Overview of Course/Syllabus

What is Macroeconomics

- Macroeconomics – study of aggregate fluctuations in employment, output and inflation
- Subject started by Keynes – 1936: The General Theory of Employment, Interest and Money
- Started with attempts to explain the Great Depression

General Tendencies and Exceptions in the Data

- Tendency for Low Inflation/Deflation, Unemployment, and Recessions (Negative Growth) to Coincide:
  - Great Depression (1929-1939) in Western Europe and the US

- Exceptions:
  - High Inflation and High Unemployment in Western Europe and the US in the late 1970s
  - Growth with Persistent High Unemployment in Spain in late 1980s and Negative Productivity Growth with Recovery

What is a Recession?

- Two Negative Quarters of Real GDP Growth in a Row (NBER Definition)

- How are Recessions Correlated With Aggregate Economic Activity?

Behavior of Macro Variables in Recessions

	Avg. Change	# Recessions Same Sign Change
Real GDP	-4.7%	9/9
Employment	-3.6%	9/9
Unemployment	+1.9%	9/9
Avg. Weekly Hours	-2.3%	9/9
Output/Hour	-1.9%	8/9
Inflation: GDP Deflator	-0.3%	4/9
Real Compensation	-0.7%	8/9
Nom. Interest Rate	-2.0%	9/9
Real M2:GDP Deflator	-1.1%	3/6

