Ch. 9: IS-LM/AD-AS Model: A General Framework for Macroeconomic Analysis

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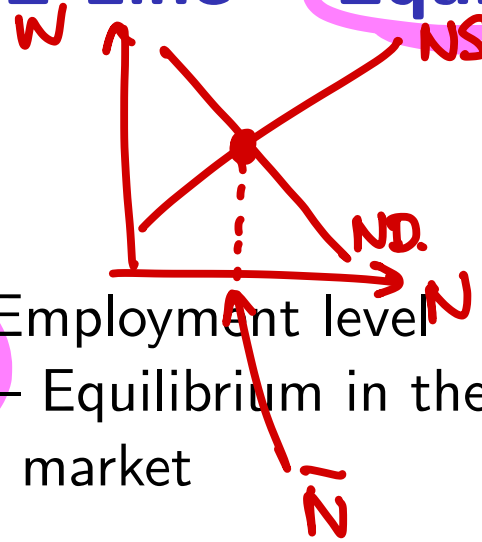
2020 Spring

Chapter Outline

- The FE Line: Equilibrium in the Labor Market
- The IS Curve: Equilibrium in the Goods Market
- The LM Curve: Asset Market Equilibrium
- General Equilibrium in the Complete IS-LM Model
- Price Adjustment and the Attainment of General Equilibrium
- Aggregate Demand and Aggregate Supply

The FE Line – Equilibrium in the Labor Market



- Full-Employment level ($\bar{N}$) – Equilibrium in the labor market
- The FE line indicates the full-employment level of output ($\bar{Y}$)
- The FE line plots $\bar{Y}$ against the real interest rate ($\rightarrow$ vertical line)

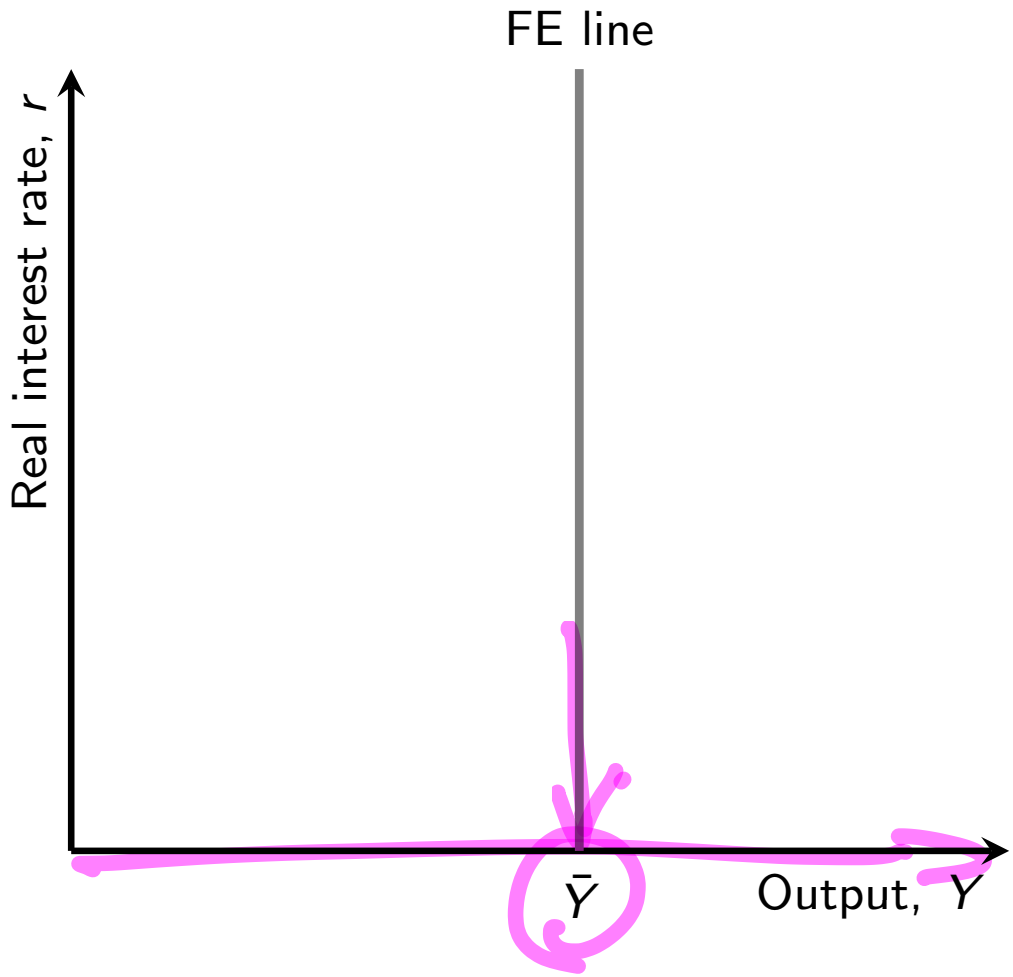
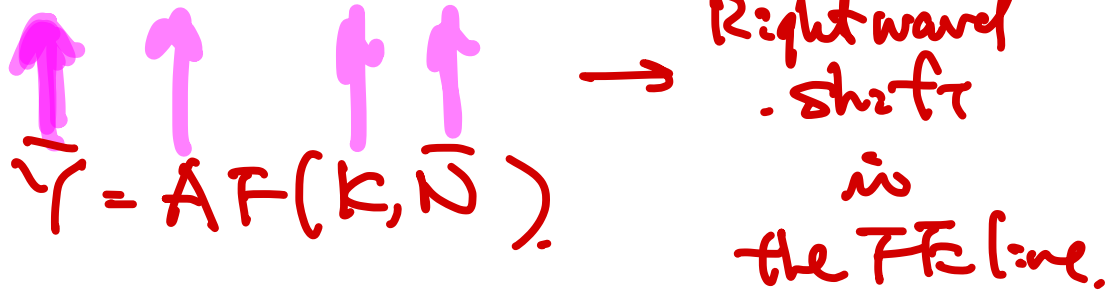


Figure: The FE Line

The FE Line (Cont'd)

- Changes in
  - Full-employment level of employment $(\bar{N})$
  - Capital K.
  - Productivity A.

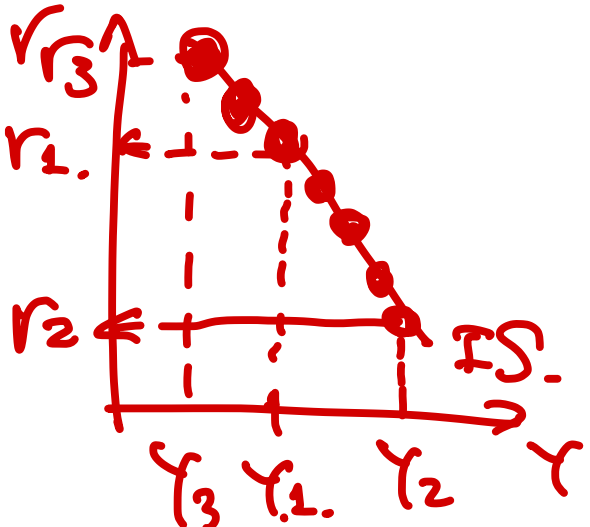
  shift the FE line



The IS Curve – Equilibrium in the Goods Market

$Y = C^d + I^d + G$ (in a closed economy)

- The goods market clears when desired investment equal desired national saving $S^d = I^d$.
- Adjustments in the real interest rate bring about equilibrium
- For any level of output Y, the IS curve shows the real interest rate r for which the goods market is in equilibrium



