



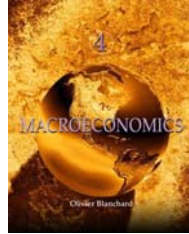
Intermediate Macroeconomics

ECON 302

Professor Yamin Ahmad

Lecture 7:

- The Labor Market
- The Classical Dichotomy
- Theories of Aggregate Supply



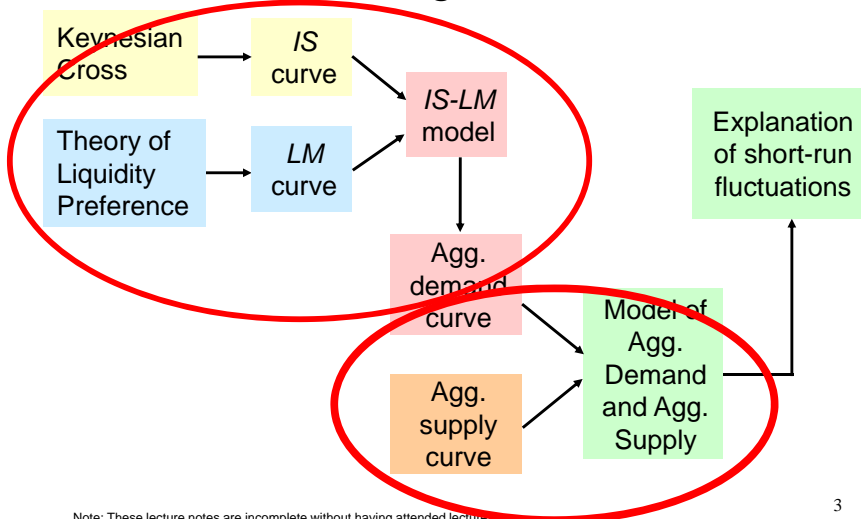
Key Concepts...

- Demand and Supply of Labor
- Aggregate Supply in the long run
- The Classical Supply and Classical Dichotomy
- Four models of Aggregate Supply in which output depends positively on the price level in the short run

Note: These lecture notes are incomplete without having attended lectures



The Big Picture



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Production Decisions

- Regardless of the long run or the short run, firms want to maximize profits
 - Profits: Revenue – Costs
 - Chooses labor and capital
- Short Run:
 - Certain factors of production are fixed, e.g. \bar{K}, \bar{Z}
 - Wages and/or prices may be fixed
- Long Run:
 - All factors of production are flexible
 - Wages and prices are flexible

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Focus: The Labor Market

Labor Demand

- Competitive Firms maximize profits

$$\begin{aligned}
 &= PF(L; \bar{K}) - WL \\
 \Rightarrow &PF_L(L^d; \bar{K}) = W \\
 \Rightarrow &L^d = L^d\left(\frac{W}{P}; \bar{K}\right) \\
 &\quad \quad \quad (-) \quad (+)
 \end{aligned}$$

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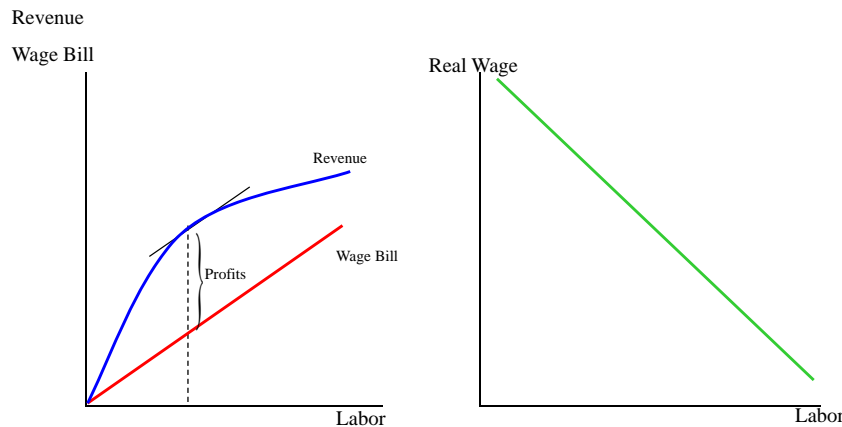
Example: Deriving labor demand

