Topics for Today

1.) Empirical Evidence on Real Business Cycle Models

2.) Problems with Simple RBC Models
- Wages are excessively procyclical
- Money/Output correlations
- Unemployment
- Measurement Bias in Technology Shocks

Key Ingredients of the RBC Approach

1.) Market-Clearing (Flexible Prices)

2.) Optimizing Behavior

3.) Strong Aggregation Assumptions
- Households + Firms are essentially all alike

4.) Technology Shocks Are the Driving Force Behind Fluctuations

5.) Monetary Neutrality

A Prototype RBC Model

Firms

$$\max_{L_t, K_t} \{ y_t - r_t K_t - w_t L_t \}$$

$$\text{subject to: } y_t = A_t F(K_t, L_t)$$

$$A_t = \rho A_{t-1} + \varepsilon_t$$

Households

$$\max_{c_t, l_t} E_t \sum_{j=0}^{\infty} u(c_{t+j}, l_{t+j})$$

(l → leisure)

$$\text{subject to: } c_t + i_t = w_t L_t + r_t K_t$$

$$T = l_t + L_t$$

$$K_{t+1} = (1-\delta) K_t + i_t$$

Solution

$$c_t = c(K_t, A_t) \qquad w_t = w(K_t, A_t)$$

$$i_t = i(K_t, A_t) \qquad r_t = r(K_t, A_t)$$

$$L_t = L(K_t, A_t)$$

Observed Data

U.S. Economy, 1954:1 - 1985:4

Plosser, Journal of Economic Perspectives (1989)

Variable	st. dev.	correl. with output
$\Delta \log(Y_t)$	2.71	1.00
$\Delta \log(C_t)$	1.27	.78
$\Delta \log(i_t)$	6.09	.92
$\Delta \log(h_t)$	2.18	.81
$\Delta \log(w_t)$	1.80	.59

