Efficiency and Labor Market Dynamics in a Model of Labor Selection

April 18, 2017

MOTIVATION

- Goals of project

- Explain business-cycle volatility in unemployment and job-finding

- Using efficient allocations
  - (Avoid wage formation altogether…)

- Using costs of hiring distinct from vacancy posting costs

- (Note: Efficient allocations in "baseline" search and matching framework will not get us there)
  - "Shimer puzzle"

METHODOLOGY

- **Methodology of project**
- **Exploit cross-sectional heterogeneity amongst (potential) new hires' characteristics**
- **Discipline with micro-economic data**
- **Micro-data about cross-sectional heterogeneity?**
  - **Person *i*-specific productivity difficult (impossible?) to measure ("How much can person *i* produce?")**

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  - **Person *i*-specific productivity difficult (impossible?) to measure ("How much can person *i* produce?")**
  - **Wage data easily available**
    - **BUT our model intentionally avoids how wages are determined**
    - **(return to this point soon…)**
- **Our framework uses micro-level "match quality" data**
  - **Costs of "integrating" / "training" potential new hires**

DATA

- **Empirics**
- **Cost of training / hiring**
  - **Apply only in the first period of employment**
  - **As new workers learn the methods of their new firm**
- **Incumbent workers incur zero training costs**
- **Real life examples of training costs**
  - **Shadowing other workers to observe how job is performed**
  - **Understanding the culture of the firm**
  - **Computer setup and configurations**
  - **Etc…**
- **Barron, Black, and Loewenstein (1989 *JLE*)**
  - **Firm-level costs of interviewing/hiring/training/integrating new workers**
  - **Based on 1982 EOPP (Employment Opportunities Pilot Project)**
  - **"…workers of varying abilities are matched to positions with different training requirements."**

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- **Reports first moments and cross-sectional second moments**
- **(Any other evidence on cross-sectional second moments?...)**

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- **Reports first moments and cross-sectional second moments**
- **(Any other evidence on cross-sectional second moments?...)**
- **1982 EOPP data continues to be used in various applications**
  - **Different investment in match-specific capital for different education groups (Cairo and Cajner, 2013 WP)**
  - **Size of labor turnover costs (relevant for search and matching models) – e.g., Silva and Toledo (2009 *MD*)**
  - **Effects of training costs of firm-specific labor turnover (Dolfin 2006 *Applied Economics*)**

MODEL

- Main components
  - Fixed cost γ^h of "training" each new hire (systematic component)
  - Idiosyncratic training cost for each new hire *i*