- Suppose that $Y = F(\bar{K}, L, \bar{Z}) = ZK^{\frac{1}{3}}L^{\frac{2}{3}}$ where $Z=1$
- Profit maximization involves: $\max_L PF(\bar{K}, L) - WL$
- First order condition (FOC) is:

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Labor Demand



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Labor Supply

Household Problem

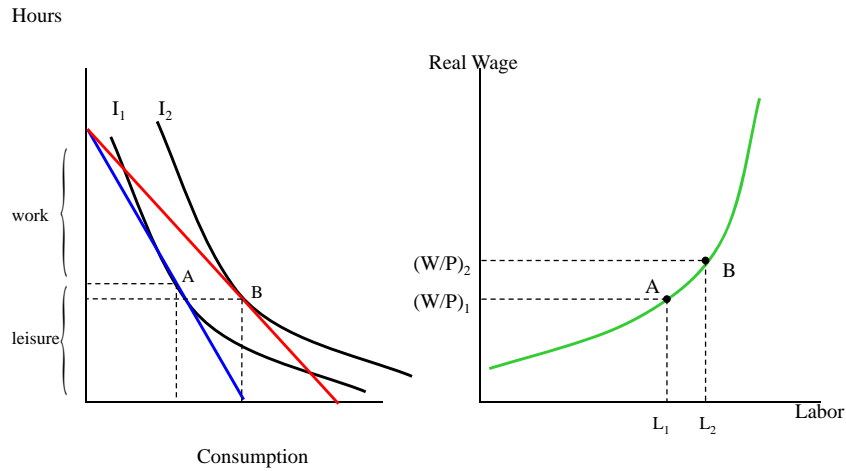
- Choice for households is to allocate time between labor and leisure: $\max_{C,L} U(C, L)$
- Worker derives utility from leisure
- However, disutility of labor yields a wage that the worker can use to purchase goods and services
 - Thus labor supply is positively related to the real wage:

$$L^S = L\left(\frac{W}{P}\right) \quad (+)$$

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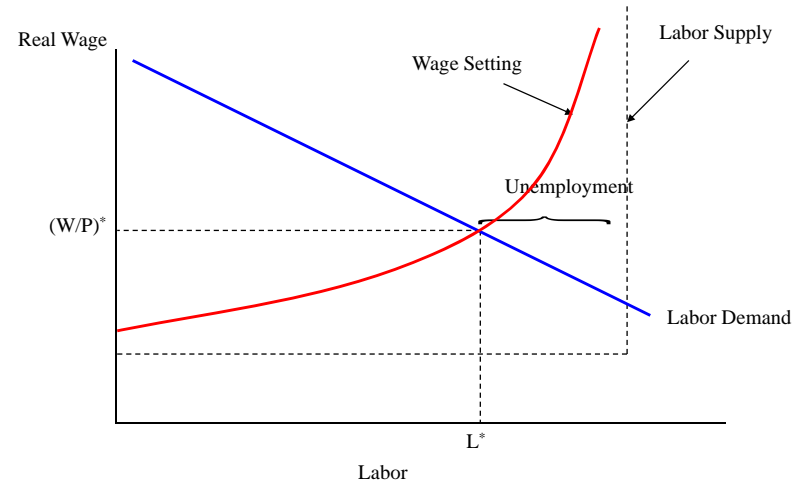
Competitive Labor Supply



