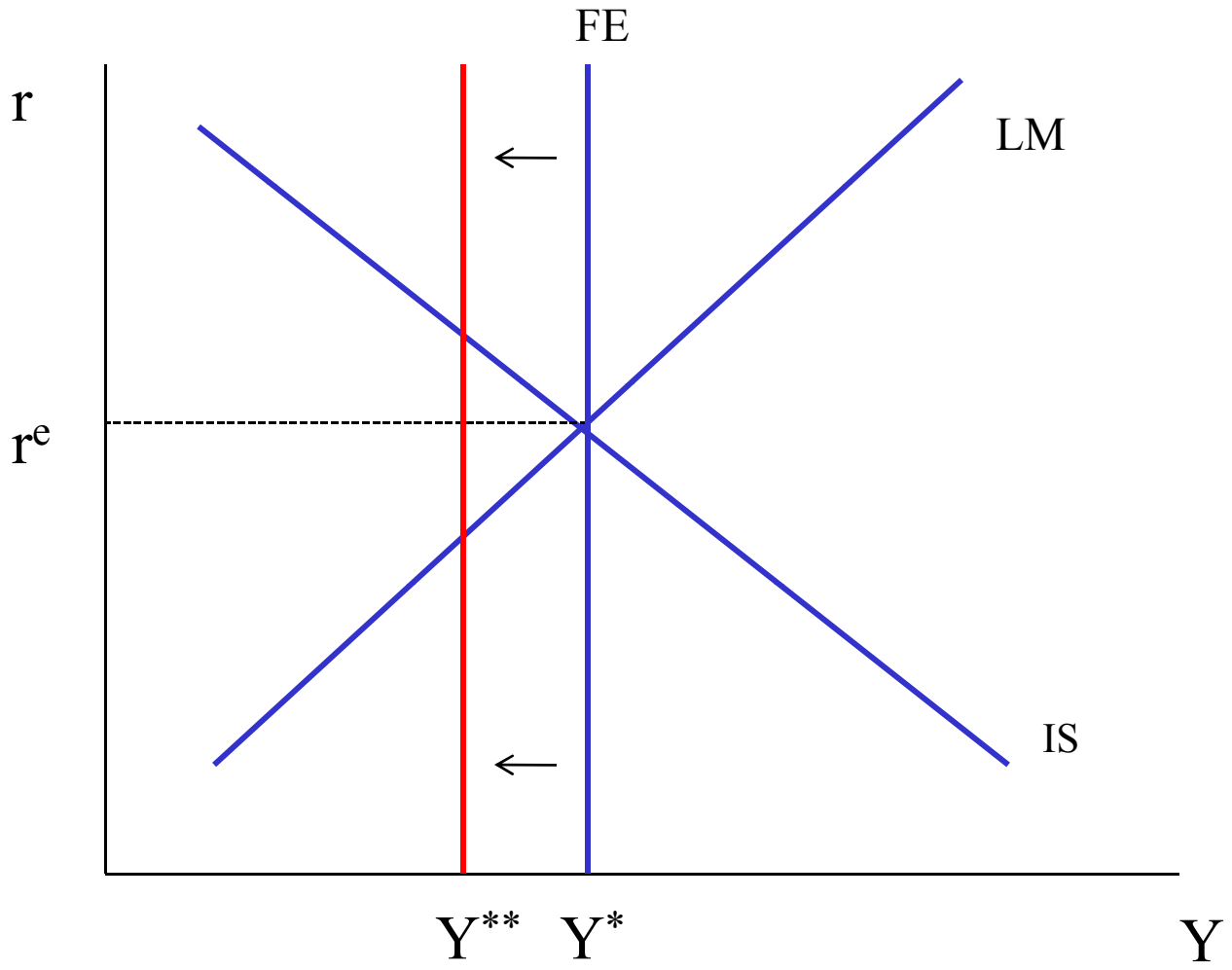
What shifts Y*?

- Anything that affects the **labor market** will affect Y*!
- If N* increases, Y* will shift to the right.
- If N* decreases, Y* will shift to the left.
- For example, Y* will shift right if:
  - A increases
  - K increases
  - population increases
  - labor income taxes fall (and income effect is small relative to substitution effect)
  - labor income taxes rise (and income effect is large relative to substitution effect)

