ECON0057 Lecture 8

Shimer Puzzle

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- Last lecture: standard DMP model with Nash Bargaining
- This lecture we look at the comovement of unemployment, vacancy creation, labor market tightness and productivity in US data
- Then we check if our standard model can approximately replicate these empirical facts
- It does not! Why? How can we fix the model?

Unemployment Fluctuations

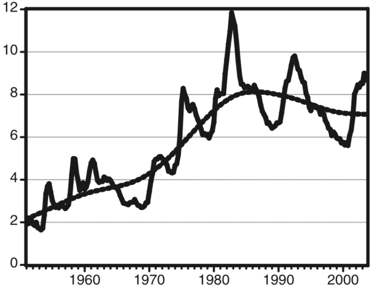

FIGURE 1. QUARTERLY U.S. UNEMPLOYMENT (IN MILLIONS) AND TREND, 1951–2003

Notes: Unemployment is a quarterly average of the seasonally adjusted monthly series constructed by the BLS from the CPS, survey home page http://www.bls.gov/cps/. The trend is an HP filter of the quarterly data with smoothing parameter 10^5.

- Monthly data, detrend unemployment series using HP filter
- Separate slow moving trend (eg demographics, change in soc. sec.) and **business cycle fluctuations**
- Compute standard deviation and auto correlation of $ln(u) - trend$ (bc fluctuations)
- 1) Unemployment is countercyclical 2) large standard deviation ($SD = 0.19$) 3) Persistent ($AC = 0.93$)

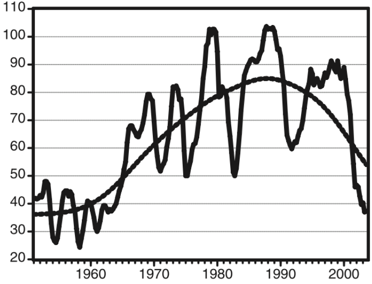

FIGURE 3. QUARTERLY U.S. HELP-WANTED ADVERTISING INDEX AND TREND, 1951–2003

Notes: The help-wanted advertising index is a quarterly average of the seasonally adjusted monthly series constructed by the Conference Board with normalization 1987 = 100. The data were downloaded from the Federal Reserve Bank of St. Louis database at http://research.stlouisfed.org/fred2/data/helpwant.txt. The trend is an HP filter of the quarterly data with smoothing parameter 10^5.

- Proxy number of vacancies by help wanted index (in newspaper). Index=100 in 1987
- Detrend in the same way as unemployment
- 1) Procyclical 2) large standard deviation ($SD = 0.2$) 3) Persistent ($AC = 0.94$)

Labor Market Tightness

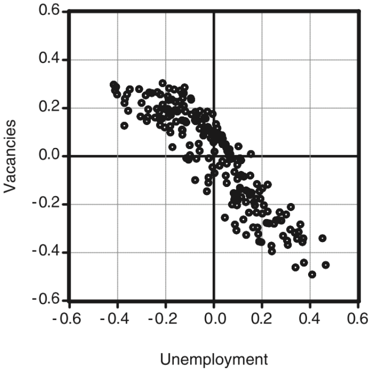

FIGURE 4. QUARTERLY U.S. BEVERIDGE CURVE, 1951–2003

Notes: Unemployment is constructed by the BLS from the CPS. The help-wanted advertising index is constructed by the Conference Board. Both are quarterly averages of seasonally adjusted monthly series and are expressed as deviations from an HP filter with smoothing parameter 10^5.

- Beveridge Curve
- v and u anticorrelated ($corr(v, u) = -0.89$)
- θ 1) Strongly Procyclical 2) Large standard deviation ($SD = 0.38$) 3) Persistent ($AC = 0.941$)

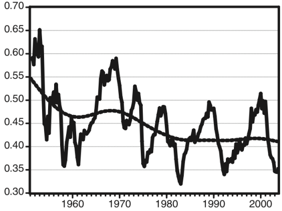

FIGURE 5. MONTHLY JOB-FINDING PROBABILITY FOR UNEMPLOYED WORKERS, 1951–2003

Notes: The job-finding rate is computed using equation (1), with unemployment and short-term unemployment data constructed and seasonally adjusted by the BLS from the CPS, survey home page http://www.bls.gov/cps/. It is expressed as a quarterly average of monthly data. The trend is an HP filter of the quarterly data with smoothing parameter 10^5.

