1. Unemployment

April 9, 2007

2-5. Cyclical movements in unemployment

- Implications of the search/bargaining model for cyclical fluctuations?

  Given cyclical fluctuations, job creation, destruction, unemployment?

  Explaining cyclical fluctuations. Given shocks, can we explain adjustment? How does it differ from competitive labor market case?

  Recessions as times of cleansing/messing up?

- Extension of DMP. The "Shimer puzzle". But linear preferences, and no nominal rigidities.

- Introducing standard preferences. Reinforcing the puzzle. Questioning Nash bargaining. Wage bands and wage rigidity. Hall.

- Introducing nominal rigidities. Blanchard-Gali. How close? How different from standard NK results?

1. Basic facts

- Stocks: Beveridge curve movements. Blanchard Diamond Fig 3
- Job flows: Job creation/job destruction? Foster-Haltiwanger-Kim, 2006, for manufacturing:

  Job destruction strongly countercyclical.

  Job creation mildly procyclical.

  (striking difference by age of plant. Figure 7. (0-3,4-8, 9+)
- (Product flows). Paper by Christian Broda. Using USP codes, procyclical product creation.

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Figure 8. Beveridge Curve, 1952-88. p. 39.
Blanchard, O., and P. Diamond. "The Beveridge curve." *Brookings Papers on Economic Activity* 1989, no. 1 (1989): 1-60.

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Figure 3. Quarterly Job Flows in Manufacturing, 1947-2005. p. 33.
Davis, S. J., R. J. Faberman, and J. Haltiwanger. "The Flow Approach to Labor Markets: New Data Sources and Micro-Macro Links." NBER Working Paper No. 12167, April 2006. pp. 1-41. (http://www.nber.org/papers/w12167)

- From job flows to workers flows:

  Recession: As layoffs increase, quits may decrease.

  Layoffs may go from E to U. Quits from E to N, or E to E.

- Worker flows. Blanchard Diamond Figure 9. Note asymmetry U, N. In recession, flow to U increases, flow to N decreases.

  Note increase in flow from U to E after 6 months. Strange? No. Difference flow/exit rate

- Exit rates. Blanchard Diamond Fig 13. In recession, more likely to become unemployed. Less likely to become employed if unemployed.

  Another way of looking at this. Fujita-Ramey. Cross-correlations between cyclical components of separations/hirings with IP. Figures 13 and 14. Need to put them in.

- The revisionist view (Hall) Separations a-cyclical. Not right. (Fujita and Ramey).

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Figure 9. Response of Growss Flows Between Employment, Unemployment, and Not in the Labor Force to an Aggregate Activity Shock, over Selected Intervals. p. 117

Blanchard, O., and P. Diamond. "The cyclical behavior of the gross flows of US workers." *Brookings Papers on Economic Activity* 1990, no. 2 (1990): 85-155.

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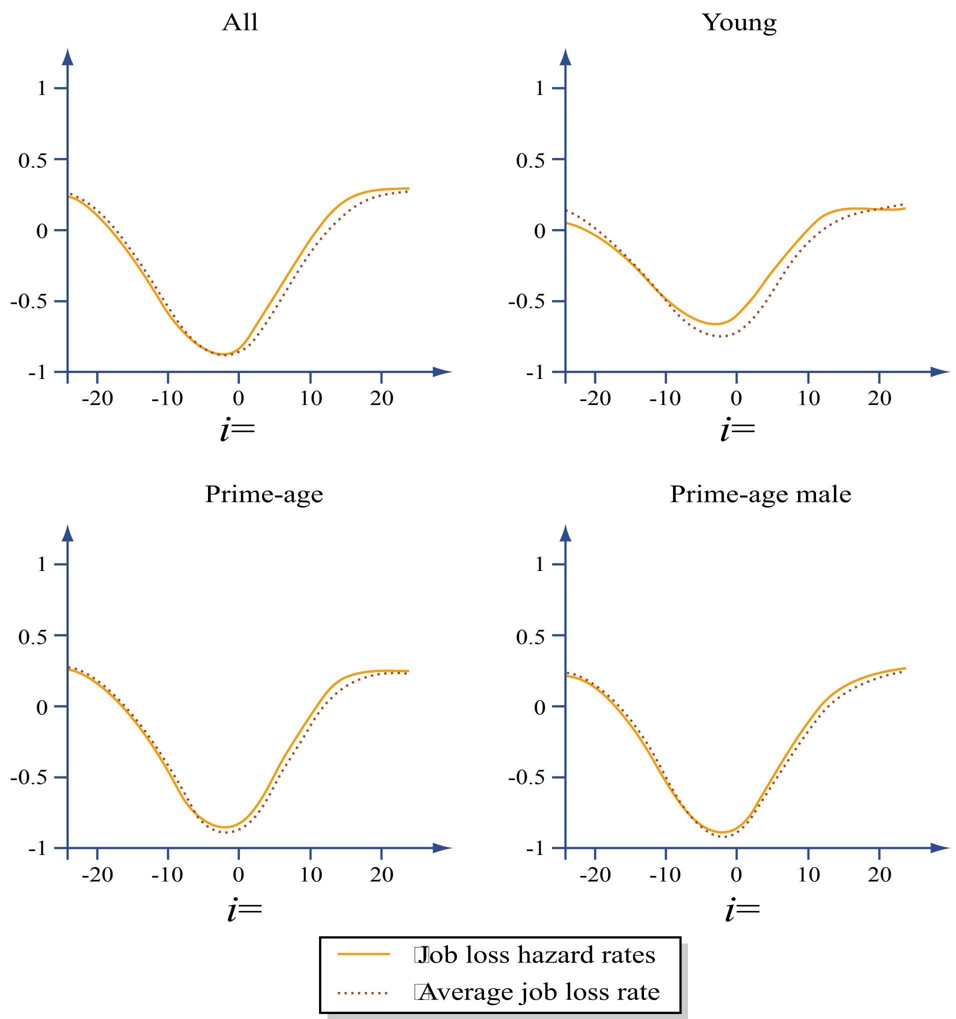
Figure 13. Response of Hazard Rates Between Employment, Unemployment, and Not in the Labor Force to Aggregate Activity Shock. p. 121.