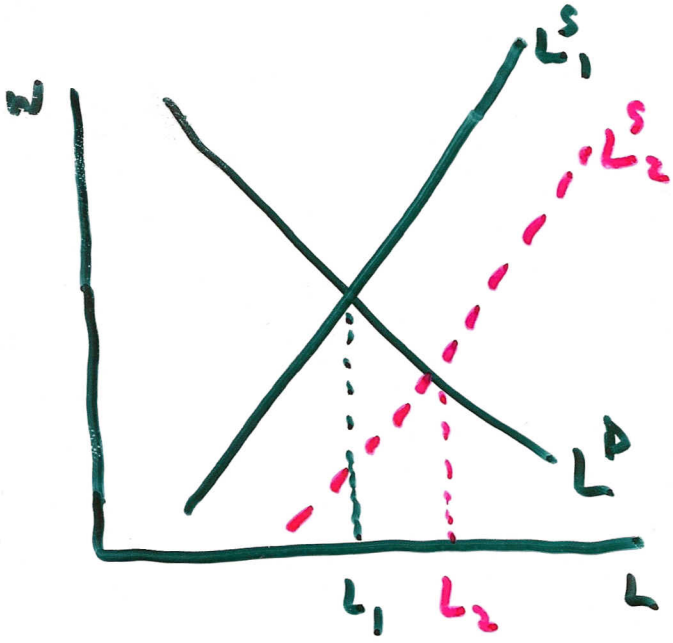
Simulated from RBC Model

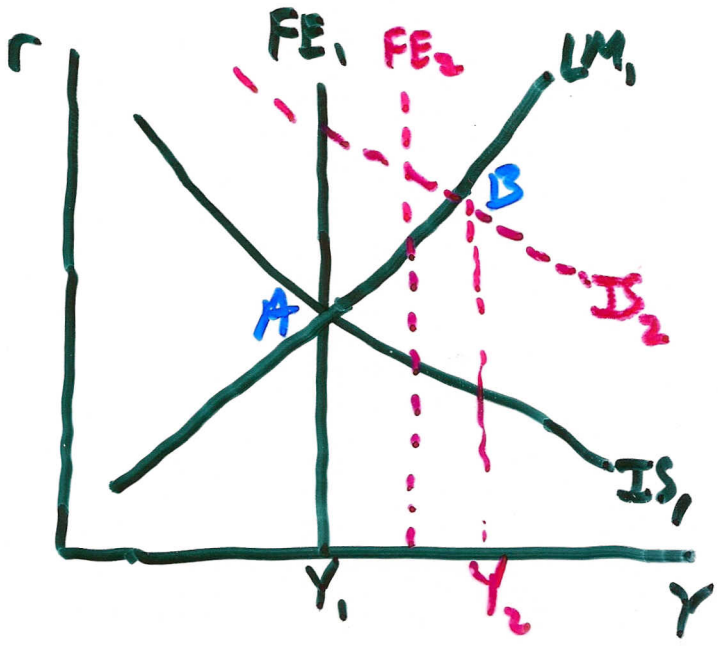
Variable	st. dev.	correl. with output	correl. with actual
$\Delta \log(Y_t)$	2.48	1.00	.87
$\Delta \log(C_t)$	1.68	.96	.76
$\Delta \log(i_t)$	4.65	.97	.72
$\Delta \log(L_t)$	.89	.87	.52
$\Delta \log(w_t)$	1.76	.97	.65

Fixing the Excessive Procyclicality of Real Wages

Solution: Incorporate demand shocks.

Suppose Govt. Spending Increases Temporarily





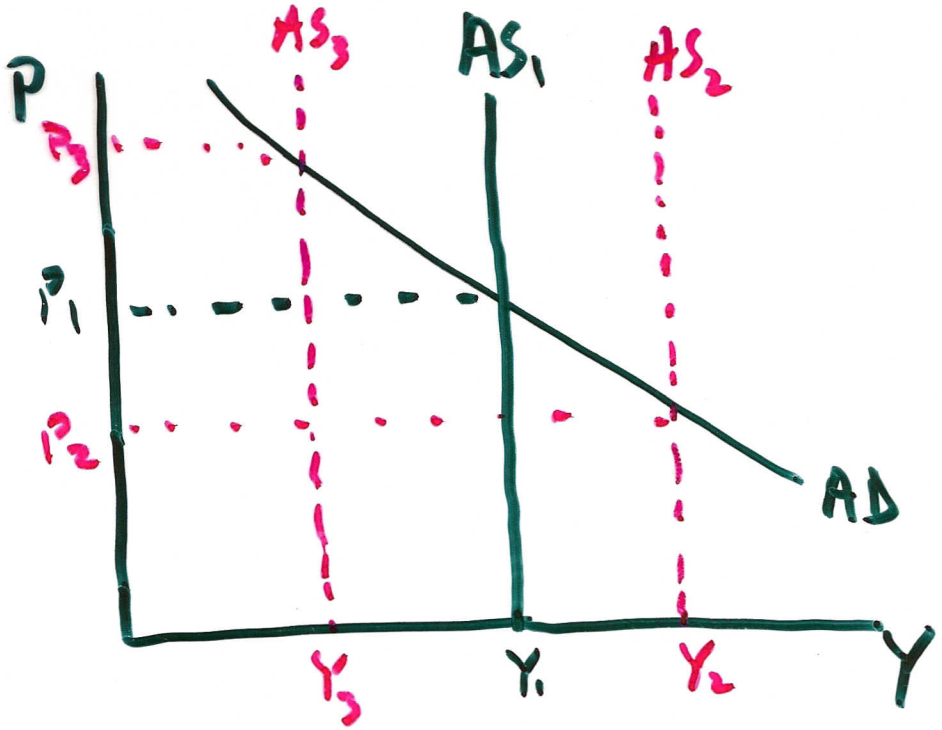
Short-run equil. moves from A to B

Note: W↓ and Y↑

$\Longrightarrow$ ~~Demand~~ Govt. Spending shocks produce counter-cyclical movement in real wages

$\Longrightarrow$ This reduces the procyclical effect of tech. shocks.