Deriving the IS Curve

$S^d = Y - C^d - G.$

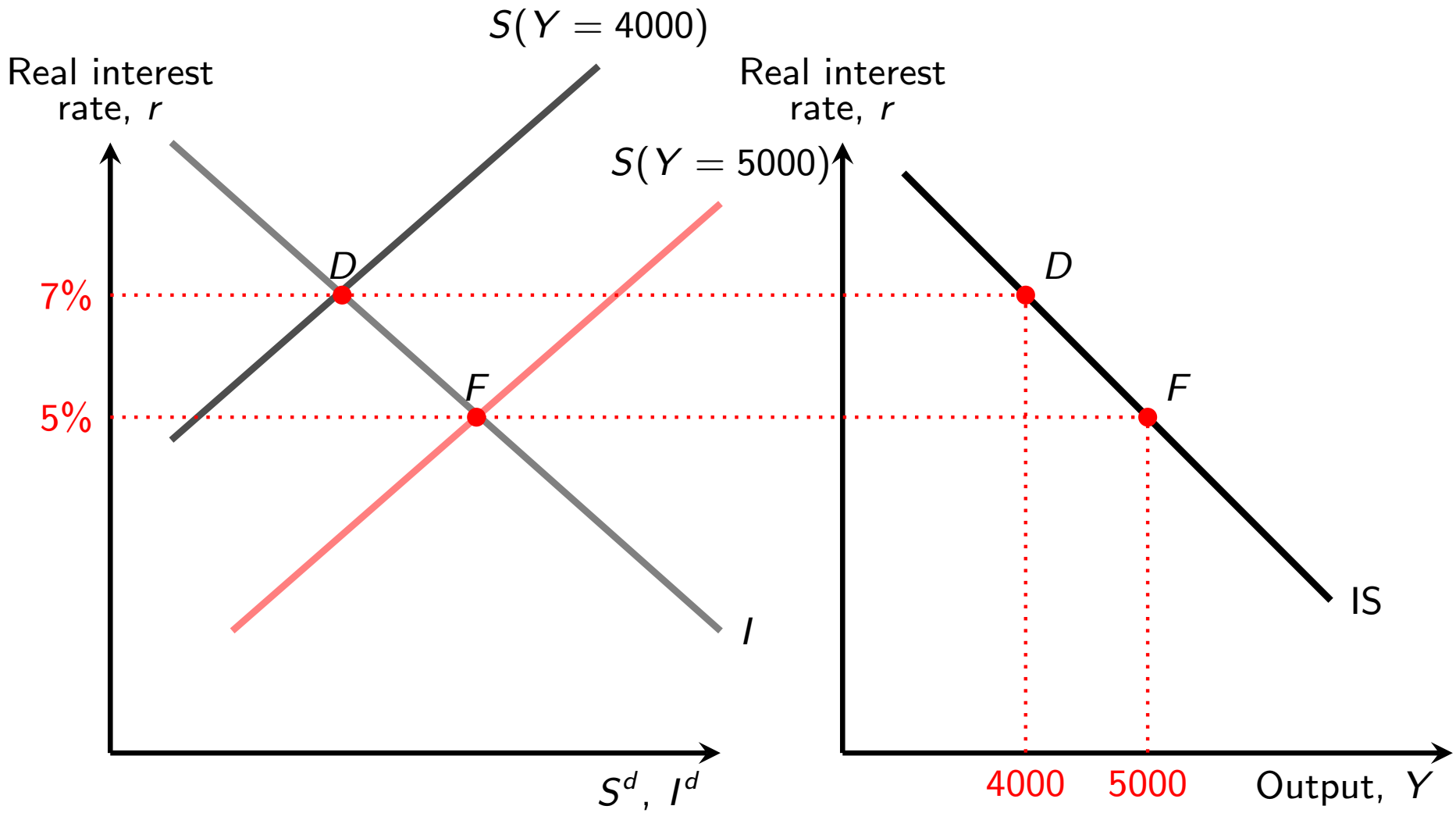
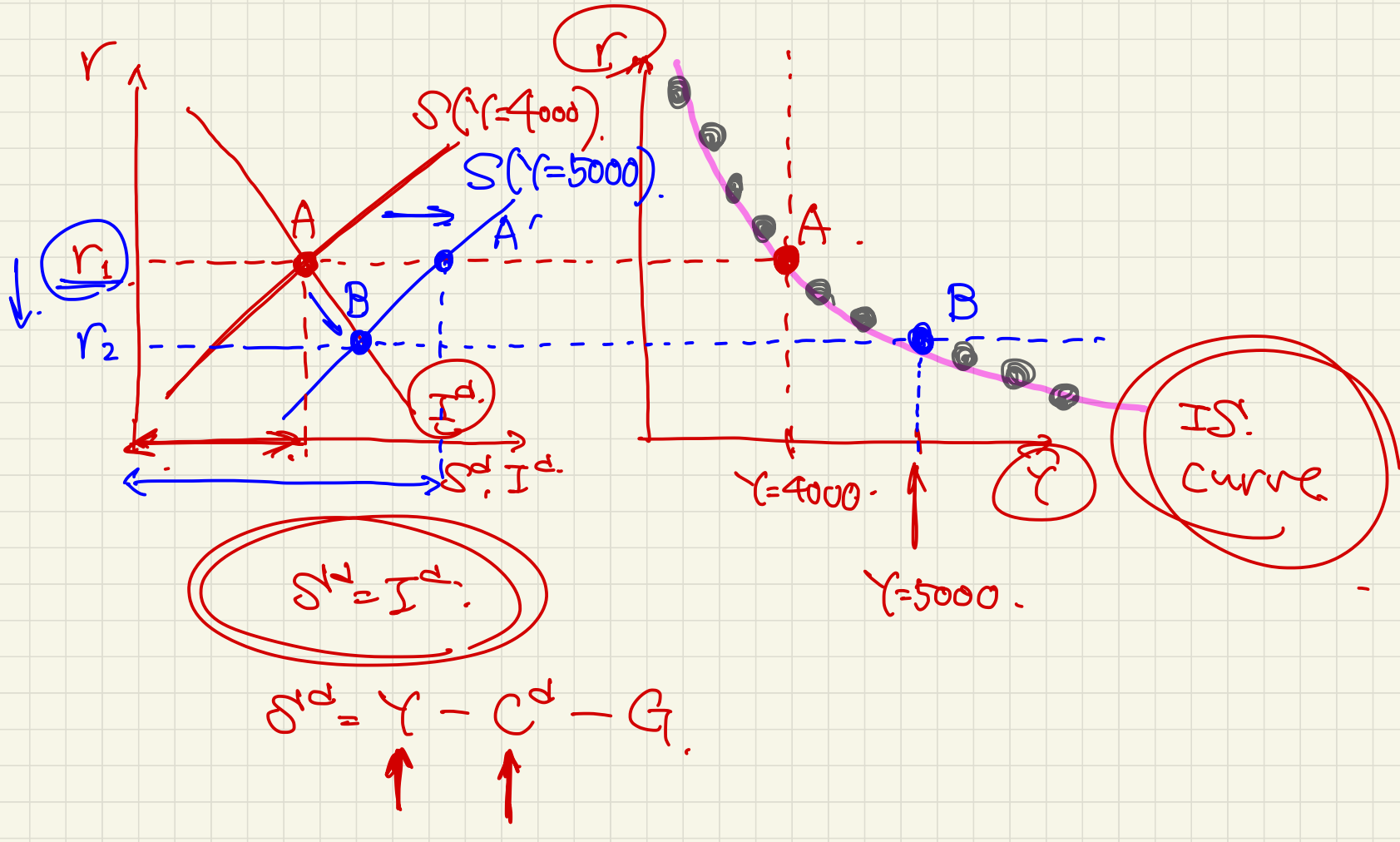
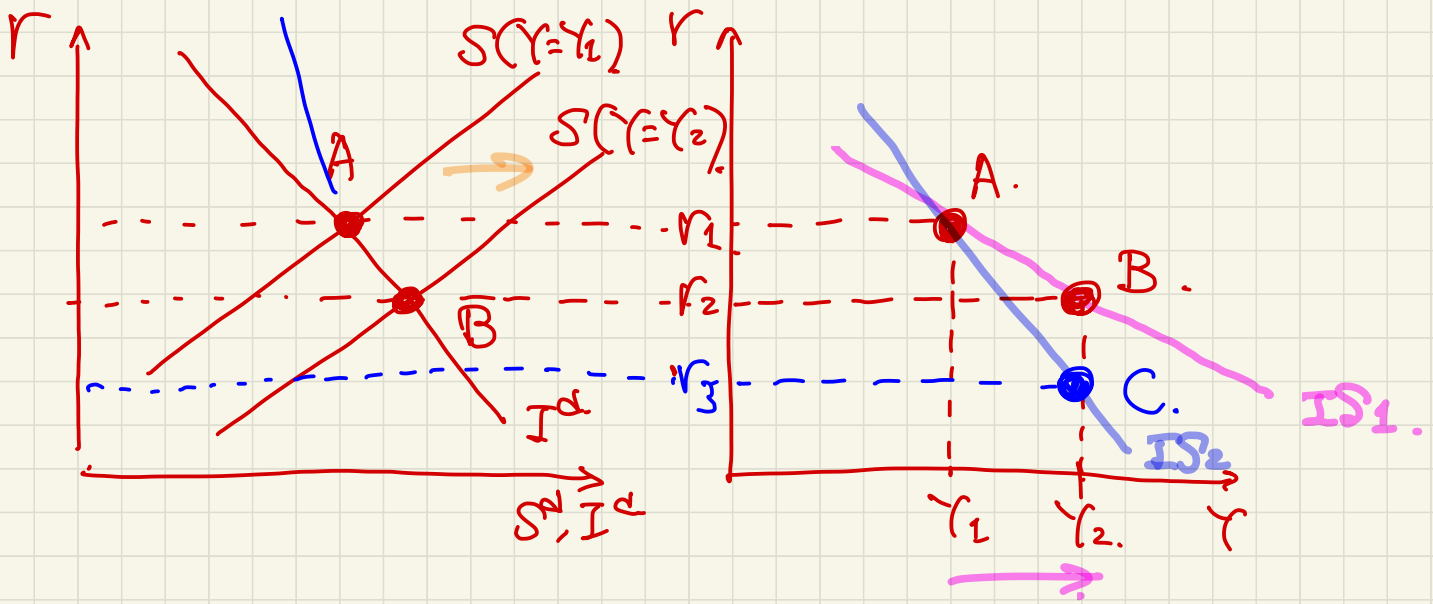


Figure: Deriving the IS Curve


r
S(Y=4000)
S(Y=5000)
A
A'
B
r1
r2
Id
Sd, Id
Sd = Id
r
A
B
IS
curve
Y=4000
Y
Y=5000
Sd = Y − Cd − G


r
S(Y=Y1)
S(Y=Y2)
A
B
Id
S, Id
r
r1
r2
r3
A.
B.
C.
IS1.
IS2
Y1
Y2.
Y

Alternative Interpretation of the IS Curve

- Beginning at a point of equilibrium, suppose the real interest rate rises
- The increased real interest rate causes people to increase saving and thus reduce consumption, and causes firms to reduce investment
- So the quantity of goods demanded declines
- To restore equilibrium, the quantity of goods supplied would have to decline
- So higher real interest rates are associated with lower output, that is, the IS curve slopes downward

The IS Curve Shifters

- For constant output, any change that reduces (increases) desired national saving relative to desired investment shifts the IS curve up (down)
- Alternative explanation: A change that increases aggregate demand for goods shifts the IS curve to the right
  - In this case, the increase in aggregate demand for goods exceeds the supply
  - The real interest rate must rise to reduce desired consumption and investment and restore equilibrium

A Shift in the IS Curve

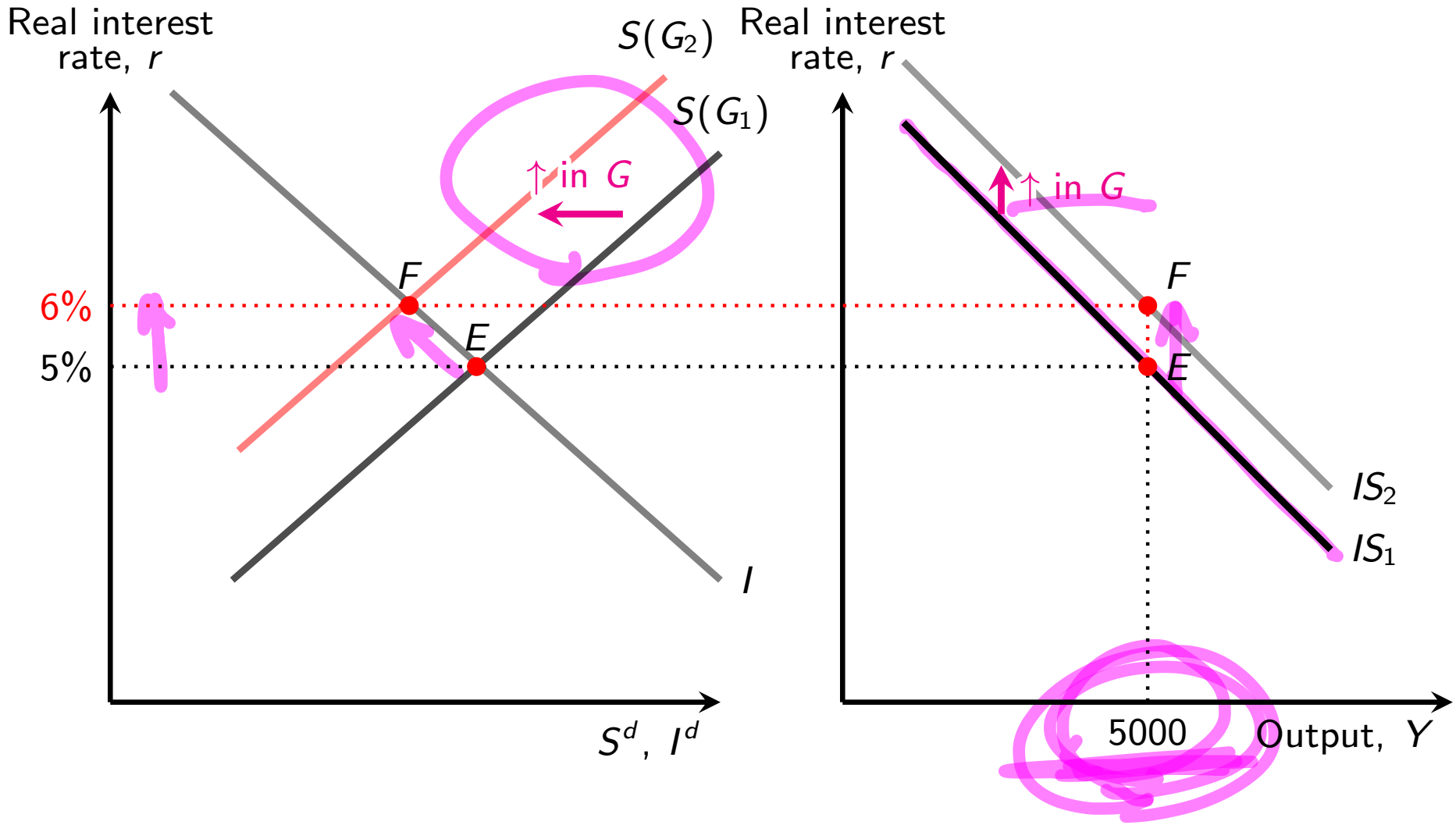
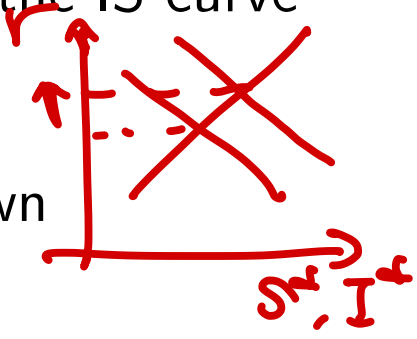


