

# AS/AD Model

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# Objectives

In this section you will learn

1. how to put IS/LM and labor market clearing together
2. how to derive aggregate supply and demand curves
3. how to analyze policies and shocks
4. why the economy tends towards potential output in the long run

Aggregate Supply (AS)

# Aggregate Supply

- ▶ The aggregate supply curve is simply the labor market clearing condition
- ▶ Recall
  - ▶ wage setting

$$W = P^e F(u, z) \quad (1)$$

with  $u = 1 - Y/L$

- ▶ price setting

$$P = (1 + m)W \quad (2)$$

- ▶ Combine the two:

$$W/P = \frac{1}{1 + m} = \frac{P^e}{P} F(1 - Y/L, z) \quad (3)$$

# How to think about AS

- ▶ The key exogenous piece is the markup

$$W/P \leftarrow \frac{\mathbf{1}}{\mathbf{1} + \mathbf{m}} \rightarrow \frac{P^e}{P} F(1 - Y/L, z) \quad (4)$$

- ▶ Price setting: markup  $\rightarrow$  real wage
- ▶ Wage setting: markup  $\rightarrow$  employment + output
  - ▶ mediated by price expectation errors
  - ▶ that generate wage setting errors

# The logic behind AS

AS captures this idea:

- ▶ Workers expect  $P^e$  and set  $W = P^e \times \text{real wage target}$  that is consistent with “full employment” (whatever that means)
- ▶ If  $P < P^e$ , the resulting real wage is “too high”
- ▶ Since labor demand is downward sloping in  $W/P$ , it falls short of full employment

# The logic behind AS

Our model does not quite work like this

- ▶ because of the linear production function  $Y = N$ , the marginal product of labor is always 1
- ▶ labor demand is not downward sloping but flat at  $W/P = 1/(1+m)$
- ▶ the real wage is fixed

The story why price expectations affect employment is not clear.

- ▶ Somehow workers don't know that  $W/P$  is fixed.
- ▶ When  $P < P^e$  they look at  $W$  and think  $W/P$  is low.

# Properties of AS

Holding constant  $P^e$ :  $Y \uparrow \implies P \uparrow$

Intuition:

Holding constant  $Y$ :  $P^e \uparrow \implies P \uparrow$

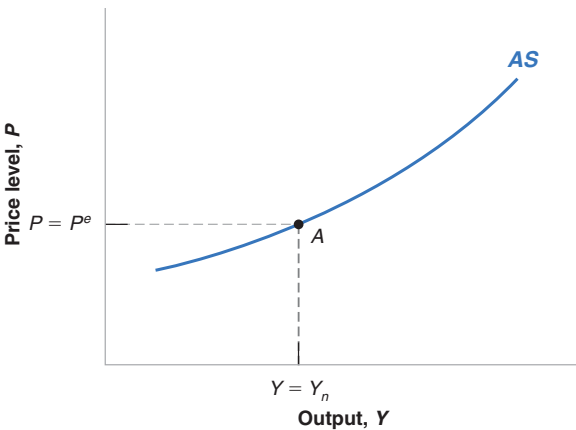
Intuition:

When  $P = P^e$ :  $Y = Y_n$  and  $u = u_n$

these values define  $Y_n, u_n$ .



# Aggregate Supply



$$P = (1 + m)P^e F(1 - Y/L, z)$$

What shifts AS?

Aggregate Demand (AD)

# Aggregate Demand

- ▶ AD combines IS and LM
- ▶ Recall:
  - ▶ IS:  $Y = C(Y - T) + I(Y, i) + G$
  - ▶ LM:  $M/P = YL(i)$
- ▶ Combine the two, so that  $i$  is eliminated

$$\mathbf{AD} : Y = Y(\underset{+}{M/P}, \underset{+}{G}, \underset{-}{T}) \quad (5)$$

- ▶ This is downward sloping:  $P \uparrow \implies Y \downarrow$
- ▶ Intuition: ...