Output / Price Level / Money Correlations



Note: RBC Models Predict a <u>Negative</u> Correlation between Y and P

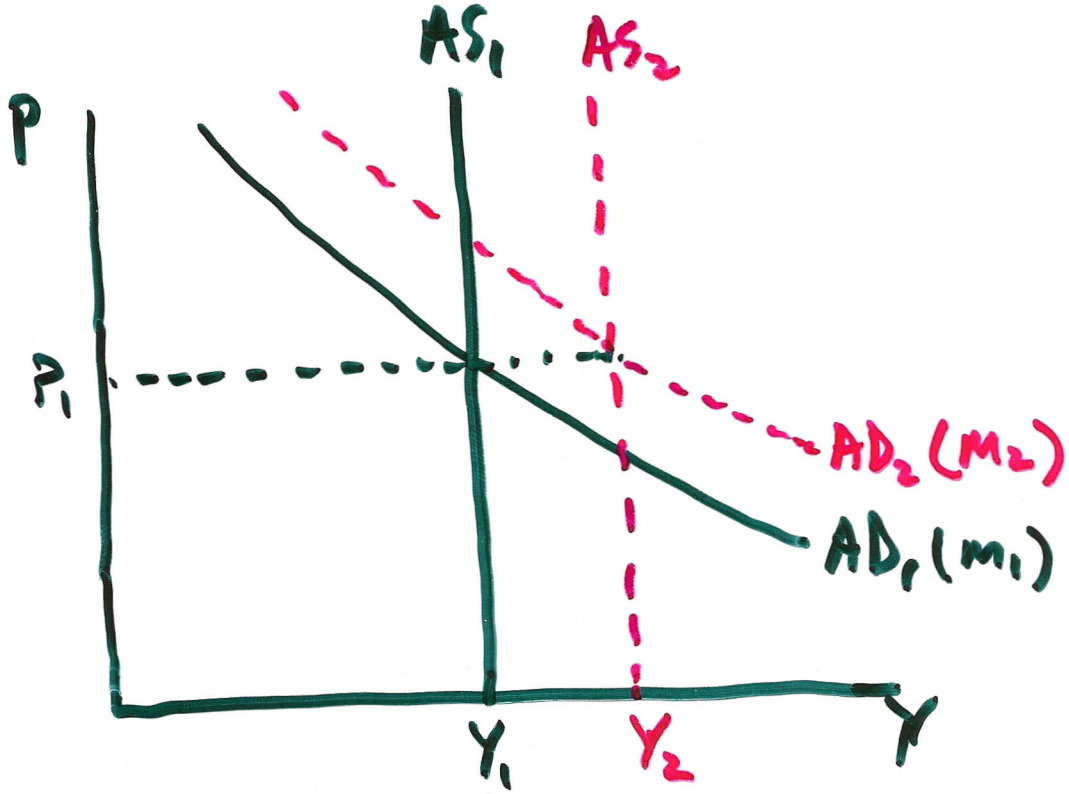
Since Money is neutral, RBC Models Predict a <u>zero</u> correlation between Y and M.

Both predictions are counter-factual.

M and P are both <u>procyclical</u>.

Reverse Causation

Suppose the Central Bank tries to target the price level (or the inflation rate).



In response to the positive technology shock, the Central Bank increases the money supply.