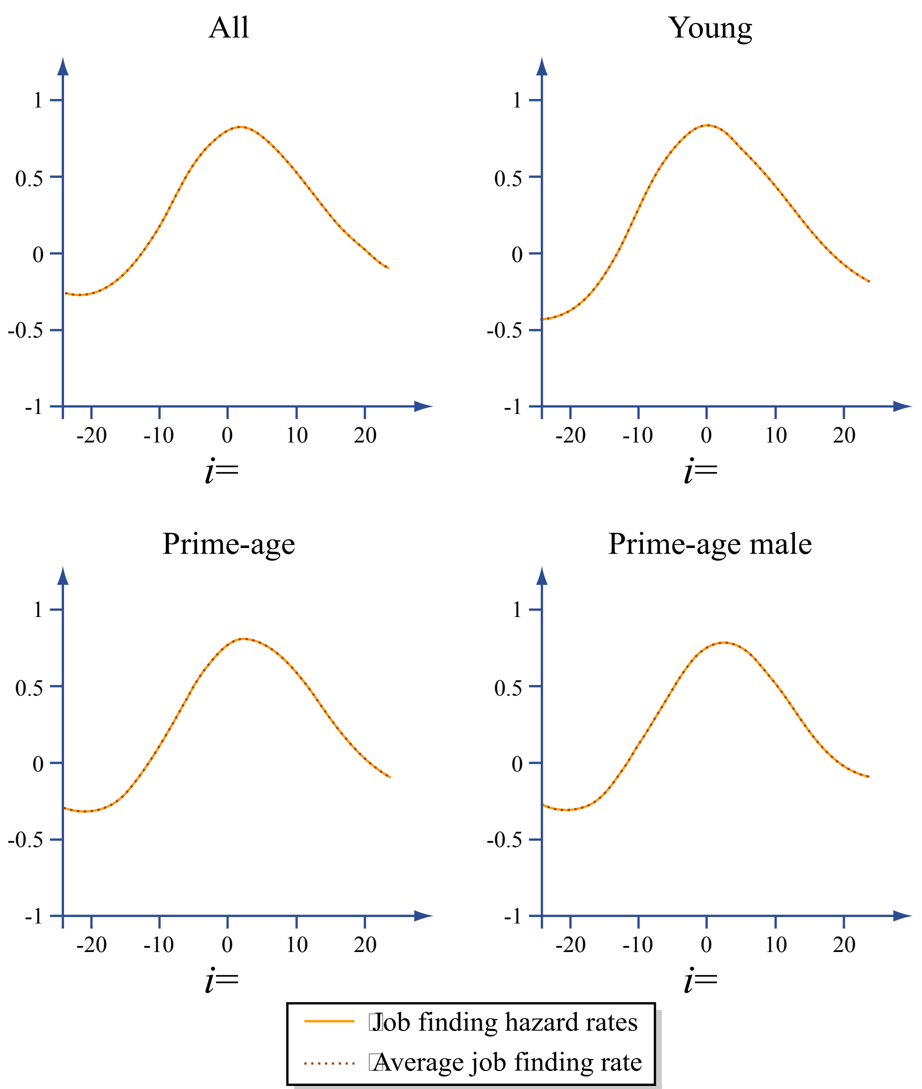
Blanchard, O., and P. Diamond. "The cyclical behavior of the gross flows of US workers." *Brookings Papers on Economic Activity* 1990, no. 2 (1990): 85-155.