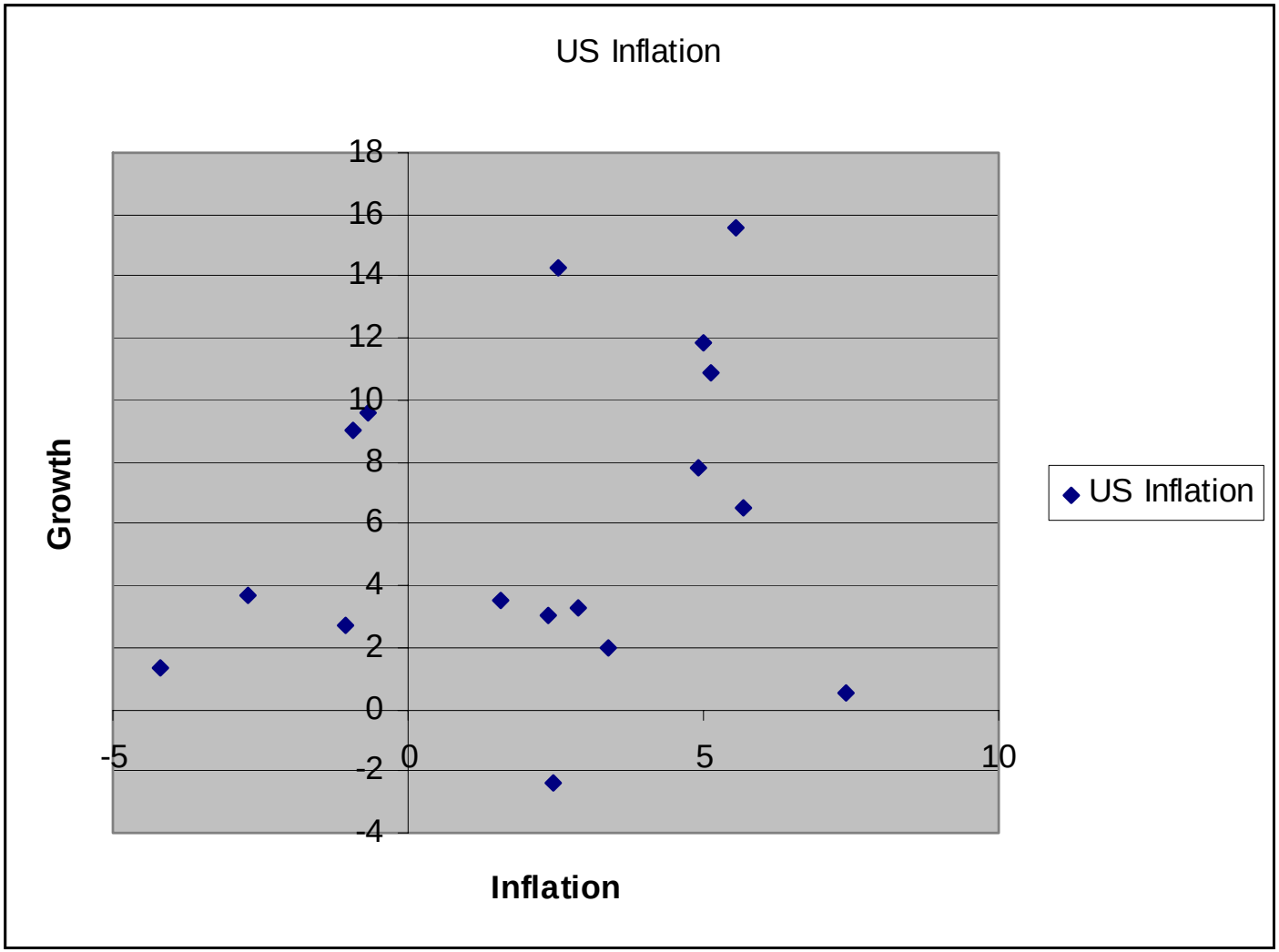
Components of GDP: US Recessions

Components	Avg GDP Share	Share in Fall
Cons Durables	8.4%	15.6%
Nondurables	25.8%	11.2%
Services	29.5%	9.1%
Inv. Residential	4.7%	20.9%
Fixed Nonres.	10.7%	11.7%
Inventories	0.7%	40.6%
Net Exports	-0.4%	-12.3%
Govt. Purchase	20.6%	3.3%

US Data

Year	US GDP Growth	US Inflation	US Unemployment
1969	2.38	3.07	3.508
1970	-1.05	2.7	4.933
1971	2.9	3.27	5.958
1972	5.11	10.85	5.617
1973	5.57	15.55	4.892
1974	-0.67	9.57	5.592
1975	-2.72	3.71	8.467
1976	5.67	6.52	7.717
1977	4.91	7.82	7.067
1978	5.01	11.82	6.067
1979	2.53	14.24	5.833
1980	-0.93	9	7.142
1981	1.55	3.56	7.6
1982	-4.19	1.3	9.708
1983	3.39	1.97	9.617
1984	7.42	0.55	7.525
1985	2.46	-2.36	7.192

US Phillips Curve – 1970s



Spanish Data: 1990s

Year	Spain Real GDP Growth	Spain Unemployment	Spain CPI
1988	5.21	19.5	-11.28
1989	4.44	17.3	-5.78
1990	3.36	16.3	0.61
1991	1.79	16.4	12.2
1992	0.13	18.4	23.51
1993	-2.04	22.725	6.38
1994	2.27	24.175	-5.17
1995	10.34	22.925	-3.05
1996	-4.75	22.225	-6.41
1997	3.9	20.8	-9.5
1998	4.24	18.825	-15.67
1999	3.81	15.875	-11.34
2000	3.32	14.075	-7.28

Japan: 1990s

Year	Japanese GDP Growth	Japan Unemployment	InflationRateJapan	Japan Discount Rate
1988	6.4	2.5	0.67	2.5
1989	5.01	2.3	2.28	4.25
1990	5.17	2.1	3.06	6
1991	2.82	2.1	3.24	4.5
1992	0.32	2.2	1.73	3.25
1993	-0.06	2.5	1.28	1.75
1994	0.55	2.892	0.71	1.75
1995	1.02	3.15	-0.13	0.5
1996	3.34	3.35	0.14	0.5
1997	1.59	3.4	1.73	0.5
1998	-1.51	4.108	0.66	0.5
1999	0.38	4.683	-0.34	0.5
2000	2.18	4.717	-0.67	0.5
2001		5.033	-0.73	0.1

Regularity of Cycles

- Kitchin (3 year), Juglar (10 year), Kuznets (20 year), Kondratiev (50 year)
- Now dropped – cycles seem not to be regular
- Booms may be getting longer without recessions getting longer

Composition Bias I

$$\frac{\partial \frac{\sum_i H_{it} W_{it}}{\sum_{it} H_{it}}}{\partial U_t} = \frac{\partial \sum_i S_{it} W_{it}}{\partial U_t} = \sum_i S_{it} \frac{\partial W_{it}}{\partial U_t} + \sum_i W_{it} \frac{\partial S_{it}}{\partial U_t}$$