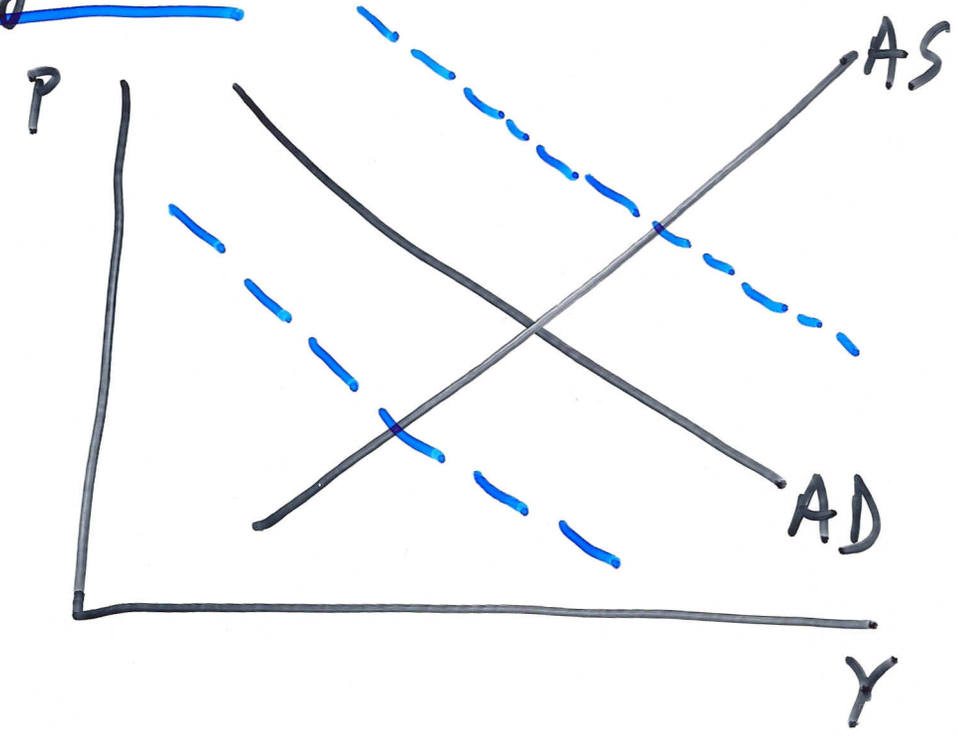
Note: M↑ and Y↑ (M is procyclical)

Reverse Causation: Money responds to output fluctuations but does not cause output fluctuations.

Output / Price Level Correlations

- Although reverse causation could conceivably explain the positive correlation between M and Y, how can the market-clearing