# LABOR SEARCH MODELS: PARTIAL-EQUILIBRIUM DYNAMICS

## NOVEMBER 15, 2011



## LABOR-MARKET EQUILIBRIUM

- **Aggregate law of motion of employment**

$$N_{t+1} = (1-\rho^x)N_t + m(u_t, v_t)$$

- **Flow equilibrium conditions (an accounting identity…)**

$$m(u_t, v_t) = u_t k^h(\theta_t) = v_t k^f(\theta_t)$$

- **Vacancy-posting (aka job-creation) condition**

$$\gamma = k^f(\theta_t) E_t \left\{ \Xi_{t+1|t} \left( z_{t+1} - w_{t+1} + \frac{(1-\rho^x)\gamma}{k^f(\theta_{t+1})} \right) \right\}$$

- **Wage determination**

$$w_t = \eta \left[ z_t + \gamma \theta_t \right] + (1-\eta) b$$

Does a good job explaining long-run (steady-state) phenomena

- **Shimer (2005) and Hall (2005): analyze the stochastic dynamics of the labor market equilibrium**
  - **Not general equilibrium dynamics**

## BASIC ISSUES AND RESULTS

- Shouldn't a model that does well at explaining long-run phenomena also be expected to do reasonably well at explaining cyclical phenomena? (should it?....)
- Labor search model's key endogenous variables
  - Unemployment $u_t$ (equivalently, $N_t = 1 - u_t$)
  - Vacancies $v_t$
  - Labor-market tightness $\theta_t$
- **Main Conclusion:** model's predicted volatility in $(u_t, v_t, \theta_t)$ far lower than empirically-observed volatility
- **Main Model Shortcoming:** the wage-setting process (i.e., assumption of Nash bargaining)
  - Exogenous rise in productivity is nearly-fully absorbed by a rise in the wage → virtually no change in firms' incentives to post vacancies
  - Vacancy-posting the key economic margin of basic labor search model





## EMPIRICAL FACTS

- Basic cyclical labor-market facts

Data Sources:

CPS, JOLTS, and Conference Board

Data displays a cyclical Beveridge Curve

Labor-market tightness $\theta$

Worker matching rate $k^h(\theta)$

Extremely high correlation consistent with basic labor-matching model (in which $k^h$ depends on *only* $\theta$)

TABLE 1—SUMMARY STATISTICS, QUARTERLY U.S. DATA, 1951–2003

| | | $u$ | $v$ | $v/u$ | $f$ | $s$ | $p$ |
|---|---|---|---|---|---|---|---|
| Standard deviation | | 0.190 | 0.202 | 0.382 | 0.118 | 0.075 | 0.020 |
| Quarterly autocorrelation | | 0.936 | 0.940 | 0.941 | 0.908 | 0.733 | 0.878 |
| Correlation matrix | $u$ | 1 | −0.894 | −0.971 | −0.949 | 0.709 | −0.408 |
| | $v$ | — | 1 | 0.975 | 0.897 | −0.684 | 0.364 |
| | $v/u$ | — | — | 1 | 0.948 | −0.715 | 0.396 |
| | $f$ | — | — | — | 1 | −0.574 | 0.396 |
| | $s$ | — | — | — | — | 1 | −0.524 |
| | $p$ | — | — | — | — | — | 1 |

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- **Estimated matching function elasticity** $m(u_t, v_t) = u_t^{\alpha} v_t^{1-\alpha}$ **:** $\alpha = 0.72$

- **Question: How well can stochastic dynamic (partial-equilibrium) labor-search model match key labor-market business cycle facts?**





# MODEL DETAILS

- **Exogenous processes**
  - **Labor productivity, $z$**
  - **Separation rate, $\rho^x$**
  - **(Markov processes, continuous time → can re-cast as AR(1)'s in discrete time)**

- **Calibration**

Accounting profit $z - w$ each period

  - **Mean productivity $z$ = 1 (normalization)**
    - **Implies real wage < $z$ because of posting costs**
  - **Worker Nash bargaining power $\eta$ = 0.72 (= $\alpha$)**
    - **Satisfies Hosios (1990 *ReStud*) condition for search efficiency**
  - **Mean quarterly separation rate $\rho^x$ = 0.1**
  - **Unemployment benefit $b$ = 0.4**
    - **Replacement rate about 40 percent of labor income**
    - **But also measures flow value of leisure/home production**
    - **A critical parameter (Hagedorn and Manovskii (2008))**
  - **(Vacancy-posting cost $\gamma$ and matching-function constant highly model-specific)**