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Wage Setting



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Labor Market Clearing

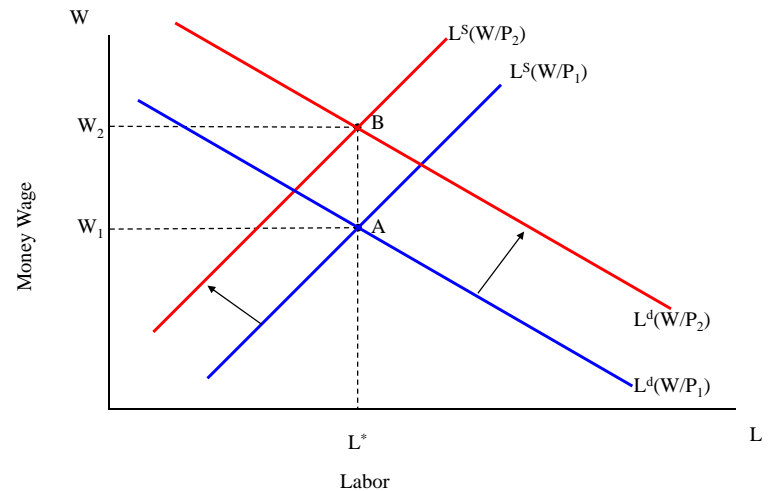
- In equilibrium, $L^s = L^d = L^*$
- Continuing our example, we can see that $L^* = f(\bar{K})$, i.e. $L^* =$
- Long run (classical) output, is thus determined as:

$$Y = F(\bar{K}, L^*) = K^{\frac{1}{3}} L^{*\frac{2}{3}}$$
- Note that output is independent of prices in the long run.

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Classical Supply



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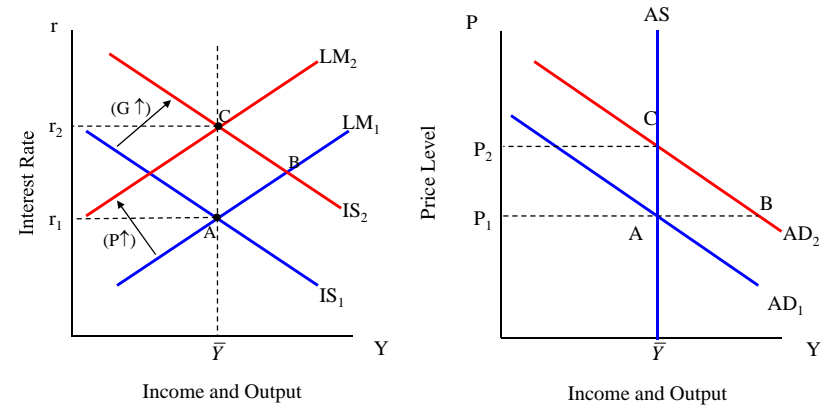
Equilibrium with Flexible Prices

- Disturbances to the demand for goods (e.g. a change in G or T) are fully offset by a change in the interest rate (“**real crowding out**”).
- Disturbances to the demand for, or supply of, money are completely offset by a change in the price level. Money is said to be **neutral**.
- Real variables are independent of nominal ones. This is known as the **Classical Dichotomy**.

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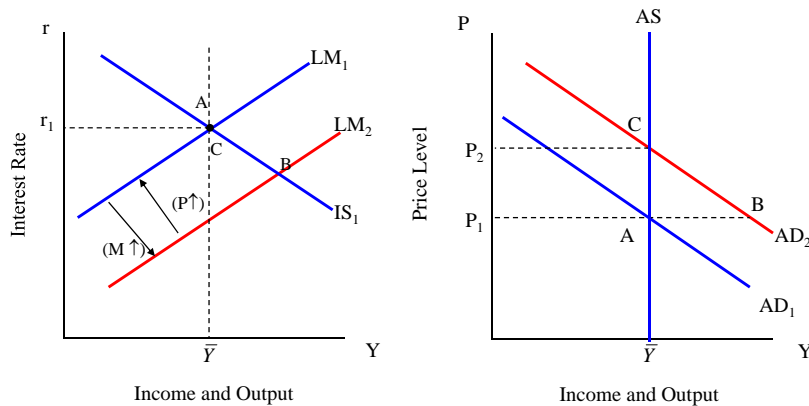
Goods Market Disturbance