approach explain a positive correlation between P and Y? Note, Keynesian models are designed the explain this correlation:

Keynesian



The Lucas Supply Curve

Assumptions

1.) Prices adjust to clear markets

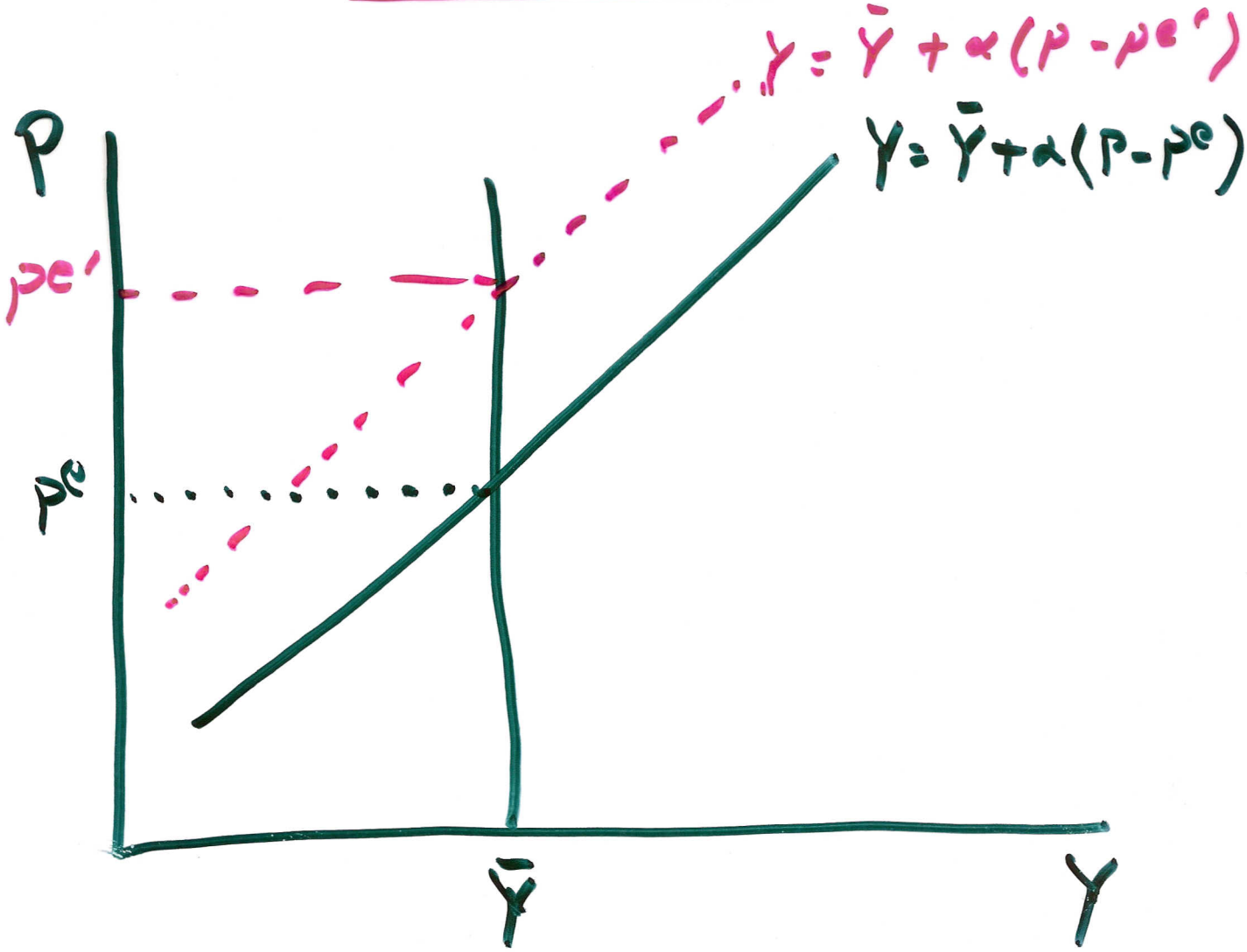
2.) There is imperfect information
- Firms cannot observe all prices.