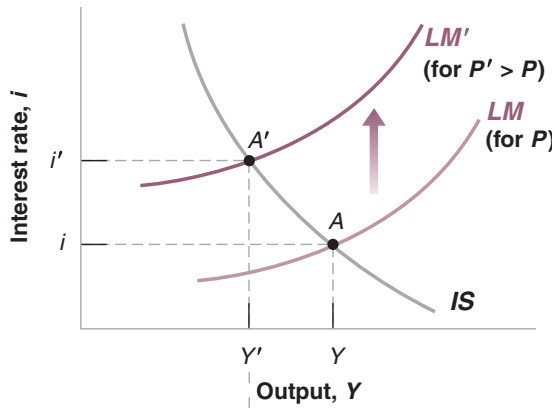
# Deriving AD

- ▶ The linear case:
  - ▶ IS:  $Y = Y_0 + a_1 Y - a_2 i$
  - ▶ LM:  $M/P = L_0 - \alpha i$
- ▶ LM:  $i = (L_0 - M/P)/\alpha$
- ▶ AD

$$Y(1 - a_1) = Y_0 - a_2(L_0 - M/P)/\alpha \quad (6)$$

$$Y = \frac{Y_0 + a_2(M/P - L_0)}{1 - a_1} \quad (7)$$

## Deriving AD Graphically



Trace out intersection of IS/LM as  $P \uparrow$ .

# AD Shifters

- ▶ Anything that shifts IS or LM left shifts AD left (towards lower  $Y$ )
- ▶ Examples
  - ▶ IS:  $G \downarrow, T \uparrow, C_0 \downarrow$
  - ▶ LM:  $M \downarrow$
- ▶ These are exactly the shocks that reduce  $Y$  in the short-run model
- ▶ AD really collects all short-run equilibria, one for each  $P$ .

Equilibrium

## Equilibrium summary

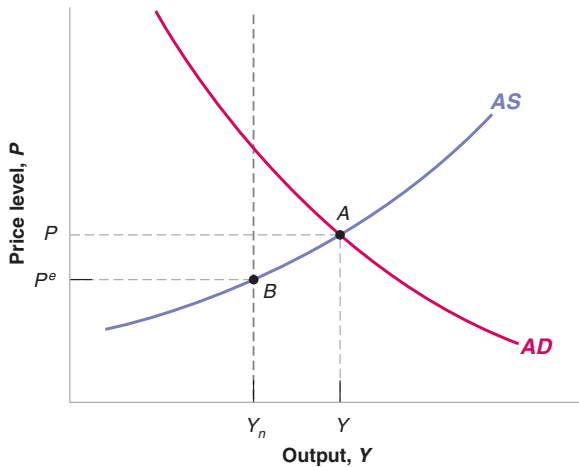
Curve	Equation	Shifters
AS	$P = (1 + m)P^e F(1 - Y/L, z)$	$m \uparrow, P^e \uparrow, z$
AD	$Y = C(Y - T) + G + I(Y, i)$ $M/P = YL(i)$	$M/P \uparrow, G \uparrow, T \downarrow$

Short run:  $P^e$  given.

Medium run:  $P^e \rightarrow P$ .

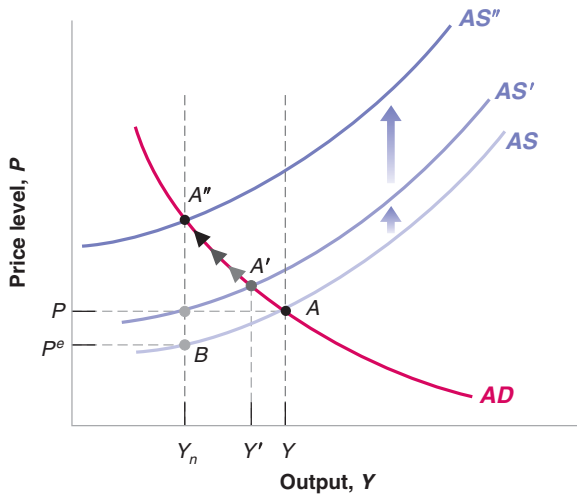


## Short-run Equilibrium



Clear all markets for a given  $P^e$

## Transition Towards Medium-run



Expectations adjust  
towards  $P^e = P$   
AS shifts up  
 $Y \rightarrow Y_n$

# Analyzing the Model

## 1. Start with the medium run:

1.1  $Y = Y_n, u = u_n, P = P^e$

1.2  $W/P = 1/(1+m) = F(u_n, z)$

## 2. Apply a shock

2.1 find the new medium run ( $P^e = P$ )

2.2  $Y_n$  only changes if  $m$  or  $z$  were shocked

2.3 find the new short-run ( $P^e$  unchanged)

## 3. Transition

3.1 AS curve shifts towards new medium run equilibrium

# Applications

# Monetary Expansion

The shock:  $M \uparrow$ .

