Directed Search

Lecture 4: Business Cycles

Lectures at Osaka University (2012)

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Main sources for this lecture:

- Menzio, G. and S. Shi, 2011, "Efficient Search on the Job and the Business Cycle," JPE 119, 468-510.
- Menzio, G. and S. Shi, 2010a, "Block Recursive Equilibria for Stochastic Models of Search on the Job," JET 145, 1453-1494.
- Menzio, G. and S. Shi, 2010b, "Directed Search on the Job, Heterogeneity, and Aggregate Fluctuations,"
  AER: P&P 100, 327-332.

1. Motivation

Facts about the US labor market:

- large monthly flows
  from unemployment to employment: UE rate = 42%;
  from employment to unemployment: EU rate = 2.6%;
  from one employer to the other: EE rate = 2.9%

- these flows vary with the business cycle
- these flows are volatile relative to labor productivity
- the stocks (of unemployment and vacancies) are volatile

Table 1. US data (CPS), 1951:I - 2006:II

	u	v	h^{ue}	h^{eu}	h^{ee}	π
monthly average	0.056	63.9	0.452	0.026	0.029	
relative std	**9.56**	10.9	**5.96**	**5.48**	**5.98**	1
quarterly acr	0.872	0.909	0.822	0.698	0.597	0.760
			cross correlation			
u	1	**-0.902**	**-0.916**	**0.778**	**-0.634**	-0.283
v		1	0.902	-0.778	0.607	0.423
π			0.299	-0.528	0.208	1

Question: How much do labor productivity shocks explain these?

To address this question, we need:

- aggregate shocks to labor productivity
- **on-the-job search** (OJS) to explain EE flow:
  - most search models rule out OJS, but in data:

$$\frac{\text{EE flow}}{\text{UE flow}} = \frac{2.9}{45} \times \frac{1-u}{u} \approx 1$$

- on-the-job search (OJS) to explain volatility: without OJS, a search model implies:
  - weak incentive for job creation
  - low volatility in unemployment (Shimer 05)

To address this question, we need (continued):

- **match heterogeneity** to explain the EU flow:
  - job separation is exogenous in most models, but it is counter-cyclical and volatile in the data
- match heterogeneity to rationalize EE flow:
  - EE flow is inefficient if matches are homogeneous

What if we add match heterogeneity but not OJS?

- economic booms are times to search
- if workers can search only when unemployed, then unemployment goes up in booms (counterfactual!)

Theoretical challenge:

Analyze business cycles with OJS and match heterogeneity.

- standard models (DMP, Shimer 05, etc.) have ignored OJS:
  - OJS endogenously generates wage distribution
  - with undirected search, distribution affects decisions
  - dynamic, two-way interaction between distribution and decisions is intractable

- directed search models offer hope: eqm is block recursive
  - decisions are independent of the distribution

Roadmap:

- extend a directed search model to incorporate:
  OJS,   match heterogeneity,   aggregate shocks
- characterize efficient allocation and equilibrium:
  - block recursive eqm (BRE) exists and is unique
  - BRE is socially efficient
  - all equilibria are BRE
- calibrate the model to quantitatively answer:
  how much do labor productivity shocks explain the observed cyclical features of the US labor market?

2. The Model

Workers and jobs

- workers (risk neutral):
  - unemployed worker can search with prob λ_u $(= 1)$
  - employed worker can search with prob λ_e
- worker flows:
  - **quits** for other jobs (due to OJS)
  - **endogenous destruction**
  - exogenous destruction: δ

- productivity of a job: $y + z$
  - aggregate productivity: $y \in Y \quad \sim \phi(\hat{y}|y)$
  - match specific productivity: $z \in Z \quad \sim f(z)$
    permanent in a match; iid across matches

- signal on match-specific productivity:

$$s = z \text{ with prob } \alpha; \qquad s \sim f \text{ with prob } 1 - \alpha$$

  - job is pure **experience good:** $\alpha = 0$
  - job is pure inspection good: $\alpha = 1$

Directed search:

- workers can directly go to specific submarkets
  x: index of submarket (to be specified)
  $\theta(x)$: vacancy/applicant (tightness)

- frictions summarized by matching prob:
  worker: $p(\theta)$;
  firm: $q(\theta) = p(\theta)/\theta$;
  $0 < p'(\theta) < p(\theta)/\theta$ (trade-off between x and θ)

		search,	match,	produce,
aggregate	job des-	offer	draw z,	
y realized	truction	contracts	see s	u benefit
$\longrightarrow$	$\longrightarrow$	$\longrightarrow$	$\longrightarrow$	$\longrightarrow$

Timing of events in a period

Planner's Problem:

- directly targeting workers at each z with tightness $\theta(z)$:

$$\begin{array}{lccccc}
\text{vacancies:} & \boxed{\theta_u} & \boxed{\theta_e(z_1)} & \boxed{\theta_e(z_2)} & \ldots\ldots & \boxed{\theta_e(z_N)} \\
\text{forming match? } c(s, z) & \Uparrow & \Uparrow & \Uparrow & & \Uparrow \\
\text{workers:} & \boxed{u} & \boxed{g(z_1)} & \boxed{g(z_2)} & \ldots\ldots & \boxed{g(z_N)} \\
\text{prob. of destruction:} & & d(z_1) & d(z_2) & \ldots\ldots & d(z_N)
\end{array}$$

Planner's chooses:

- vacancy creation: tightness
  for unemployed: θ_u,
  for employed at z: $\theta_e(z)$

- match formation probability:
  for unemployed with match signal s: $c_u(s)$
  for employed at z with signal s: $c_e(s, z)$

- job destruction prob $d \in [\delta, 1]$:
  $d = \delta$: Nature destroys a match

State of economy: $\psi \equiv (y, u, g) \in \Psi$

- y: aggregate labor productivity

- distribution of workers (large dimension):

  u: measure of unemployed workers

  $g(z)$: measure of workers employed at z.

- social planner's value function:

$$W(\psi) = \max \ \left[F(d, \theta_u, \theta_e, c_u, c_e|\psi) \ + \ \beta \, \mathbb{E} \, W(\hat{\psi})\right]$$

- net output in a period: $F(d, \theta_u, \theta_e, c_u, c_e|\psi) =$

$$\hat{u} \ b \ + \ \sum_z (y+z)\hat{g}(z) \quad \text{(home and market output)}$$

$$-k \left\{ \lambda_u u \ \theta_u \ + \ \sum_z \left[1 - d(z)\right] g(z) \lambda_e \ \theta_e(z) \right\} \ \text{(vacancy cost)}$$

- constraints on $\hat{u}$ and $\hat{g}$ (see next 2 pages)

• measure of unemployed workers next period:

$$\hat{u} = \underbrace{u\left[1 - \lambda_u p(\theta_u)\ m_u\right]}_{\text{hiring from } u} + \underbrace{\sum\nolimits_z d(z)g(z)}_{\text{job destruction}}$$

prob that a meeting with u turns into a match:

$$m_u = \sum\nolimits_s \underbrace{c_u(s)}_{\text{creation prob}}\ f(s)$$

• measure of workers employed at z:

$$\begin{aligned}\hat{g}(z) = \ & \text{inflow from } u \text{ into } z \\ & + \text{workers employed at } z \text{ who stay put} \\ & + \sum\nolimits_{z'} g(z') \times prob(\text{each worker at } z' \text{ moves to } z)\end{aligned}$$

$prob$(each worker at z' moves to z):

$$\left[1 - d(z')\right] \underbrace{\lambda_e p(\theta_e(z'))}_{\text{search}} \underbrace{\left[\alpha c_e(z, z') + (1-\alpha) m_e(z')\right] f(z)}_{\text{prob of forming match at } z}$$

$$m_e(z') = \sum\nolimits_s c_e(s, z') f(s)$$

Potential difficulty: dynamics of distribution $g(z)$

- OJS $\Longrightarrow$ distribution of matches

- distribution can affect choices/allocation and market tightness

- choices/allocation + distribution $\Longrightarrow$ new distribution

Theorem 1:

- social value function $W(\psi)$ is unique
- social value function is linear in (u, g):

$$\underbrace{W(\psi)}_{\text{value of}} = \underbrace{W_u(y)}_{\text{unemployed}} \times u + \sum_z \underbrace{W_e(z, y)}_{\text{employed at } z} \times g(z)$$

- **block recursivity**:
  - $W_u(y)$ and $W_e(z, y)$ are independent of (u, g)
  - efficient choices are all independent of (u, g)

$$
\begin{aligned}
& W_u(y) \\
= & \max_{(\theta_u, c_u)} \left\{ -k\lambda_u\theta_u + (1-\lambda_u p(\theta_u) m_u)\left[b + \beta \mathbb{E} W_u(\hat{y})\right] \right. \\
& \left. +\lambda_u p(\theta_u) \mathbb{E}_{z'} \left\{ \begin{array}{l} \left[\alpha c_u(z') + (1-\alpha) m_u\right] \\ \times \left[y + z' + \beta \mathbb{E} W_e(z', \hat{y})\right] \end{array} \right\} \right\}
\end{aligned}
$$

$$
\begin{aligned}
& W_e(z, y) \\
= & \max_{(d, \theta_e, c_e)} \left\{ d\left[b + \beta \mathbb{E} W_u(\hat{y})\right] - (1-d)\, k\lambda_e\theta_e \right. \\
& +(1-d)\,(1-\lambda_e p(\theta_e) m_e)\left[y + z + \beta \mathbb{E} W_e(z, \hat{y})\right] \\
& \left. +(1-d)\lambda_e p(\theta_e) \mathbb{E}_{z'} \left\{ \begin{array}{l} \left[\alpha c_e(z') + (1-\alpha) m_e\right] \\ \times\left[y + z' + \beta \mathbb{E} W_e(z', \hat{y})\right] \end{array} \right\} \right\}
\end{aligned}
$$