IS-LM-FE Equilibrium

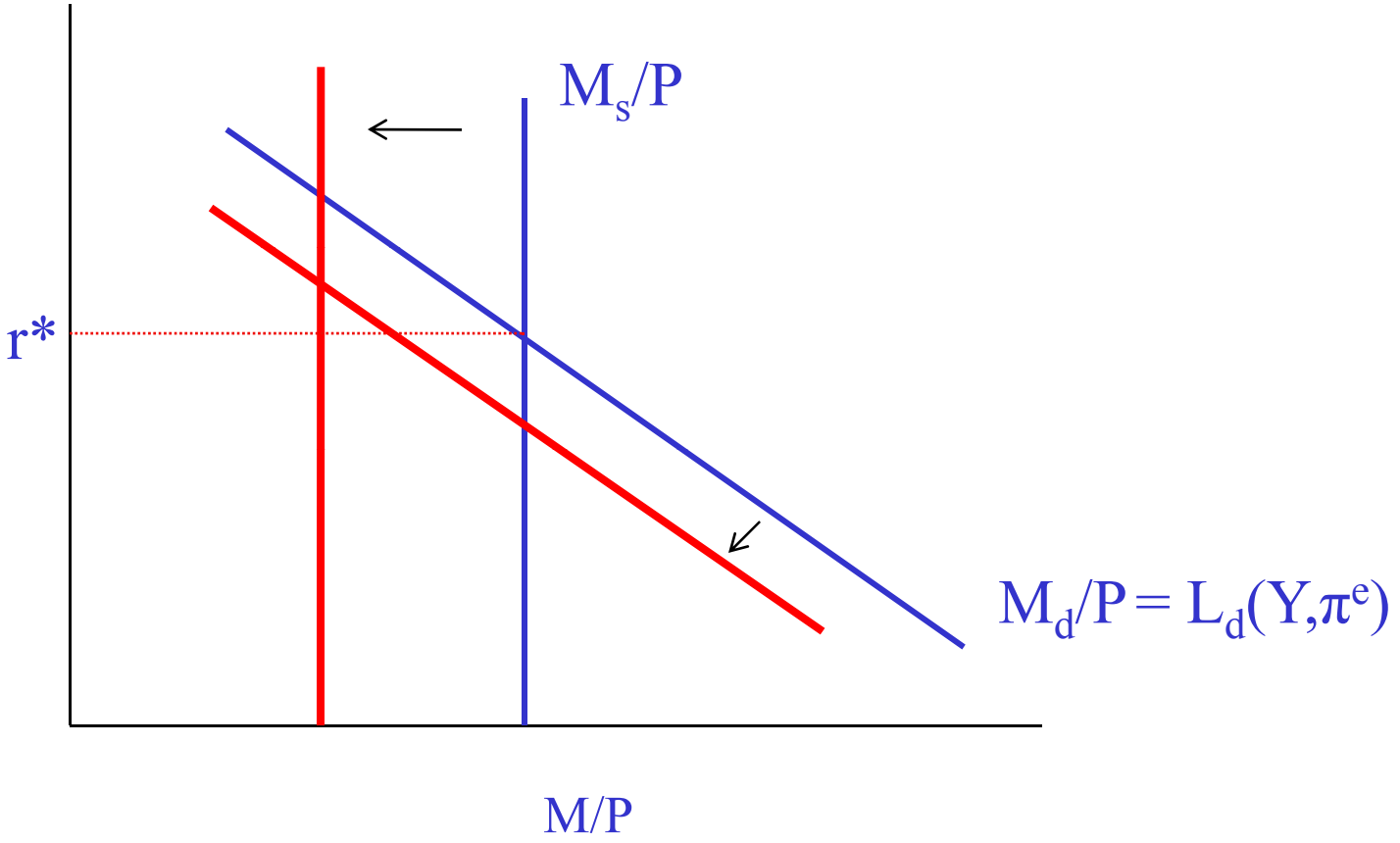


Temporary Decrease in A (Step 1)

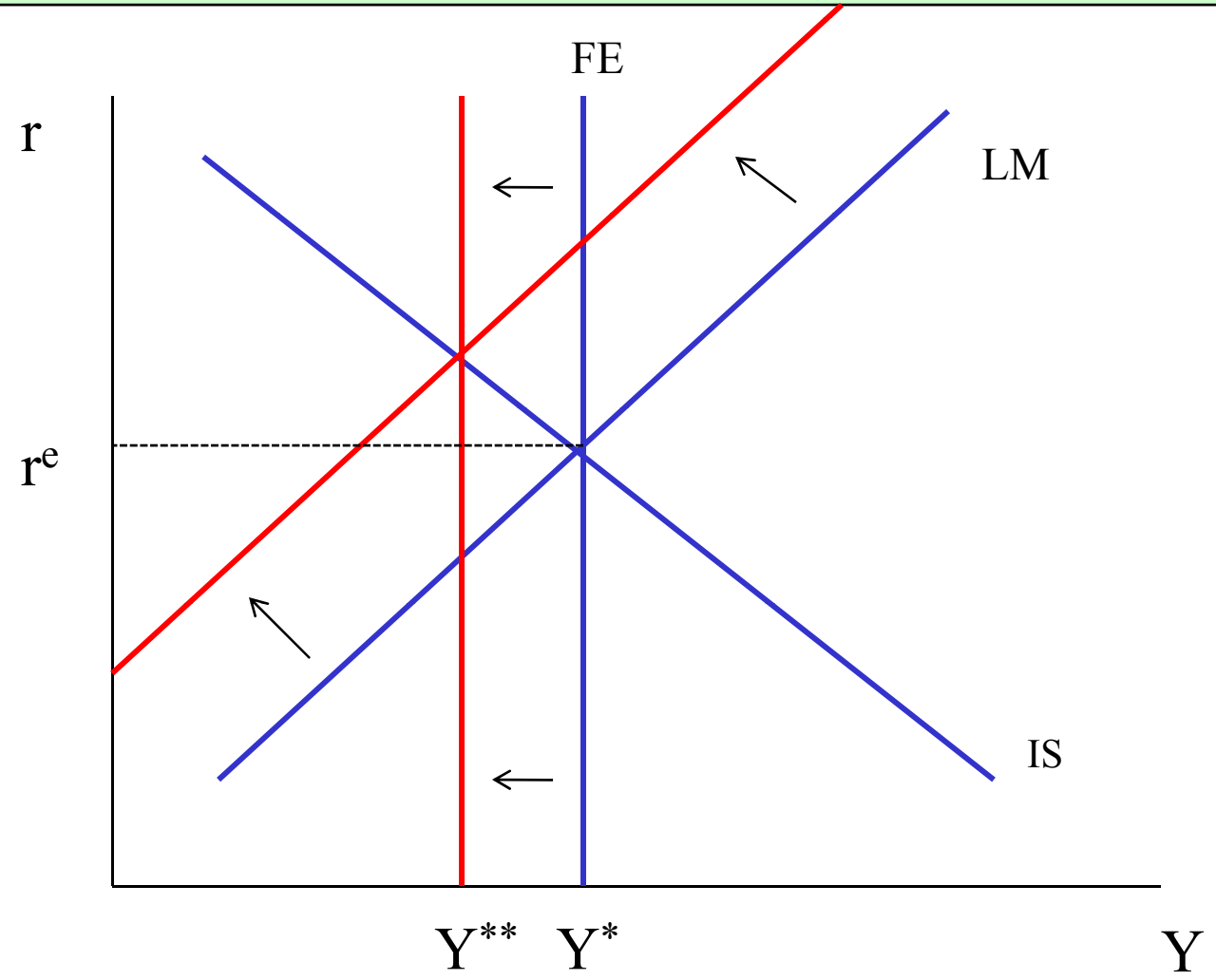


Firms are not going to be willing to produce Y* anymore for long, hence P will increase!

In the Money Market…



Temporary Decrease in A (Step 2)



In the new long run equilibrium, output is lower, interest rate higher and prices higher!

Short Run versus Long run!

- Conventional Definition:
  - SHORT RUN: Prices are sticky
  - LONG RUN: Prices adjust

- Traditional debate in Macroeconomics on the "length" of the Short Run!
  - Classical economists: prices adjust fast
  - Keynesian economists: prices adjust slowly

- Basic Distintion:
  - Business Cycle: focus on the short run
  - Growth: focus on the long run

Long Run

- The short run equilibrium is an equilibrium in the sense that the aggregate quantity of goods produced is equal to the quantity demanded