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Money Market Disturbance



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Models of Aggregate Supply

- The Sticky-Wage model (Traditional Keynesian)
- Worker Misperceptions model (Friedman, Phelps)
- The Imperfect-Information model (Lucas)
- The Sticky-Price model (“New Keynesian”, “New Neoclassical”)

All these models imply:

$$Y = \bar{Y} + \alpha (P - P^e)$$

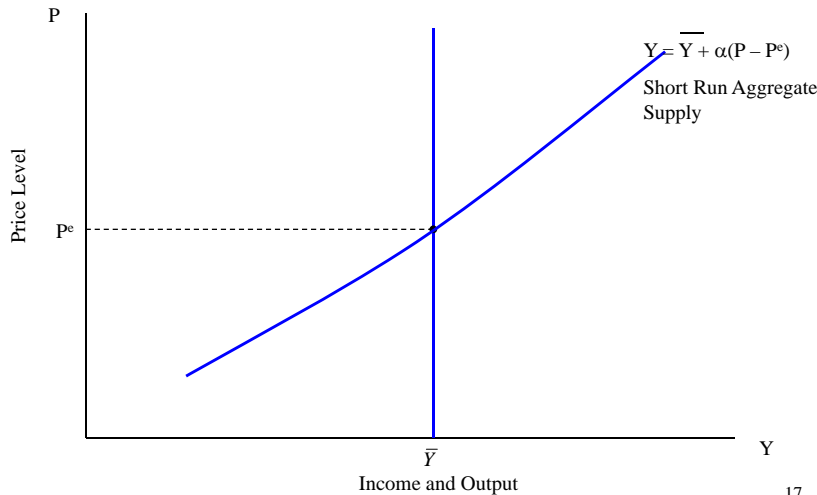
Diagram illustrating the components of the equation:

- agg. output** (green box) points to Y
- natural rate of output** (orange box) points to \bar{Y}
- a positive parameter** (cyan box) points to α
- the actual price level** (pink box) points to P
- the expected price level** (yellow box) points to P^e

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The Short Run Aggregate Supply Curve



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The Sticky-Wage model

- Assumes that firms and workers negotiate contracts and fix the nominal wage before they know what the price level will turn out to be.
- The nominal wage they set is the product of a target real wage and the expected price level:

$$W = \omega \times P^e$$

Target real wage

$$\Rightarrow \frac{W}{P} = \omega \times \frac{P^e}{P}$$

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The Sticky-Wage model

$$\frac{W}{P} = \omega \times \frac{P^e}{P}$$

If it turns out that

$$P = P^e$$

then Unemployment and output are at their natural rates.

$$P > P^e$$

Real wage is less than its target, so firms hire more workers and output rises above its natural rate.

$$P < P^e$$

Real wage exceeds its target, so firms hire fewer workers and output falls below its natural rate.

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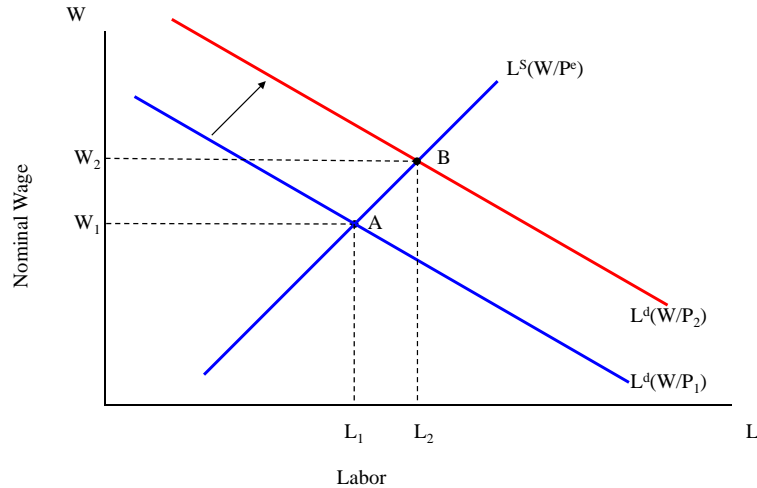
The Sticky-Wage model