Cross correlations of cyclical components: industrial production at t and job loss rates at $t + i$ ($E \longrightarrow U$)

Figure by MIT OCW.

Nr. 9



Cross correlations of cyclical components: industrial production at t and job finding rates at $t + i$ ($U \rightarrow E$)

Nr. 10

Figure by MIT OCW.

2. Productivity shocks and unemployment in DMP

Based on Shimer (2005)

- Standard DMP, exogenous separation, extended to allow for aggregate shocks.
- Two types of aggregate shocks. Shocks to y and shocks to s, but I shall ignore the shocks to s here.
- Go back to the basic equation characterizing equilibrium $\theta(\equiv v/u)$ (recall $q(\theta) \equiv h/v$):

$$(r+s)\frac{c}{q(\theta)} = (1-\beta)(y-b) - \beta\theta c - c\frac{q'(\theta)}{q(\theta)^2}\dot{\theta}$$

- Here the equation takes the slightly modified form:

$$(r+s)\frac{c}{q(\theta)} = (1-\beta)(y-b) - \beta\theta c - c\lambda(Eq(\theta') - q(\theta))$$

where λ is the Poisson arrival rate of aggregate shocks.

- Use this equation to look at θ and by implication, unemployment, in response to shocks.

- First ignore the last term. Define ϵ as the elasticity of θ to $y-b$. It is given by:

$$\epsilon = \frac{r+s+\beta\theta q(\theta)}{(r+s)(\theta q'(\theta)/q(\theta) + \beta\theta q(\theta)}$$

- If $h = m = u^{\alpha} v^{1-\alpha}$, then

$$\epsilon = \frac{r + s + \beta(h/u)}{(r+s)(1-\alpha) + \beta(h/u)}$$

- Now put values, with time unit a month. $r \approx 0.0, s \approx 0.0$ relative to $(h/u) = .4$. So $\epsilon \approx 1.0$.

  Take a productivity shock of 1%. If $b = .4y$, leads to an increase in $y - b$ of (1/.6)%, and so an increase in v/u of (1/.6)%. In the data, $\sigma_{v/u} = 38\%$

- So very small movements in u and v.

- Behind the scene: the adjustment of the wage:

$$w = (1 - \beta)b + \beta(y + c\theta)$$

- To fit the steady state facts (for $\beta = .7$) $c = .2$. So an increase in y of 1% leads to an increase of .7 (1% + .2 1%) = 0.9%.

- Turning to full dynamics. Assume AR(1) process for productivity, with $\rho = .996$, and $\sigma = 0.0165$. (in continuous time, but irrelevant here)

  Table 3 from Shimer. No action.

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Table 3. Labor Productivity Shocks. p. 39.

Shimer, R. "The Cyclical Behavior of Equilibrium Unemployment and Vacancies." *American Economic Review* 95, no. 1 (2005): 25-49.

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Figure 5. Response of Unemployment to Negative Impulse, Model and Actual. p. 62.

Hall, R. "Employment Fluctuations with Equilibrium Wage Stickiness." *American Economic Review* 95, no. 1 (2005): 50-64.

Ways out?

- Very small surplus (Hagedorn-Manovskii). $y - b$. Suppose $b = .95$. Then, increase in v/u is 20%. Convincing? No.

- Wage rigidity. Wage can be anywhere in wage band. If aggregate fluctuations not too large, wage can be constant. Hall.

- Constant wage for existing matches: irrelevant. Same wage for new matches as for old matches.

- Evidence? Carneiro Portugal. IZA WP 2604. (Useful survey as well)

  Much stronger procyclicality for hires and for stayers (Portuguese data)

  Stayers. 1% decrease in u: 1.0% increase in earnings.

  New hires: 1% decrease in u: 2.0% increase in earnings.

- Relate to computations above? Productivity shocks?

Need to extend the model further.

- Concave preferences
- Nominal rigidities. From wages to inflation.
- Non-tech shocks.

3. Introducing concave preferences

Households

Representative household, continuum of members, $[0,1]$

$$E_0 \sum \beta^t \ \left(\log C_t - \chi \ \frac{N_t^{\ 1+\phi}}{1+\phi} \right)$$

where

$$C_t \equiv \left(\int_0^1 C_t(j)^{\frac{\epsilon-1}{\epsilon}} di \right)^{\frac{\epsilon}{\epsilon-1}}$$

$$0 \leq N_t \leq 1$$

Note: Utility specification standard from NK model, but different from DMP model. Bodies, not hours margin. Usual—and unappealing—consumption insurance.