Block Recursivity (Shi 09)**:**

$$\boxed{\begin{array}{c}\text{optimal decisions}\\ \text{including tightness,}\\ \\ \text{value functions}\end{array}} \quad \begin{array}{c} ====\Longrightarrow \\ \\ \Longleftarrow=\neq\neq\neq \end{array} \quad \boxed{\begin{array}{c}\text{distribution}\\ \text{of workers,}\\ u,\ g(z)\end{array}}$$

- We can solve the left block first, and then the right block
- eliminate complexity generated by dynamics of distribution

Why does directed search produce block recursivity?

- able to target specific group of workers:

$$\begin{array}{lccccc} \text{vacancies:} & \boxed{\theta_u} & \boxed{\theta_e(z_1)} & \boxed{\theta_e(z_2)} & \ldots\ldots & \boxed{\theta_e(z_N)} \\ & \Uparrow & \Uparrow & \Uparrow & & \Uparrow \\ \text{workers:} & \boxed{u} & \boxed{g(z_1)} & \boxed{g(z_2)} & \ldots\ldots & \boxed{g(z_N)} \end{array}$$

- free-entry generates the right tightness for each submarket:

$$k = p'(\theta_e(z)) \underbrace{\{\text{value of future job relative to current job}\}}_{\text{INDEPENDENT of distribution of workers}}$$

- no need to consider how other types of workers are distributed

Block recursivity FAILS when search is undirected:

$$k = p'(\theta_e(z))\,[\text{acceptance prob}]\,[\text{value added by match}]$$

Because applicant is random draw from distribution,

- acceptance prob depends on distribution;
- value added by a match depends on distribution

Block recursivity does NOT rely on:

- risk neutrality of workers

- completeness of contracts

Examples:

- Risk averse workers and wage-tenure contracts (Shi 09)
- Dynamic contracts or fixed wage contracts (Menzio and Shi 10b)

Properties of efficient allocation:

- efficient choices are unique

- match formation – cutoff rule
  - form match for unemployed iff $s \geq r_u^*(y)$
  - form match for employed iff $s \geq r_e^*(z, y)$
  - cutoff $r_e^*(z, y)$ is increasing in z

Efficient choices of forming matches:

- form match for unemployed worker iff

$$b + \beta \mathbb{E} W_u(\hat{y}) \quad \text{(value when unemployed)}$$

$$\leq \alpha[y + s + \beta \mathbb{E} W_e(s, \hat{y})] \ \text{(employed with correct signal)}$$

$$+(1-\alpha)\mathbb{E}_{z'}[y + z' + \beta \mathbb{E} W_e(z', \hat{y})] \ \text{(with random signal)}$$

- cutoff rule: form match iff signal $s \geq r_u^*(y)$

- form match for employed worker at z iff

$$y + z + \beta \mathbb{E} W_e(z, \hat{y}) \quad \text{(value of staying at } z\text{)}$$

$$\leq \alpha[y + s + \beta \mathbb{E} W_e(s, \hat{y})] \quad \text{(employed at } s\text{)}$$

$$+(1-\alpha)\mathbb{E}_{z'}[y + z' + \beta \mathbb{E} W_e(z', \hat{y})] \text{ (at random } z'\text{)}$$

- cutoff rule: form match iff $s \geq r_e^*(z, y)$

- $r_e^*(z, y)$ is increasing in z

Properties of efficient allocation (continued):

- vacancy creation:
  - tightness is $\theta_u^*(y)$ for unemployed
  - tightness is $\theta_e^*(z, y)$ for employed at z
  - tightness $\theta_e^*(z, y)$ is decreasing in z:
    (more jobs are created for lower z)

Efficient choices of job creation:

- tightness of market for unemployed: $\theta_u^*(y) \geq 0$ and

$$k \geq p'(\theta_u^*(y)) \sum_{s \geq r_u^*(y)} \left\{ \begin{array}{c} \text{expected social surplus of} \\ \text{employment relative to } u \end{array} \right\} f(s)$$

- expected social surplus of employment:

$$\alpha \left[y + s - b + \beta \mathbb{E} \left[W_e(s, \hat{y}) - W_u(\hat{y}) \right] \right]$$

$$+(1-\alpha)\mathbb{E}_{z'} \left\{ y + z' - b + \beta \mathbb{E} \left[W_e(z', \hat{y}) - W_u(\hat{y}) \right] \right\}$$

- tightness of market for employed at z: $\theta_e^*(z,y) \geq 0$ and

$$k \geq p'(\theta_e^*(z,y)) \sum_{s \geq r_e^*(z,y)} \begin{bmatrix} \alpha\,[\text{surplus of emp at } s \text{ relative to } z] \\ +(1-\alpha)\mathbb{E}_{z'}\left[\text{emp at } z' \text{ relative to } z\right] \end{bmatrix} f(s)$$