- Labor Demand: $L^d = L^d(W/P; \bar{K})$
(-) (+)
- Labor Supply/ Wage Setting: $L^S = L^S(W/P)$
(+)
- Negotiation costs \Rightarrow money wage set infrequently. Let ω be expected equilibrium real wage. Then money wage set so that $\bar{W} = \omega P^e$.
- $L = L^d(\bar{W}/P; \bar{K}) = L^d(\omega P^e/P; \bar{K})$
 $\Rightarrow Y^S = F(L^d; \bar{K}) = Y^S(P/P^e; \bar{K})$
(+) (+)

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Worker Misperceptions Model



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The Imperfect-Information model

Assumptions

- All wages and prices are perfectly flexible, all markets are clear.
- Each supplier produces one good, consumes many goods.
- Each supplier knows the nominal price of the good she produces, but does not know the overall price level.
- Supplier does not know price level at the time she makes her production decision, so uses the expected price level, P^e .

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The Imperfect-Information model

- Similar to worker misperception model, but people use local market conditions to make inferences about aggregate prices.

- General Price Level: $P = P^e + u$ (u random)

- Local Price Level : $P_i = P + v_i$ (v_i random)

- Worker-firm pair : $Y^S_i = \bar{Y}^S_i + \alpha(P_i - P^e)$

where P^e ≡ best guess of P given P^e and P_i .

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The Imperfect-Information model

- Using a result from statistics: $P^e = \theta P^e + (1 - \theta)P_i$

where $\theta \equiv \text{Var}(v_i) / (\text{Var}(v_i) + \text{Var}(u))$

Hence: $Y^S_i = \bar{Y}^S_i + \alpha\theta(P_i - P^e)$

In aggregate: $Y^S = \bar{Y}^S + \alpha\theta(P - P^e)$

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The Imperfect-Information model

- Suppose P rises but P^e does not.
 - Supplier thinks her relative price has risen, so she produces more.
 - With many producers thinking this way, Y will rise whenever P rises above P^e .
- So slope of Aggregate Supply curve also depends on the informativeness of the price mechanism. If aggregate demand is very variable, e.g. because of erratic policy, the AS will be very steep because θ is small.

The Sticky-Price model

- Like the Sticky Wage Model, but now **prices** are pre-set.
- Firm side:-
 - Monopolistic Competition: produce differentiated products
 - Fraction of firms can reset their prices (Calvo, Taylor)
 - Firms set price as a markup over marginal cost
 - All goods 'bundled' into one product through an 'Aggregator'
- Consumer side:-
 - Consumers purchase units of 'bundled' goods
 - Maximize utility

The Sticky-Price model

- **Reasons for sticky prices:**
 - long-term contracts between firms and customers
 - menu costs
 - firms not wishing to annoy customers with frequent price changes
- **Key Assumptions:**
 - Firms set their own prices as a markup over marginal costs (e.g., as with monopolies).
 - Only a fraction of firms can reoptimize their price

The Sticky-Price model

- An individual firm's desired price is

$$p = P + a(Y - \bar{Y})$$

where $a > 0$.

Suppose two types of firms:

- firms with flexible prices, set prices as above
- firms with sticky prices, must set their price before they know how P and Y will turn out:

$$p = P^e + a(Y^e - \bar{Y}^e)$$



The Sticky-Price model

$$p = P^e + a(Y^e - \bar{Y}^e)$$

- Assume sticky price firms expect that output will equal its natural rate. Then,

$$p = P^e$$

- To derive the aggregate supply curve, we first find an expression for the overall price level.
- Let s denote the fraction of firms with sticky prices. Then, we can write the overall price level as...