FIGURE 6. MONTHLY U.S. MATCHING FUNCTION, 1951–2003

Notes: The v-u ratio is constructed by the BLS from the CPS and by the Conference Board. The job-finding rate is constructed using equation (1) and BLS data from the CPS. Both are quarterly averages of seasonally adjusted monthly

High correlation (0.95) between f_t and θ, (consistent with model $f = \theta q(\theta)$). $m(u, v)$ well approximated by CD $u^{\alpha} v^{1-\alpha}$ with $\alpha = 0.72$

Measurement $u_{t+1} = u_t^s + (1 - f_t)u_t$ back up f_t (u_t^s: unemployment started in current month)

Separations

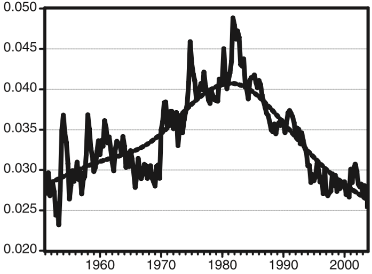

FIGURE 7. MONTHLY SEPARATION PROBABILITY FOR EMPLOYED WORKERS, 1951–2003

Notes: The separation rate is computed using equation (2), with employment, unemployment, and short-term unemployment data constructed and seasonally adjusted by the BLS from the CPS, survey home page http://www.bls.gov/cps/. It is expressed as a quarterly average of monthly data. The trend is an HP filter of the quarterly data with smoothing parameter 10^5.

- Average separation rate $s = 0.034$: average job last 2.5 years
- 1) $Corr(\theta, s) = -0.72$, sep. rate countercyclical 2) Smaller standard deviation $SD = 0.08$ 3) Smaller persistence ($AC = 0.73$
- Measurement: could backup s_t from $u_t^s = s_t e_t$ but some workers find a job directly (so would underestimate), instead back up s_t from $u_t^s = s_t e_t(1 - 0.5 f_t)$

Labor Productivity

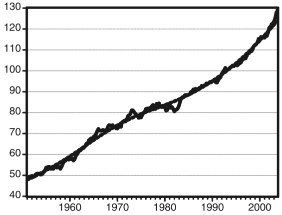

Figure 8. Quarterly U.S. Average Labor Productivity and Trend, 1951–2003

Notes: Real output per person in the non-farm business sector, constructed by the BLS Major Sector Productivity and Costs program, survey home page http://www.bls.gov/lpc/, 1992 = 100. The trend is an HP filter of the quarterly data with smoothing parameter 10^5.

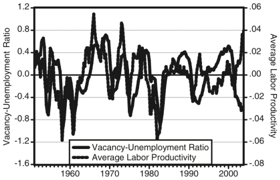

Figure 9. Quarterly U.S. Vacancy-Unemployment Ratio and Average Labor Productivity, 1951–2003

Notes: Unemployment is constructed by the BLS from the CPS. The help-wanted advertising index is constructed by the Conference Board. Both are quarterly averages of seasonally adjusted monthly series. Labor productivity is real average output per worker in the non-farm business sector, constructed by the BLS Major Sector Productivity and Costs program. The v-u ratio and labor productivity are expressed as deviations from an HP filter with smoothing parameter 10^5.

Labor productivity less cyclical ($Corr(y, \theta) = 0.54$), less persistent $AR = 0.87$, and **20 times less volatile** than θ ($SD = 0.02$ vs 0.38)

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
	u	1	−0.894	−0.971	−0.949	0.709	−0.408
	v	—	1	0.975	0.897	−0.684	0.364
Correlation matrix	v/u	—	—	1	0.948	−0.715	0.396
	f	—	—	—	1	−0.574	0.396
	s	—	—	—	—	1	−0.524
	p	—	—	—	—	—	1

Notes: Seasonally adjusted unemployment u is constructed by the BLS from the Current Population Survey (CPS). The seasonally adjusted help-wanted advertising index v is constructed by the Conference Board. The job-finding rate f and separation rate s are constructed from seasonally adjusted employment, unemployment, and mean unemployment duration, all computed by the BLS from the CPS, as explained in equations (1) and (2). u, v, f, and s are quarterly averages of monthly series. Average labor productivity p is seasonally adjusted real average output per person in the non-farm business sector, constructed by the Bureau of Labor Statistics (BLS) from the National Income and Product Accounts and the Current Employment Statistics. All variables are reported in logs as deviations from an HP trend with smoothing parameter 10^5.