- expected surplus of employment at s relative to z

$$\alpha\left[s - z + \beta\mathbb{E}\left(W_e(s,\hat{y}) - W_e(z,\hat{y})\right)\right]$$

$$+(1-\alpha)\mathbb{E}_{z'}\left\{z' - z + \beta\mathbb{E}\Big(W_e(z',\hat{y}) - W_e(z,\hat{y})\Big)\right\}$$

Properties of efficient allocation (continued):

- job destruction: $d^*(z,y) = 1$ whenever

  value of unemployed

  $>$ joint value of keeping the match

  otherwise, $d^*(z,y) = \delta$ (exogenous separation)

- cutoff rule: $d^*(z,y) = 1$ iff $z < r_d^*(y)$

3. Decentralization:

Markets:

- continuum of submarkets indexed by (x, r):
  x: lifetime utility of offer to a worker
  r: match is formed iff signal $s \geq r$

- tightness $\theta(x, r, \psi)$: determined by free entry of v

- tradeoff between offer and matching prob $p(\theta)$

Directed search

- surplus from search by a worker in match V:

$$D(x, r, V, \psi) = \underbrace{p(\theta(x, r, \psi))}_{\text{meeting prob,}} \underbrace{m(r)}_{\text{match,}} \underbrace{(x - V)}_{\text{gain}}$$

- prob of forming a match: $m(r) = \sum_{s \geq r} f(s)$

- workers are endogenously separated according to V: higher $V \Longrightarrow$ less concerned about p than the gain $(x - V)$ $\Longrightarrow$ searching for higher x.

Employment contracts:

- specify job separation: $d \in [\delta, 1]$
  and submarket for OJS: (x, r)
- contingent on history (z, ψ^t), $\quad \psi^t = (\psi_1, ..., \psi_t)$
- implicit assumption: contracts are bilaterally efficient
  (V in search problem is match's joint value)

Justifications for the assumption on contracts:

- example: wage-tenure contracts
- benchmark: uniqueness and efficiency of eqm
- not necessary for block recursivity

Value functions:

- unemployed worker's value:

$$V_u(\psi) = b + \beta \mathbb{E} \max[\ V_u(\hat{\psi}) + \lambda_u\ D(x, r, V_u(\hat{\psi}), \hat{\psi})\ ]$$

- joint value of a match at z:

$$V_e(z, \psi) = \ y + z + \beta \mathbb{E}\ \max_{(d,x,r)}\{\ d\ V_u(\hat{\psi})$$

$$+(1-d)[V_e(z, \hat{\psi}) + \lambda_e D(x, r, V_e(z, \hat{\psi}), \hat{\psi})]\ \}$$

Market tightness: $\theta(x, r, \psi)$

- determined by free entry of vacancies: for all (x, r),

$\theta(x, r, \psi) \geq 0$ and

$$k \geq \underbrace{q(\theta(x, r, \psi))}_{\text{filling prob}} \sum_{s \geq r} \left[\underbrace{\begin{pmatrix} \alpha\, V_e(s, \psi) + \\ (1-\alpha)\mathbb{E}_z V_e(z, \psi) \end{pmatrix}}_{\text{expected joint value of a match}} - x \right] f(s)$$

Theorem:

- All equilibria are block recursive:
  i.e., the following elements are independent of (u, g):
  - optimal choices of (d, x, r);
  - value functions: $V_u(y)$ and $V_e(z, y)$
  - market tightness function: $\theta(x, r, y)$

- There exists a unique block recursive equilibrium (BRE)

- The BRE is socially efficient

Recap: Why is equilibrium Block Recursive?

- Directed search
  $\Longrightarrow$ endogenous separation of workers into submarkets

- Free entry of firms into each submarket
  $\Longrightarrow$ each submarket's tightness independent of other submarkets

Block recursivity does NOT rely on:

- risk neutrality of workers (see Shi 09)
- efficient contracts (see Menzio and Shi 10b)

4. Data and Calibration

Data:

- HP-filtered CPS, 1951:I - 2006:II

  1992 index of average labor productivity = 100

- 1987 CPS Tenure Supplement;

- Conference Board Help-Wanted Index:
  2000 vacancy index = 100.

Functional forms:

- matching function: $p(\theta) = \min\{1, \theta^{\gamma}\}$, $\gamma \in (0,1)$;

- match specific productivity, $f(z) \sim Weibull(\mu_z, \alpha_z, \sigma_z)$:
  $\mu_z = 0$; α_z: shape parameter; σ_z: scale parameter;

- aggregate productivity $y \in Y$: 3-state Markov
  mean: $\mu_y = 1$, std: σ_y, autocorrelation: ρ_y.