# MODEL SIMULATION RESULTS

- **Productivity shocks alone**

Model displays a cyclical Beveridge Curve

All much lower than the data

TABLE 3—LABOR PRODUCTIVITY SHOCKS

| | | $u$ | $v$ | $v/u$ | $f$ | $p$ |
|---|---|---|---|---|---|---|
| Standard deviation | | 0.009 (0.001) | 0.027 (0.004) | 0.035 (0.005) | 0.010 (0.001) | 0.020 (0.003) |
| Quarterly autocorrelation | | 0.939 (0.018) | 0.835 (0.045) | 0.878 (0.035) | 0.878 (0.035) | 0.878 (0.035) |
| Correlation matrix | $u$ | 1 | −0.927 (0.020) | −0.958 (0.012) | −0.958 (0.012) | −0.958 (0.012) |
| | $v$ | — | 1 | 0.996 (0.001) | 0.996 (0.001) | 0.995 (0.001) |
| | $v/u$ | — | — | 1 | 1.000 (0.000) | 0.999 (0.001) |
| | $f$ | — | — | — | 1 | 0.999 (0.001) |
| | $p$ | — | — | — | — | 1 |





# MODEL SIMULATION RESULTS

- **Separation-rate shocks alone**

Model fails to display a cyclical Beveridge Curve

All much lower than the data

TABLE 4—SEPARATION RATE SHOCKS

| | | $u$ | $v$ | $v/u$ | $f$ | $s$ |
|---|---|---|---|---|---|---|
| Standard deviation | | 0.065 (0.007) | 0.059 (0.006) | 0.006 (0.001) | 0.002 (0.000) | 0.075 (0.007) |
| Quarterly autocorrelation | | 0.864 (0.026) | 0.862 (0.026) | 0.732 (0.048) | 0.732 (0.048) | 0.733 (0.048) |
| Correlation matrix | $u$ | 1 | 0.999 (0.000) | −0.906 (0.017) | −0.906 (0.017) | 0.908 (0.017) |
| | $v$ | — | 1 | −0.887 (0.020) | −0.887 (0.020) | 0.888 (0.021) |
| | $v/u$ | — | — | 1 | 1.000 (0.000) | −0.999 (0.000) |
| | $f$ | — | — | — | 1 | −0.999 (0.000) |
| | $s$ | — | — | — | — | 1 |

- **Proceeds to dismiss fluctuations in separation rate**
  - **A point of controversy – see Fujita and Ramey (2007)**

## MODEL MECHANISM(?)

- Consider a single firm's vacancy-posting decision

$$\gamma = k^f(\theta_t) E_t \left\{ \Xi_{t+1|t} \left( \underbrace{z_{t+1} - w_{t+1}}_{\text{Flow profits, } = pr_{t+1}} + \frac{(1-\rho^x)\gamma}{k^f(\theta_{t+1})} \right) \right\}$$

- Interpretation of Shimer (2005) result
  - Wages absorb too much of any change in productivity
  - → not much change in firms' vacancy posting incentives
  - → (in equilibrium) not much change in $\theta$
  - → (in equilibrium) not much change in $u$ (because $k^h(\theta)$ governs transitions into/out of jobs)

- The Shimer Puzzle
  - How to address the model shortcoming?
  - Not a criticism of the labor search structure per se – a criticism of the wage-setting mechanism (Nash) used in the model





## BEYOND THE BASIC MODEL

- Hall (2005): a "social norm" under which $w$ doesn't change in response to cyclical fluctuations
  - Permissible as an equilibrium DUE TO the "bargaining interval" between $z$ and $b$
  - NOT something rationalizable in a standard Walrasian view of labor market
  - Larger fraction of $z$ shock passed on to change in $pr$ → model does better at accounting for volatility in $v$, $u$, $\theta$

- Full DSGE macro models that take on the Shimer Puzzle
  - Krause and Lubik (2005): job-to-job transitions
  - Gertler and Trigari (2009): "staggered (Calvo) Nash bargaining"
  - Rotemberg (2006): monopolistic competition and markup shocks
  - Acemoglu and Hawkins (2006): Shapley-value as model of bargaining
  - Krusell et al (2007), Nakajima (2007): heterogenous risk-averse households (hence no consumption insurance)
  - Weinke and Sveen (2007): New Keynesian sticky-price model
  - Chugh (2009): financial accelerator