Discussion

- Endogenous fluctuations summarized by θ (and f): volatile, procyclical, persistent
- Exogenous shocks (separation rate and productivity) are substantially less volatile, less cyclical, less persistent
- Need a model that amplifies exogenous shocks and propagate them to generate realistic fluctuations in θ (and u)
- Can the standard DMP model with Nash bargaining achieve that?

Model Evaluation

- Shimer considers a stochastic version of the standard DMP model with productivity and separation shocks (continuous time analogue of an $AR(1)$ process to fit the data)

- Matching Function:

$$m(u, v) = \mu u^{\alpha} v^{1-\alpha},$$

  α is set to 0.72 to fit the correlation between f and θ

- Not a good way to choose the bargaining parameter, chooses $\phi = 0.72$ (Hosios condition, the economy is efficient) changing ϕ does not matter much

- $z = 0.4y$ to fit the replacement rate from UI and $r = 0.004$.

- Need to estimate μ and c (vacancy cost)

  $\rightarrow$ calibrated to fit the average job finding rate and the average θ

Model Result: Productivity Shocks Only

TABLE 3—LABOR PRODUCTIVITY SHOCKS

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

Notes: Results from simulating the model with stochastic labor productivity. All variables are reported in logs as deviations from an HP trend with smoothing parameter 10^5. Bootstrapped standard errors—the standard deviation across 10,000 model simulations—are reported in parentheses. The text provides details on the stochastic process for productivity.

Model Result: Separation Shocks Only

TABLE 4—SEPARATION RATE SHOCKS

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

Notes: Results from simulating the model with a stochastic separation rate. All variables are reported in logs as deviations from an HP trend with smoothing parameter 10^5. Bootstrapped standard errors—the standard deviation across 10,000 model simulations—are reported in parentheses. The text provides details on the stochastic process for the separation rate.

Model Result: Productivity and Separation Shocks

TABLE 5—LABOR PRODUCTIVITY AND SEPARATION RATE SHOCKS

		u	v	v/u	f	s	p
Standard deviation		0.031	0.011	0.037	0.014	0.020	0.020
		(0.005)	(0.001)	(0.006)	(0.002)	(0.003)	(0.003)
Quarterly autocorrelation		0.933	0.291	0.878	0.878	0.878	0.878
		(0.020)	(0.085)	(0.035)	(0.035)	(0.035)	(0.035)
	u	1	−0.427	−0.964	−0.964	0.964	−0.964
			(0.068)	(0.011)	(0.011)	(0.011)	(0.011)
	v	—	1	0.650	0.650	−0.649	0.648
				(0.042)	(0.042)	(0.042)	(0.042)
Correlation matrix	v/u	—	—	1	1.000	−1.000	0.999
					(0.000)	(0.000)	(0.001)
	f	—	—	—	1	−1.000	0.999
						(0.000)	(0.001)
	s	—	—	—	—	1	−0.999
							(0.001)
	p	—	—	—	—	—	1

Notes: Results from simulating the model with stochastic but perfectly correlated labor productivity and separations. All variables are reported in logs as deviations from an HP trend with smoothing parameter 10^5. Bootstrapped standard errors—the standard deviation across 10,000 model simulations—are reported in parentheses. The text provides details on the stochastic process.

Why does the model fail so badly?

- To understand the model failures consider the standard model without stochastic shocks
- Equilibrium characterized by three equations:

$$
\begin{aligned}
w &= y - \frac{s+r}{q(\theta)}c \quad \textit{Job Creation} \\
w &= z + \phi(y - z + \theta c) \quad \textit{Wage Equation} \\
u &= \frac{s}{s+\theta} \quad \textit{Beveridge Curve}
\end{aligned}
$$

- As we saw last time, when y decreases or s increases θ decreases, but by how much?