Composition Bias I

- Solon, Barsky and Parker, “Measuring the Cyclicality of the Wage: How Important is Composition Bias?”, *Quarterly Journal of Economics* (February, 1994)

$$\frac{\partial \frac{\sum_i H_{it} W_{it}}{\sum_{it} H_{it}}}{\partial U_t} = \frac{\partial \sum_i S_{it} W_{it}}{\partial U_t} = \sum_i S_{it} \frac{\partial W_{it}}{\partial U_t} + \sum_i W_{it} \frac{\partial S_{it}}{\partial U_t}$$

Composition Bias II

Difference From Previous Studies:

Use a balanced Panel of Workers

PSID – Male Heads of Household with positive labor earnings for every year between 1968 and 1988

$$\Delta w_t = w_t - w_{t-1} = \gamma_1 + \gamma_2 t + \gamma_3 t^2 + \gamma_4 \left[U_t - \delta_1 - \delta_2 t - \delta_3 t^2 \right] + \varepsilon_t -$$
$$\left[\gamma_1 + \gamma_2 (t-1) + \gamma_3 (t-1)^2 + \gamma_4 \left[U_t - \delta_1 - \delta_2 (t-1) - \delta_3 (t-1)^2 \right] + \varepsilon_{t-1} \right]$$

Composition Bias III

- Final Estimation:

$$\Delta w_t = \gamma_2 + \gamma_3(2t-1) + \gamma_4 \Delta U_t - \delta_2\gamma_4 - \gamma_4\delta_3(2t-1) + \Delta\varepsilon_t$$
$$= [\gamma_2 - \gamma_3 + \delta_3\gamma_4 - \gamma_4\delta_2] + 2(\gamma_3 - \gamma_4\delta_3)t + \gamma_4 \Delta U_t + \Delta\varepsilon_t$$

- Results
  - Unweighted: -1.4% for white men
  - Weighted by Hours (to counter claims of heterogeneity): -.57% : Matches Cross-Sectional Results with Unbalanced Panels

Composition Bias IV: Measurement Error

- Note that these numbers generate implausibly high labor supply elasticities:
  - 1.0 to 1.4 (previous estimates even higher: 1.2-1.7)

- Could be Due to Measurement Error:

$$p\lim\left(\overline{X}'\overline{X}\right)^{-1}\overline{X}'Y = p\lim\left(\overline{X}'\overline{X}\right)^{-1}\overline{X}'\left(X\beta+\varepsilon\right)$$
$$=\left(X'X+\Sigma_{\delta}\right)^{-1}X'X\beta<\left(X'X\right)^{-1}X'X\beta=\beta$$

$$\overline{X}=X+\delta,\delta\approx \mathrm{N}[0,\sigma^{2}]$$

Pre/Post Great Depression Cyclical Volatility I

- Christina Romer: Aggregate Bias in Pre-War Series Due to Limited Data (Output Data Available Only in Most Volatile Sectors):
  - "Spurious Volatility in Historical Unemployment Data", *Journal of Political Economy* (February, 1986)
  - "Is the Stabilization of the Postwar Economy a Figment of the Data?", *American Economic Review* (June, 1986)

- Balke, Nathan S. and Gordon, Robert J., "The Estimation of Prewar Gross National Product: Methodology and New Evidence", *Journal of Political Economy* (February, 1989)

Christina Romer: SDs of Aggregate Series Pre/Post

Series	1886-1916	1920-1940	1948-1984	1985-1997
Industrial Prod.	6.2%	16.0%	5.7%	2.2%
GNP	3.0%	7.1%	2.8%	1.3%
Comm. Output	5.2%	9.0%	5.3%	3.6%
Unemp. Rate	1.4%		1.2%	0.6%

Empirical and Theoretical Lessons

- (1.) Be Careful of How You Measure
- (2.) Be Careful of Interpreting Data Causally
- (3.) How Should A Theory Be Judged?
  - Friedman, Milton, “The Methodology of Positive Economics”, *Essays in Positive Economics (1953)*

What are the Major Facts to Be Explained?

- Summarize!

