EFFICIENCY AND LABOR MARKET DYNAMICS IN A MODEL OF LABOR SELECTION

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LABOR FRICTIONS

- Labor selection
  - Potential new hires are heterogeneous in the cross section
- Heterogeneous along which dimensions?
  - Many…..
  - …but which ones have explicit micro-level evidence?
- Training costs / hiring costs
  - Apply only in the first period of employment
  - As new workers learn the methods of their new firm
- Incumbent workers have zero training costs
- Real life examples of training costs
  - Shadowing other workers to observe how job is performed
  - Computer setup and configurations
  - Understanding the culture of the firm
  - Etc.

LABOR FRICTIONS

- **Empirics**
  - **Firm-level evidence on costs of hiring and training in Barron, Black, and Loewenstein (1989 *JLE*)**
  - **Based on 1982 EOPP (Employment Opportunities Pilot Project)**
  - **Firms measure costs of hiring / training / looking for / integrating new workers**

  - **Subsequent literature based on Barron et al approach (e.g., Dolfin (2006))**
  - **Summary appears in Barron, Berger, and Black (1997 *Economic Inquiry*)**

- **Theory**
  - **DMP-style search and matching approach has become common …**
  - **…but other components of "hiring costs" likely also important**

  - **Davis, Faberman, and Haltiwanger (2013 *QJE*)**
    - **Evidence of heavy reliance by firms on other margins for hiring in addition to vacancy postings (JOLTS)**

LABOR FRICTIONS

- **Main Question**
  - How volatile are aggregates in response to business-cycle TFP shocks
  - Focusing only on efficient allocations
  - "Shimer puzzle" type of analysis
- **Main Result**

Training costs + heterogeneity in its idiosyncratic component

⇓ **Aggregate TFP shocks**

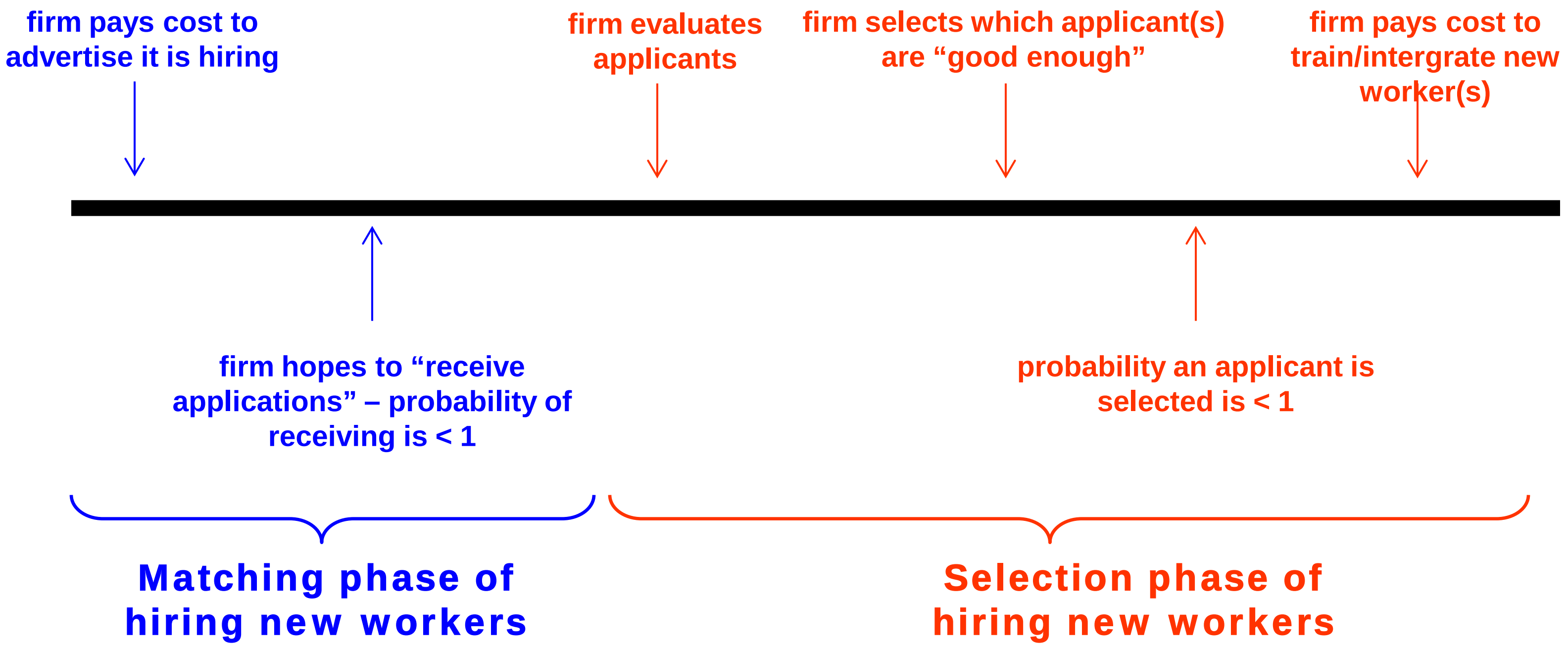
Fluctuations of unemployment and hiring (aka job-finding) rates an order of magnitude larger than efficient version of matching model