As a result, firms partially attribute an increase in the general price level to an increase in their own industry's (relative) price.

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

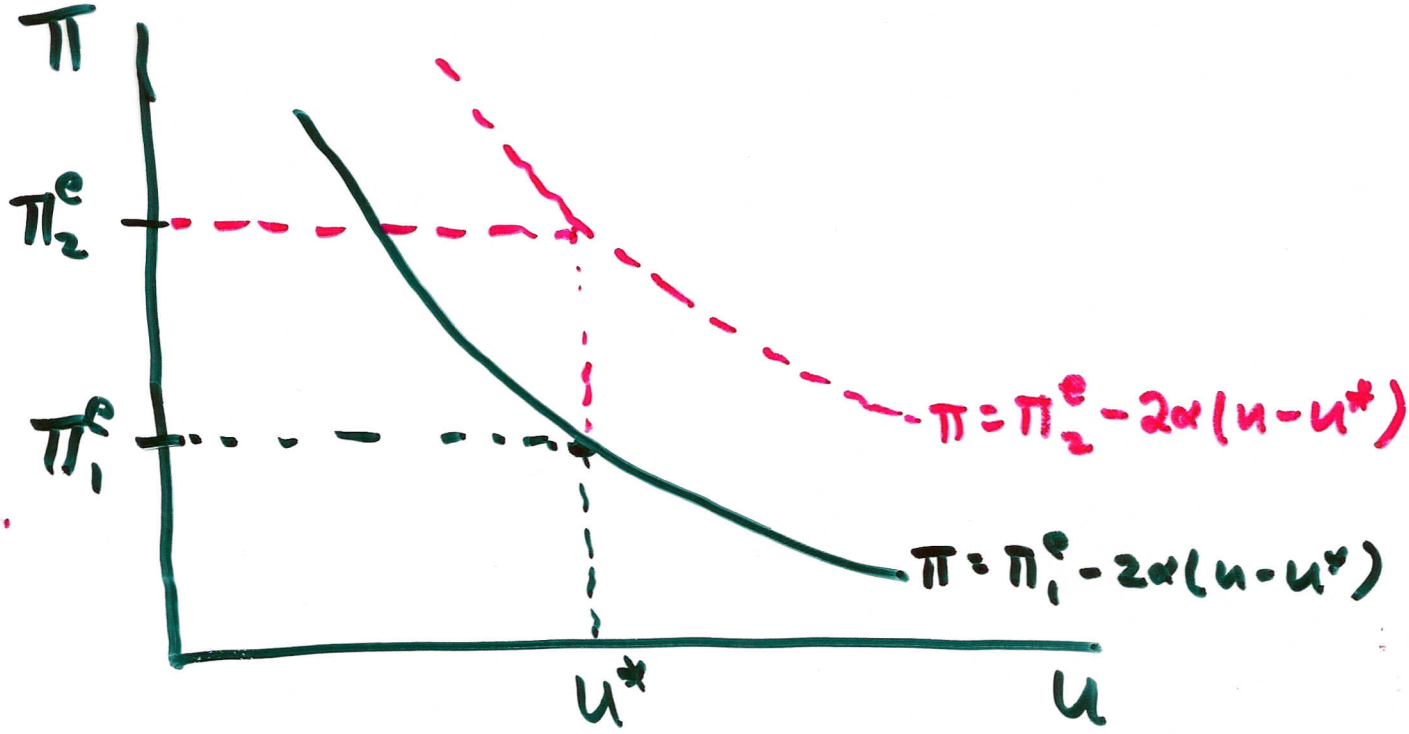
- $\bar{Y}$: natural rate of output
- P: actual price level
- P^e: expected price level