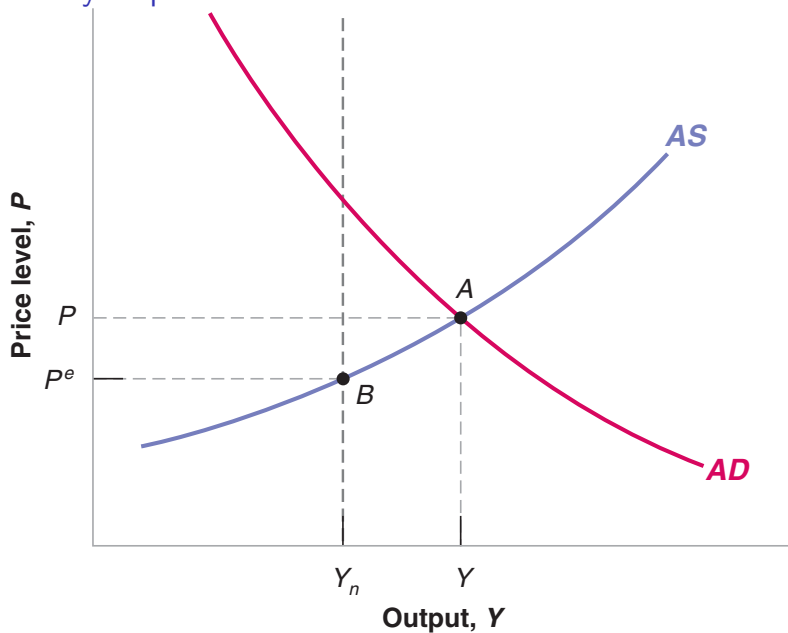
Medium run:

Short run:

Transition:

- ▶ AS shifts toward  $Y_n$ .

## Monetary Expansion



# Monetary Expansion

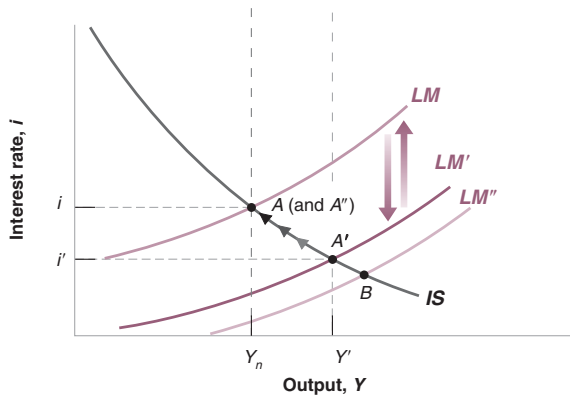
## Result

Money is neutral in the medium run:

- ▶  $M$  affects prices, but not any real variables
- ▶ Doubling  $M$  doubles  $P$

This is why we could ignore money in the long-run growth analysis.

# Intuition



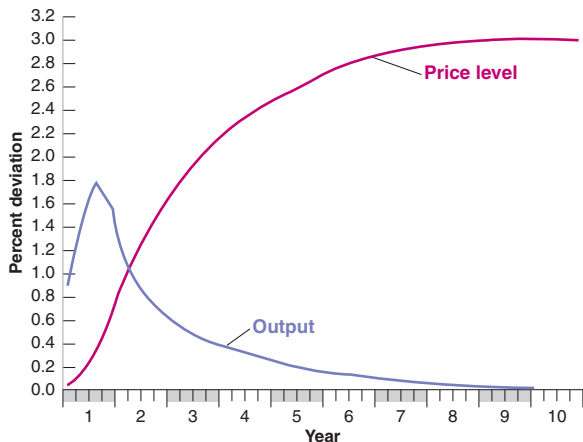
$$M \uparrow \implies i \downarrow \implies I \uparrow$$