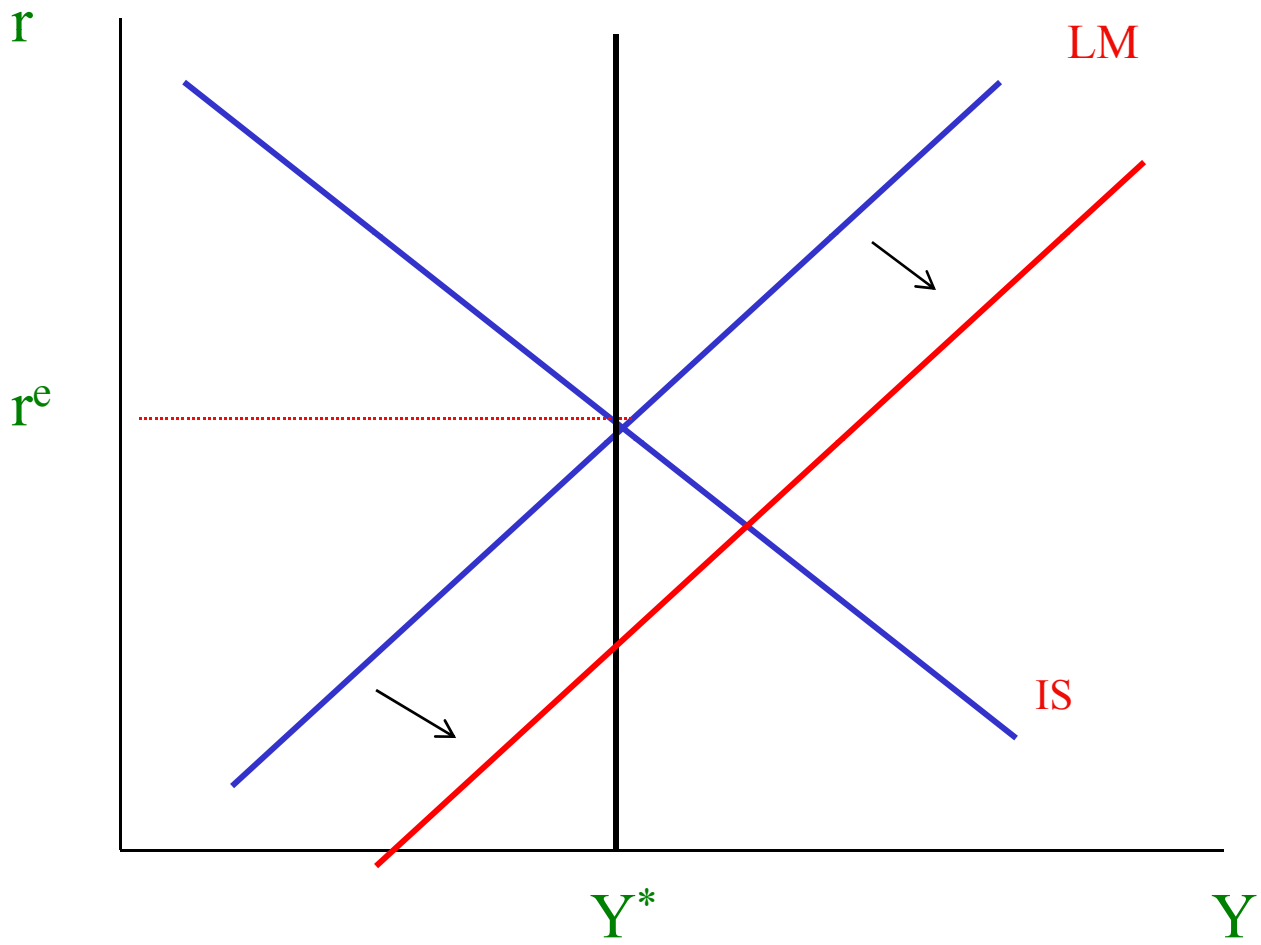
- **It is not an equilibrium in the sense that to meet the aggregate demand of goods, firms have to produce more (or less)$_{\text{out}}$ put than their potential level Y*!**

- Y* is the level of output that maximizes firms' profits. Hence, firms are producing more (or less) than what they would like.

- **This will induce at some point firms to change prices.** If M increases, firms will start to increase prices up to the point that M/P is the same as before, so that the demand is equal to Y*!

Monetary Policy in the Short Run

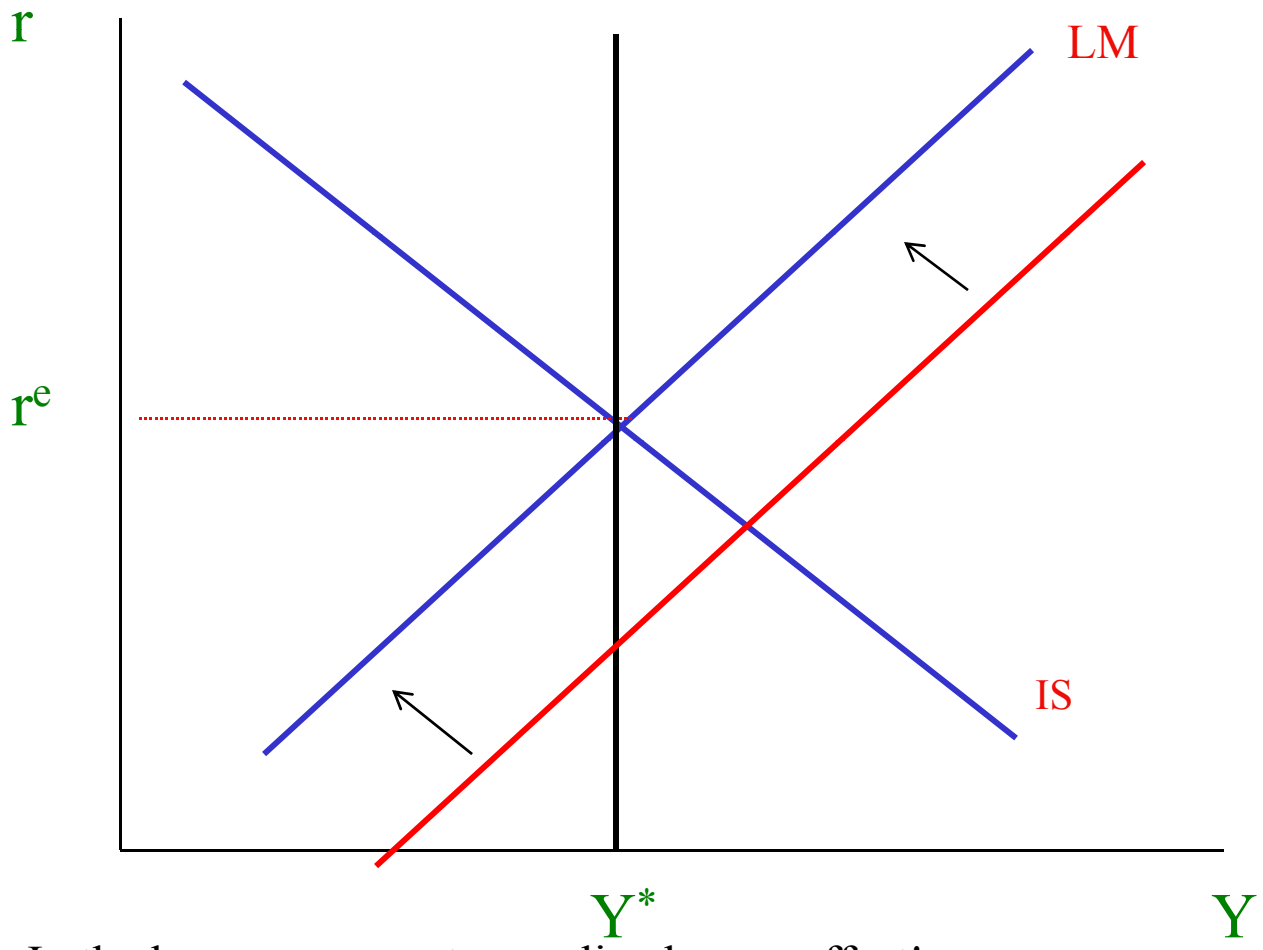
SHORT RUN: P are fixed



As M increase, money holders have more money than what they need and increase the demand for bonds and decrease r. This increases I and C.