- **Contribution**
  - Other directly measurable micro-level aspects of the hiring process are quantitatively important
  - Don't have to resort to frictions in X or Y or Z…

LABOR FRICTIONS

- **Think about selection model as “extracting” a component from matching fct.**
- **Interpret “matching process” as a costly “contact process” or “meeting process”**

- **But also allow other costs in the hiring of workers**



firm pays cost to advertise it is hiring

firm hopes to “receive applications” – probability of receiving is < 1

firm evaluates applicants

firm selects which applicant(s) are “good enough”

probability an applicant is selected is < 1

firm pays cost to train/intergrate new worker(s)

Matching phase of hiring new workers

Selection phase of hiring new workers

LABOR FRICTIONS

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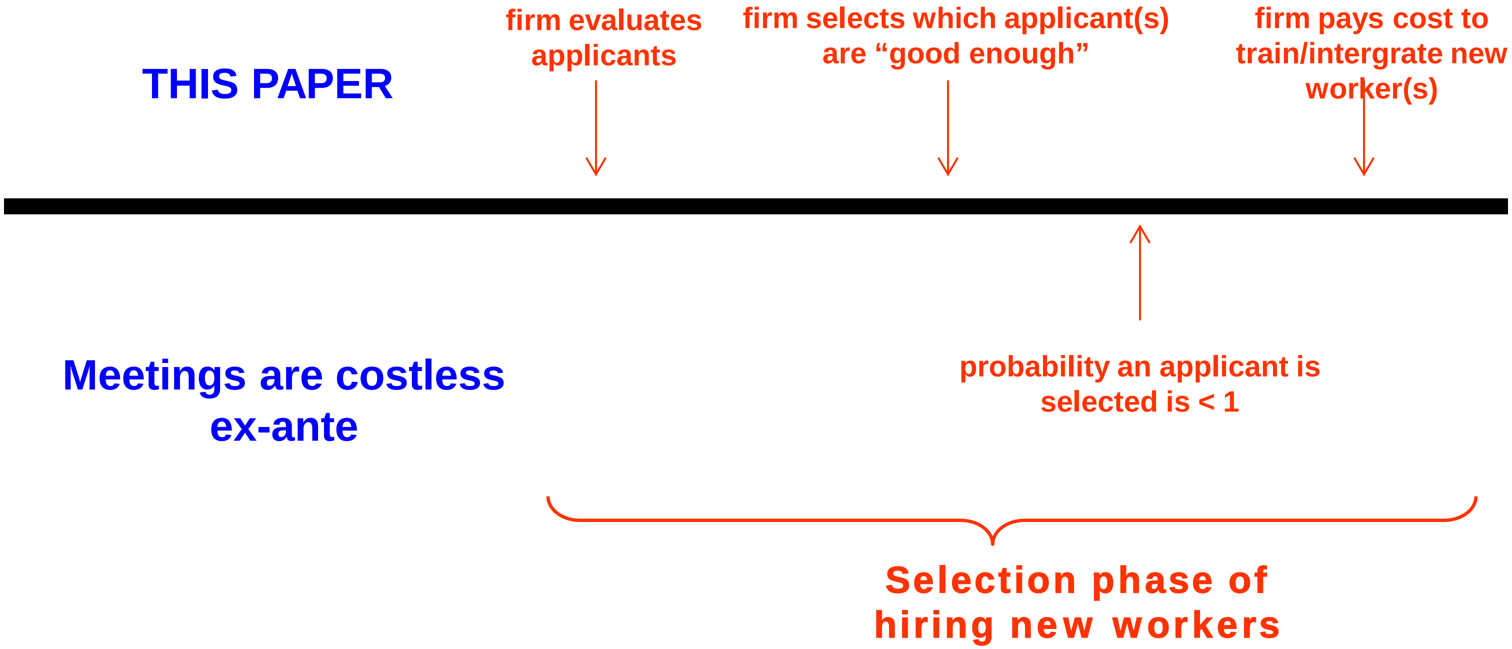


THIS PAPER

firm evaluates applicants

firm selects which applicant(s) are “good enough”

firm pays cost to train/intergrate new worker(s)