## BEYOND THE BASIC MODEL

- Pissarides (2009 *Econometrica*)
  - Wage stickiness NOT the answer
  - Empirically
    - Wages in new hires are very volatile over the business cycle
    - Wages in ongoing jobs much less volatile (i.e., "sticky")…
    - …but irrelevant for the dynamics of the job-creation condition of a search model!
- Proposes model of decreasing marginal costs of posting vacancies
  - Rather than typical constant marginal cost of posting vacancies
  - i.e., increasing returns recruiting/posting technology
  - A type of amplification mechanism





## MODEL MECHANISM

- Aggregate law of motion of employment

$$N_{t+1} = (1-\rho^x)N_t + m(u_t, v_t)$$

- Flow equilibrium conditions (an accounting identity…)

$$m(u_t, v_t) = u_t k^h(\theta_t) = v_t k^f(\theta_t)$$

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- Wage determination

$$w_t = \eta\left[z_t + \gamma\theta_t\right] + (1-\eta)b$$

- HM's key insight: in basic RBC model, "gap" between social value of market work (*z*) and value of non-market activity (*b*) equals ZERO
  - So this ought to be the heart of the issue in a search model, too…not the wage-determination mechanism ***per se***

## MODEL MECHANISM

- To gain intuition, solve analytically for steady state of labor market (i.e., Pissarides Chapter 1)
- Can show (HM 2008, p. 1695) steady state elasticity of labor market tightness to labor productivity is

$$\varepsilon_{\theta,z} = \frac{z}{z-b}\frac{\eta k^h(\theta) + (1-\beta(1-\rho^x))/\beta}{\eta k^h(\theta) + (1-\xi)(1-\beta(1-\rho^x))/\beta}$$





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- Depends on many things….
- …in particular, depends on the gap between social value of market work (*z*) and value of non-market activity (*b*)
- Shimer calibration of *b* = 0.4 (unemployment "benefit" 40% of the value of labor income) inconsistent with G.E. business cycle models in which indifference conditions are satisfied in equilibrium
- Steady-state intuition maybe a guide to dynamics? Cyclical fluctuations typically "pretty linear"

# BEYOND THE BASIC MODEL

- Hagedorn and Manovskii (2008)
  - Use data on vacancy posting costs
  - Use data on elasticity of wages with respect to productivity
    - (Recall from basic RBC: quite low)
  - Consider effects of taxes (which affects the receipt of labor income by households)

Back out values of $\eta$ (worker Nash bargaining weight) and $b$ (flow value of unemployment)

$\eta = 0.05$ (much smaller than Shimer and typical labor literature)

$b = 0.95$ (much larger than Shimer and typical labor literature)





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$b = 0.95$ (much larger than Shimer and typical labor literature)

High value of $b$ more important than low value of $\eta$ because it essentially makes profits more responsive to $z$ shocks

But low $\eta$ helps a lot too...

Simulations of the Hagedorn and Manovskii calibration: matches data well

Table 4: Results from the Calibrated Model.

| | | $u$ | $v$ | $v/u$ | $p$ |
|---|---|---|---|---|---|
| Standard Deviation | | 0.145 | 0.169 | 0.292 | 0.013 |
| Quarterly Autocorrelation | | 0.830 | 0.575 | 0.751 | 0.765 |
| Correlation Matrix | $u$ | 1 | -0.866 | -0.966 | -0.949 |
| | $v$ | — | 1 | 0.966 | 0.946 |
| | $v/u$ | — | — | 1 | 0.981 |
| | $p$ | — | — | — | 1 |

## FULL MACRO MODELS

- **Full DSGE macro models that take on the Shimer Puzzle**
  - **Krause and Lubik (2005): job-to-job transitions**
  - **Gertler and Trigari (2009): "staggered (Calvo) Nash bargaining"**
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- **Pre-Shimer: the effects of labor matching frictions on basic RBC model dynamics?**
  - **Andolfatto (1996 *AER*)**
  - **Merz (1995 *JME*)**
  - **den Haan, Ramey, Watson (2000 *AER*)**