Monetary Policy in the Long Run

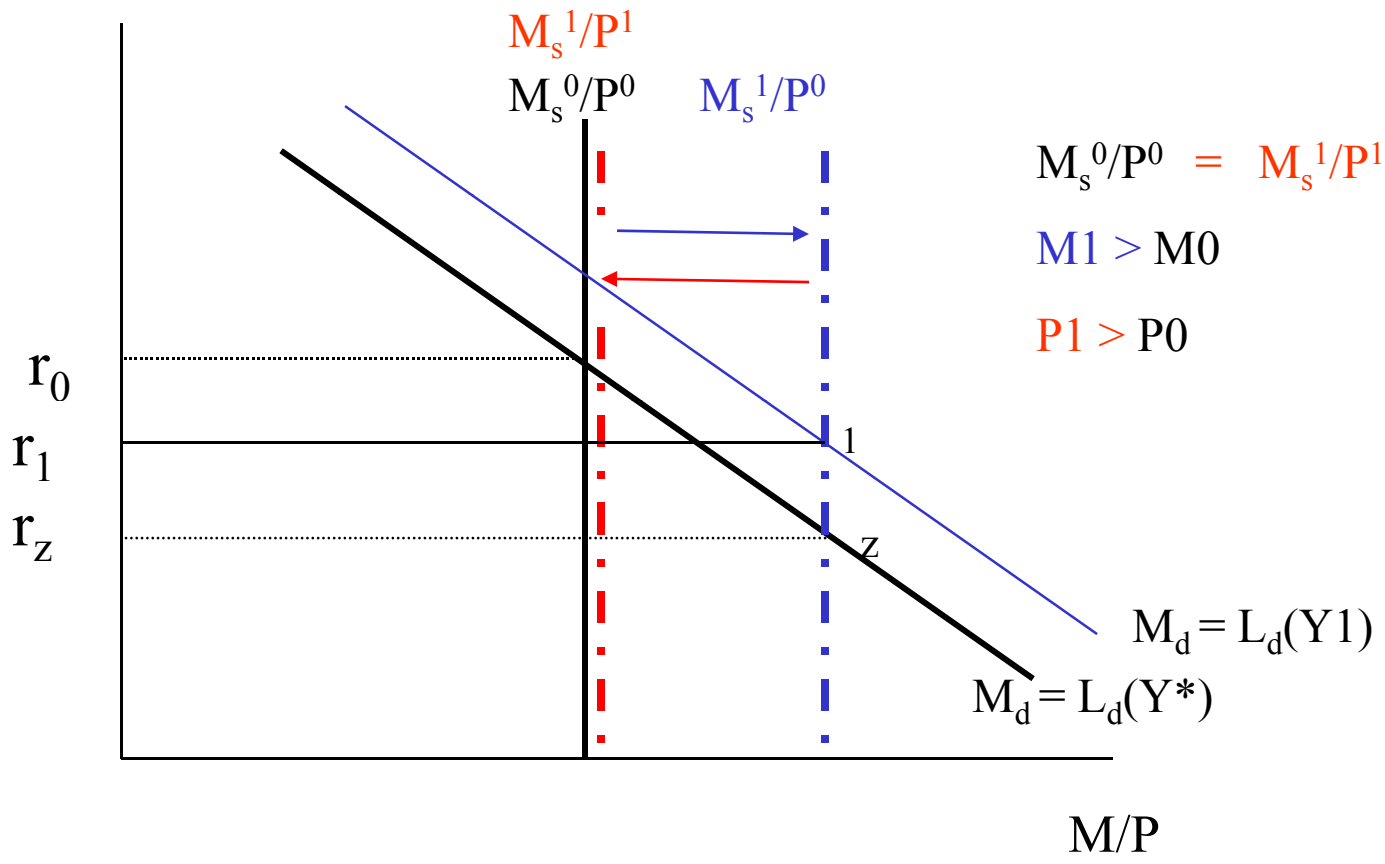
LONG RUN: prices adjust and back to the general equilibrium



In the long-run, monetary policy has no effect!

Money Market (Short run / Long run)