Meetings are costless ex-ante

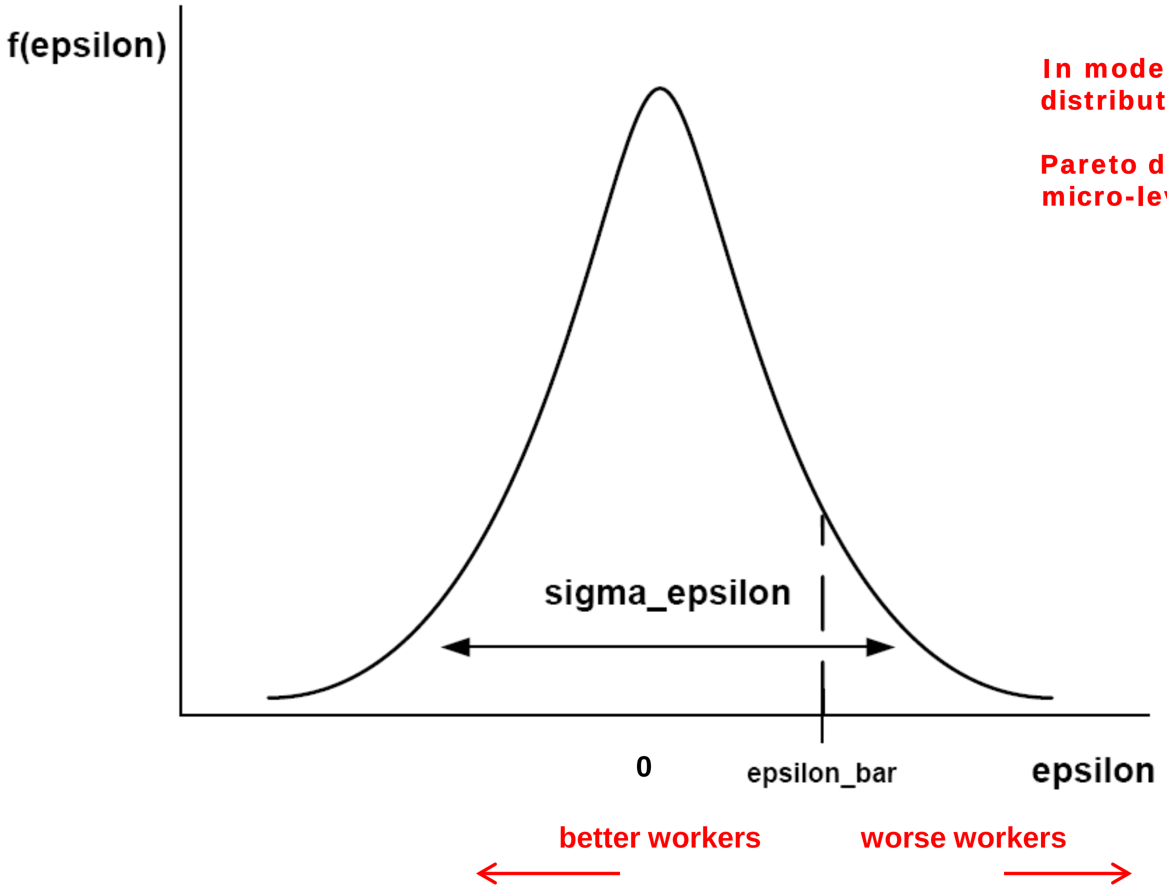
probability an applicant is selected is < 1

Selection phase of hiring new workers

- ☐ **Each unemployed individual can meet with only one firm in a period**

LABOR FRICTIONS

- ☐ **Cross-sectional distribution of training costs in period *t***



In model, we use log-normal distribution

Pareto distribution may match micro-level data better…

LABOR FRICTIONS

- **Crucial parameters**
  - **$\sigma_\varepsilon > 0$: cross-sectional standard deviation of potential worker *i*' s idiosyncratic / residual training cost**
  - **$\gamma^h > 0$: fixed cost to a firm of hiring ANY new individual – NOT *i*-specific**

- **Total training cost for new worker *i* in period *t* = $\gamma^h + \varepsilon^i$**