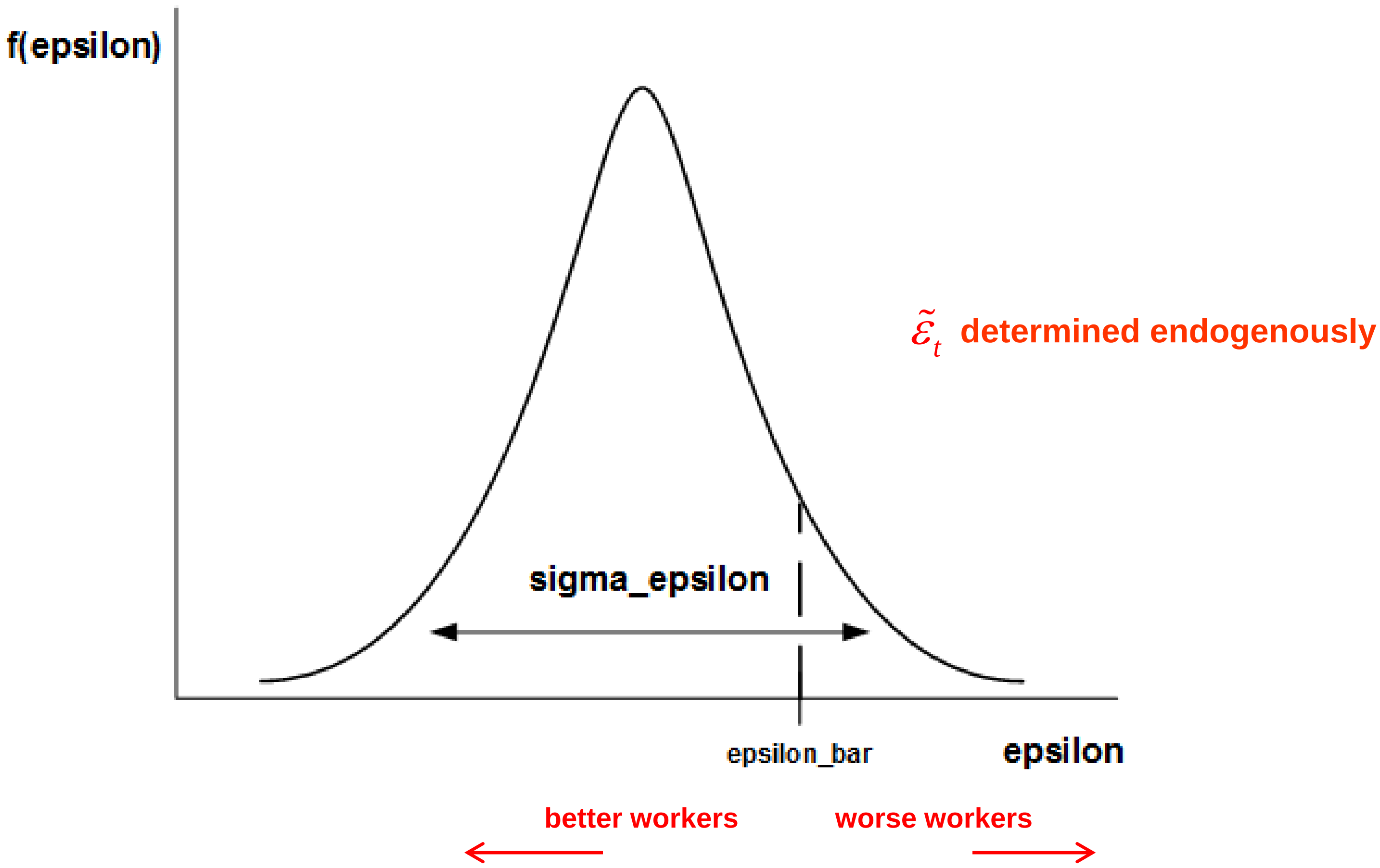
- Total training cost for new worker *i* in period *t* = $\gamma^h + \varepsilon^i$