Elasticity of θ with respect to productivity

Rewrite the equation determining θ as:

$$\frac{1-\phi}{c}(y-z) = \phi\theta + \frac{s+r}{q(\theta)}$$

Since in Shimer $y-z$ is large compared to the fluctuations in y we can compute the elasticity of θ wrt $y-z$, using the implicit function theorem, we have

$$\frac{1-\phi}{c} = \left(\phi - \frac{s+r}{q(\theta)}\frac{q'(\theta)}{q(\theta)}\right)\frac{d\theta}{d(y-z)}$$

Recall that $q(\theta) = \frac{f(\theta)}{\theta}$ so $q'(\theta) = \frac{\theta f' - f}{\theta^2}$. Denoting $\eta(\theta) = \theta f'/f$ we have:

$$\frac{y-z}{\theta}\frac{d\theta}{d(y-z)} = \frac{\phi f(\theta) + s + r}{\phi f(\theta) + (s+r)(1-\eta)}$$

Elasticity of θ with respect to productivity

$$\epsilon_{\theta,y-z} = \frac{\phi f(\theta) + s + r}{\phi f(\theta) + (s+r)(1-\eta)}$$

- To have larger responses of θ, we need ϕ low and η close to 1
- η is not that large: remember that we have $f(\theta) = \theta^{1-\alpha}$ so $\eta = 1 - \alpha = 0.28$ to fit the data
- We have $s + r \simeq 0.034$, while $f \simeq 0.45$ and $\phi = 0.72$ in the benchmark estimation

  $\rightarrow$ we have $\phi f \gg s + r$ and $\epsilon_{\theta,y-z} \simeq 1$

  $\rightarrow$ way lower than what we need (we would need something close to 20)

Elasticity of θ with respect to productivity

- Even with lower values of ϕ the elasticity is too low
  - With $\phi = 0$ we have $\epsilon_{\theta,y-z} = (1-\eta)^{-1} = 1.39$.
  - Note that with $\phi = 0$ the wage is fixed at z so the per period profit of the firm is $y - z = 0.6$
  - The SD deviation of y is small (a few percent) firm's profit and labor demand are close to constant

- We would need $y - w$ initially close to 0 to hope generate large fluctuation of profits, but using the wage equation:

$$\frac{y-z}{w-z}\frac{d(w-z)}{d(y-z)} = 1 + \frac{\phi c\theta}{w-z}(\epsilon_{\theta,y-z} - 1)$$

  So for $\epsilon_{\theta,y-z} \simeq 1$ the wage reacts one to one to change in productivity:
  - firm's profit does not change much since wage decreases by the amount of the productivity shock.
  - There's no amplification of the shocks through labor demand
  - unemployment increases due to the initial productivity shocks and lower vacancy creation
  - wages are then reduced which increases vacancy creation

Elasticity of θ with respect to s

Using the same reasoning, we can derive the elasticity of θ with respect to s

$$\epsilon_{\theta,s} = \frac{s}{\theta}\frac{d\theta}{ds} = \frac{-s}{\phi f(\theta) + (s+r)(1-\eta)}$$

Using the same calibration, we have $\epsilon_{\theta,s} = -0.1$, even less reaction!

This is even worse: note that from the Beveridge Curve, we can easily see that u increases when s increases (and θ decreases).

However, since θ remains approximately constant it means v has to increase as well, u and v are almost perfectly correlated instead of being anticorrelated

Hagedorn & Manovski (2008)

- HM provides a simple (partial) solution to Shimer Puzzle
- Shimer assumed that $z = 0.4y$ so the surplus from jobs is significant

  $\rightarrow$ based on UI replacement rate
- However z potentially captures more: home production, cost of working etc
- In a neoclassical model where agent divide their labor ℓ between home production and work we would have $\max_\ell \ell y + (1-\ell)z$ and $y = z$
- Now the elasticity of θ with respect to y (rather than $y - z$) is:

$$\epsilon_\theta = \frac{y}{\theta}\frac{d\theta}{dy} = \frac{y}{y-z}\frac{\phi f(\theta) + s + r}{\phi f(\theta) + (s+r)(1-\eta)}$$