Firms

Continuum of monopolistically competitive firms, each producing a differentiated good, $i \in [0,1]$ (no capital)

Technology:

$$Y_t(i) = A_t \; N_t(i)$$

Employment

$$N_t(i) = (1-\delta) \; N_{t-1}(i) + H_t(i)$$

(δ constant. no endogenous separations)

The labor market

- Beginning-of-period unemployment (given full participation):

$$U_t = (1 - N_{t-1}) + \delta N_{t-1} = 1 - (1 - \delta) N_{t-1}$$

- Aggregate hiring

$$H_t = N_t - (1 - \delta)\ N_{t-1}$$

- Index of *labor market tightness* (central variable in what follows; determinant of marginal cost, of inflation)

$$x_t \equiv \frac{H_t}{U_t} \in [0, 1]$$

- End-of-period unemployment:

$$u_t \equiv 1 - N_t$$

The labor market, continued.

Hiring costs: For an individual firm:

$$G_t \ H_t(i)$$

with the cost per hire G_t taken as given.

Aggregate determinant of cost per hire:

$$G_t = A_t \ B x_t^{\alpha}$$

(In DMP: cost related to expected time to fill a vacancy, function of labor market tightness. Here directly a function of labor market tightness.)

(Relation of this assumption to conventional DMP)

In DMP, expected cost of a vacancy proportional to expected duration, V/H. Assume a matching function:

$$H = zU^{\eta}V^{1-\eta}$$

Then:

$$\frac{V}{H} = z^{1/(1-\eta)} \left(\frac{H}{U}\right)^{\frac{\eta}{1-\eta}}$$

So

$$\frac{V}{H} = Bx^{\alpha}$$

where $B \equiv z^{1/(1-\eta)}$ and $\alpha = \eta/(1-\eta)$

Cost of formalization: No explicit variable for vacancies.

4. Constrained efficient equilibrium

Social planner maximizes expected utility, subject to production and hiring constraints:

Optimality condition (interior solution):

$$\frac{\chi C_t N_t^{\phi}}{A_t} = 1 - (1+\alpha) B x_t^{\alpha} + \beta(1-\delta)\ E_t \left\{ \frac{C_t}{C_{t+1}} \frac{A_{t+1}}{A_t} B((x_{t+1}^{\alpha} - \alpha x_{t+1}^{\alpha}(1 - x_{t+1})) \right\}$$

- LHS: MRS, normalized by productivity.
- RHS: MRT, normalized by productivity

  Marginal product this period

  minus marginal hiring cost this period (direct, indirect through x).

  plus expected saving in hiring costs next period. (lower hiring rate, lower unemployment pool)

Implications

- Looks like a rich dynamic equation. And it is. But:
- With respect to productivity shocks:

  Constant employment, hiring rate.

  Consumption moves one for one with productivity.

  (Check that $C_t/A_t, N_t, x_t =$ ct is a solution with respect to movements in A_t).
- Invariance of employment to productivity shocks: Income/substitution effects, and no capital accumulation.

  Model inherits RBC implications (take $B = 0$), now for unemployment.

  If capital accumulation, then some action, but close to RBC.

- Compare to DMP, and the Shimer conclusions.

  $C_t \ {N_t}^{\phi}$ instead of b.

  Put another way: Reservation wage adjusts one for one with productivity. Nothing else matters.

  A much stronger (and more depressing) result than Shimer.