Idiosyncratic training/residual cost for new hire *i*

$$\varepsilon^i \sim \text{iid} \ln N(0,\sigma_\varepsilon^2)$$

TRAINING COSTS

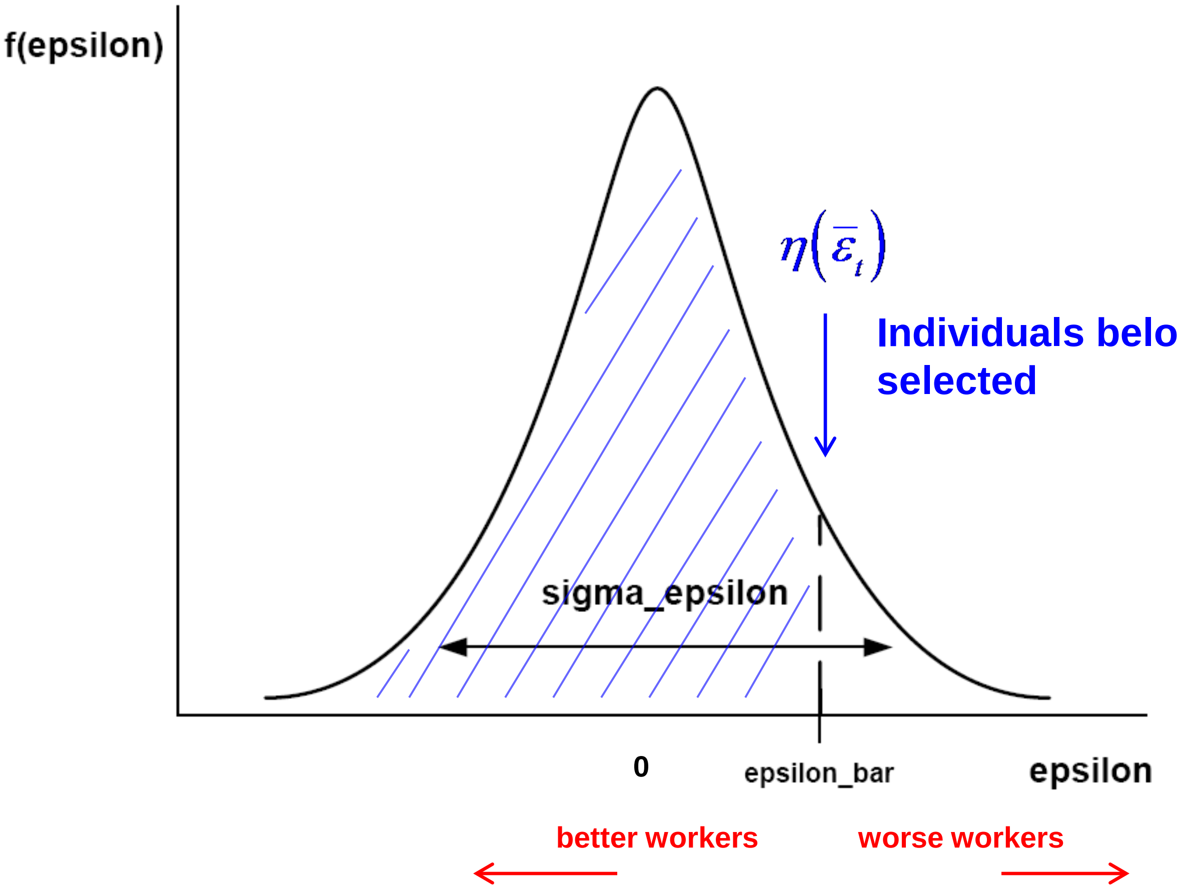
- **Optimal decision characterized by cutoff rule**
  - **Choose endogenous threshold $\bar{\varepsilon}_t$ below which everybody is selected to work**

- **CDF (hiring rate, aka selection rate, job-finding rate)**

$$\eta\left(\bar{\varepsilon}_t\right) = \int_{\varepsilon_t^i \leq \bar{\varepsilon}_t} f(\varepsilon_t^i) d\varepsilon_t^i$$

TRAINING COSTS

- ❑ **Cross-sectional distribution of training costs in period *t***



Individuals below CDF $\eta(\varepsilon_t)$ are selected

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$$\eta\left(\bar{\varepsilon}_t\right)=\int_{\varepsilon_t^i\le\bar{\varepsilon}_t} f(\varepsilon_t^i)d\varepsilon_t^i$$

- ❑ **Training cost for threshold new worker = $\gamma^h + \varepsilon^i$**
- ❑ **Average idiosyncratic training costs for those individuals who are hired**

$$H\left(\bar{\varepsilon}_t\right)=\int_{\varepsilon_t^i\le\bar{\varepsilon}_t} \varepsilon_t^i f(\varepsilon_t^i)d\varepsilon_t^i$$