Figure: Effect on the IS Curve of a Temporary Increase in G

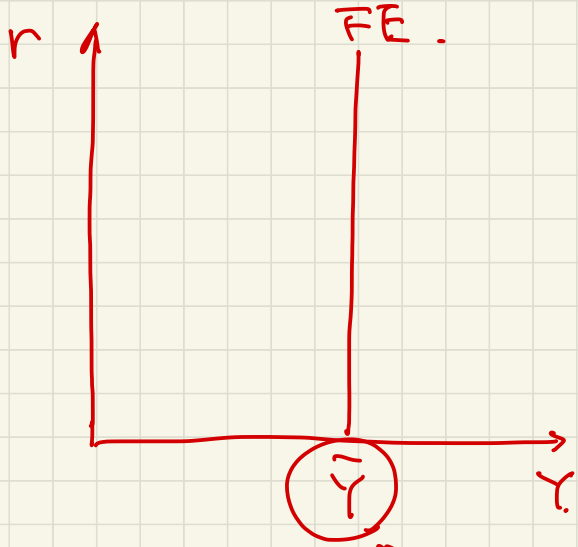
Summary of the IS Curve Shifters

- ↑ in expected future output shifts the IS curve up
- ↑ in wealth shifts the IS curve up
- ↑ in government purchases shifts the IS curve up
- ↑ in taxes does not shift the IS curve if Ricardian equivalence holds
- ↑ in taxes shifts the IS curve down if Ricardian equivalence does not hold
- ↑ in expected future marginal product of capital shifts the IS curve up
- ↑ in effective tax rate on capital shifts the IS curve down

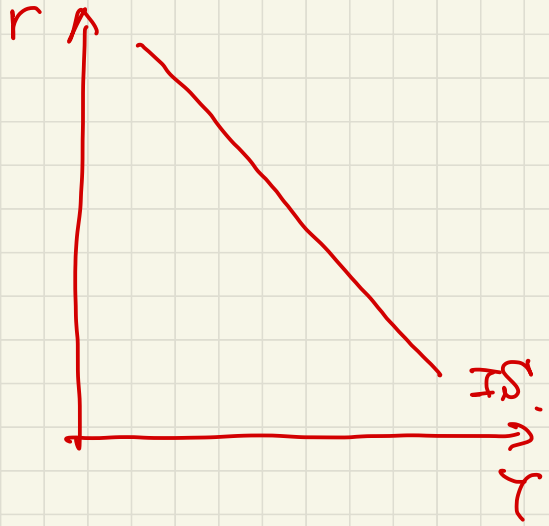


Asset Market Equilibrium (Ch. 7.4)

- Assume that all assets can be grouped into two categories, money and nonmonetary assets
- Money includes currency and checking accounts
  - Pays interest rate i^m
  - Supply is fixed at M
- Nonmonetary assets include stocks, bonds, land, etc
  - Pays interest rate $i = r + \pi$
  - Supply is fixed at NM



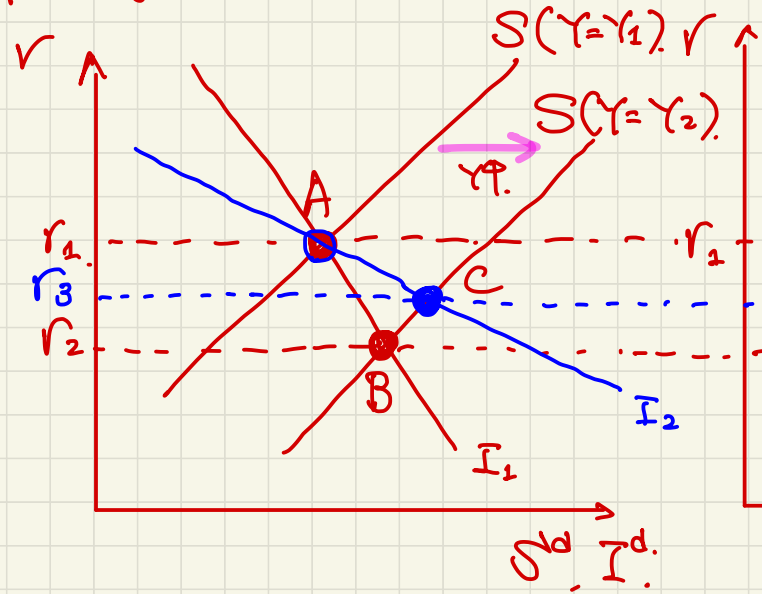
$\bar{Y} = \bar{A} F(\underline{K}, \bar{N})$.

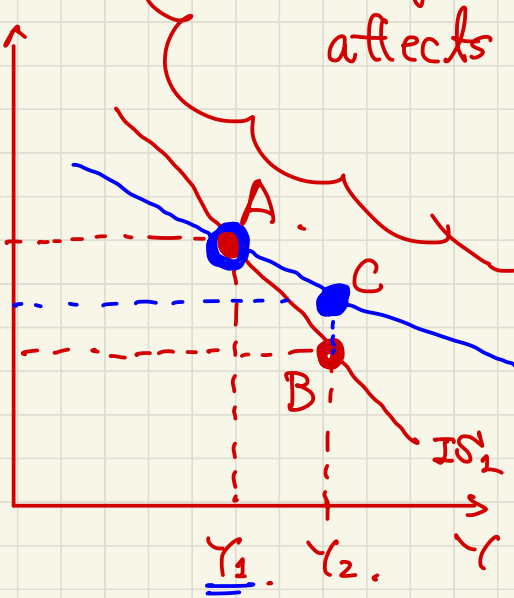


Every point on the IS curve represents an equilibrium in the goods market

$S = I$.

Slope of the IS curve.





Slope of I curve affects slope of IS curve.

$Y\uparrow \Rightarrow S^d\uparrow$ ($\because S^d = Y - C^d - G$).

B is an equilibrium with I_1 and Y_2.

C " " I_2 and Y_2.

Asset Market Equilibrium (Ch. 7.4, Cont'd)

- Asset market equilibrium occurs when quantity of money supplied equals quantity of money demanded

$$m^d + nm^d = \text{total nominal wealth of an individual} \quad (1)$$

$$M^d + NM^d = \text{aggregate nominal wealth} \quad (2)$$

$$M + NM = \text{aggregate (supply of) nominal wealth} \quad (3)$$

- Subtracting (3) from (2) gives

$$(M^d - M) + (NM^d - NM) = 0 \quad (4)$$

- If money supply equals money demand, nonmonetary asset supply must equal nonmonetary asset demand

- Then entire asset market is in equilibrium

Asset Market Equilibrium Condition (Ch. 7.4)

- The asset market equilibrium condition

$$\frac{M}{P} = L(\underset{(+)}{Y}, \underset{(-)}{r + \pi^e}) \tag{5}$$

$$\text{real money supply} = \text{real money demand} \tag{6}$$

- M is determined by the central bank
- π^e is fixed (for now)
- The labor market determines the level of employment; using employment in the production function determines Y
- Given Y, the goods market equilibrium condition determines r

Price Level Determination (Ch. 7.4)

- With all variables in (5) determined, the asset market equilibrium condition determines the price level

$$P = \frac{M}{L(Y, r + \pi^e)} \quad (7)$$

- The price level is the ratio of nominal money supply to real money demand

- Doubling the money supply would double the price level

Interest Rate and Price of Nonmonetary Asset

- The price of a nonmonetary asset is inversely related to its interest rate or yield

bond price ↑ ⟶ yield ↓.

- Example:
  - A bond pays \$10,000 in one year
  - Its current price is \$9,615
  - Its interest rate is 4%

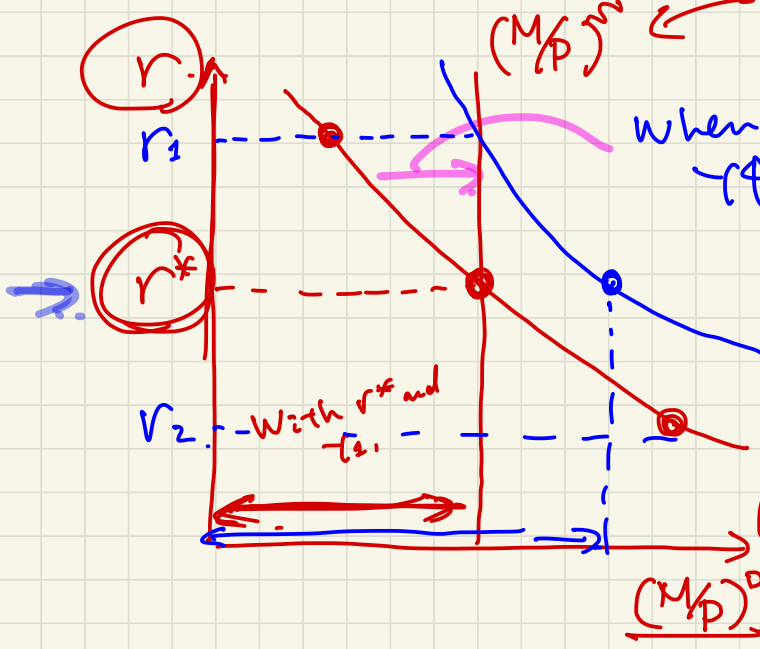
$$\frac{(\$10,000 - \$9,615)}{\$9,615} = 0.04 = 4\% \tag{8}$$

  - If the price of the bond in the market were to fall to \$9,524, its yield would rise to 5%

$$\frac{(\$10,000 - \$9,524)}{\$9,524} = 0.05 = 5\% \tag{9}$$

The LM Curve – Asset Market Equilibrium

- Equilibrium in the asset market requires that the real money supply equals the real quantity of money demanded
- Real money supply is determined by the central bank and is not affected by the real interest rate
- Real money demand falls as the real interest rate rises
- Real money demand rises as the level of output rises



vertical (∵ it's independent of r)

real money demand.

$\left(\frac{M}{P}\right)^D = L(Y, r+\pi^e)$

(+) (−)

$(M/P)^D$ (when $Y = Y_2$)

$r\uparrow \Rightarrow (M/P)^D \downarrow$.