The Lucas Supply Curve



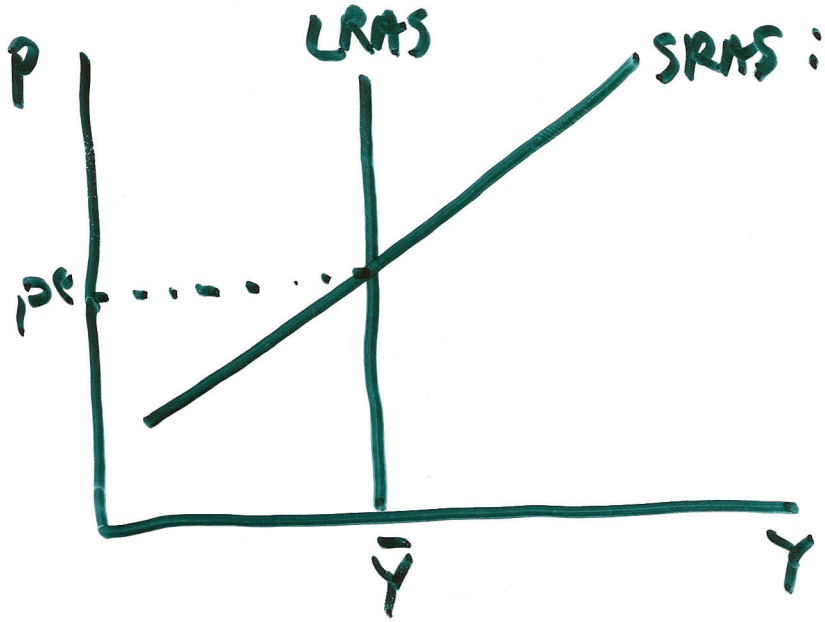
Expectations Augmented Phillips Curve

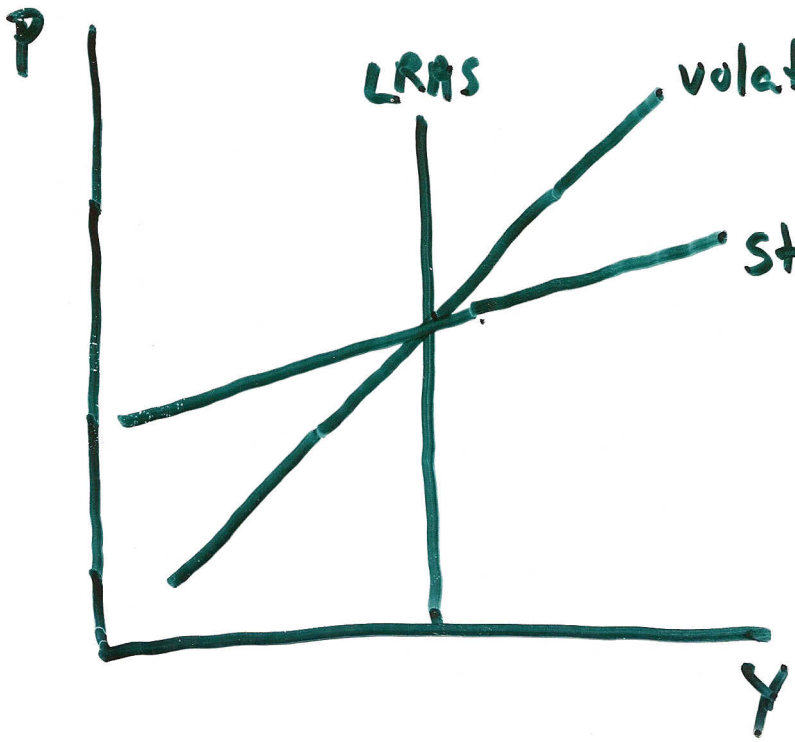
$$\pi = \pi^e - 2\alpha(u - u^*)$$



Procyclical Price Level and Non-neutral Money

Lucas Supply Curve : Assume imperfect information about the general price level





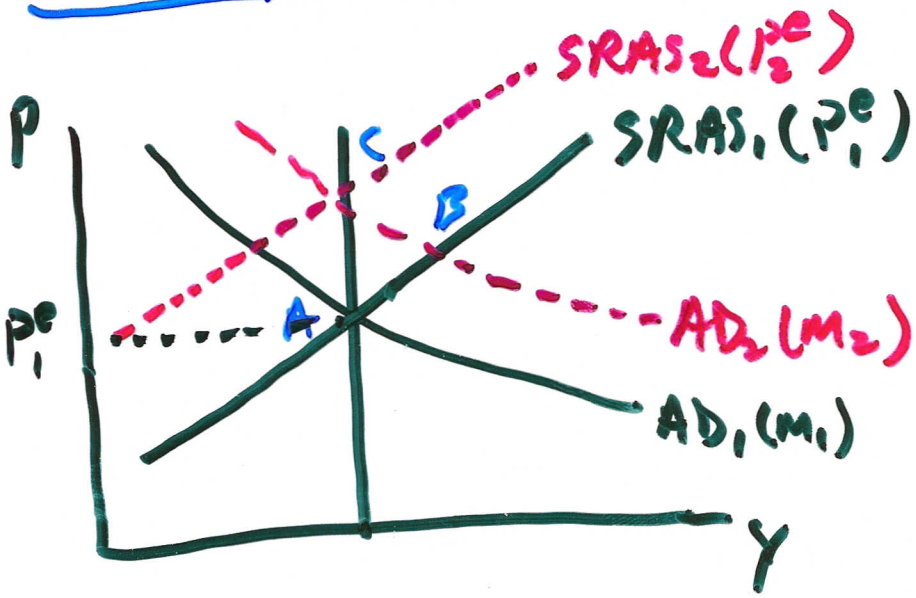
Most unexpected price changes attributed to inflation

Most unexpected price changes attributed to relative price changes

Key Prediction of the Lucas Supply Curve:

Only unanticipated changes in the money supply affect output.