The Sticky-Price model

$$P = sP^e + (1-s)[P + a(Y - \bar{Y})]$$

price set by sticky price firms

price set by flexible price firms

- Subtract $(1-s)P$ from both sides:

$$sP = sP^e + (1-s)[a(Y - \bar{Y})]$$

- Divide both sides by s :

$$P = P^e + \left[\frac{(1-s)a}{s} \right] (Y - \bar{Y})$$



The Sticky-Price model

$$P = P^e + \left[\frac{(1-s)a}{s} \right] (Y - \bar{Y})$$

- High $P^e \Rightarrow$ High P
If firms expect high prices, then firms that must set prices in advance will set them high. Other firms respond by setting high prices.
- High $Y \Rightarrow$ High P
When income is high, the demand for goods is high. Firms with flexible prices set high prices. The greater the fraction of flexible price firms, the smaller is s and the bigger is the effect of ΔY on P .



The Sticky-Price model

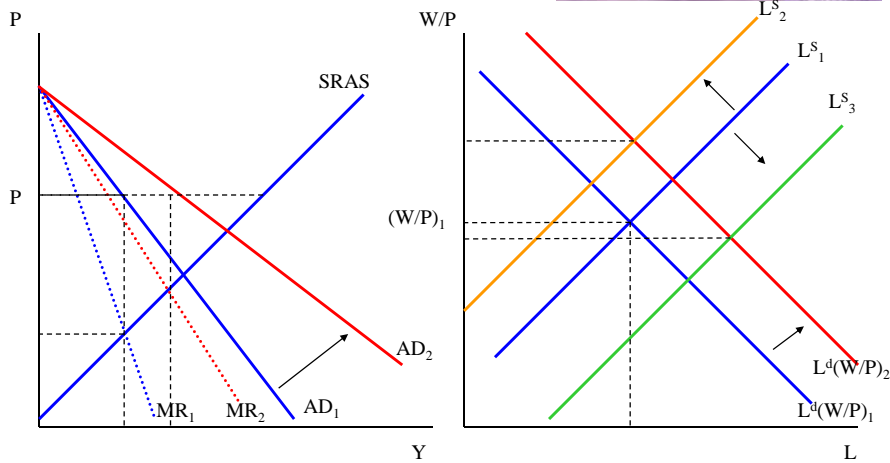
$$P = P^e + \left[\frac{(1-s)a}{s} \right] (Y - \bar{Y})$$

- Finally, derive AS equation by solving for Y :

$$Y = \bar{Y} + \alpha(P - P^e),$$

where $\alpha = \frac{s}{(1-s)a}$

- Note: Slope of Aggregate Supply curve now depends on fraction of firms with pre-set prices.

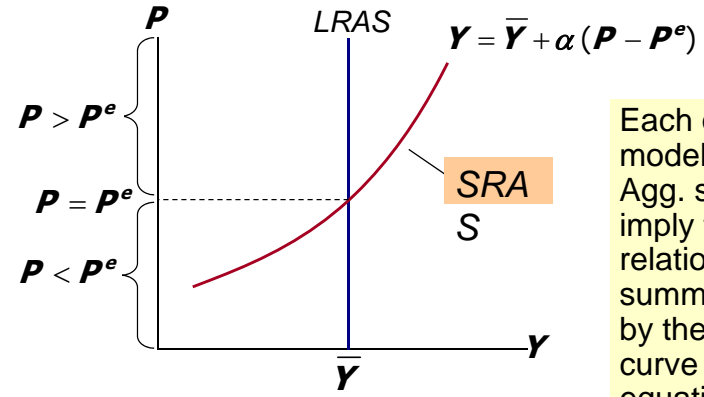


- If **substitution effect dominates**, labor supply shifts L^{S_1} to L^{S_2}
- If **income effect dominates**, labor supply shifts L^{S_1} to L^{S_3}

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Summary & Implications



Each of the models of Agg. supply imply the relationship summarized by the SRAS curve & equation.