$Y\uparrow$

$(Y_1 < Y_2)$

Δs in M affect $(M/P)^S$

Δs in P also affect $(M/P)^S$. $\frac{M\uparrow}{P\uparrow\downarrow}$

Deriving the LM Curve

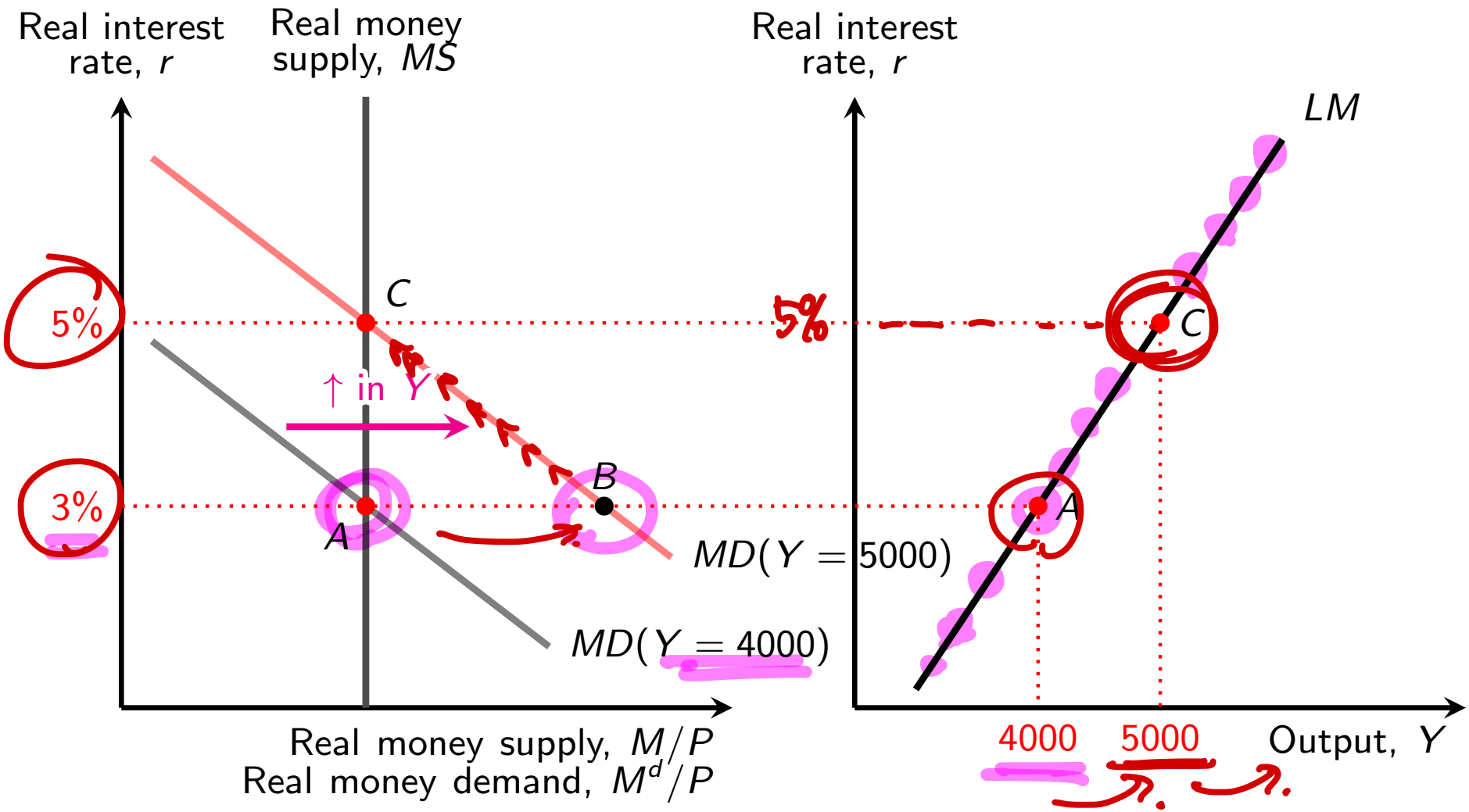


Figure: Deriving the LM Curve

Deriving the LM Curve (Cont'd)

- Starting at equilibrium, suppose output rise, so real money demand increases (A → B).
- The rise in people's demand for money makes them sell nonmonetary assets, so the price of those assets falls and the real interest rate rises
- As the interest rate rises, the demand for money declines until equilibrium is reached (B → C).
- The LM curve shows the combinations of the real interest rate and output that clear the asset market

The LM Curve Shifters

- Any change that reduces real money supply relative to real money demand shifts the LM curve up
- For a given level of output, the reduction in real money supply relative to real money demand causes the equilibrium real interest rate to rise
- The rise in the real interest rate is shown as an upward shift of the LM curve

A Shift in the LM Curve

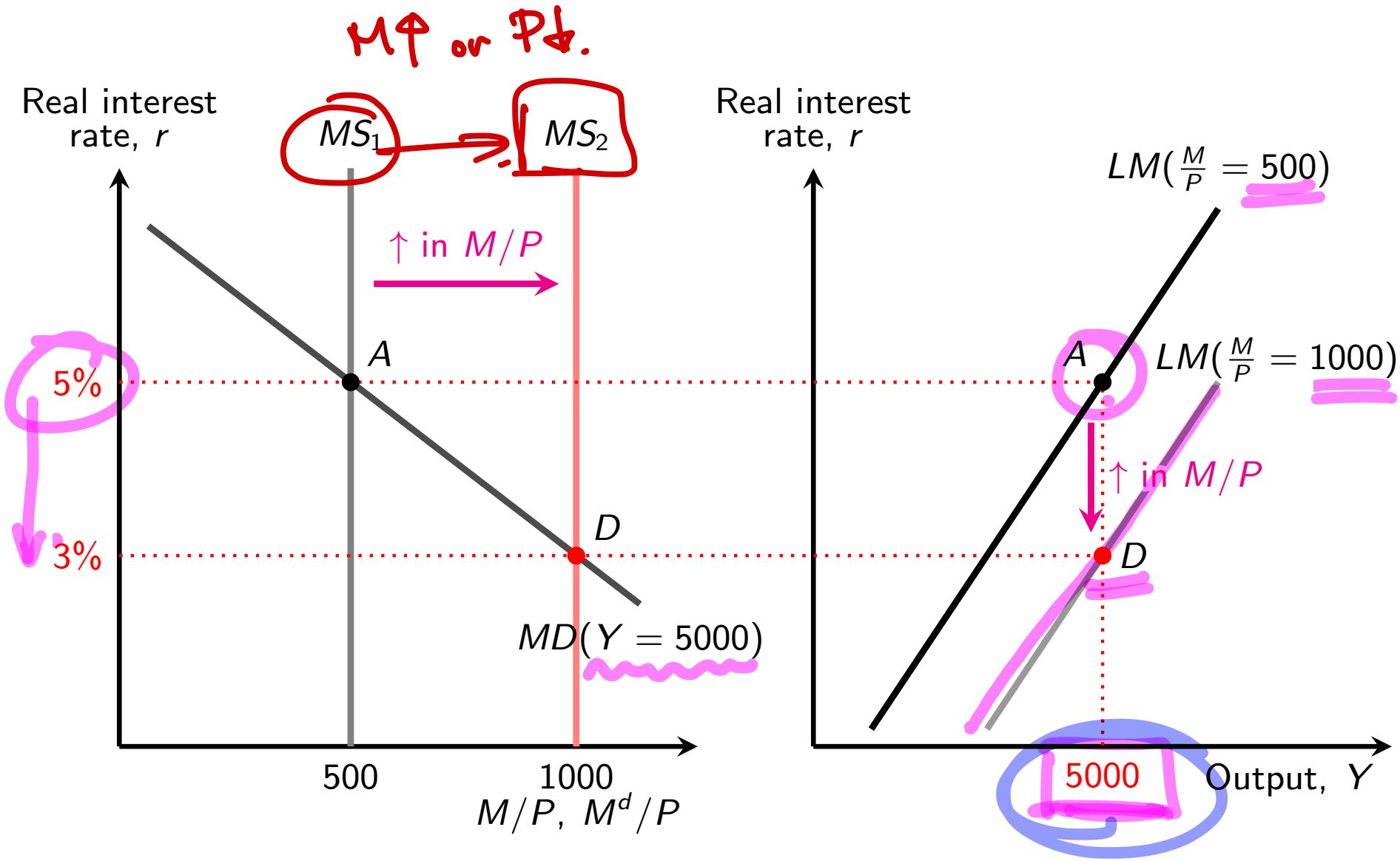


Figure: An Increase in the Real Money Supply

A Shift in the LM Curve (Cont'd)

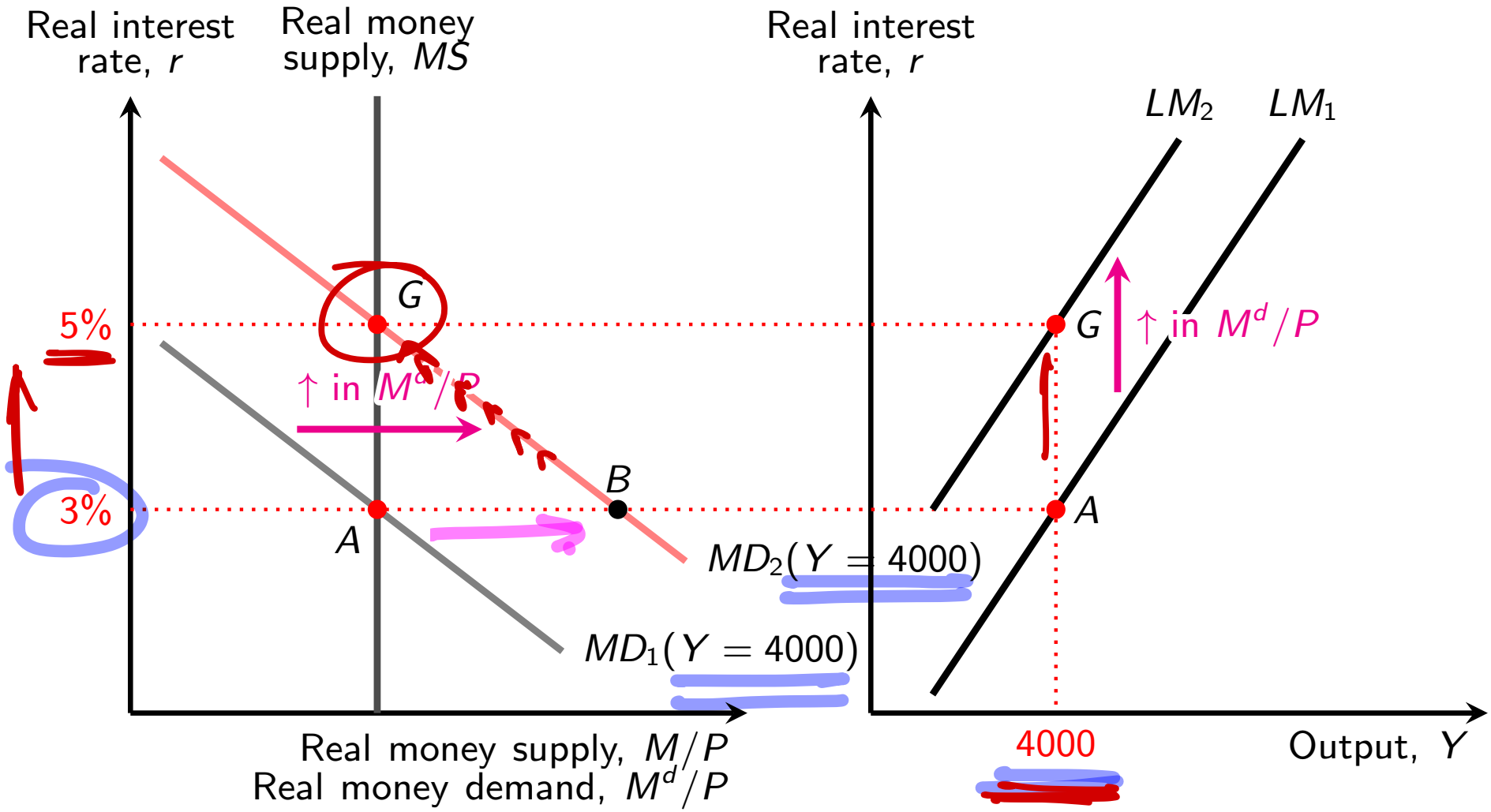
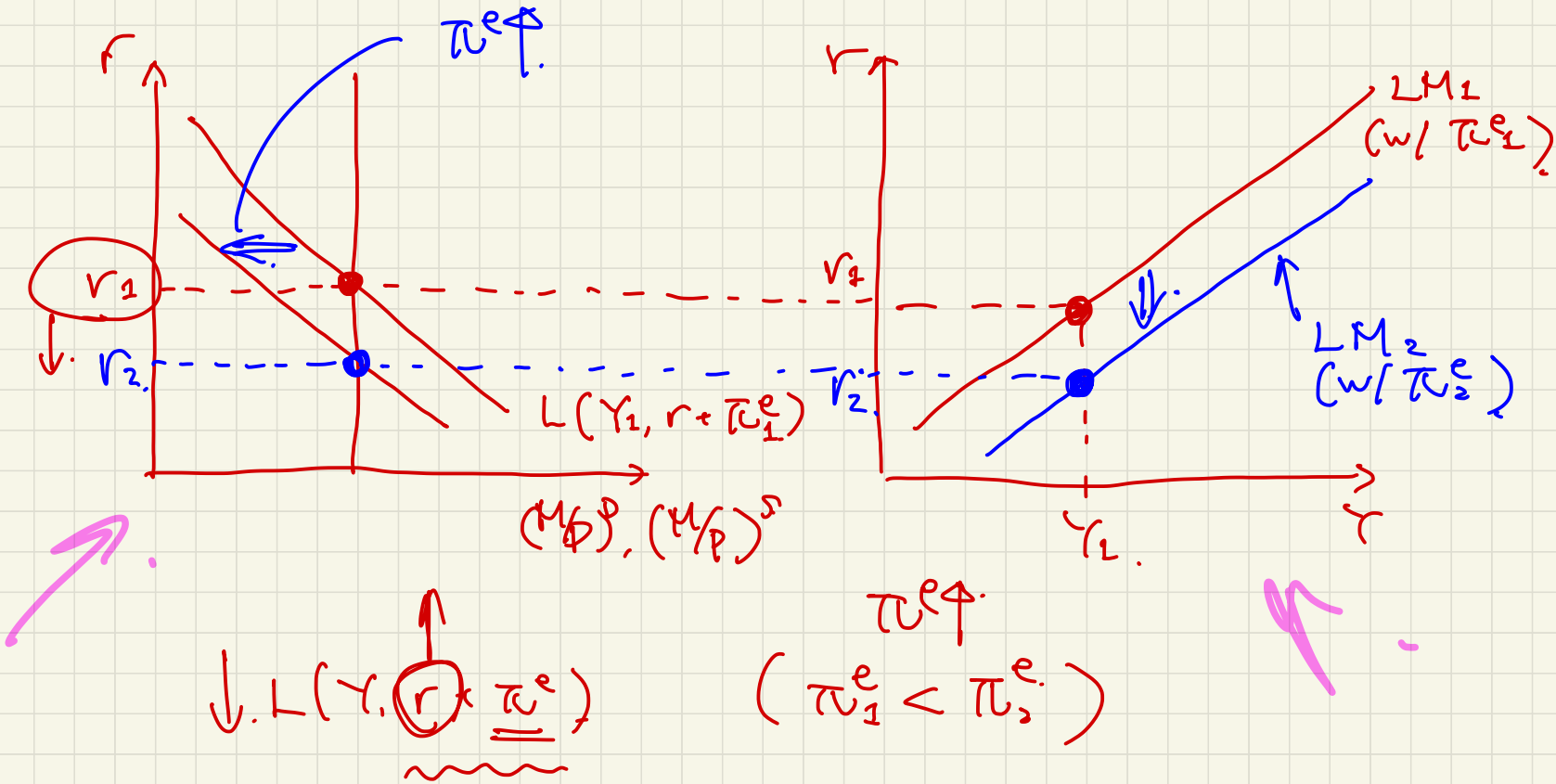


