
LABOR SEARCH MODELS: PARTIAL-EQUILIBRIUM DYNAMICS

MARCH 28, 2017

LABOR-MARKET EQUILIBRIUM

- Aggregate law of motion of employment

$$n_{t+1} = (1 - \rho_x)n_t + m(u_t, v_t)$$

- Matching-market equilibrium

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

- 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

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

- Shimer (2005) and Hall (2005): analyze the **stochastic dynamics** of the labor market equilibrium

- **Not** general equilibrium dynamics

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

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 θ_t

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 θ_t
- ❑ **Main Conclusion:** model's predicted volatility in (u_t, v_t, θ_t) far lower than empirically-observed volatility
- ❑ **Main Model Shortcoming:** the wage-setting process (i.e., assumption of Nash bargaining at a particular parameterization)
 - ❑ Exogenous rise in productivity is nearly-fully absorbed by a rise in the wage \rightarrow virtually no change in firms' incentives to post vacancies
 - ❑ Vacancy-posting key economic margin of basic labor search model

Recall $z_{t+1} - w_{t+1}$ the (future) payoff governing vacancy-posting decision

EMPIRICAL FACTS

□ Basic cyclical labor-market facts

Data Sources:

CPS, JOLTS,
and
Conference
Board

Labor-market
tightness θ Worker matching
rate $k^h(\theta)$

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

EMPIRICAL FACTS

Basic cyclical labor-market facts

Data Sources:

CPS, JOLTS,
and
Conference
Board

Data displays a cyclical
Beveridge Curve

Labor-market
tightness θ Worker matching
rate $k^h(\theta)$

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

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	-0.949	0.709	-0.408
	v	—	1	0.897	-0.684	0.364
	v/u	—	—	1	0.948	-0.715
	f	—	—	—	1	-0.574
	s	—	—	—	—	1
	p	—	—	—	—	—

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, ρ_x
 - (Markov processes, continuous time \rightarrow can re-cast as AR(1)'s in discrete time)

MODEL DETAILS

□ Exogenous processes

- Labor productivity, z
- Separation rate, ρ_x
- (Markov processes, continuous time \rightarrow 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))

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

MODEL MECHANISM(?)

- Consider a single firm's vacancy-posting decision

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

MODEL MECHANISM(?)

- Consider a single firm's vacancy-posting decision

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

- 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 θ
 - → (in equilibrium) not much change in u (because $k^h(\theta)$ governs transitions into/out of jobs)
- "Shimer Puzzle"
 - How to address the model shortcoming?
 - Not a criticism of the labor search structure per se...
 - ...a criticism of flexible wage-setting mechanism (Nash-Hosios)

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 $pr \rightarrow$ model does better at accounting for volatility in v, u, θ

- 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 (2010 *ReStud*), Nakajima (2012 *IER*): heterogenous risk-averse households (hence no consumption insurance)
 - Weinke and Sveen (2007): New Keynesian sticky-price model
 - Chugh (2013 *JEDC*): CF 1998 agency-cost financial frictions
 - ...

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 vacancy-creation condition of a matching model**

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 vacancy-creation condition of a matching model**

- ❑ Proposes model of decreasing marginal costs of posting vacancies
 - ❑ (Technically, a model of fixed hiring costs and constant MC of posting)
 - ❑ Rather than typical constant marginal cost of posting vacancies
 - ❑ i.e., increasing returns recruiting/posting technology
 - ❑ A type of amplification mechanism

- ❑ Micro-level evidence on finer levels of “hiring costs”
 - ❑ Barron, Berger, and Black (1997) survey
 - ❑ More anecdotal evidence on “hiring standards” by Davis, Faberman, and Haltiwanger (2013 *QJE*)
 - ❑ **Some ex-ante of a match, some ex-post of a match**

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...)

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

- 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

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

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...)