Useful for later to give a graphical representation of the equilibrium

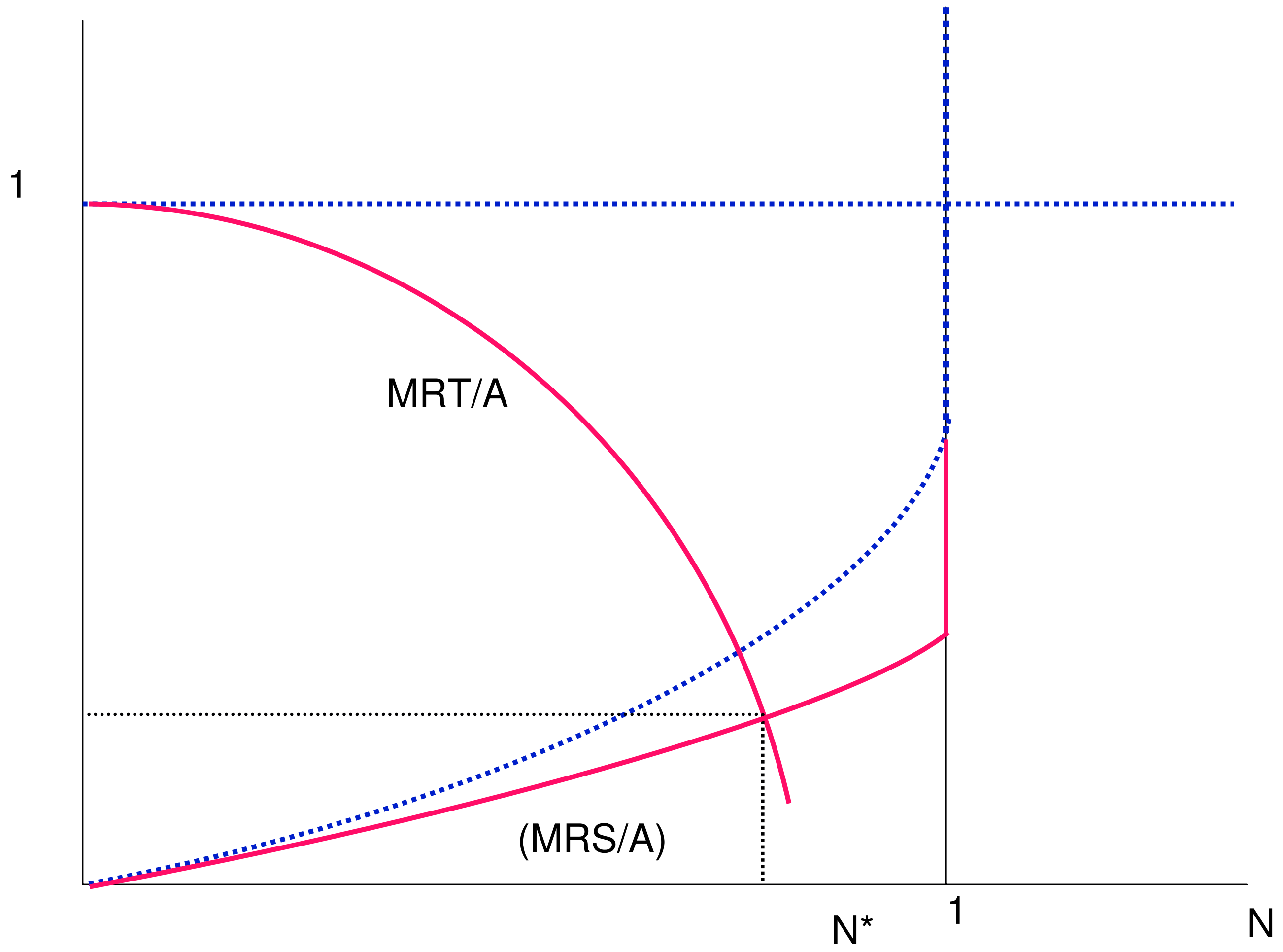
- Dashed blue lines: No frictions.

- Solid red lines:

  $MRT/A < 1$: Increasing marginal cost of hiring

  MRS/A lower: Lower consumption due to hiring costs.

The constrained efficient allocation



5. Decentralized equilibrium

Price setting by monopolistic competitors:

Optimality condition:

$$P_t(i) = \mathcal{M}\ P_t\ MC_t \quad \text{where} \quad \mathcal{M} \equiv \frac{\epsilon}{\epsilon - 1}$$

where

$$MC_t = \frac{W_t}{A_t} + Bx_t^{\alpha} - \beta(1-\delta)\ E_t\left\{\frac{C_t}{C_{t+1}}\ \frac{A_{t+1}}{A_t}\ Bx_{t+1}^{\alpha}\right\}$$

Symmetric Equilibrium:

$$MC_t = \frac{1}{\mathcal{M}}$$

$$\frac{W_t}{A_t} = \frac{1}{\mathcal{M}} - Bx_t^{\alpha} + \beta(1-\delta)\ E_t\left\{\frac{C_t}{C_{t+1}}\ \frac{A_{t+1}}{A_t}\ Bx_{t+1}^{\alpha}\right\}$$

Real wages determined by Nash bargaining:

Assume workers get ϑ of surplus (used β already). Then:

$$\frac{W_t}{A_t} = \frac{\chi C_t N_t^{\varphi}}{A_t} + \vartheta B x_t^{\alpha} - \beta(1-\delta)\ E_t \left\{ \frac{C_t}{C_{t+1}}\ \frac{A_{t+1}}{A_t}\ (1 - x_{t+1})\ \vartheta\ B x_{t+1}^{\alpha} \right\}$$