Table 2. Identification of parameters
(**experience-goods: $\boldsymbol{\alpha} = \mathbf{0}$**)

	description	target	data	value
β	discount	real int. rate		0.996
λ_u	off the job search prob	normalize		1
μ_y	mean of average prod π	normalize		1
σ_y	std. of agg. shock	std. of agg. productivity	CPS	0.0152
ρ_y	persistence of π	persis of prod	CPS	0.76

Table 2. Identification of parameters (continued)
(**experience-goods: $\boldsymbol{\alpha} = \mathbf{0}$**)

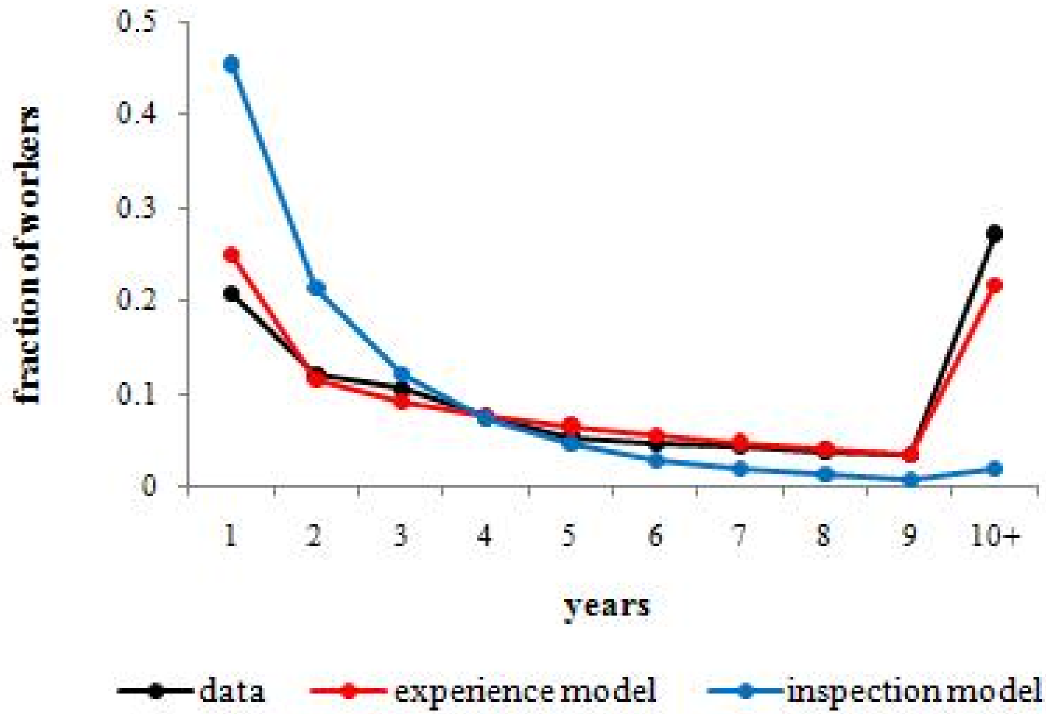
	description	target	data	value
k	vacancy cost	UE rate =0.45	CPS	1.550
b	unem benefit	EU rate =0.026	CPS	0.907
λ_e	OJS prob	EE rate =0.029	CPS	0.735
γ	parameter in matching	elasticity of h^{ue} to v/u (=0.27)	CPS	0.600

Transition rates are monthly

Table 2. Identification of parameters (continued)
(**experience-goods: $\boldsymbol{\alpha} = \mathbf{0}$**)

	description	target	data	value
σ_z	scale of specific prod.	ratio of home to market prod.	Hall & M. (= 0.71)	0.952
α_z	shape of specific prod.	tenure distribution	Diebold et al. 97	4.000
δ	exogenous destr. rate	same as above		0.012

Figure 9: Tenure distribution



5. Model's Predictions (experience goods)

$(\alpha = 0)$

	u	v	h^{ue}	h^{eu}	h^{ee}	π
relative std	**7.88**	2.54	**2.51**	**6.23**	**5.59**	1
	(9.56)	(10.9)	(5.96)	(5.48)	(5.98)	
quarterly acr	0.850	0.637	0.799	0.772	0.823	0.762
			cross correlation			
u	1	**-0.807**	**-0.976**	**0.972**	**-0.979**	-0.977
		(-0.902)	(-0.916)	(0.778)	(-0.634)	
v		1	0.897	**-0.898**	**0.858**	0.894
			(0.902)	(-0.778)	(0.607)	
π			0.999	-0.979	0.983	1