Idiosyncratic training/residual cost for new hire *i*

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

DISTRIBUTION

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



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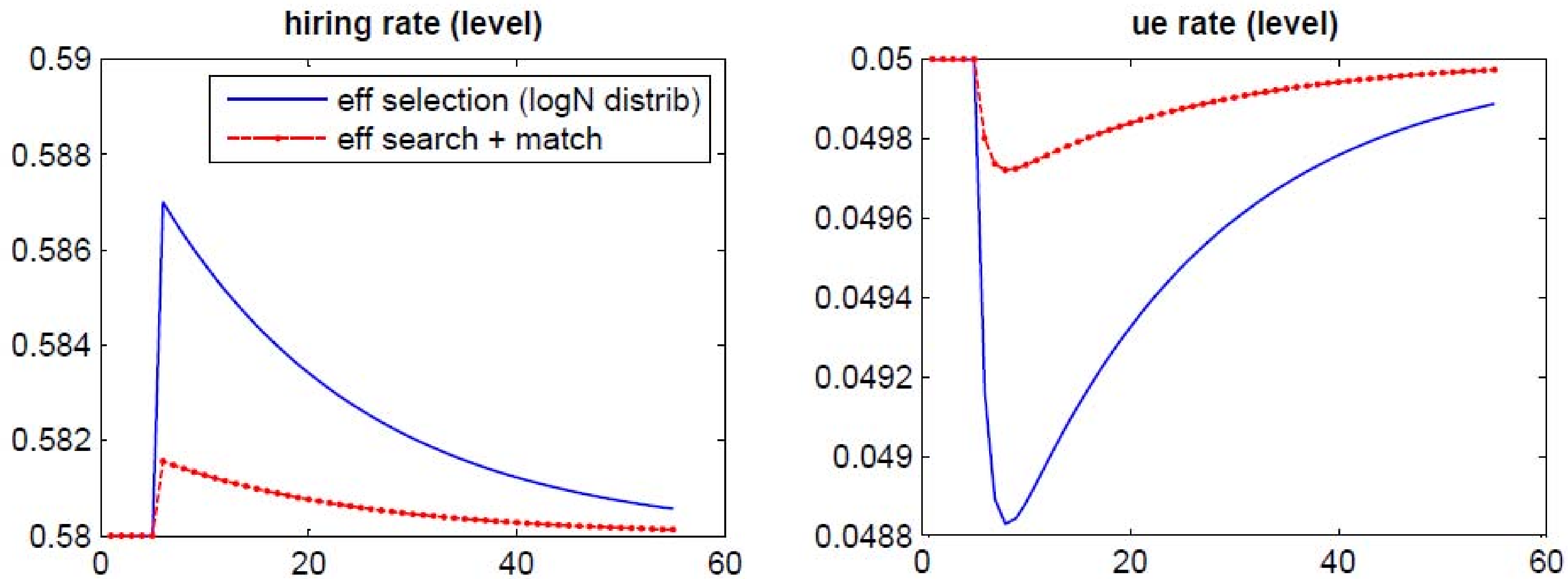
- Cross-sectional SD σ_ε informed by Barron et al

- Dispersion of training costs considered a primitive
  - (Similar to matching function taken as primitive in DMP-based models)

- No search and matching component
  - To focus on the endogenous selection component
  - Davis, Faberman, and Haltiwanger (2013 *QJE*): Evidence of heavily reliance on other margins for hiring in addition to vacancy postings (JOLTS)

MAIN RESULTS AND CONTRIBUTIONS

- **Efficient volatility arises and is meaningful**
  - **No wage decentralization in model**
  - **Conditional on TFP shocks**



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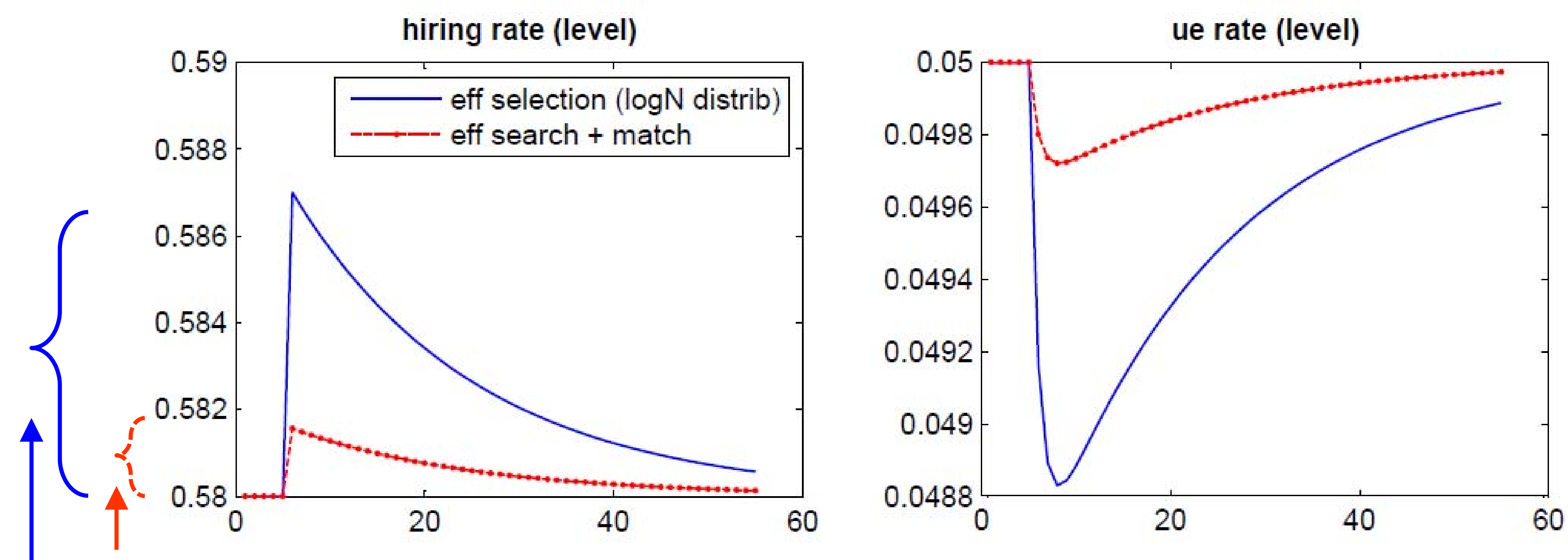