Implications:

- Constrained efficient? If $\mathcal{M} = 1$ and $\vartheta = \alpha$: Hosios-like condition.
- Efficient or not: Employment (unemployment) invariant to productivity shocks. (Income/substitution effects, and no capital accumulation)
- Real wages move one-for-one with productivity. $W_t = \Theta\ A_t$

Graphical representation of the equilibrium

- Solid red lines: Constrained efficient

- Dashed lines: Decentralized equilibrium

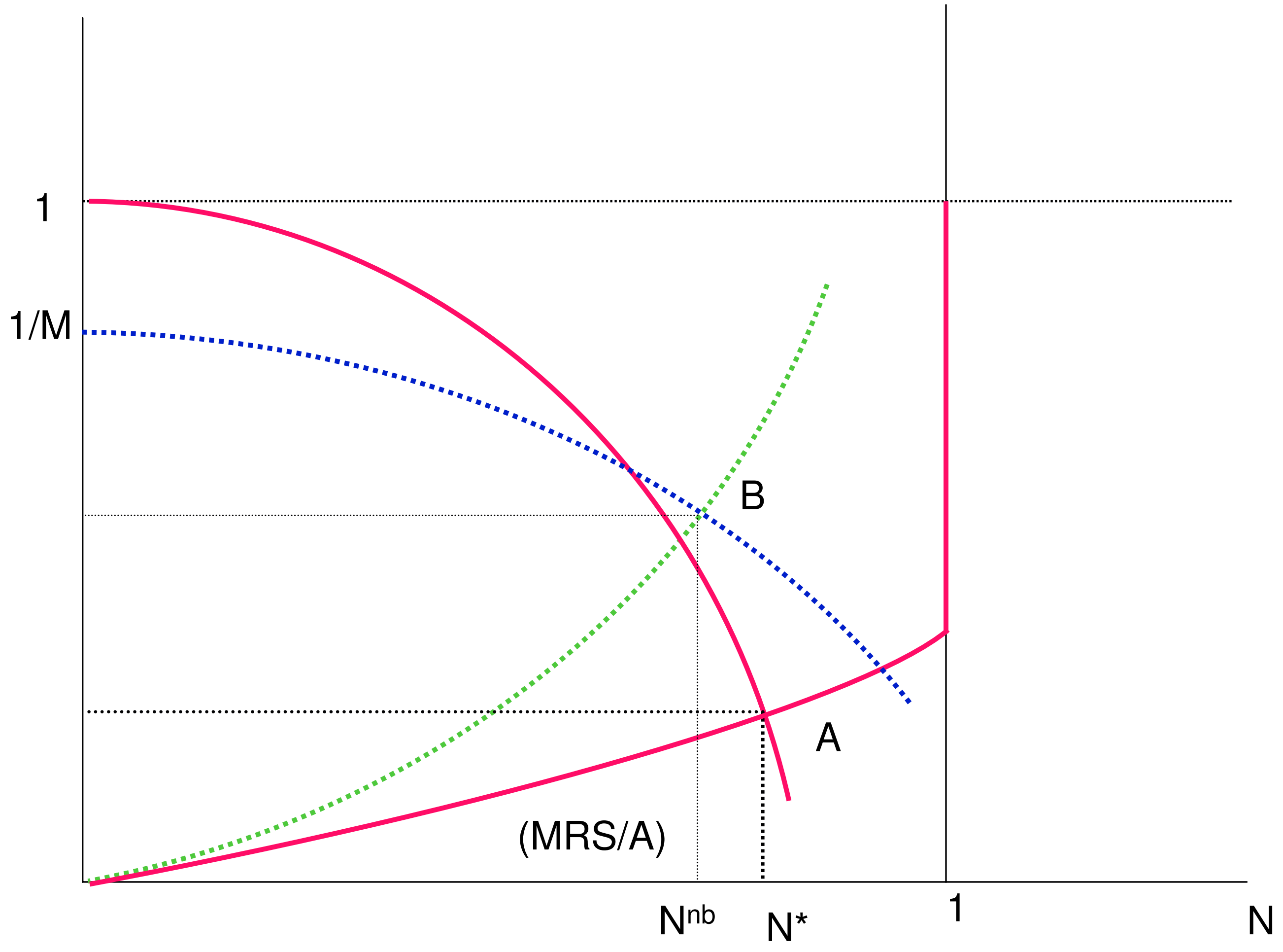
  MRT/A: Lower (monopoly power). Flatter: firms do not take into account externalities.