Figure: An Increase in the Real Money Demand

Summary of the LM Curve Shifters

- ↑ in nominal money supply shifts the LM curve down
- ↑ in price level shifts the LM curve up
- ↑ in expected inflation shifts the LM curve down
- ↑ in nominal interest rate shifts the LM curve up
- ↑ in real money demand (for constant output) shifts the LM curve up

  Factors that increase real money demand:
  - ↑ in wealth
  - ↓ in risk of holding money (relative to alternative assets)
  - ↓ in the liquidity of alternative assets
  - ↓ in the efficiency of payment technologies


r
$\pi^e \uparrow$.
r_1
r_2
$L(Y_1, r + \pi^e_1)$
$(M/P)^S$, $(M/P)^D$
r
LM_1 (w/ π^e_1)
LM_2 (w/ π^e_2)
r_1
r_2
Y_1
Y
$\downarrow$. $L(Y, r + \pi^e)$
$\pi^e \uparrow$.
($\pi^e_1 < \pi^e_2$)

General Equilibrium in the IS-LM Model

- When all markets are simultaneously in equilibrium, there is a general equilibrium
- This occurs where the FE line, IS and LM curves intersect

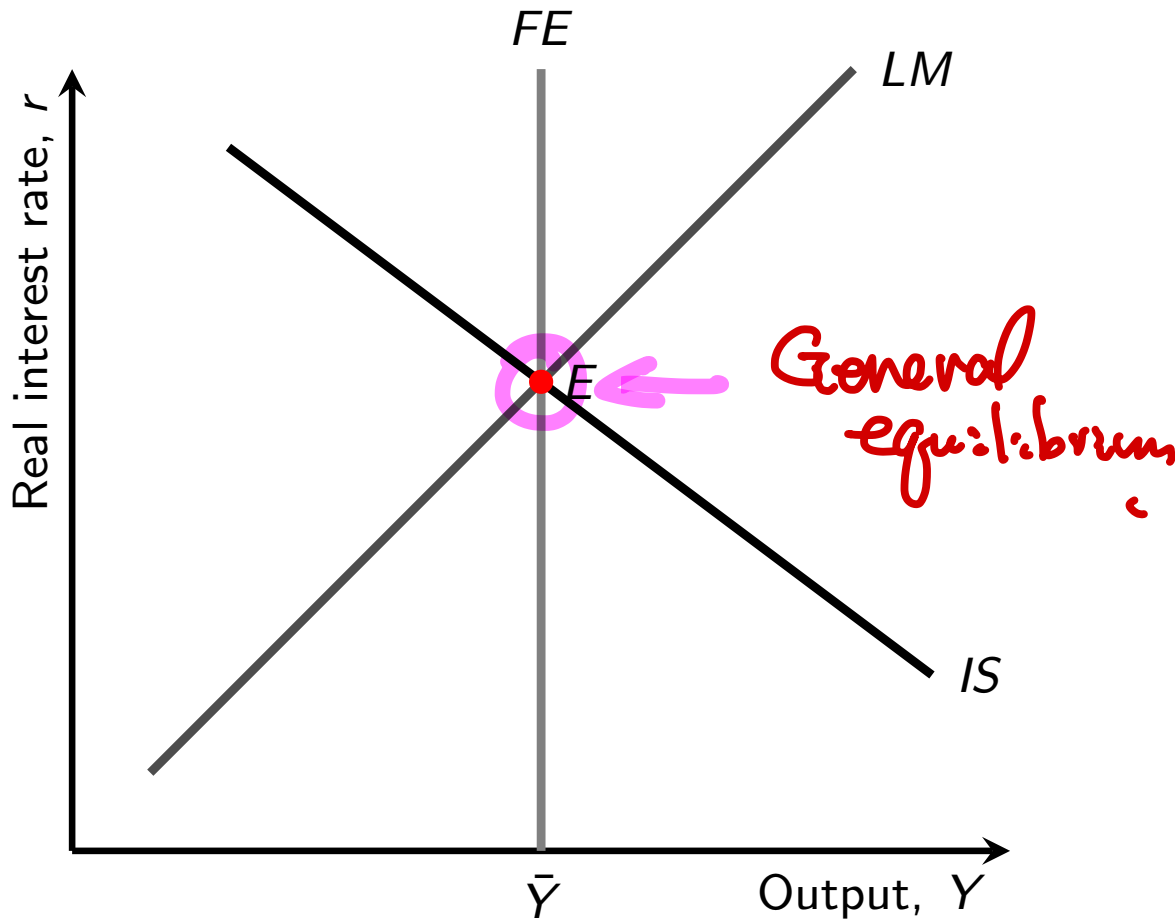
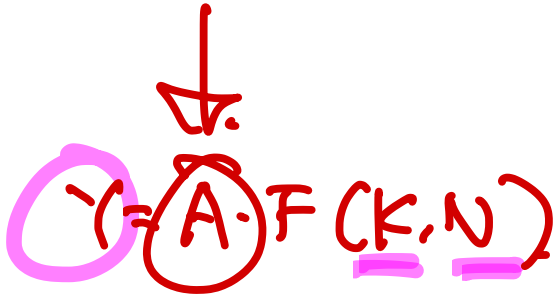


Figure: General Equilibrium in the IS-LM Model

The Effect of a Temporary Supply Shock



- Suppose the level of productivity falls temporarily
- How does the supply shock affect the FE line, IS and LM curves?
- How is the new equilibrium achieved?
- How do the real wage, employment, output, the real interest rate and price level change?

The Effect of a Temporary Supply Shock (Cont'd)

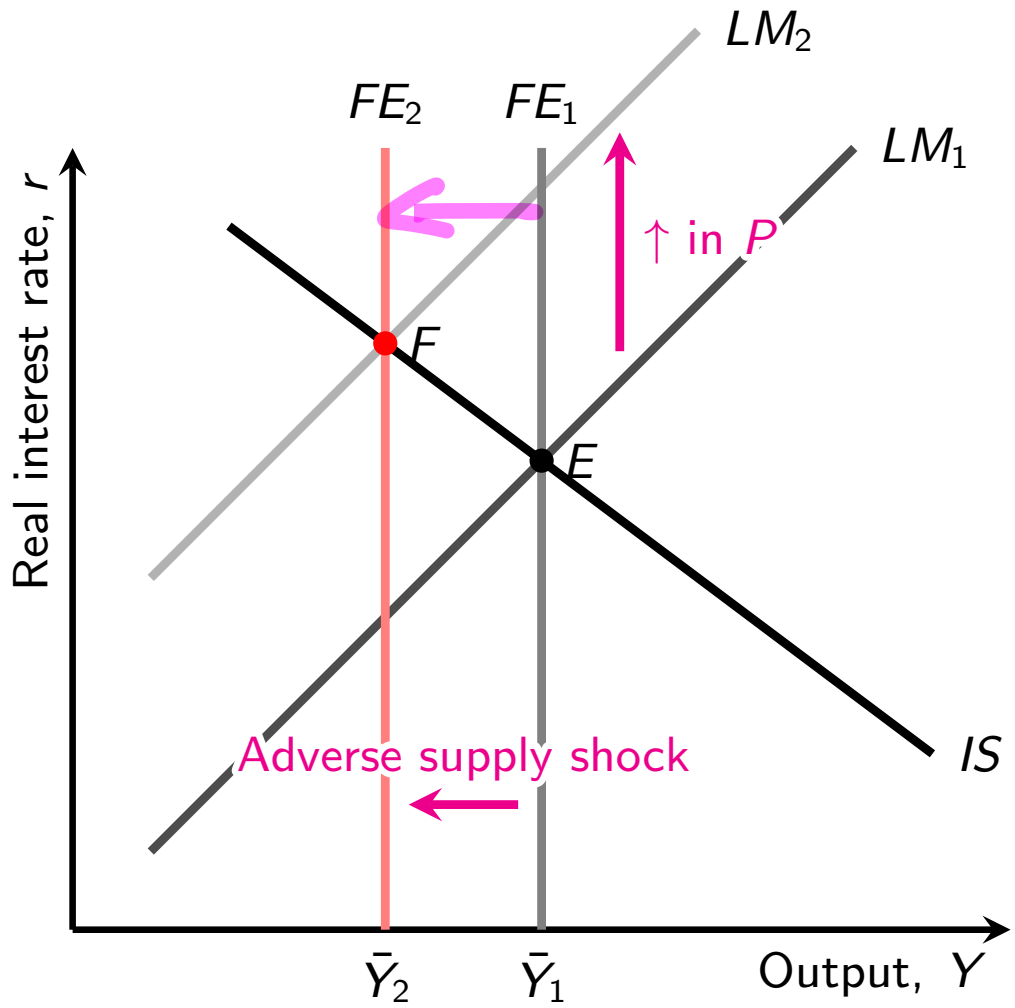
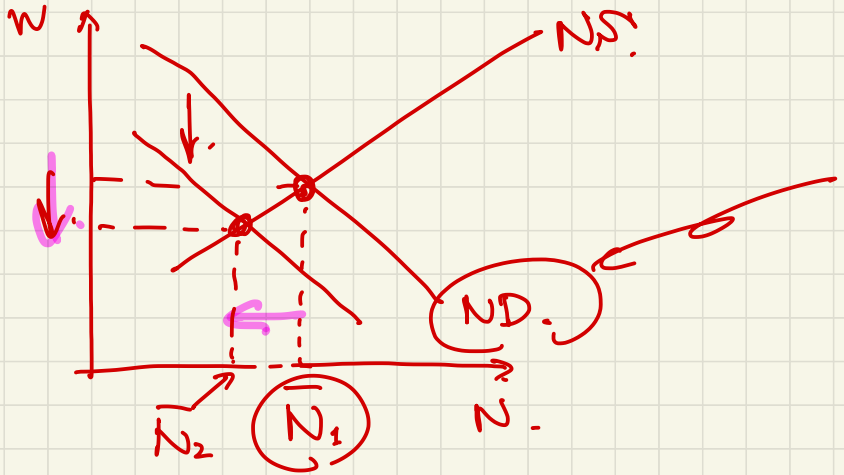