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

- 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

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

- 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

- Hence ought to be the heart of the issue in a matching model, too...
- ...not 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

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

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

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

- ❑ 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**

MODEL MECHANISM

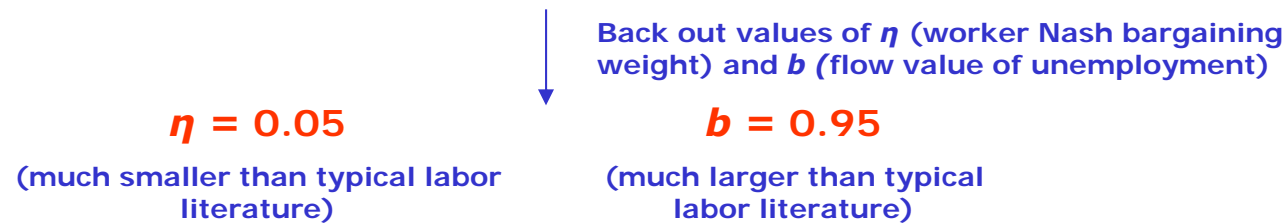
- ❑ To gain intuition, solve analytically for steady state of labor market (i.e., Pissarides Chapter 1)
- ❑ Can show (HM 2008, p. 1695) steady state elasticity of labor market tightness to labor productivity is

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

- ❑ 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 only vacancy posting costs, not broader “hiring costs”
 - Consider effects of taxes (which affects the receipt of labor income by households)



BEYOND THE BASIC MODEL

- Hagedorn and Manovskii (2008)
 - Use data on only vacancy posting costs, not broader “hiring costs”
 - Consider effects of taxes (which affects the receipt of labor income by households)

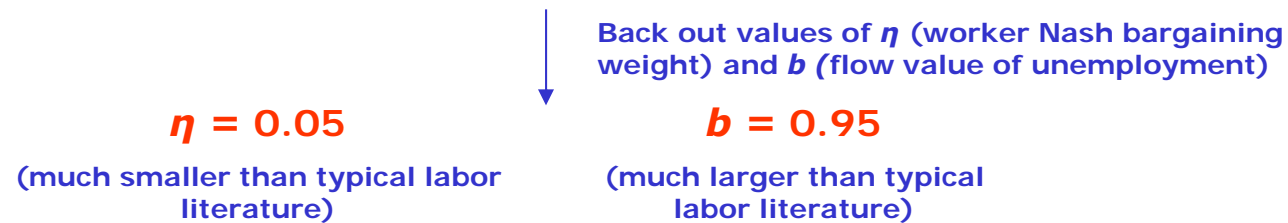


Table 4: Results from the Calibrated Model.

	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
	v	—	1	0.966
	v/u	—	—	1
	p	—	—	—

Simulations of the Hagedorn and Manovskii calibration: matches data well

BEYOND THE BASIC MODEL

- Hagedorn and Manovskii (2008)
 - Use data on only vacancy posting costs, not broader “hiring costs”
 - Consider effects of taxes (which affects the receipt of labor income by households)

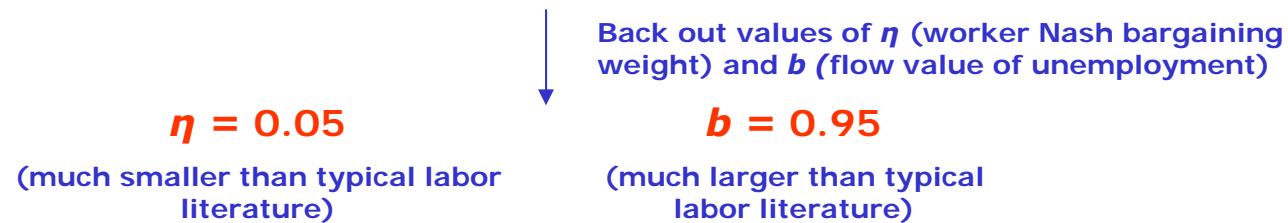


Table 4: Results from the Calibrated Model.

	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
	u	1	-0.866	-0.966
	v	—	1	0.966
Correlation Matrix	v/u	—	—	1
	p	—	—	—
				1

Simulations of the Hagedorn and Manovskii calibration: matches data well

- Intuitively, mechanism generates real wage rigidity
- All of this raises conceptual question: what are “rigid wages?”

FULL MACRO MODELS

- ❑ **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 (2014): Shapley-value as model of bargaining
 - ❑ **Krusell et al (2010 *ReStud*): heterogenous risk-averse households**
 - ❑ **Nakajima (2012 *IER*): heterogenous risk-averse households**
 - ❑ Weinke and Sveen (2007): New Keynesian sticky-price model
 - ❑ Chugh (2013 *JEDC*): CF (1998) agency-cost financial frictions
 - ❑ ...

- ❑ **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*)