Three Major Schools

- Keynesian
  - Keynes
  - Neoclassical Synthesis (Hicks, Solow, Samuelson, Modigliani)
  - New Keynesians (Romer, Woodford, Blanchard, Kiyotaki, Mankiw, Summers, Bernanke)
  - Post Keynesians (Paul Davidson)
- Monetarist: Friedman
- Neoclassical
  - Lucas, Sargent, Prescott, Kydland

ISLM I

- History of ISLM:
  - Keynes, John Maynard, *The General Theory of Employment, Interest and Money*, 1936
  - Hicks, Sir John, “Mr. Keynes and the Classics: A Suggested Simplication”, *Econometrica* (1937)
  - Modigliani, Franco, “Liquidity Preference and the Theory of Interest and Money”, *Econometrica* (1944)
  - Samuelson, Paul, “Interaction Between the Multiplier Analysis and the Principle of Acceleration”, *Review of Economic Studies* (1937)
  - Tobin, James, “Liquidity Preference as Behavior Towards Risk”, *Review of Economic Studies* (1958)

- Why ISLM?

ISLM II

C, I, G → IS curve (Y, i)

Money Demand, Money Supply → LM Curve (Y, i)

IS curve (Y, i), LM Curve (Y, i) → Aggregate Demand (P, Y)

Aggregate Supply (P, Y)

Aggregate Demand (P, Y), Aggregate Supply (P, Y) → Equilibrium (P, Y)

Equilibrium (P, Y) → Labor Supply, Labor Demand $(L, \frac{w}{p})$

Labor Supply, Labor Demand $(L, \frac{w}{p})$ → Wage, Employment, Unemployment

IS Curve I: Keynesian Cross

$$E = C(Y - T) + I(i - \pi^e) + G$$

$$E = Y$$

- What Assumptions are We Making?
- What Criticism/Defenses of These Assumptions Can Be Made?

IS Curve II: Derivation

- Derive the Slope:

$$Y = E(Y, i - \pi^e, G, T)$$

- Totally Differentiate with Respect to the Interest Rate

$$dY = \frac{\partial E}{\partial Y} dY + \frac{\partial E}{\partial i} di$$

$$\frac{dY}{di} = \frac{\frac{\partial E}{\partial i}}{1 - \frac{\partial E}{\partial Y}} < 0$$

LM Curve I

- Money Supply Fixed at $M^S = M$
- Money Demand = $\frac{M^D}{P} = L(i, Y)$
- Total Differentiate Equation: Money Supply = Money Demand

$$0 = \frac{\partial L}{\partial i} di + \frac{\partial L}{\partial Y} dY \qquad \Rightarrow \qquad \frac{dY}{di} = -\frac{\frac{\partial L}{\partial Y}}{\frac{\partial L}{\partial i}} > 0$$

LM Curve II

- What assumptions have we made?
- How defensible are these assumptions?

Aggregate Demand I

- Aggregate Demand is a relationship between Price and Output (not Income and Output).
- Different from IS and LM, it is a Demand Curve.
- It is obtained by parametrically changing the money supply, which shifts the LM curve, and traces out the relationship between price and equilibrium output along the IS curve.

Aggregate Demand II

- Deriving the slope: Two equations and two unknowns (one from LM and one from IS)

- From IS: $$dY = \frac{\partial E}{\partial Y} dY + \frac{\partial E}{\partial i} di$$

$$\frac{dY}{dP} = \frac{\partial E}{\partial Y}\frac{dY}{dP} + \frac{\partial E}{\partial i}\frac{di}{dP}$$

- From LM: $$-\frac{M}{P^2} dP = \frac{\partial L}{\partial i} di + \frac{\partial L}{\partial Y} dY$$

$$-\frac{M}{P^2} = \frac{\partial L}{\partial i}\frac{di}{dP} + \frac{\partial L}{\partial Y}\frac{dY}{dP}$$

Aggregate Demand III

- Matrix Method

$$\begin{pmatrix} \frac{\partial E}{\partial Y} - 1 & \frac{\partial E}{\partial i} \\ \frac{\partial L}{\partial i} & \frac{\partial L}{\partial i} \end{pmatrix} \begin{pmatrix} \frac{dY}{dP} \\ \frac{di}{dP} \end{pmatrix} = \begin{pmatrix} 0 \\ -\frac{M}{P^2} \end{pmatrix}$$