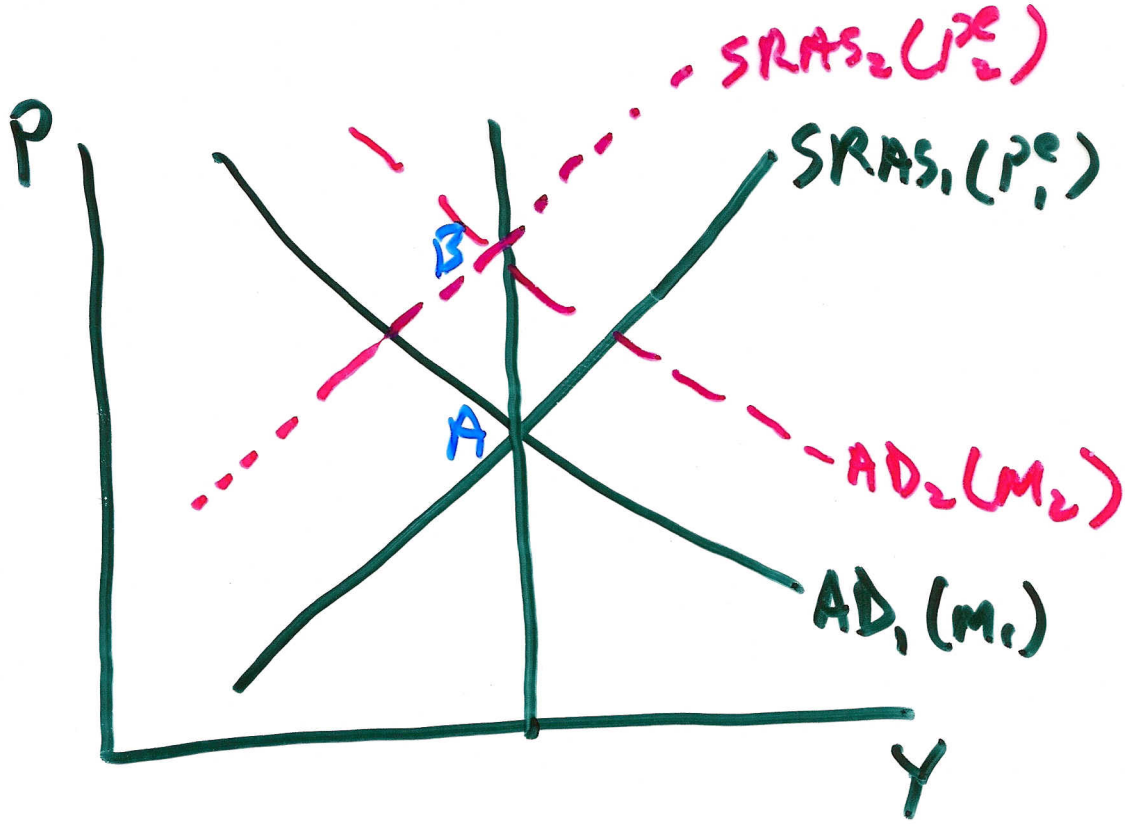
Unanticipated Increase in M



Initially, economy moves from A to B.

Once forecasts are revised, however, P^e↑ and the economy moves to C.

Anticipated Increase in M



If the M↑ was anticipated, pe↑ at the same time, which shifts up the SRAS curve.

Economy moves directly to B.

Unemployment in RBC Models

1.) $u_t = \frac{s_t \uparrow}{f_t + s_t}$ } Varying natural rate

2.) Introduce fixed cost to working. Produces fluctuations in both the intensive and extensive margins

Measurement Bias in Technology Shocks

Suppose factor utilization varies systematically over the cycle.

$$Y_t = A_t F(u_{Kt} \cdot K_t, u_{Lt} \cdot L_t)$$

$$= A_t (u_{Kt} \cdot K_t)^{\alpha} (u_{Lt} \cdot L_t)^{1-\alpha}$$

u_{Kt} = Utilization Rate of Capital

u_{Lt} = Utilization Rate of Labor

$$\text{Measured Solow Residual} = \frac{A_t (u_{Kt} \cdot K_t)^{\alpha} (u_{Lt} \cdot L_t)^{1-\alpha}}{K_t^{\alpha} L_t^{1-\alpha}}$$

$$= A_t u_{Kt}^{\alpha} u_{Lt}^{1-\alpha}$$

Part of the procyclical movement in A_t could in fact be procyclical movements in u_{Kt} and u_{Lt}.