SELECTION PROBLEM

- **Dynamic surplus maximization problem**

non-market payoff

$$\max_{\{n_t,\bar{\varepsilon}_t\}} E_0\sum_{t=0}^{\infty}\left(\frac{1}{1+r}\right)^t\left[z_t n_t + s_t\left(1-\eta\left(\bar{\varepsilon}_t\right)\right)\overset{\downarrow}{b} - s_t\eta\left(\bar{\varepsilon}_t\right)\left(\gamma^h+\frac{H\left(\bar{\varepsilon}_t\right)}{\eta\left(\bar{\varepsilon}_t\right)}\right)\right]$$

$$n_t=(1-\rho)n_{t-1}+s_t\eta\left(\bar{\varepsilon}_t\right)$$

$$s_t=\ell fp-(1-\rho)n_{t-1}$$

***lfp* fixed in partial equilibrium**

- **Efficient selection condition**

$$\underbrace{\gamma^h+\bar{\varepsilon}_t}_{\text{Asset value of a new worker}}=z_t-b+\left(\frac{1-\rho}{1+r}\right)E_t\left\{\underbrace{H(\bar{\varepsilon}_{t+1})-\bar{\varepsilon}_{t+1}\eta(\bar{\varepsilon}_{t+1})}_{\text{Expected social cost of a replacement new worker hired in } t+1}+\underbrace{\gamma^h+\bar{\varepsilon}_{t+1}}_{\text{Asset value of a replacement new worker}}\right\}$$

EFFICIENT ALLOCATION

- **Endogenous processes $\{\tilde{\varepsilon}_t, n_t\}_{t=0}^{\infty}$ that satisfy**
  - **Selection condition**

$$\underbrace{\gamma^h + \bar{\varepsilon}_t}_{\text{Asset value of a new worker}} = z_t - b + \left(\frac{1-\rho}{1+r}\right) E_t \left\{ \underbrace{H(\bar{\varepsilon}_{t+1}) - \bar{\varepsilon}_{t+1}\eta(\bar{\varepsilon}_{t+1})}_{\text{Expected social cost of a replacement new worker hired in } t+1} + \underbrace{\gamma^h + \bar{\varepsilon}_{t+1}}_{\text{Asset value of a replacement new worker}} \right\}$$

  - **Law of motion for aggregate labor**

$$n_t = (1-\rho)n_{t-1} + s_t\left(1 - \eta\left(\tilde{\varepsilon}_t\right)\right)$$

taking as given initial labor n_{-1} and exogenous stochastic process $\{z_t\}_{t=0}^{\infty}$

ELASTICITIES

- ❑ **One-period elasticity (ρ = 1)**

$$\frac{\partial \ln \bar{\varepsilon}_t}{\partial \ln z_t} = \frac{z_t}{\bar{\varepsilon}_t}$$

- ❑ **Multi-period elasticity (steady state, for 0 < ρ < 1)**

$$\frac{\partial \ln \bar{\varepsilon}}{\partial \ln z} = \frac{z}{\bar{\varepsilon}} \cdot \frac{1+r}{r+\rho+(1-\rho)\eta(\bar{\varepsilon})}$$

- ❑ **Hiring rate**

$$\frac{\partial \ln \eta(\bar{\varepsilon})}{\partial \ln z} = \frac{\partial \ln \eta(\bar{\varepsilon})}{\partial \ln \bar{\varepsilon}} \cdot \frac{\partial \ln \bar{\varepsilon}}{\partial \ln z}$$

HIRING

- ❑ **Analytical example**

$$U[-0.7,0.7] \qquad f(\varepsilon)=\frac{1}{0.7-(-0.7)} \qquad \eta(\bar{\varepsilon})=\frac{\bar{\varepsilon}-(-0.7)}{2\cdot 0.7}$$

$$\frac{\partial \ln \eta(\bar{\varepsilon})}{\partial \ln z}=\frac{\partial \ln \eta(\bar{\varepsilon})}{\partial \ln \bar{\varepsilon}}\cdot\frac{\partial \ln \bar{\varepsilon}}{\partial \ln z}$$

$$=\frac{\eta'(\bar{\varepsilon})}{\eta(\bar{\varepsilon})}\cdot\frac{z}{\bar{\varepsilon}}\cdot\frac{1+r}{r+\rho+(1-\rho)\eta(\bar{\varepsilon})}$$

Using conventional quarterly calibration

$$=\frac{1}{0.58}\cdot 1.43\cdot 1.60$$

η = 0.58 (job-finding rate by unemployed)
ρ = 0.10 (employment separation rate)
r = 0.01