The effectiveness of Monetary Policy will depend on how sticky prices are

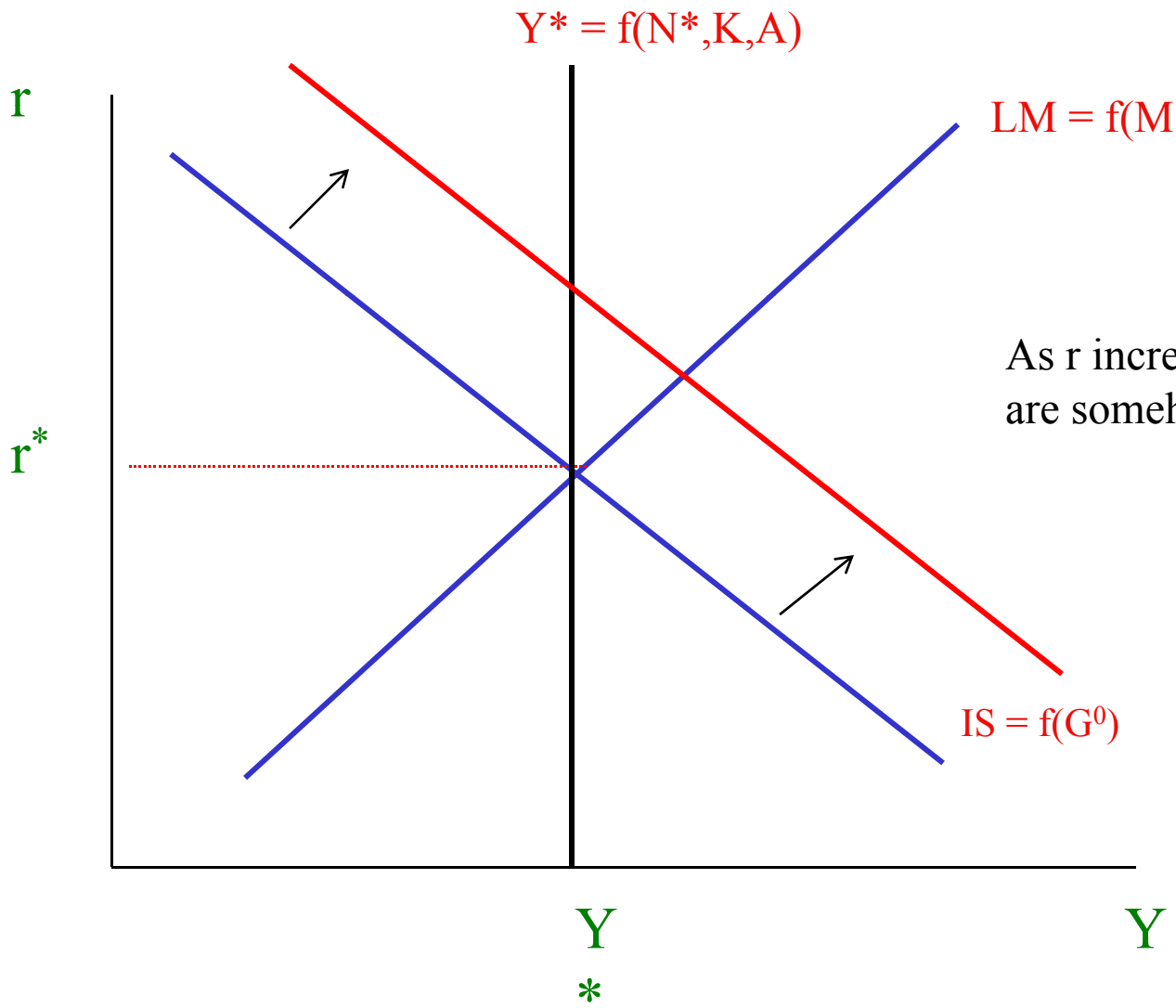


Monetary Neutrality

- **Consensus: after some economic disturbance prices will eventually restore the economic general equilibrium**
- Disagreement on the speed of this adjustment!
- Classical economists: prices adjust immediately
  - Money is Neutral!
- Keynesian economists: prices are sticky
- **Money is neutral only in the long run, it is non-neutral in the short run!**

Fiscal Policy in the Short Run

Suppose G increases

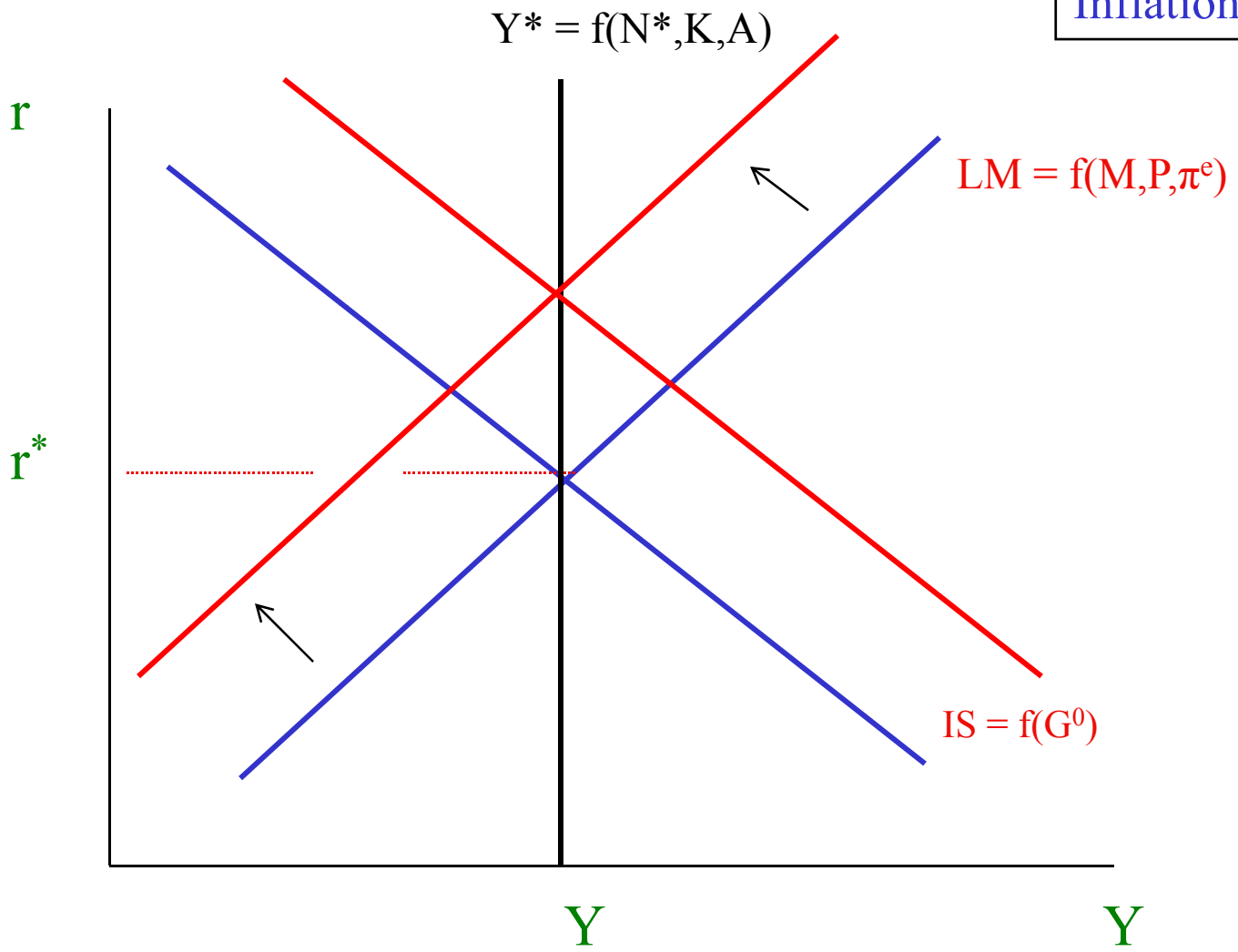


As r increases, private I and C are somehow crowded out

Fiscal Policy in the Long Run

If fiscal policy doesn't affect Y*, then prices will rise and LM shifts in….

Inflationary pressures



Output is unchanged and G has crowded out C and I (through higher r)

A first look at the current recession

How can we can represent the current recession in the IS-LM model?