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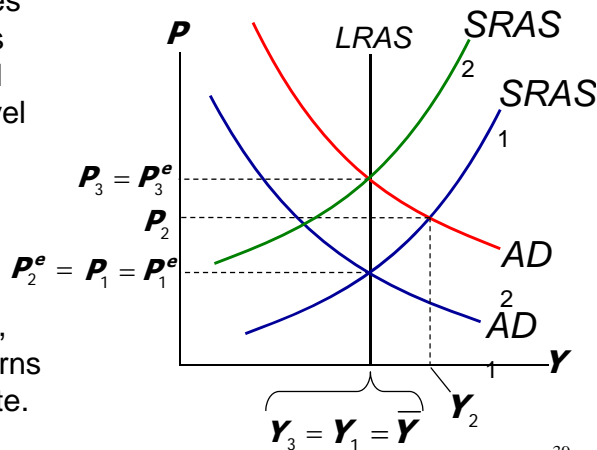


Summary & Implications

Suppose a positive AD shock moves output above its natural rate and P above the level people had expected.

SRAS equation: $Y = \bar{Y} + \alpha(P - P^e)$

Over time, P^e rises, SRAS shifts up, and output returns to its natural rate.



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Summary of Model Implications For Real Wage

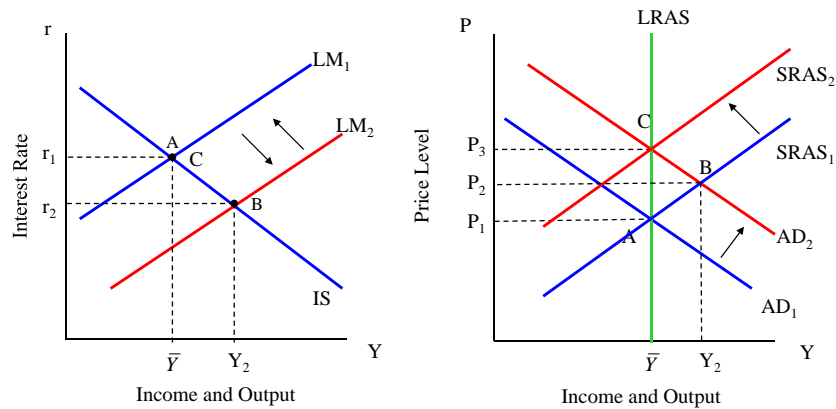
Model	Market Clearing?	Effect of AD on Real Wage?
Sticky Wage	No	Countercyclical
Worker Misperception	Yes	Countercyclical
Imperfect Information	Yes	Countercyclical
Sticky Price	No	Pro- or Countercyclical

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Putting it all together...

Monetary Expansion

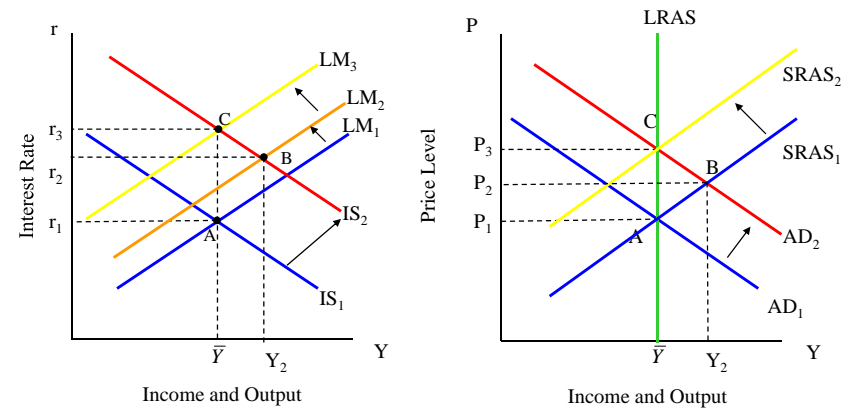


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Putting it all together...

Fiscal Expansion



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Summary

1. Four models of aggregate supply in the short run:

- sticky-wage model
- worker misperceptions model
- imperfect-information model
- sticky-price model

All three models imply that output rises above its natural rate when the price level rises above the expected price level.

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