- Invert and Solve for $\frac{dY}{dP}$

$$\begin{pmatrix} \frac{dY}{dP} \\ \frac{di}{dP} \end{pmatrix} = \frac{1}{\left(\frac{\partial E}{\partial Y} - 1\right)\frac{\partial L}{\partial i} - \frac{\partial L}{\partial i}\frac{\partial E}{\partial i}} \begin{pmatrix} \frac{\partial L}{\partial i} & -\frac{\partial E}{\partial i} \\ -\frac{\partial L}{\partial i} & \frac{\partial E}{\partial Y} - 1 \end{pmatrix} \begin{pmatrix} 0 \\ -\frac{M}{P^2} \end{pmatrix}$$

Aggregate Demand V

- Slope Calculation:

$$\frac{dY}{dP} = \frac{-\frac{M}{P^2}}{\frac{\partial L}{\partial Y} + \frac{\frac{\partial L}{\partial i}}{\frac{\partial E}{\partial i}}\left(1 - \frac{\partial E}{\partial Y}\right)} < 0$$

- Interpretation?

Aggregate Supply

- We are now about to finish the model. What do we want to be able to predict?

- We will cover 4 basic aggregate supply theories. (See Graphs)
  - Nominal Wage Rigidity
  - Nominal Price Rigidity, Monopolistic Competition in Output Markets
  - Nominal Wage Rigidity, Monopolistic Competition in Output Markets
  - Nominal Price Rigidity, Monopolistic Competition in Output Markets, Real Wage Rigidity

Predictions of Models

	Unemployment	Procyclical Wage	Procyclical Markup
NWR	Yes	No	No
NPR, MC	No	Yes	Yes
NWR, MC	Yes	Depends	Depends
NPR, MC, RWR	Yes	Yes	Yes
Neo-Classical	No	Yes	No

Unemployment: Efficiency Wages I

- N Workers Choose Effort Level: E=e or e=0
- When working get utility flow U=w-e per period
- When not employed but not working get utility flow=w per period
- When not employed U=0
- Probability b per unit time of exogenous separation between worker and firm
- Probability q of worker getting caught shirking if worker is shirking

Unemployment: Efficiency Wages II

- Worker maximizes:

$$\underset{E}{Max}\int_{t=0}^{\infty} e^{-rt}U\left(w(t),e(t)\right)dt$$

- In other words, worker chooses between V_E and V_S

- Calculating V_E :

$$\int_{t=0}^{\Delta t} e^{-bt}e^{-rt}\left[w-e\right]dt + e^{-r\Delta t}\left[e^{-b\Delta t}V_E\left(\Delta t\right)+\left(1-e^{-b\Delta t}\right)V_U\left(\Delta t\right)\right]$$

Unemployment: Efficiency Wages III

$$V_E(\Delta t) = \frac{1}{b+r}\left[1 - e^{-(b+r)\Delta t}\right][w-e] + e^{-r\Delta t}\left[e^{-b\Delta t}V_E(\Delta t) + \left(1 - e^{-b\Delta t}\right)V_U(\Delta t)\right]$$

$$V_E(\Delta t) = \frac{1}{b+r}[w-e] + \frac{e^{-r\Delta t}\left(1 - e^{-b\Delta t}\right)V_U(\Delta t)}{1 - e^{-(b+r)\Delta t}}$$

$$\lim_{\Delta t \to 0} V_E(\Delta t) = \frac{1}{b+r}\left[w - e + bV_U\right]$$

Unemployment: Efficiency Wages IV

- Similarly, we get

$$V_S = \frac{1}{r}\left[w - (b + r)(V_S - V_U)\right]$$

- And denoting a as the transition probability from unemployment

$$V_U = \frac{1}{r} a\left[V_E - V_U\right]$$

Unemployment: Efficiency Wages V

- No Shirking Condition: (Never optimal for firms to purchase shirking labor)

$$w - e - b\left[V_E - V_U\right] = V_S = V_E = w - \left(b + q\right)\left[V_E - V_U\right]$$

$$\Rightarrow V_E - V_U = \frac{e}{q}$$

- Equilibrium Unemployment Rate is Stable:

$$a\left(\overline{L} - NL\right) = NLb \Rightarrow a = \frac{NLb}{\overline{L} - NL}$$

Unemployment: Efficiency Wages VI

- Solving for the real wage rigidity locus:

$$rV_U = \frac{ae}{q} \ (\text{from } \mathrm{V_E} - V_U) \qquad rV_E = w - e - b\frac{e}{q} \ (\text{from } \mathrm{V_E} - V_U)$$