Figure: Effects of a Temporary Adverse Supply Shock



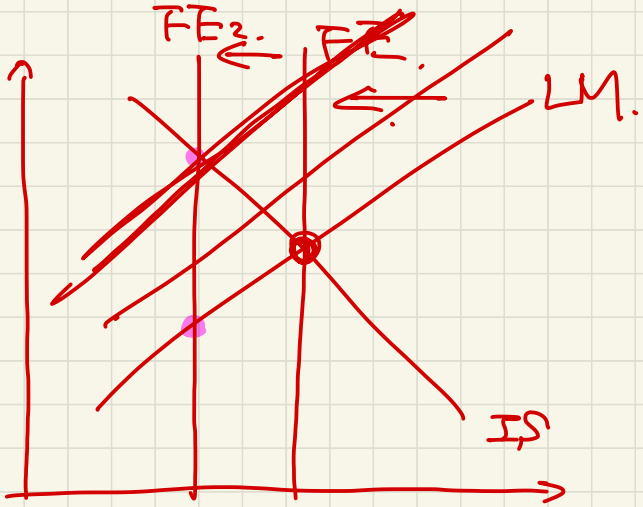
derived from MPN.

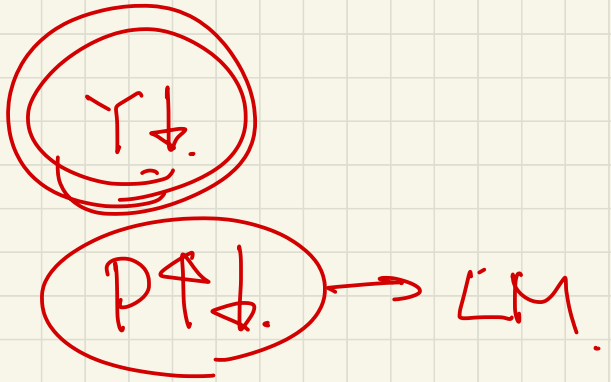
↑

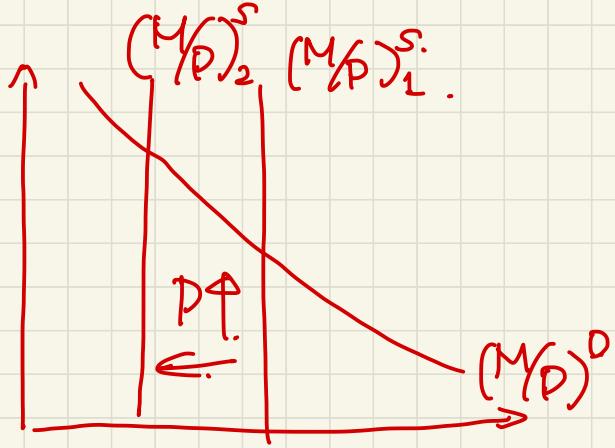
Affected by A

→ Affects FE line.

A ↓. ⇒ w ↓. and $\bar{N}$ ↓. ⇒ FE line ←

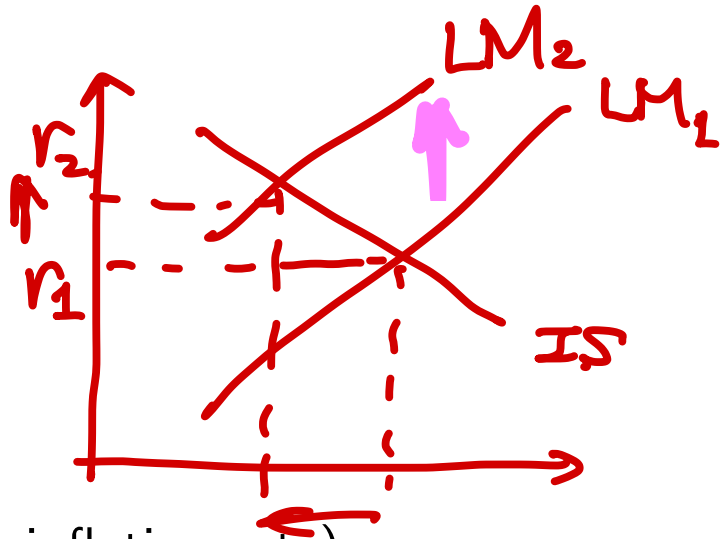

FE₂.
FE.
LM.
IS


Y↓.
P↑↓.
LM.


(M/P)ˢ₂
(M/P)ˢ₁.
P↑.
(M/P)ᴰ

The Effect of a Temporary Supply Shock (Cont'd)

- A temporary adverse supply shock causes:
  - $\downarrow$ in the real wage
  - $\downarrow$ in employment
  - $\downarrow$ in output
  - $\uparrow$ in the real interest rate
  - $\uparrow$ in price level ($\rightarrow$ temporary rises in the inflation rate)



- Consumption must be lower ($\because$ lower output)
- Investment must be lower ($\because$ higher real interest rate)

$Y = C + I + G$

Application: The 2008 Oil Price Shock

- In 2008, oil prices increased sharply in first half of year
- In theory, this would make real interest rates increase
- But housing crisis and financial crisis led the Fed to cut interest rates, causing real interest rates to become negative
- The financial crisis led demand for oil to fall, so oil prices fell sharply in late 2008
- So, adverse supply shock became beneficial supply shock
- But damage from housing crisis and financial crisis dominated effect of beneficial supply shock

The Effect of a Monetary Expansion

7/22.

- An increase in money supply shifts the LM curve down
- Because financial markets respond most quickly to changes in economic conditions, the asset market responds to the disequilibrium
  - The FE line is slow to respond because job matching and wage renegotiation take time
  - The IS curve responds somewhat slowly
  - We assume that the labor market is temporarily out of equilibrium, so there is a short-run equilibrium at the intersection of the IS and LM curves

The Effect of a Monetary Expansion (Cont'd)

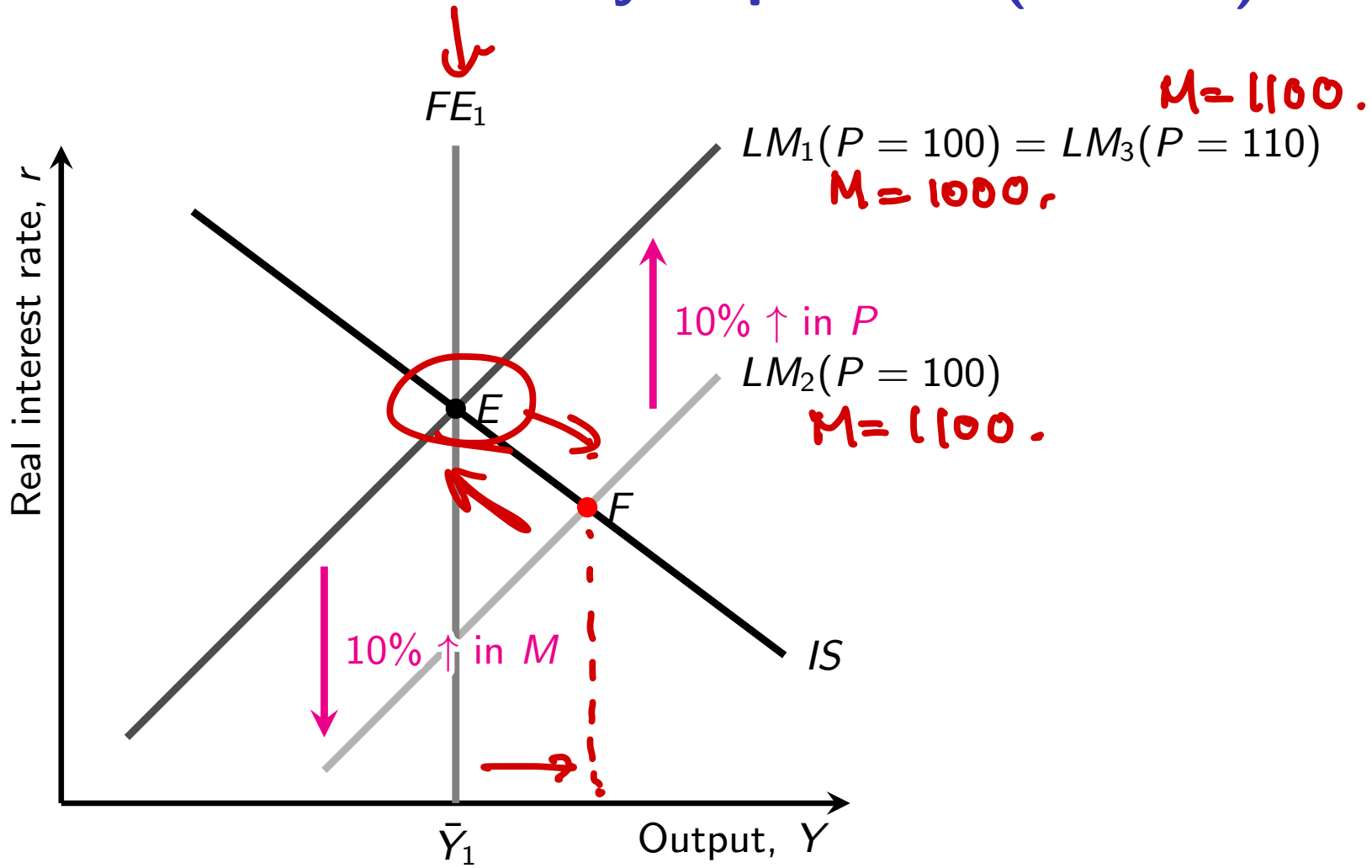


Figure: Effects of a Monetary Expansion

The Effect of a Monetary Expansion (Cont'd)

- The increase in the money supply causes people to try to get rid of excess money balances by buying assets, driving the real interest rate down
  - The decline in the real interest rate causes consumption and investment to increase temporarily
  - Output is assumed to increase temporarily to meet the extra demand
- Price level adjustment
  - Since the demand for goods exceed firms' desired supply of goods, firms raise prices
  - The rise in the price level causes the LM curve to shift up
  - The price level continues to rise until the LM curve intersects with the FE line and the IS curve at general equilibrium