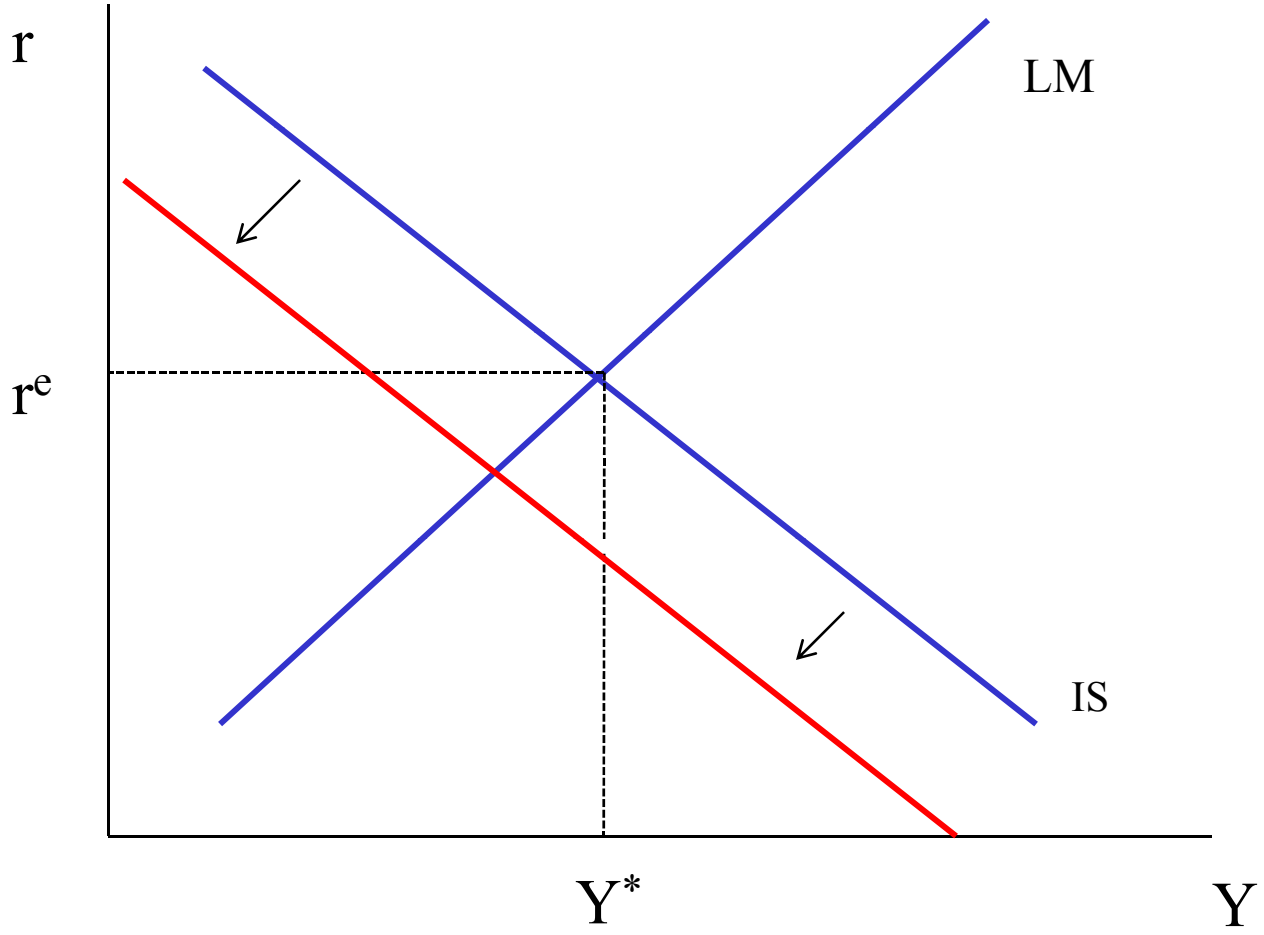
As a **negative shock to the IS Curve** for different reasons:

1) Direct reduction in C and I due to credit crunch

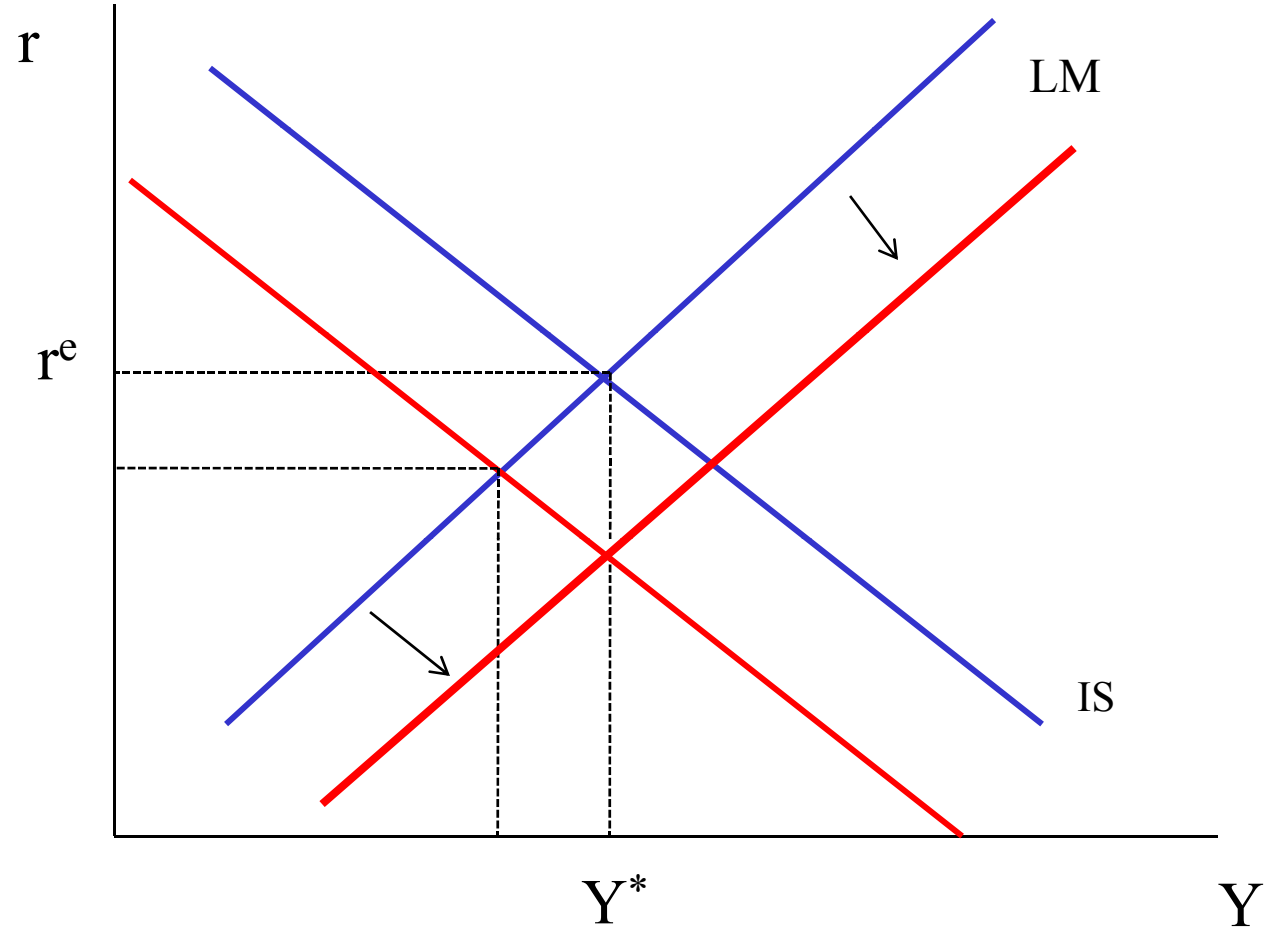
2) Fall in consumer and business confidence