  MRS/A higher: Bargaining gives workers some of the surplus.

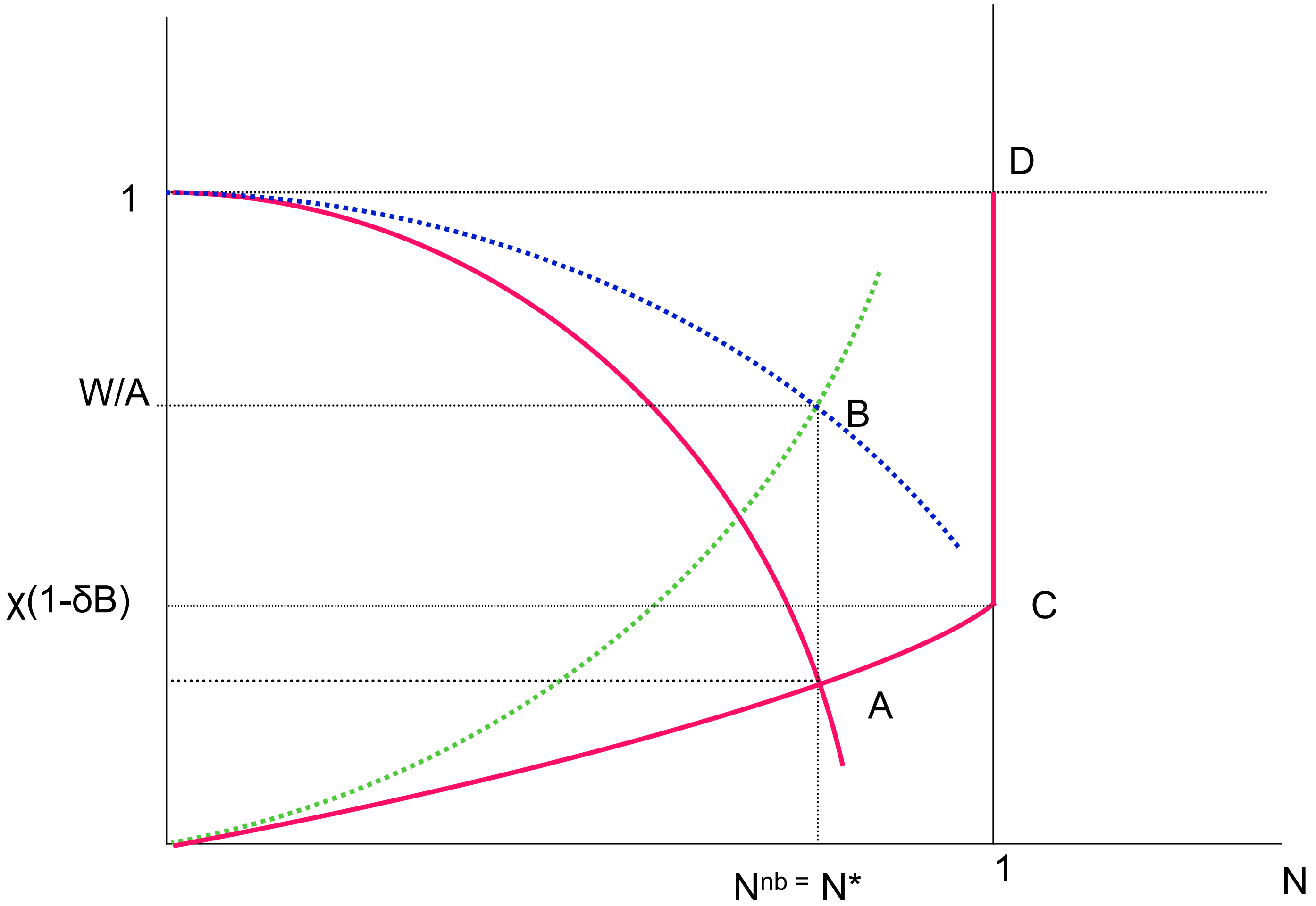
- Figure 2: Inefficient. Figure 3: Efficient. In both, involuntary unemployment: $W > MRS$. Participation?

- Note: wage band: CD.

Equilibrium with Nash bargaining.



Efficient equilibrium with Nash bargaining.