The Effect of a Monetary Expansion (Cont'd)

- No changes in
  - employment
  - output
  - the real interest rate
- The price level is higher by the same proportion as the increase in the money supply
- So all real variables (including the real wage) are unchanged, while nominal values (including the nominal wage) have risen proportionately with the change in the money supply

Trend Money Growth and Inflation

- This analysis also handles the case in which the money supply is growing continuously
- If both the money supply and price level rise by the same proportion, there is no change in the real money supply
- The LM curve does not shift
- If the money supply grew faster than the price level, the LM curve would shift down

Classical vs. Keynesian Versions of the IS-LM Model

- There are two key questions in the debate between classical and Keynesian approaches
  - How rapidly does the economy reach general equilibrium?
  - What are the effects of monetary policy on the economy?
- Price adjustment and the self-correcting economy
  - The economy is brought into general equilibrium by adjustment of the price level
  - The speed at which this adjustment occurs is much debated
- Classical economists see rapid adjustment of the price level
  - If firms change pries instead of output in response to a change in demand, the adjustment process is almost immediate
- Keynesian economists see slow adjustment of the price level
  - When not in general equilibrium, output is determined by aggregate demand at the intersection of the IS and LM curves, and the labor market is not in equilibrium

Monetary Neutrality

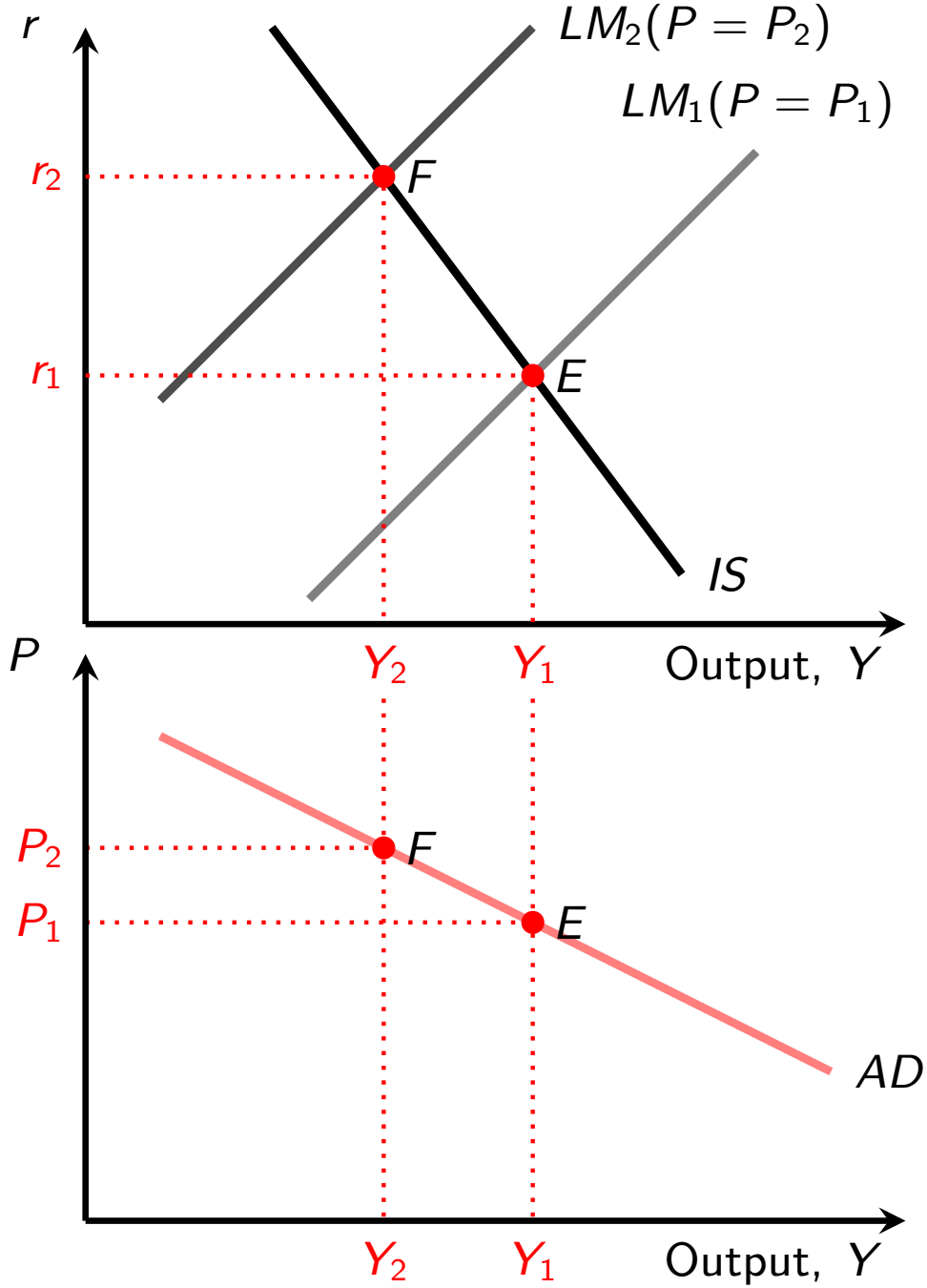
- Money is neutral if a change in the nominal money supply changes the price level proportionately, but has no effect on real variables
- The classical view is that a monetary expansion affects prices quickly with at most a transitory effect on real variables
- Keynesian think the economy may spend a long time in disequilibrium, so a monetary expansion increases output and employment and causes the real interest rate to fall
- Keynesian believe in monetary neutrality in the long run, but not the short run, while classicals believe it holds even in the relatively short run

Aggregate Demand and Aggregate Supply

- Use the IS-LM model to develop the AD-AS model
- The two models are equivalent
- Depending on the issue, one model of the other may prove more useful
- IS-LM relates the real interest rate to output
- AD-AS relates the price level to output

AD Curve

- The relationship between the quantity of goods demanded and the price level when the goods market and asset market are in equilibrium
- So the AD curve represents the price level and output level at which the IS and LM curves intersect

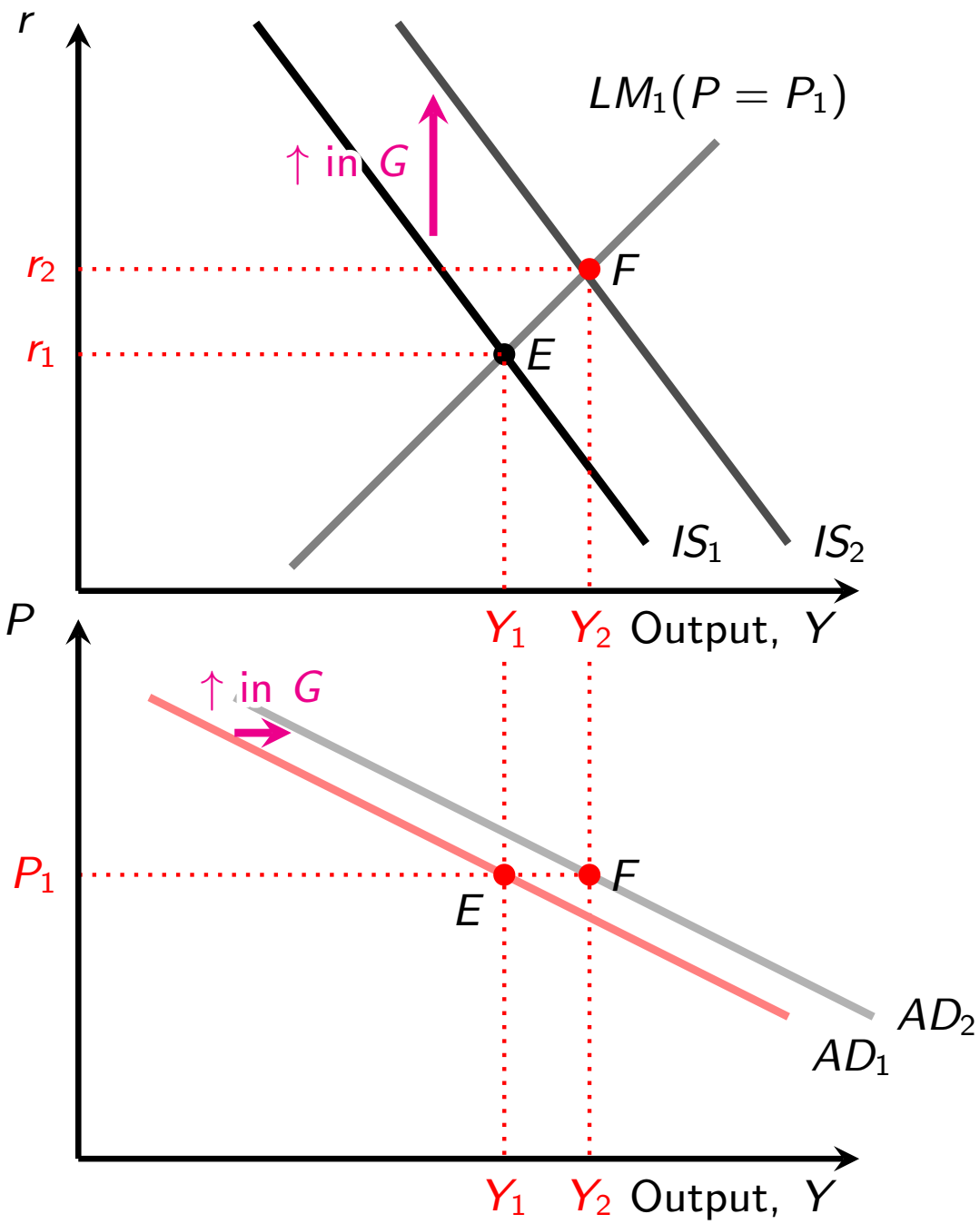


AD Curve (Cont'd)

- The AD curve relates the total quantity of goods and services to the general price level, not a relative price
- The AD curve slopes down because a higher price level is associated with lower real money supply, shifting the LM curve up, raising the real interest rate, and decreasing output demanded

The AD Curve Shifters

- Any factor that causes the intersection of the IS and LM curves to shift to the left causes the AD curve to shift to the left
- Example: a temporary increase in government purchases



The AD Curve Shifters (Cont'd)

- Through shifting the IS curve:
  - $\uparrow$ in expected future output shifts the AD curve up
  - $\uparrow$ in wealth shifts the AD curve up
  - $\uparrow$ in government purchase shifts the AD curve up
  - $\downarrow$ in taxes shifts the AD curve up
  - $\uparrow$ in the expected future MPK shifts the AD curve up
  - $\downarrow$ in the effective tax rate on capital shifts the AD curve up
- Through shifting the LM curve:
  - $\uparrow$ in the nominal money supply shifts the AD curve up
  - $\uparrow$ in expected inflation shifts the AD curve up
  - $\downarrow$ in the nominal interest rate on money shifts the AD curve up
  - Any change that reduces the real demand for money shifts the AD curve up

The Aggregate Supply Curve

- The aggregate supply curve shows the relationship between the price level and the aggregate amount of output that firms supply
- In the short run, prices remain fixed, so firms supply whatever output is demanded
  $\rightarrow$ the short-run aggregate supply (SRAS) is horizontal
- Full-employment output is not affected by the price level, so the long-run aggregate supply curve (LRAS) is vertical

The Aggregate Supply Curve (Cont'd)