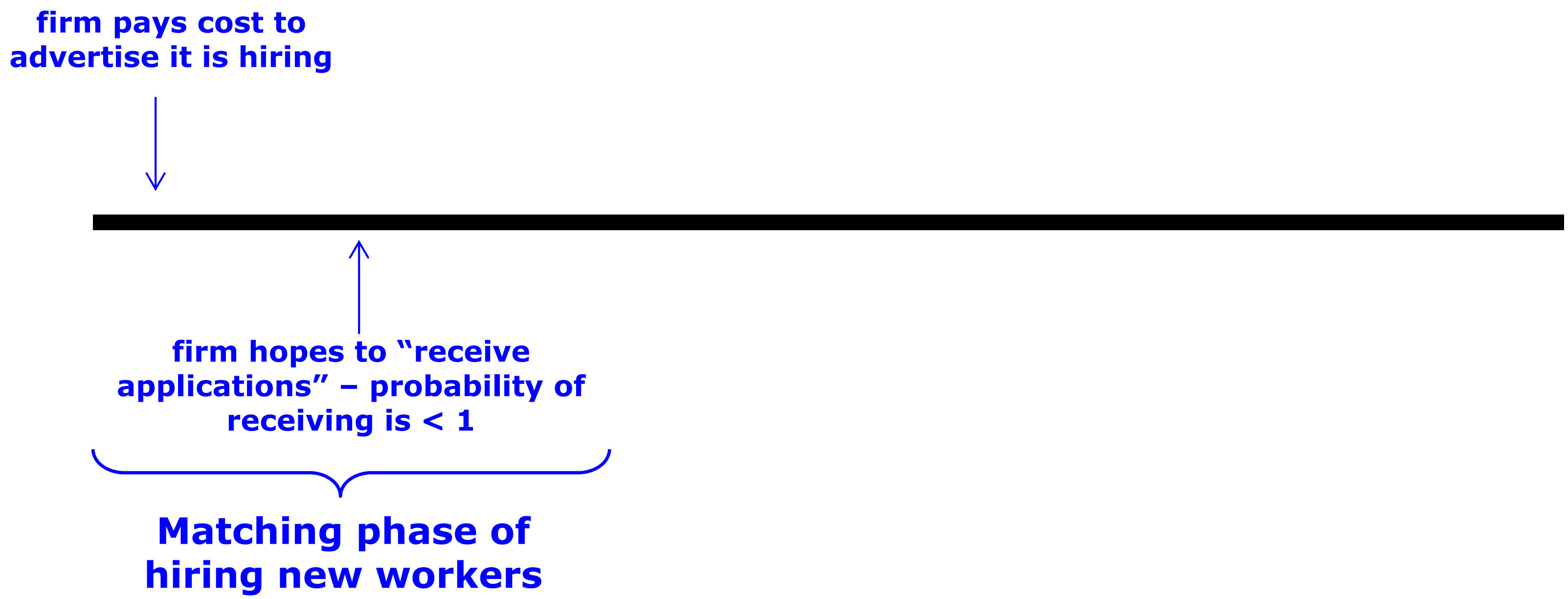
elasticity = 0.3

elasticity = 1.2

Empirical elasticity = 2.9

EX-ANTE VS. EX-POST HIRING COSTS

- ❑ **Think about selection model as hiring candidates who have the "best skills"**
- ❑ **Interpret "matching process" as a costly "contact process" or "meeting process"**