Figure 3: Transition rates, Experience model

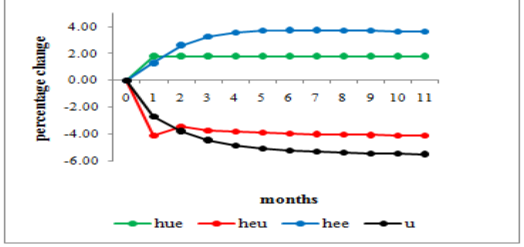


Figure 4: Vacancies, Experience model

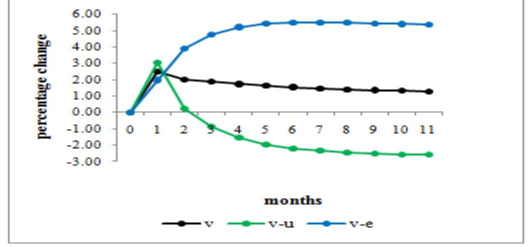


Figure 5: Productivities, Experience model

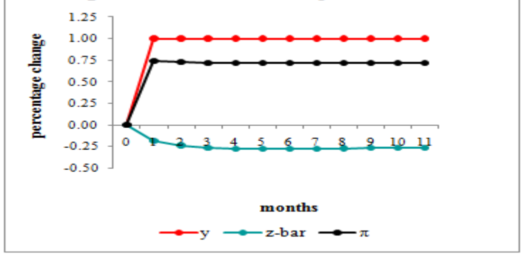


Figure 6: Transition rates, Inspection model

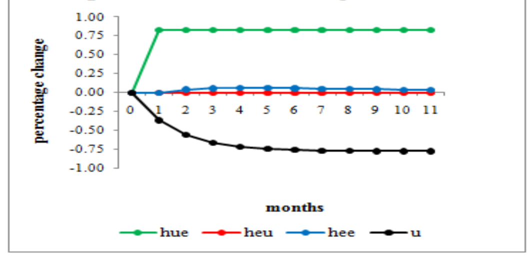


Figure 7: Vacancies, Inspection model

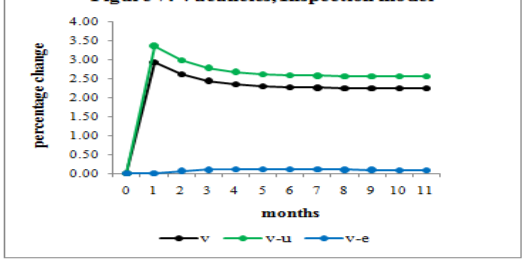
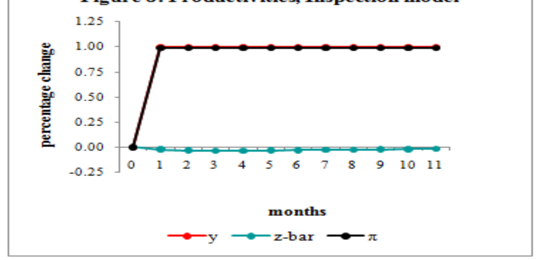


Figure 8: Productivities, Inspection model



Canonical model: no OJS ($\lambda_e = 0$); no heterogeneity ($\sigma_z = 0$)

	u	v	h^{ue}	h^{eu}	h^{ee}	π
relative std	**0.820**	2.690	**0.910**	**0**	—	1
	(9.56)	(10.9)	(5.96)	(5.48)	(5.98)	
quarterly acr	0.815	0.677	0.994	1	—	0.745
			cross correlation			
u	1	-0.932	-0.936	**0**	—	-0.972
		(-0.902)	(-0.916)	(0.778)	(-0.634)	
v		1	0.994	**0**	—	0.990
			(0.902)	(-0.778)	(0.607)	
π			0.999	0	—	1

What if OJS is prohibited?

- y shocks have no effect on vacancies for employed

- incentive to create vacancies weak
  $\Longrightarrow EU$ rate not volatile

- Beveridge curve may or may not be negatively sloped
  (when there is endogenous separation)

What if OJS is prohibited? (continued)

- under-estimate γ in matching function $[p(\theta) = \theta^{\gamma}]$

  $\Longrightarrow UE$ rate less responsive to θ (hence less volatile)

$\gamma = \frac{\Delta \log h^{ue}}{\Delta \log \theta_u} =$	$\frac{\Delta \log h^{ue}}{\Delta \log(v/u)}$	$\times$	$\frac{\Delta \log(v/u)}{\Delta \log \theta_u}$	$std(h^{ue})$
this model	0.27	$\times$	2.22	2.51
no OJS	0.27	$\times$	1	0.91

What if matches is homogeneous?