With fixed  $P$ :  $A \rightarrow B$   
(IS/LM)

$P \uparrow$  dampens the  
short-run effect



# Empirical Evidence



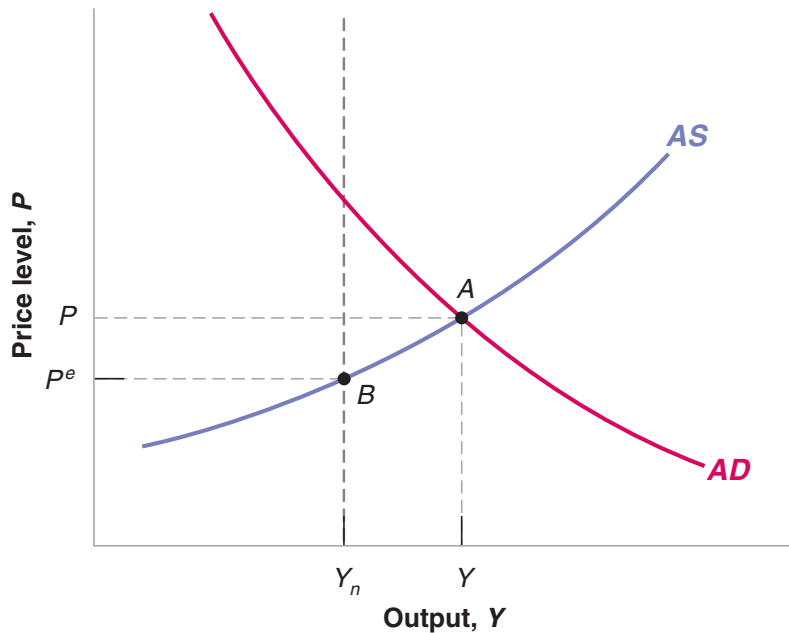
Estimated macro models imply:

- ▶ the peak effect of monetary policy hits after nearly 1 year
- ▶ it takes several years for the real effects to wear off

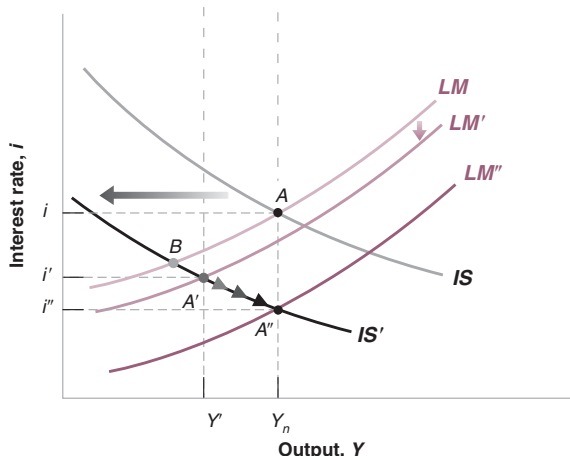
# Deficit Reduction

- ▶ The shock:  $G \downarrow$ .
- ▶ Medium run:
  - ▶ AS:
  - ▶ AD:
- ▶ Short run:
  - ▶ AS:
  - ▶ AD:
- ▶ Transition:
  - ▶ AS shifts towards  $Y_n$

## Deficit Reduction



# Deficit Reduction



With fixed  $P$ :  $A \rightarrow B$ .

Short run:  $G \downarrow \Rightarrow P \downarrow$   
 $\Rightarrow M/P \uparrow \Rightarrow i \downarrow$

Medium run:

$P \downarrow \Rightarrow LM \downarrow$

# Deficit Reduction

Short run:

- ▶  $Y \downarrow$
- ▶  $I$  ambiguous ( $Y \downarrow$  but  $i \downarrow$ )

Medium run:

- ▶  $Y$  returns to natural level
- ▶  $I \uparrow$ : crowding in

Long run:

- ▶  $K \uparrow \implies Y \uparrow$

This is the source of current disagreement: how to trade off the short run pain against the long run gain.

# Adverse Supply Shock

- ▶ Example: permanent increase in the price of oil
- ▶ Main effect: given wages, prices must rise
- ▶ Model as increase in markup:  $m \uparrow$ .