EX-ANTE VS. EX-POST HIRING COSTS

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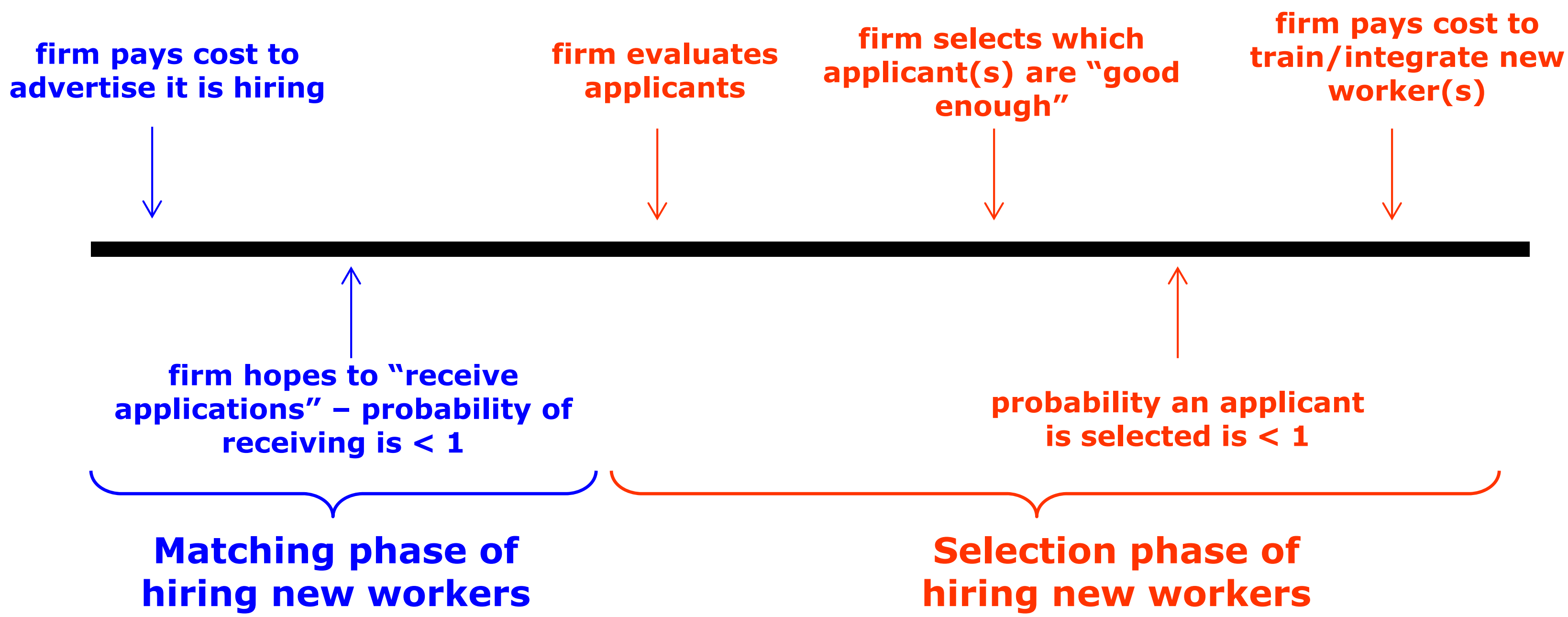
- Interpret "matching process" as a costly "contact process" or "meeting process"
- But also allow other costs in the hiring of workers