- Combining the two above equations:

$$r\frac{e}{q} = r(V_E - V_U) = w - e - b\frac{e}{q} - a\frac{e}{q} \ (\text{from } \mathrm{V_E} - V_U) \Rightarrow w = e + (a + b + r)\frac{e}{q}$$

- Replacing a and combining with b:

$$w = e + \left[r + \frac{b(\bar{L} - NL) + NLb}{\bar{L} - NL} \right] \frac{e}{q}$$

Unemployment: Efficiency Wages VII

- Solving for Equilibrium 'Supply' Replacement:

$$w = e + \left[r + \frac{b\bar{L}}{\bar{L} - NL} \right] \frac{e}{q}$$

- Labor Demand:

$$\Pi(L) = F(eL) - wL \Rightarrow eF'(eL) = w$$

Unemployment: Efficiency Wages VIII

- Things to Note:
  - Always Unemployment
  - Counter-Cyclical Wage
  - If b=0, then neither pro nor counter cyclical wage
  - Monitoring intensity lowers unemployment and lowers wage
- Criticism
  - Not an optimal contract

Unemployment: Efficiency Wages IX

- Inefficiency:
  - (1.) Negative Externality from firms to other firms. Each firm hires too few workers. Doesn't internalize the externality that for every worker it hires, it lowers the unemployment rate, lowering the ability of other firms to get workers to provide effort at a given wage. Unemployment level is suboptimally low.
  - (2.) Firms see private cost of w per worker. However, social cost is e, less than w. Therefore, firms hire based on a social cost that is too low. Unemployment level is suboptimally high.
  - Unemployment can be suboptimally low or high depending upon whether effect (1.) or effect (2.) dominates.

- Corrective Measures: Government can tax profits and subsidize wages.

Implicit Contracts I

- Can risk-sharing Contracts between firms and workers explain wage rigidity and unemployment?

- Firms Maximize Profits choosing a wage contract

$$\Pi = p_i \left[A_i F(L) - wL \right], \mathrm{F'(L)} > 0, \mathrm{F''(L)} < 0$$

$$\mathrm{p(A = A_i)} = p_i$$

- Subject to Worker Participation

$$E[u] = \sum_i p_i \left[U(C_i) - V(L_i) \right], \mathrm{U'(C)} > 0, \mathrm{U''(C)} < 0, \mathrm{V'(L)} > 0, \mathrm{V''(L)} < 0$$

Implicit Contracts II

- Lagrangian Formulation:

$$L = \sum_i p_i \left[A_i F(L_i) - C_i \right] + \lambda \left[\left(\sum_i p_i \left[U(C_i) - V(L_i) \right] - u_0 \right) \right]$$

- FOCs

$$\frac{\partial L}{\partial C_i} = 0 \Rightarrow \frac{dU}{dC_i} = \frac{1}{\lambda}$$

$$\frac{\partial L}{\partial L_i} = 0 \Rightarrow p_i A_i F'(L_i) = \lambda p_i V'(L_i) \Rightarrow A_i F'\left(L_i\right) = \frac{V'(L_i)}{U'(C_i)}$$

Insider/Outsider Theory

- Developped by Lindbeck and Snower

- Firms Maximize Profits; Must hire Insiders. Can choose how many Outsiders to hire. Can choose wages but wage differentials between insiders and outsiders must be maintained. Also, insider must be guaranteed outside option:

$$L = \sum_i p_i \left[A_i F\left(\overline{L}_I + L_{0i}\right) - w_{Ii}\overline{L}_I - \left(w_{Ii} - r\right)L_{0i} \right] + \lambda \left[\left(\sum_i p_i \left[U(w_{Ii}) \right] - u_0 \right) \right]$$

Insider/Outsider II

- FOCs:

$$\frac{\partial L}{\partial w_{Ii}} = -p_i\left(\overline{L}_i + L_{0i}\right) + \lambda p_i U'\left(w_{Ii}\right) = 0$$

$$\frac{\partial L}{\partial L_{Oi}} = 0 \Rightarrow A_i F'\left(L_I + L_{Oi}\right) = w_{Ii} - c$$

- If we assume that outsider labor supply is completely inelastic and sufficiently large, we have equilibrium unemployment as a consequence.

Hysteresis

- Persistence in Unemployment: This period's new hires become next period's insiders – causes persistence.

- Blanchard and Summers (1986)… try to use this to explain persistent unemployment in the 1980s in Europe.