6. Rigid real wages

Within the bargaining band—assume that real wages follow:

$$W_t = \Theta \; A_t^{1-\gamma}$$

so γ degree of real wage rigidity (and A is stationary). (Very rough: A better specification: $W_t = (\Theta A_t)^{1-\gamma} \; {W_{t-1}}^{\gamma}$, but less tractable)

Implications:

$$Bx_t^{\alpha} = \sum_{k=0}^{\infty} (\beta(1-\delta))^k \; E_t \left\{ \Lambda_{t,t+k} \; \left(\frac{1}{\mathcal{M}} - \Theta \; A_{t+k}^{-\gamma} \right) \right\}$$

where $\Lambda_{t,t+k} \equiv (C_t / C_{t+k}) \; (A_{t+k} / A_t)$

If $\gamma > 0$, productivity movements affect hiring, and in turn lead to (inefficient) unemployment fluctuations. (relevant equation to go back to Shimer calibration.)

7. Introducing nominal price rigidity

Assume Calvo pricing by firms (θ: prop not adjusting). Then, equilibrium characterized by:

Price depending on expected MC ($Q_{t,t+k} \equiv (C_t/C_{t+k})(P_t/P_{t+k})$):

$$E_t \left\{ \sum_{k=0}^{\infty} \theta^k \; Q_{t,t+k} Y_{t+k|t} \; (P_t^* - \mathcal{M} \; P_{t+k} \; MC_{t+k}) \right\} = 0$$

Marginal cost depending on A and x:

$$MC_t = \Theta \; A_t^{-\gamma} + B x_t^{\alpha} - \beta(1-\delta) \; E_t \left\{ \frac{C_t}{C_{t+1}} \; \frac{A_{t+1}}{A_t} \; B x_{t+1}^{\alpha} \right\}$$

Role of x on MC and by implication on inflation.

A simple approximation

After log-linearization and dropping second-order terms (hats: deviations from steady state):

$$\pi_t = \alpha g \mathcal{M} \lambda \; \widehat{x}_t - \lambda \Phi \gamma \; \sum_{k=0}^{\infty} \beta^k \; E_t\{a_{t+k}\}$$

$$\widehat{u}_t = (1-\delta)(1-x) \; \widehat{u}_{t-1} \; - (1-u)\delta \; \widehat{x}_t$$

Interpretation.

Static relation π, x given current and expected productivity? Reflects the same dependence on the expected future.
Implication: credibility determines position on trade-off, not position of trade-off.

Back to the inflation-unemployment relation

Assume log productivity follows a stationary AR(1), with parameter ρ_a. Then:

$$\pi_t = \alpha g \mathcal{M} \lambda \, \widehat{x}_t - \Psi \gamma \, a_t$$

Or

$$\pi_t = -\kappa(1 - (1-\delta)(1-x)) \, \widehat{u}_t - \kappa(1-\delta)(1-x) \, \Delta u_t - \Psi \gamma \, a_t$$

Note

- Level and rate of change of unemployment rate. Relative weights depend on x. More sclerotic market: more weight on Δu.
- If $\gamma > 0$, no "divine coincidence" in the presence of productivity shocks. Cannot stabilize both unemployment and inflation. (Recall constrained efficient unemployment is constant).

Ad-hoc monetary policies:

Assume a follows an AR(1) with $\rho = .9$ (quarterly)

Two labor markets; "Fluid": US: $x = .7$ (quarterly), $u = .05$. "Sclerotic": Europe $x = .25$ (quarterly), $u = 0.10$.

- Unemployment stabilization (constrained efficient unemployment is constant.) Higher inflation in response to negative productivity shock. 0.8% for 1%.

- Inflation stabilization. (Unemployment equal to natural rate, suboptimal). (Very) large increase in unemployment in response to negative shock.

  Larger in Europe than in the US: 9% versus 6%: x more closely related to Δn, and thus Δu.

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Optimal monetary policy

Welfare function:

$$E_0 \sum_{t=0}^{\infty} \beta^t \left(\pi_t^2 + \alpha_u \; \widehat{u}_t^2\right)$$

Back to optimal monetary policy. Figure 5.

- Accept more inflation for some time.
- Large gains in terms of smaller (inefficient) unemployment fluctuations. (from 9% to 0.5% for Europe, 6% to 1.1% for the US)

Nearly optimal Taylor rules:

For the US: $i_t = 1.5\pi_t - 0.2\hat{u}_t$

For Europe $i_t = 1.5\pi_t - 0.6\hat{u}_t$

Conclusions/Extensions:

Can the NK+DMP model explain fluctuations?

- Model gives us a tool to think about:

  relation between productivity shocks, unemployment, and inflation.

  the role of monetary policy in the transmission of shocks.

- Practical implications.

  Labor market differences matter for inflation-unemployment relation.

  No divine coincidence. Flexible inflation targeting.

- Obvious research agenda items.

  Nature, extent, origins of real wage rigidities. Internal organization of firms?

  Back to the Shimer puzzle, with inflation/real wages/unemployment, and productivity and non productivity shocks.