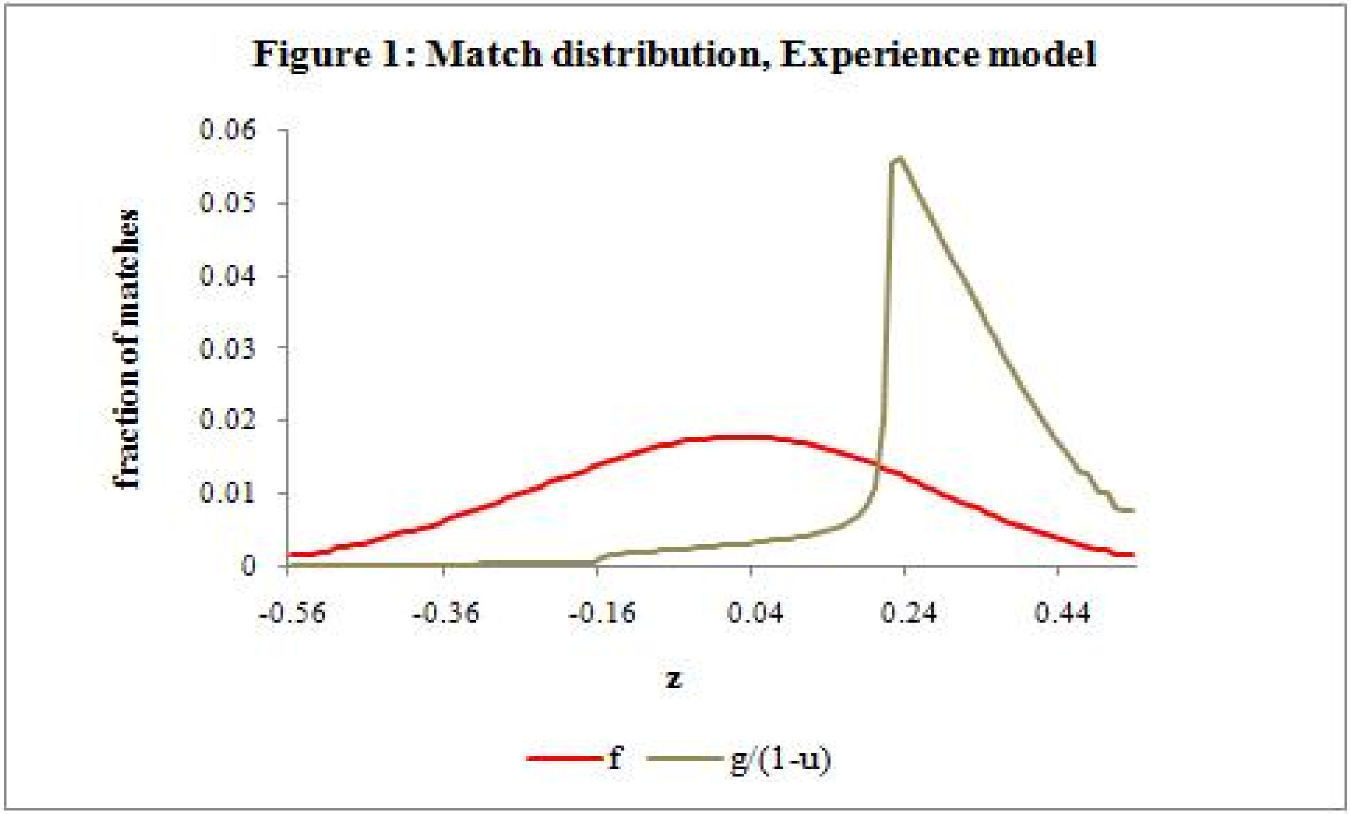
- EE flows not part of efficient allocation

- EU rate not countercyclical or volatile

  - missing mechanism:
    $y \uparrow \Longrightarrow$ critical level of s for job destruction falls

- underestimate volatility in y shocks
  (match heterogeneity $\Longrightarrow$ selection in match formation
  $\Longrightarrow$ dispersion in observed $p <$ dispersion in y)

Return to "matching capital"



Cleansing effect of recessions:

- on job creation:
  - negative y-shocks raise cutoff levels r_u and r_e above which matches are formed

- on job destruction:
  - negative y-shocks raise cutoff level r_d below which matches are destroyed

How important is cleansing effect?

Consider inspection-good version ($\alpha = 1$)

- cleansing effect on job destruction not operational
  reason: creation cutoffs r_u, $r_e >$ destruction cutoff r_d

- recalibrate model to the same targets

- model fails to
  - fit calibration target on tenure distribution
  - generate large volatility in labor market