$$=3.94$$

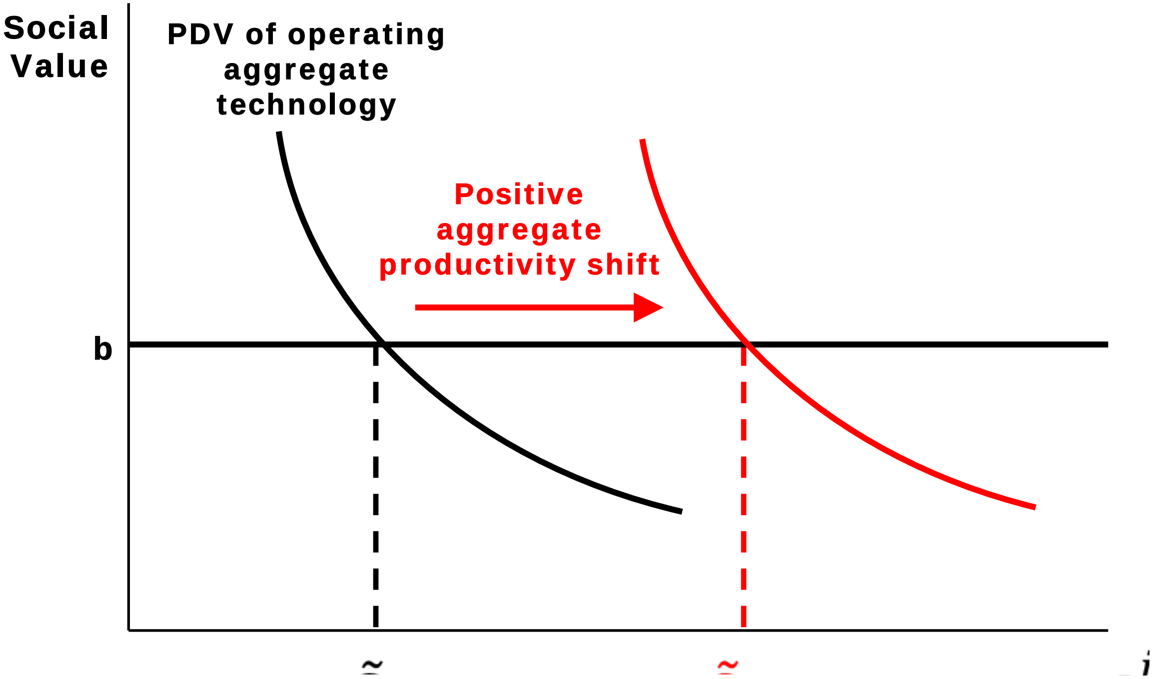
Much larger than the ZERO efficient fluctuations in baseline matching model

- ❑ **Remarkably similar to the empirical elasticity of 2.9**

HIRING

- ❑ **Downward-sloping “labor demand function”**

$$\gamma^h + \bar{\varepsilon}_t = z_t - b + \left(\frac{1-\rho}{1+r}\right) E_t \left\{ H(\bar{\varepsilon}_{t+1}) - \bar{\varepsilon}_{t+1}\eta(\bar{\varepsilon}_{t+1}) + \gamma^h + \bar{\varepsilon}_{t+1} \right\}$$



CALIBRATION

- ❑ **Quantitative example**

- ❑ **Distribution of training costs**
  - ❑ **σ_ε chosen to hit cross-sectional SD of training costs of 40 percent of MPN**
    - ❑ **Barron, Black, and Loewenstein (1989, p. 5): SD across new hires of training costs during first three months of employment = 207 hours (= 40% of MPL)**
    - ❑ **In our model implies the SD is 40% of worker's long-run marginal product of labor, which is normalized to z = 1**

Based on 1982 EOPP survey conducted by BLS

CALIBRATION

- **Quantitative example**

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Based on 1982 EOPP survey conducted by BLS

- **Calibrate γ^h to hit average hiring rate ≈ 58% (a macro calibration approach)**
  - **Average hiring cost turns out > Barron et al's measure (= 150 hours)**
    - **Consumes too much (> 100%) of new hire's MPL in the model**
    - **Nobody has negative training costs → skewed distribution**

- **Calibrate outside option b = 71 percent of new worker's marginal product**
  - **Rationale: re-matching in the market is not the relevant "outside option" (Hall and Milgrom (2008 *AER*))**

- **Other parameters conventional**
  - **$r = 0.01$, standard quarterly TFP process ($\rho_z = 0.95$, $\sigma_z = 0.01$)**

DATA

- **U.S. economy: 1951:Q1 – 2006:Q4**
  - **(HP-filtered, smoothing parameter 1,600)**

	N	UE	ETA
Mean	**0.69**	**0.05**	**0.58**
Volatility (SD %)	**0.60**	**5.15**	**8.30**
Autocorr.	**0.89**	**0.87**	**0.82**

MODEL

- **Business cycle moments**
- **Partial equilibrium and aggregate productivity shocks**