3) Fall in financial wealth (NPVLR)

Fall in private demand: a recession



Fighting the recession: Monetary Policy



Expansionary Monetary Policy by the Fed: M^s increases
Recall: prices are fixed for now.

When Monetary Policy does not work…

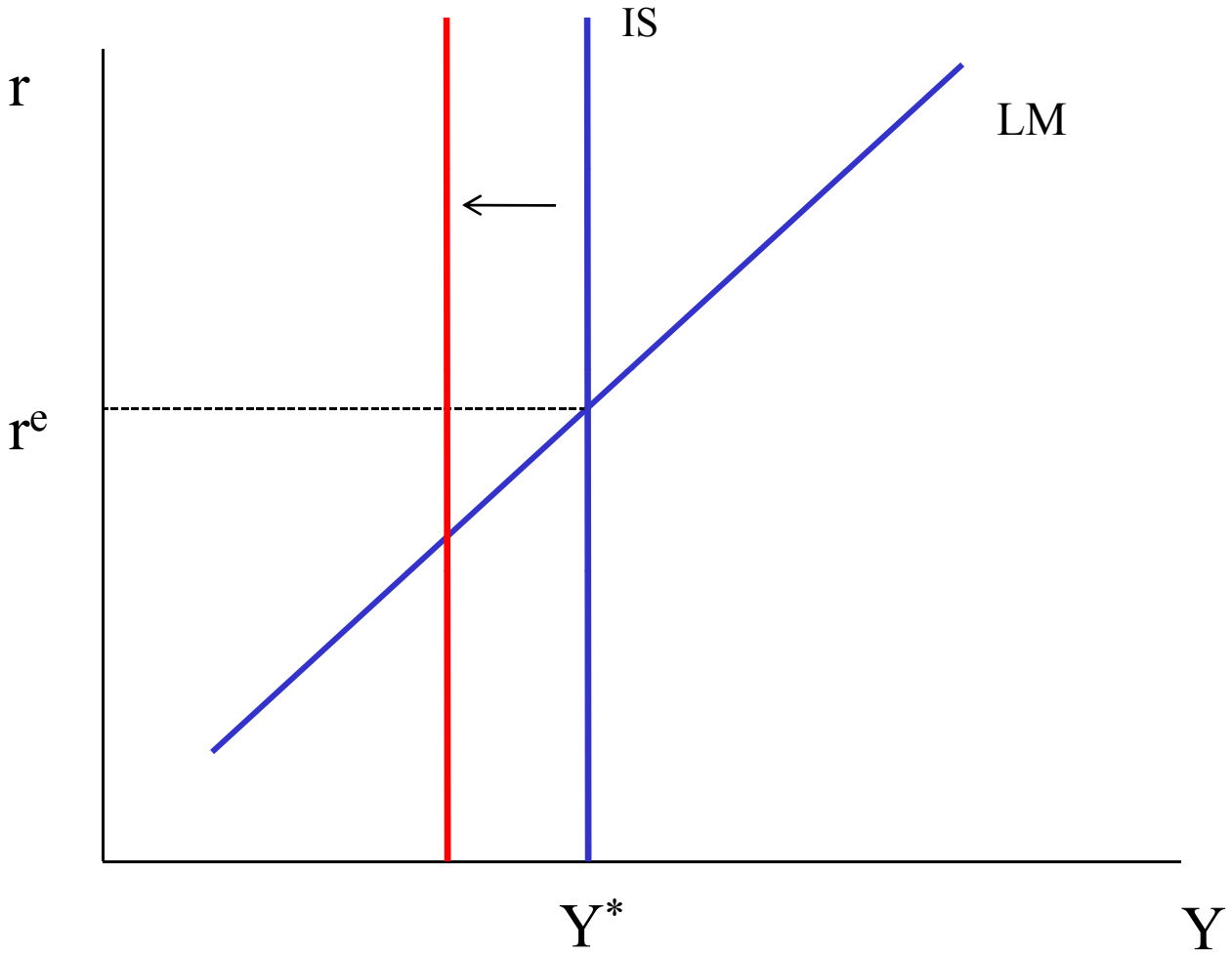
1) Vertical IS Curve

- firms don't respond much to interest rate changes if they think that the banking system is frozen
- The effect of an expansionary monetary policy is dampened