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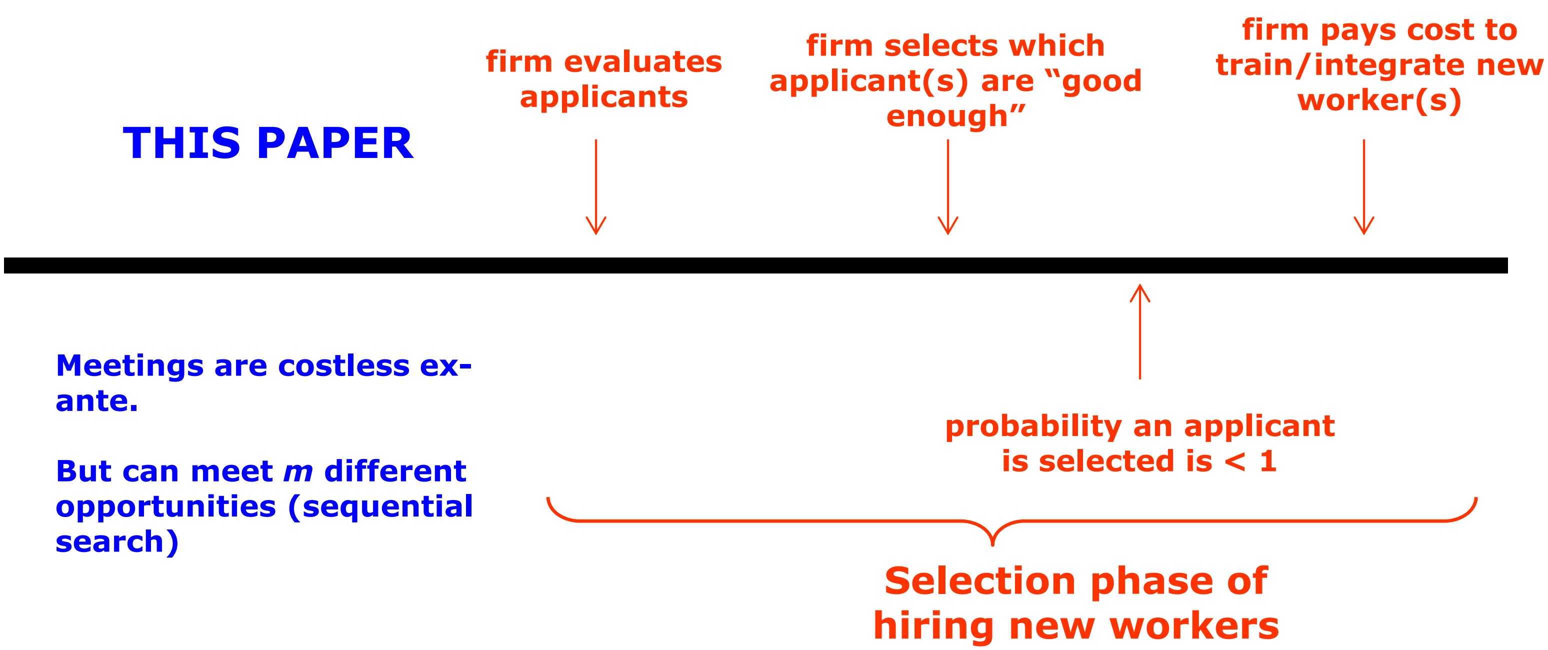

- ❑ **Baseline: Each unemployed individual meets only one firm in any period**
- ❑ **Can generalize to allow *N* Poisson meetings per period (i.e., N=2, N=3, ...)**

MAIN RESULTS AND CONTRIBUTIONS

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- **Elasticity of hiring rate wrt TFP: Empirical value = 2.9**
  - **Has not appeared in literature (as far as we know…)**
  - **Constructed using data from Shimer (2005) and Michaillat (2012)**
  - **(Potentially?) another contribution**

- **Endogenous value from previous example: 1.2**

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- **Caveat / Question**
  - **Depends on the data we employ to calibrate SD σ_ε …**
  - **… we use training cost dispersion**
  - **What if we use new hires' wage dispersion as "upper bound" on SD σ_ε?**