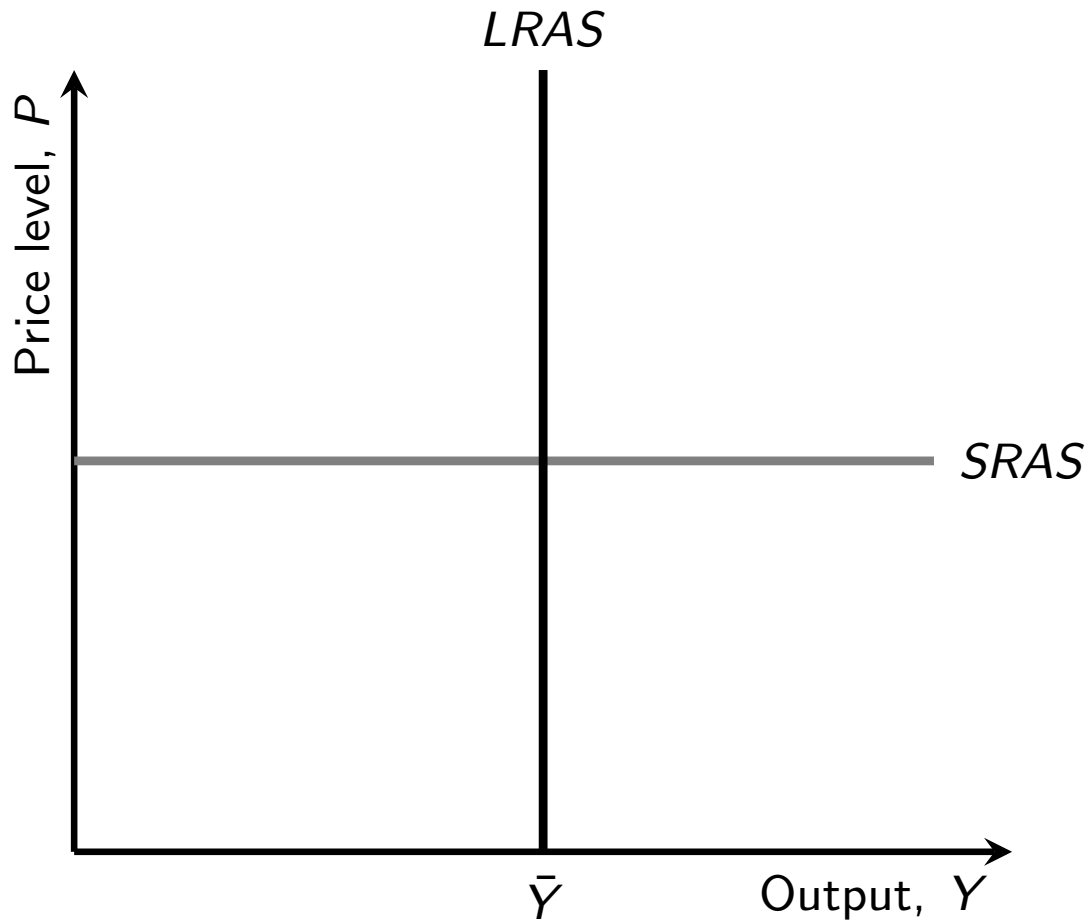


Figure: The Short-Run and Long-Run Aggregate Supply Curves

The AS Curve Shifters

- The SRAS curve shifts whenever firms change their prices in the short run
  - Factors like increased costs of producing goods lead firms to increase prices, shifting SRAS up
- Anything that increases (decreases) full-employment output shifts the LRAS curve right (left)
  - Changes in the labor force or productivity

Equilibrium in the AD-AS Model

- If the economy is not in general equilibrium, economic forces work to restore general equilibrium both in AD-AS diagram and IS-LM diagram

Long-Run Adjustment

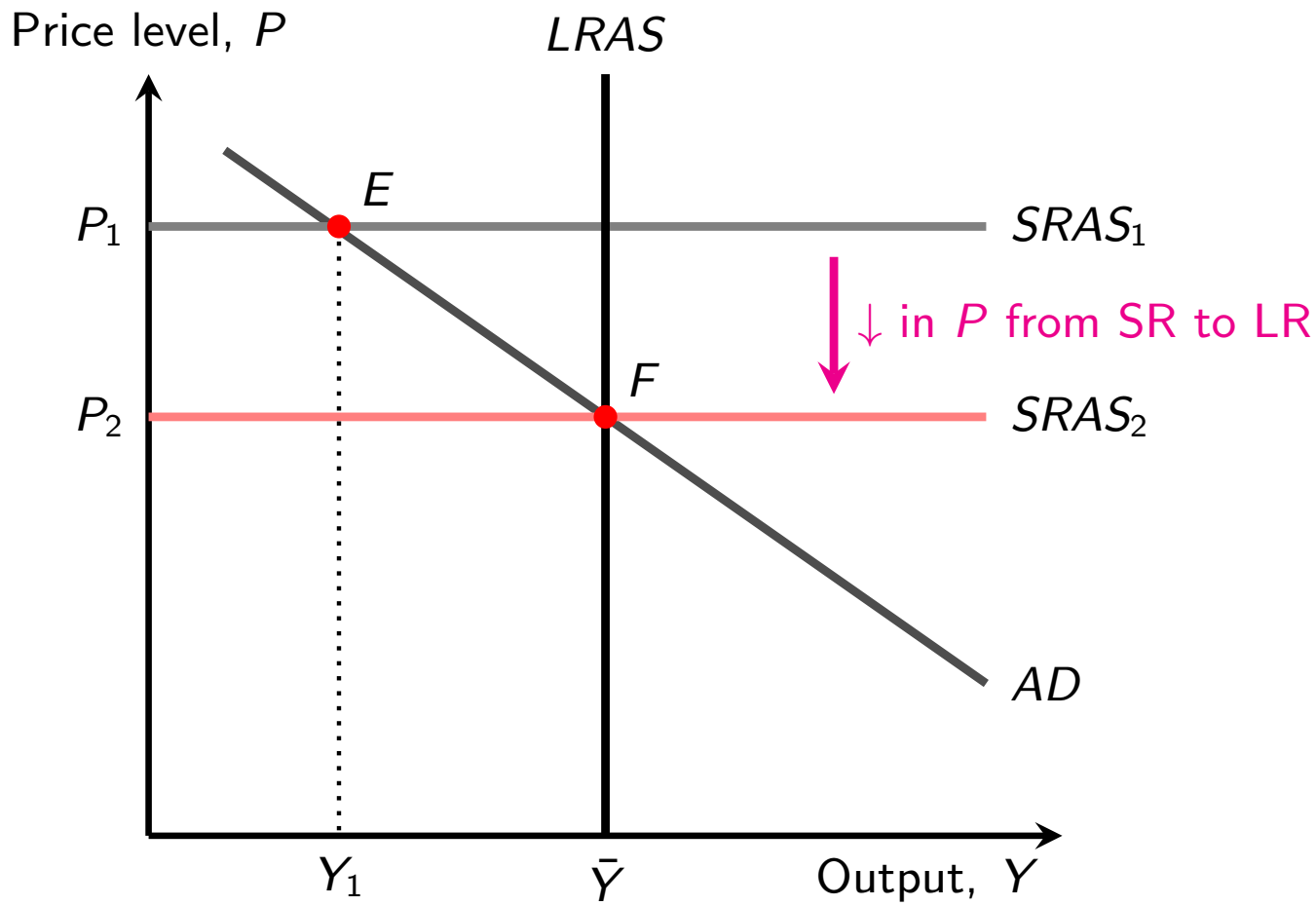


Figure: The Short-Run and Long-Run Aggregate Supply Curves

Monetary Neutrality in the AD-AS Model

- Suppose the economy begins in general equilibrium, but then the money supply is increased by 10%
- How does this affect the AD curve?
- How does the price level change?
- How does the real money supply change?

Monetary Neutrality in the AD-AS Model (Cont'd)

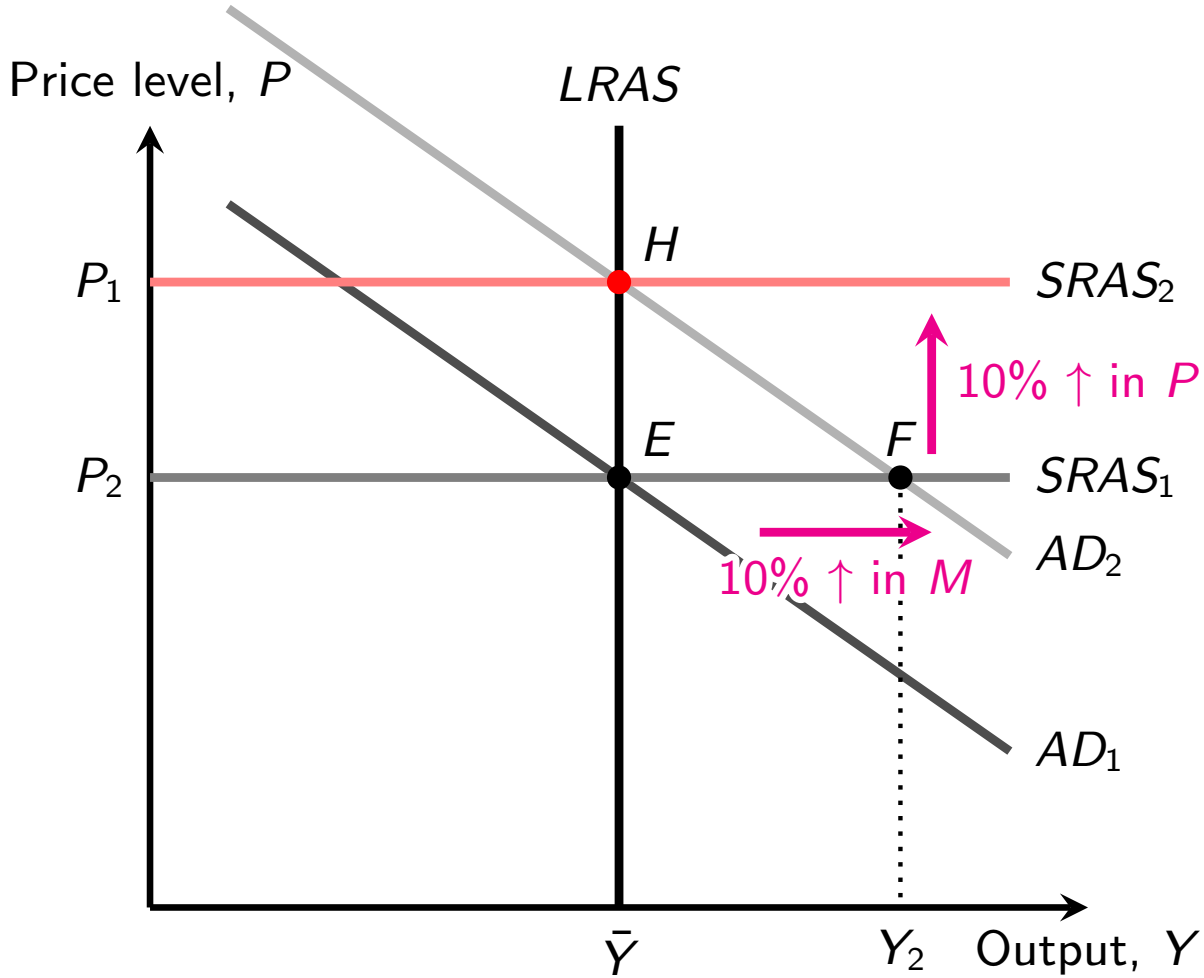


Figure: The Monetary Neutrality in the AD-AS Framework

Monetary Neutrality in the AD-AS Model (Cont'd)

- The key question is: How long does it take to get from the short run to the long run?
- The answer to this question is what separates classicals from Keynesians