1) Horizontal LM Curve ⟶ Liquidity Trap

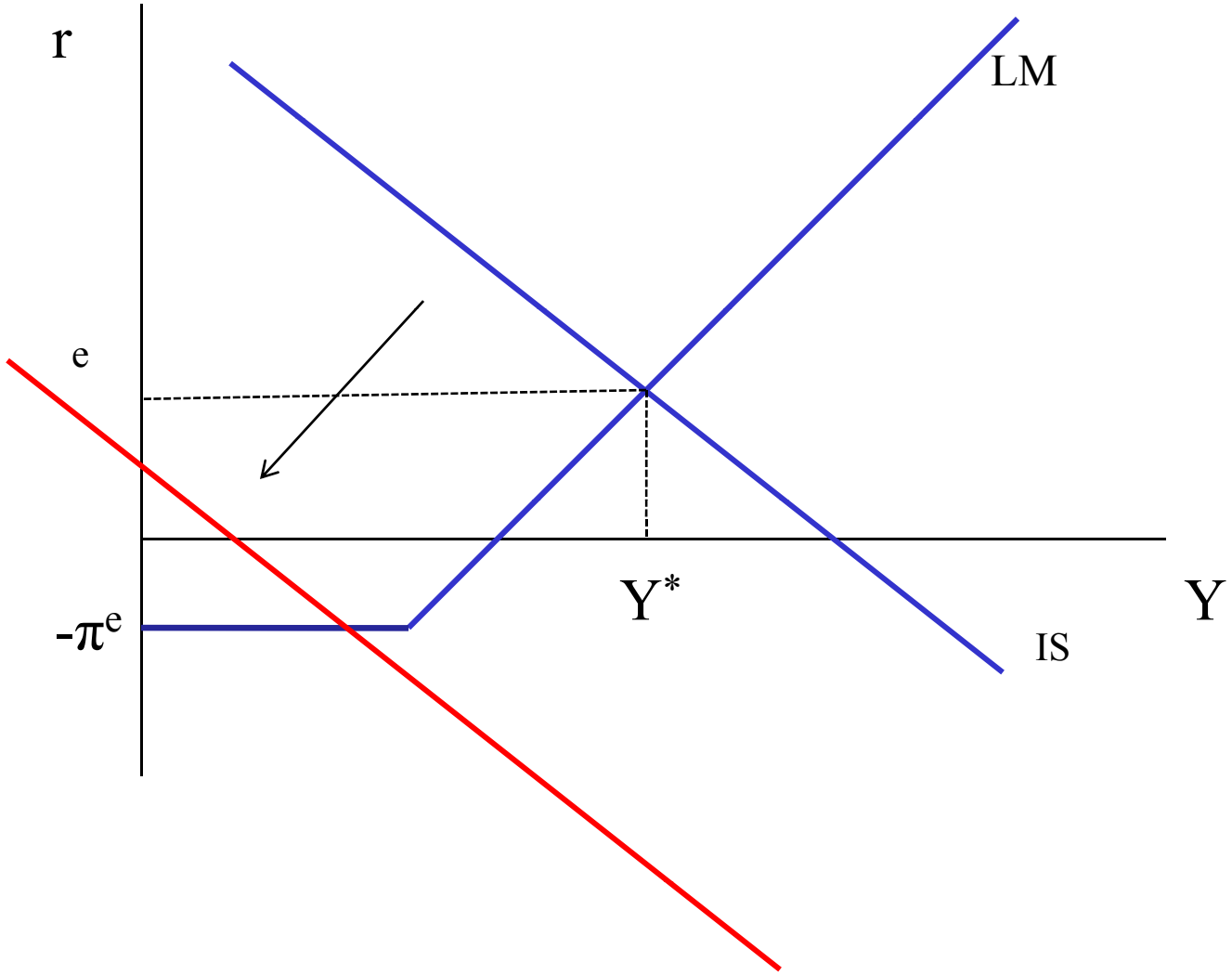
- Nominal interests rates are bounded at zero
- Lower bound on r is equal$_{to}$ _ π^e and the Fed cannot reduce it further!
- This is what is happening now in the US and what happened in Japan in the late 1990s
- Read Krugman's Babysitting the Economy (From Week 1)

Vertical IS

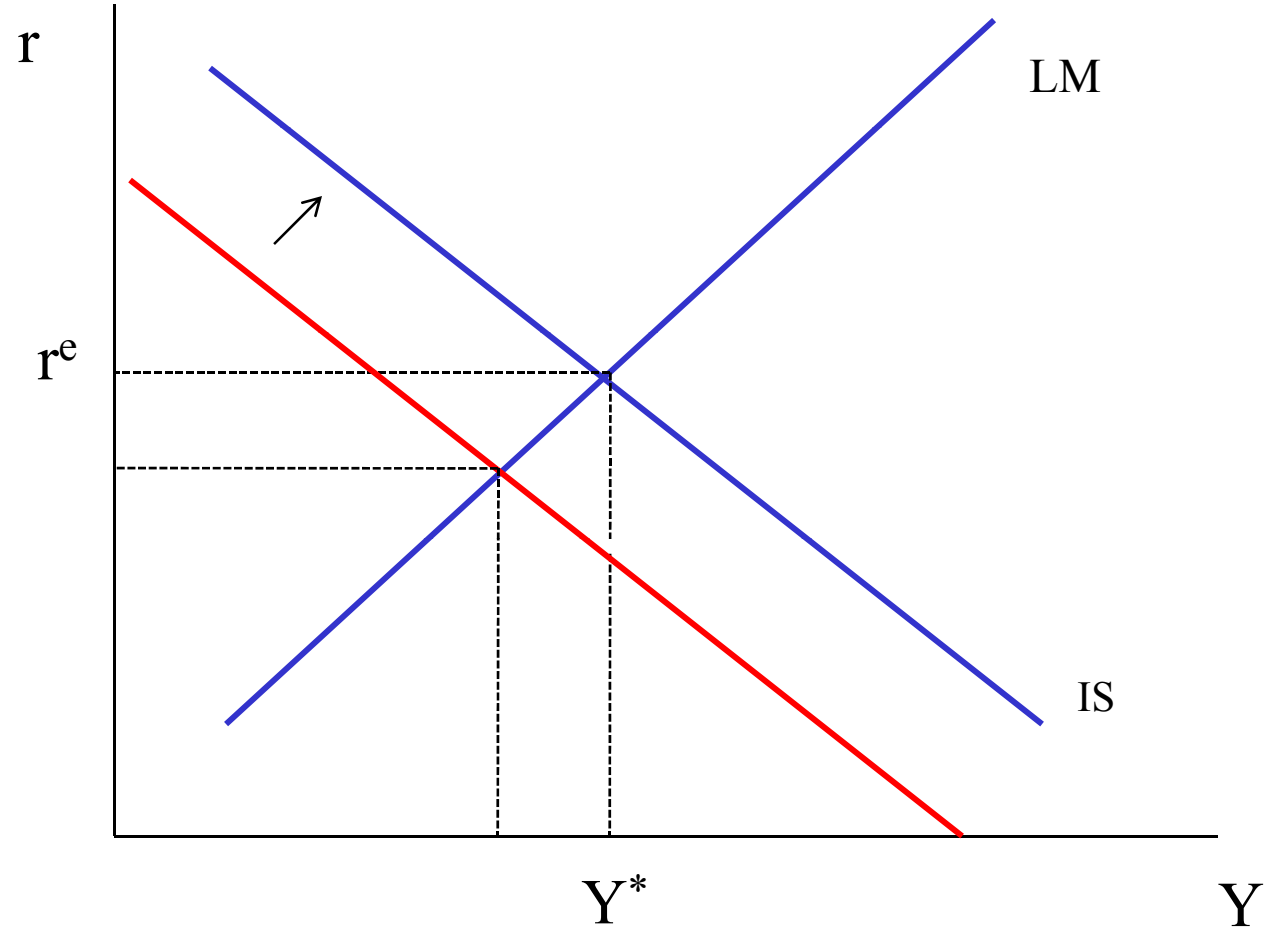


What if Ms increases?

Liquidity Trap



Fighting the Recession: Fiscal Policy



If monetary policy does not work ⟶

fiscal stimulus: G increases

14.02 Principles of Macroeconomics

Fall 2009