σ_ε from wage dispersion = 1.5 σ_ε from hiring cost dispersion

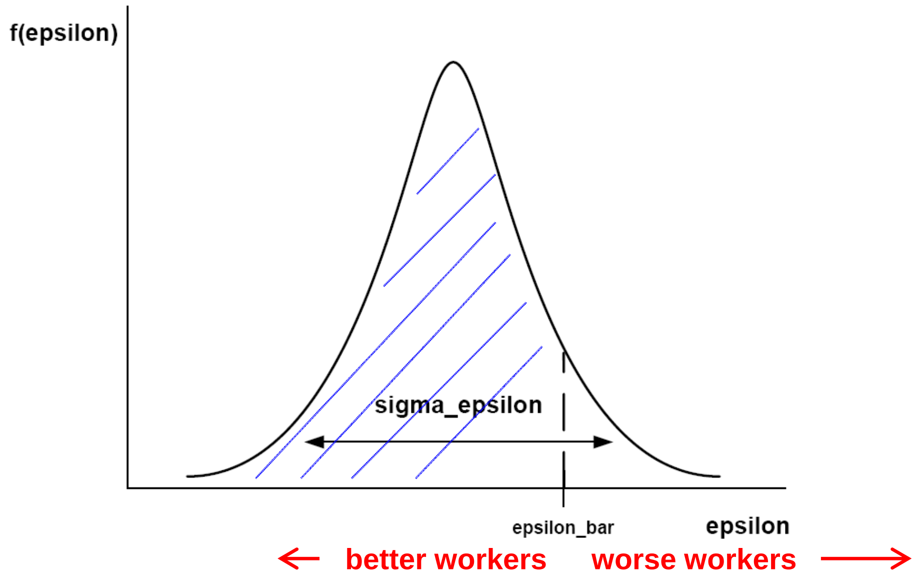
→ Volatility results dampen a tiny bit…

Definitions

SELECTION MARGIN

- **Optimal decision characterized by cutoff rule**
  - **Choose endogenous threshold $\tilde{\varepsilon}_t$ below which everybody is selected to work**
- **CDF (hiring rate, aka selection rate, aka job-finding rate)**

$$\eta(\tilde{\varepsilon}_t) = \int_{\varepsilon_t^i \le \tilde{\varepsilon}_t} f(\varepsilon_t^i) \cdot d\varepsilon_t^i$$



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

$$H(\tilde{\varepsilon}_t) = \int_{\varepsilon_t^i \le \tilde{\varepsilon}_t} \varepsilon_t^i f(\varepsilon_t^i) \cdot d\varepsilon_t^i$$

Social Planner Model
(Partial Equilibrium)

EFFICIENT SELECTION

- Dynamic surplus maximization problem

non-market payoff

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

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

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

lfp **fixed in partial equilibrium**

EFFICIENT ALLOCATION

- **Definition: efficient allocations are endogenous processes** $\left\{\tilde{\varepsilon}_t, n_t\right\}_{t=0}^{\infty}$ **that satisfy**