  So we can have very large elasticities ϵ_θ if $z \simeq y$, even if the wage elasticity is also large. Total surplus is then very sensible to fluctuations in y
- HM choose $z = 0.95y$

HM quantitative Results

Table 3: Summary Statistics, quarterly U.S. data, 1951:1 to 2004:4.

		u	v	v/u	p
Standard Deviation		0.125	0.139	0.259	0.013
Quarterly Autocorrelation		0.870	0.904	0.896	0.765
	u	1	-0.919	-0.977	-0.302
	v	—	1	0.982	0.460
Correlation Matrix	v/u	—	—	1	0.393
	p	—	—	—	1

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	-0.724	-0.916	-0.892
	v	—	1	0.940	0.904
Correlation Matrix	v/u	—	—	1	0.967
	p	—	—	—	1

Note - All variables are reported in logs as deviations from an HP trend with smoothing parameter 1600. Calibrated parameter values are described in Table 2.

Hall (2005)

- Another potential issue in Shimer is the assumption of Nash Bargaining
- Any wage between $\{\underline{w}(y), \bar{w}(y)\}$ (defined by $\phi = 0$, $\phi = 1$ is possible
- Hall considers the case where the wage is fixed at some value w^*

  maybe due to extreme nominal rigidities
- When y varies, we have to be careful (eg we could have $w^* > \bar{w}(y)$ for some y)

  $\rightarrow$ w^* has to be lower that the net present value of profits in the lowest state
- If we choose w^* high enough so that $y - w^*$ is *small* then profit is sensible to y fluctuations since w^* does not decrease with productivity shocks

Hall: Possible Fixed Wages

FIGURE 3. WAGE ELEMENTS

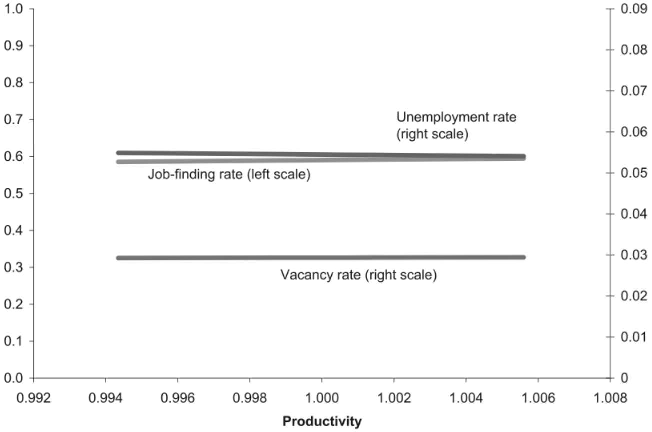

FIGURE 4. JOB FINDING, VACANCY, AND UNEMPLOYMENT RATES, NASH-BARGAIN WAGE

Hall: Fixed Wage

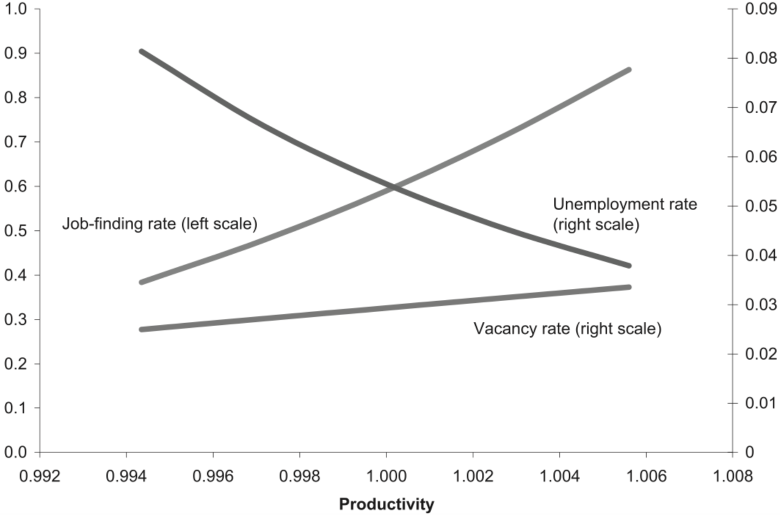

FIGURE 2. JOB FINDING, VACANCY, AND UNEMPLOYMENT RATES, FIXED WAGE