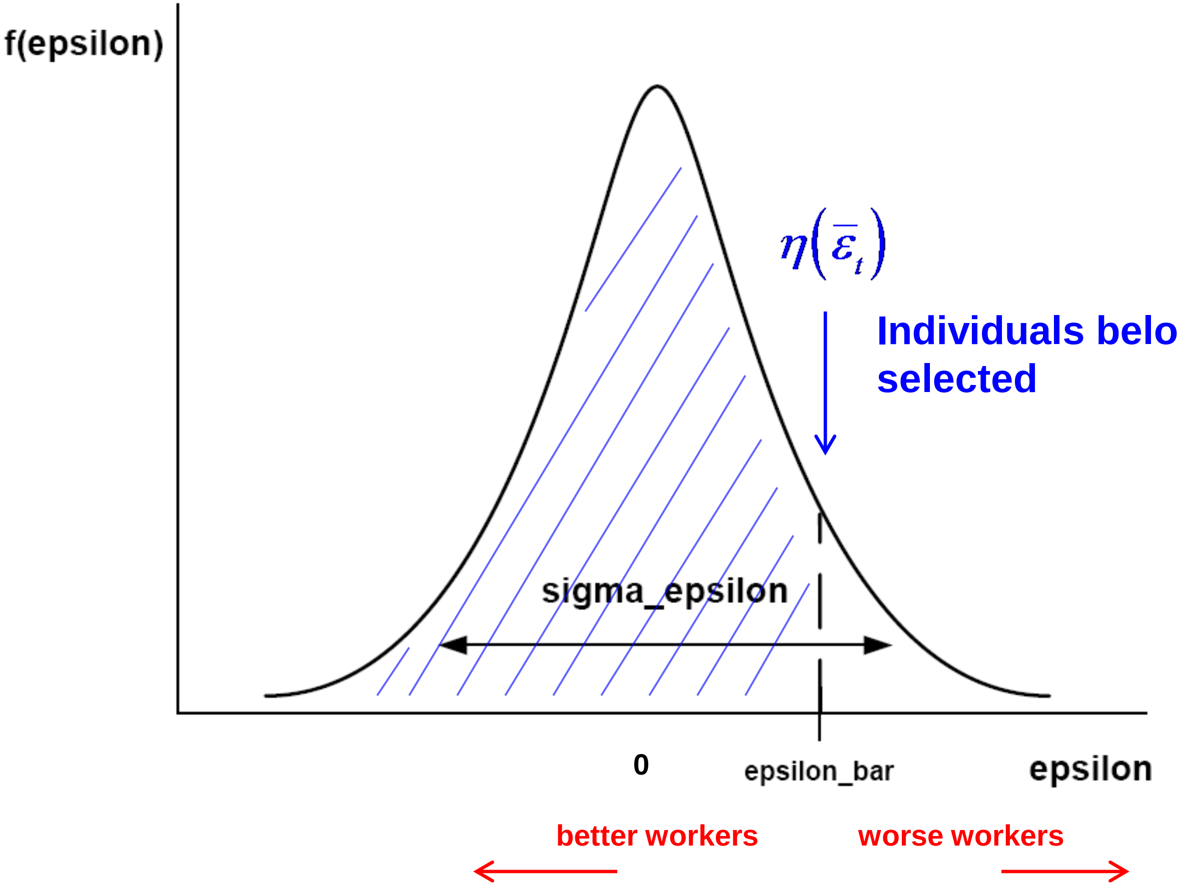
	N	UE	ETA
Mean	0.69	0.05	0.58
Volatility (SD %)	0.50	6.85	3.46
Autocorr.	0.87	0.87	0.76

One to two orders of magnitude larger than responses to TFP shocks in efficient baseline matching model.

(Infinitely larger if considering the slightly tweaked model of Shimer (2010) and Rogerson and Shimer (2011))

MODEL

- **Cross-sectional distribution of training costs in period *t***



Individuals below CDF $\eta(\varepsilon_t)$ are selected

HOW TO CALIBRATE σ_ε?

- ☐ Cross-sectional dispersion σ_ε of idiosyncratic characteristics a vital parameter
  - ☐ So far basing it on Barron et al (1989) and Dolfin (2006)
  - ☐ Pro: Micro-level evidence
  - ☐ Con: Relatively old data

- ☐ Can we use cross-sectional wage data directly?
  - ☐ Requires assuming some wage function, itself a tricky matter
  - ☐ (There is no concept of Hosios-efficient wage determination in selection model)

- ☐ **Firm-level data** on integration / training / administrative costs of new hires?
  - ☐ Only evidence we know is from 1982 EOPP (Barron et al (1989), Dolfin (2006))

PARETO DISTRIBUTION

- ❑ **Pareto would allow us to jointly target exactly the first moment AND the second moment in the micro data**
- ❑ **Clear pro: would align well with the Ghironi and Melitz (2005) based literature**
- ❑ **However…**
  - ❑ **We have data on idiosyncratic COSTS….**
  - ❑ **Not on idiosyncratic PRODUCTIVITY**
  - ❑ **Seems very analogous, but is it valid to simply state the distribution in terms of the INVERSE of idiosyncratic training costs?….**

BEVERIDGE CURVE

- Do selection effects have implications for Beveridge Curve?
- Model does not display a Beveridge Curve (vacancy posting costs = 0)