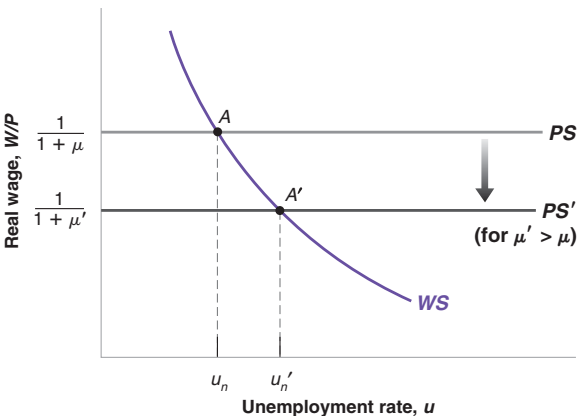
# Adverse Supply Shock

Medium run:

Short run:

Transition: AS shifts towards  $Y_n$ .

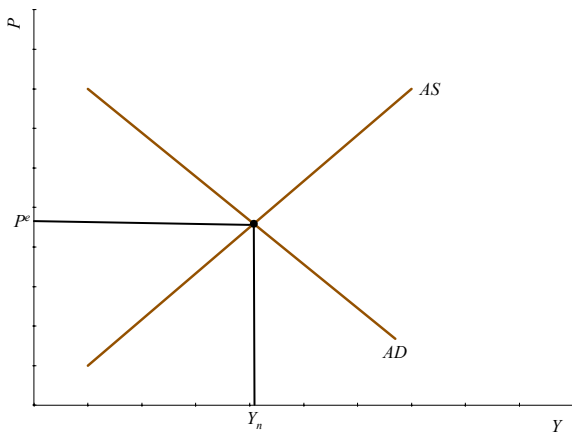
## Medium Run: Labor Market



- ▶  $W/P = 1/(1+m) \downarrow$
- ▶ Lower real wage reduces employment.



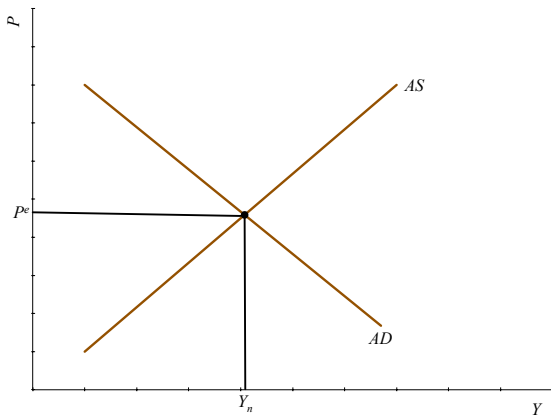
## Adverse Supply Shock



# Stabilization Policy

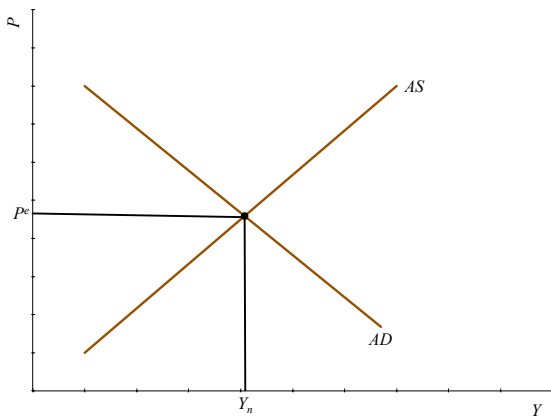
How should policy respond to recessions?

Case 1: Adverse demand shock



# Stabilization Policy

## Case 2: Adverse supply shock



# Stabilization Policy

What happens if policy makers misdiagnose the source of the shock?

Historical examples?

# Summary

	Short run			Medium run		
	$Y$	$i$	$P$	$Y$	$i$	$P$
$M \uparrow$	$\uparrow$	$\downarrow$	$\uparrow$	–	–	$\uparrow$
$G \uparrow$	$\uparrow$	$\uparrow$	$\uparrow$	–	$\uparrow$	$\uparrow$

Short-run effects of shocks differ from medium-run effects.

Intuition: In the short run, wages do not fully adjust (b/c  $P^e$  is sticky).

# Reading

Blanchard/Johnson, Macroeconomics, 6th ed, ch. 7