Figure 9: Tenure distribution

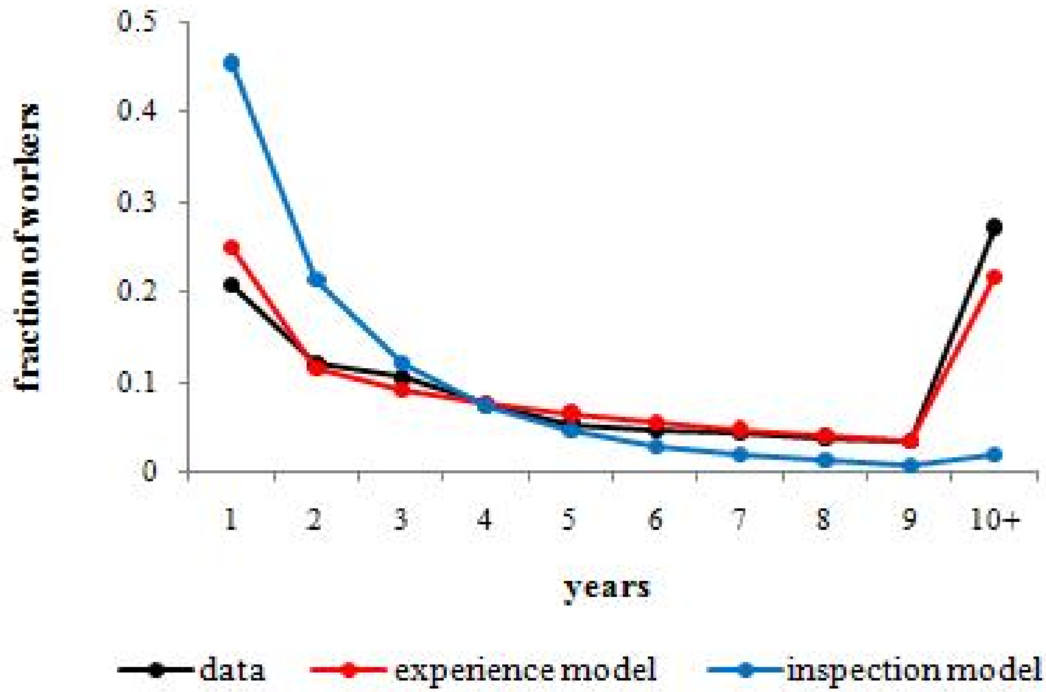
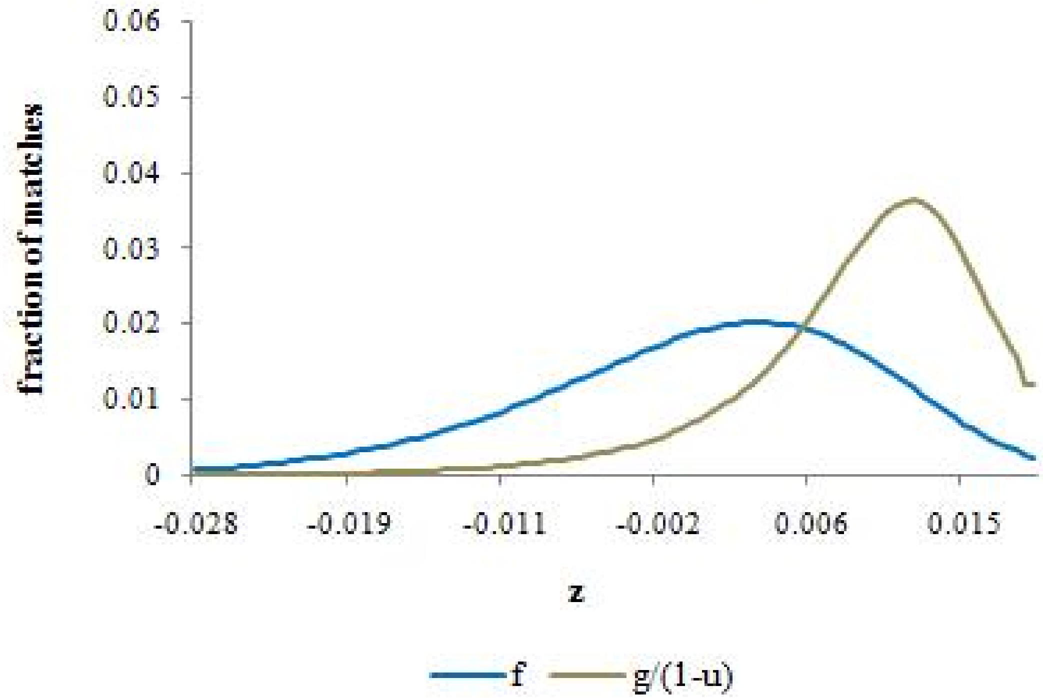


Figure 2: Match distribution, Inspection model



Model's predictions: inspection goods ($\alpha = 1$)

	u	v	h^{ue}	h^{eu}	h^{ee}	π
relative std	**0.75**	2.40	**0.84**	**0**	**0.06**	1
	(9.56)	(10.9)	(5.96)	(5.48)	(5.98)	
quarterly acr	0.829	0.686	0.747	1	0.743	0.750
u	1	**-0.935**	**-0.971**	**0**	**-0.817**	-0.977
		(-0.902)	(-0.916)	(0.778)	(-0.634)	
v		1	0.992	**0**	**0.824**	0.992
			(0.902)	(-0.778)	(0.607)	
π			0.999	0	0.833	1

6. Conclusion

- Tractable framework for studying business cycles with OJS and match heterogeneity

- BRE exists, is unique and socially efficient

- OJS + match heterogeneity account for
  - 80% of volatility in unemployment
  - strong Beveridge relationship
  - cyclical features of UE, EU and EE flows
  - experience-goods and tenure distribution