- Suppose vacancies < ∞
  - **Conjecture:** Increase in cross-sectional dispersion σ_ε → Beveridge Curve shifts outward
  - Mechanism
    - Hold all other parameters fixed
    - For any level of v, increase in σ_ε would cause fewer potential workers to be hired
- All depends on the curvature of the distribution around the selection threshold

SELECTION + MATCHING

- In progress with Merkl and Lechthaler
- Dynamic surplus maximization problem

standard DMP matching function

$$E_0 \sum_{t=0}^{\infty} \left(\frac{1}{1+r}\right)^t \left[z_t n_t + \left[s_t - m(s_t, v_t) \right] b - \eta\left(\bar{\varepsilon}_t\right) m(s_t, v_t) \left(\gamma^h + \frac{H\left(\bar{\varepsilon}_t\right)}{\eta\left(\bar{\varepsilon}_t\right)} \right) - \vartheta(v_t) \right]$$

standard DMP
vacancy posting cost

$$n_t = (1-\rho) n_{t-1} + \eta\left(\bar{\varepsilon}_t\right) m(s_t, v_t)$$

$$s_t = \ell f p - (1-\rho) n_{t-1}$$

SELECTION + MATCHING

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standard DMP matching function

$$E_0\sum_{t=0}^{\infty}\left(\frac{1}{1+r}\right)^t\left[z_t n_t + \left[s_t - m(s_t,v_t)\right]b - \eta\left(\bar{\varepsilon}_t\right)m(s_t,v_t)\left(\gamma^h + \frac{H\left(\bar{\varepsilon}_t\right)}{\eta\left(\bar{\varepsilon}_t\right)}\right) - \vartheta(v_t)\right]$$

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standard DMP
vacancy posting cost

$$s_t = \ell fp - (1-\rho)n_{t-1}$$

- **Efficient selection condition**

$$\gamma^h + \bar{\varepsilon}_t = z_t - b + \left(\frac{1-\rho}{1+r}\right)E_t\left\{m_{st+1}\cdot\left[H(\bar{\varepsilon}_{t+1}) - \bar{\varepsilon}_{t+1}\cdot\eta(\bar{\varepsilon}_{t+1})\right] + \gamma^h + \bar{\varepsilon}_{t+1}\right\}$$

- **Efficient vacancy creation condition**

$$\frac{\vartheta'(v_t)}{m_{vt}} = \bar{\varepsilon}_t\eta(\bar{\varepsilon}_t) - H(\bar{\varepsilon}_t)$$

SELECTION + MATCHING

- ☐ **Selection model: high elasticity of hiring rate wrt TFP**
- ☐ **Matching model: low / zero elasticity of hiring rate wrt TFP**
- ☐ **Natural conjecture: combined model will deliver something in between**

- ☐ **Elasticities (steady state)**

Cobb-Douglas matching

$$\frac{\partial \ln \bar{\varepsilon}}{\partial \ln z} = \frac{z}{\bar{\varepsilon}} \cdot \frac{1+r}{r+\rho+\frac{(1-\rho)\eta(\bar{\varepsilon})}{\xi}} < \overbrace{\frac{z}{\bar{\varepsilon}} \cdot \frac{1+r}{r+\rho+(1-\rho)\eta(\bar{\varepsilon})}}^{\text{Pure selection model}}$$

Generalized CRS matching (den Haan et al (2000 *AER*))

$$\frac{\partial \ln \bar{\varepsilon}}{\partial \ln z} = \frac{z}{\bar{\varepsilon}} \cdot \frac{1+r}{r+\rho+(1-\rho)\eta(\bar{\varepsilon}) \cdot m_s \cdot \left(1+\frac{1+\theta^{\xi}}{\theta^{2\xi}}\right)} < \frac{z}{\bar{\varepsilon}} \cdot \frac{1+r}{r+\rho+(1-\rho)\eta(\bar{\varepsilon})}$$

SUMMARY

- ☐ **Powerful amplification effects of aggregate productivity on labor market**
  - ☐ **Does not require any particular wage decentralization scheme**
- ☐ **(General equilibrium model works the same way – see Table 2)**
- ☐ **How best to calibrate or even measure σ_ε?**
- ☐ **Changes in cross-sectional distribution of risk?**
- ☐ **"Risk shocks" in labor data? i.e., has σ_ε gotten larger…**
  - ☐ **Compared to pre-2008? Pre- vs. post-1984?**
- ☐ **Labor selection and labor matching complementary mechanisms**
  - ☐ **Selection stresses cross-sectional issues ("I hope this new worker integrates into the job easily")**
  - ☐ **Matching stresses intertemporal issues ("I hope we find any suitable candidates at all")**
  - ☐ **In progress (with Merkl and Lechthaler): efficient matching + selection model**
  - ☐ **In progress (with Merkl and Lechthaler): optimal fiscal policy in selection model**