  - **Selection condition**

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

  - **Law of motion for aggregate labor**

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

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

Shape of Distribution

Slope of Distribution at Threshold

How to Calibrate σ_ε

ELASTICITIES

- Steady-state elasticities
- Elasticity of selection threshold wrt TFP

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

- Elasticity of hiring rate wrt TFP

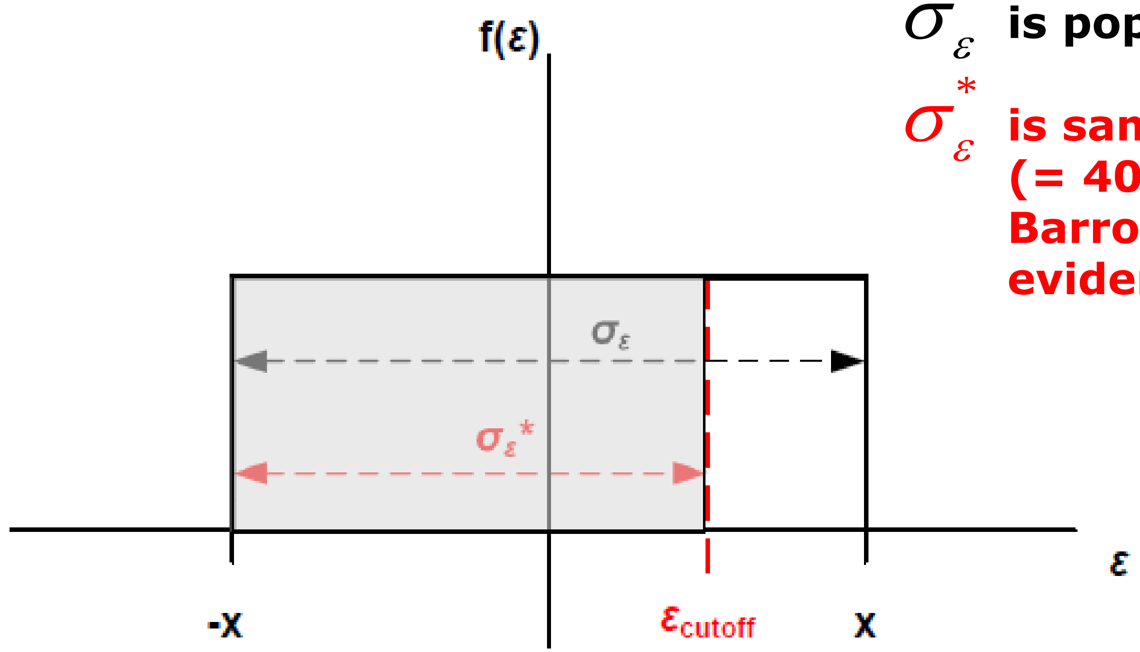
$$\frac{\partial \ln \eta(\tilde{\varepsilon})}{\partial \ln z} = \frac{\partial \ln \eta(\tilde{\varepsilon})}{\partial \ln \tilde{\varepsilon}} \frac{\partial \ln \tilde{\varepsilon}}{\partial \ln z}$$

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

- **Empirical data to measure slope at endogenous cutoff point $\tilde{\varepsilon}$?**
- **Depends on shape of distribution…**

UNIFORM DISTRIBUTION

- **Warm-up example**
- $\eta'(\tilde{\varepsilon})$ **independent of** ε_i



σ_ε **is population SD**

σ^*_ε **is sample SD (= 40% of MPL in Barron et al evidence)**

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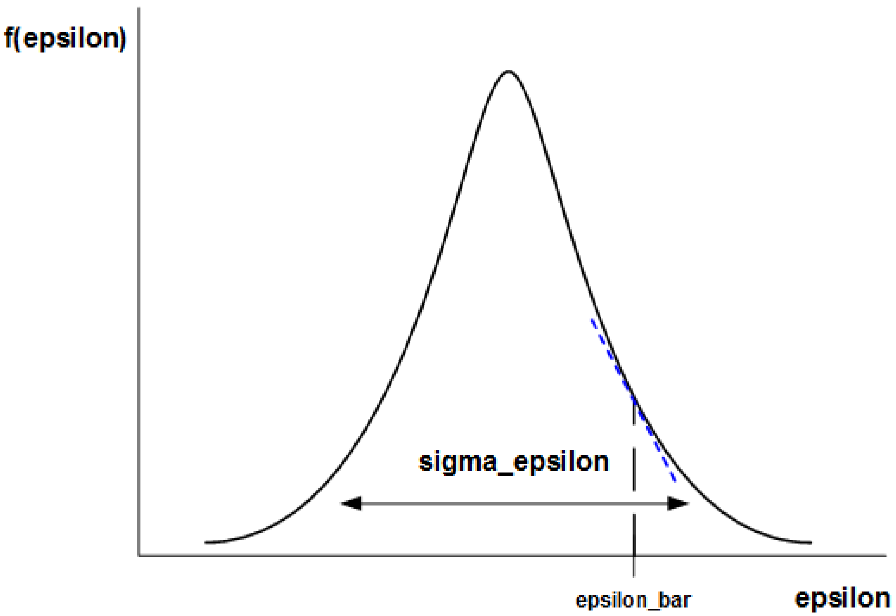
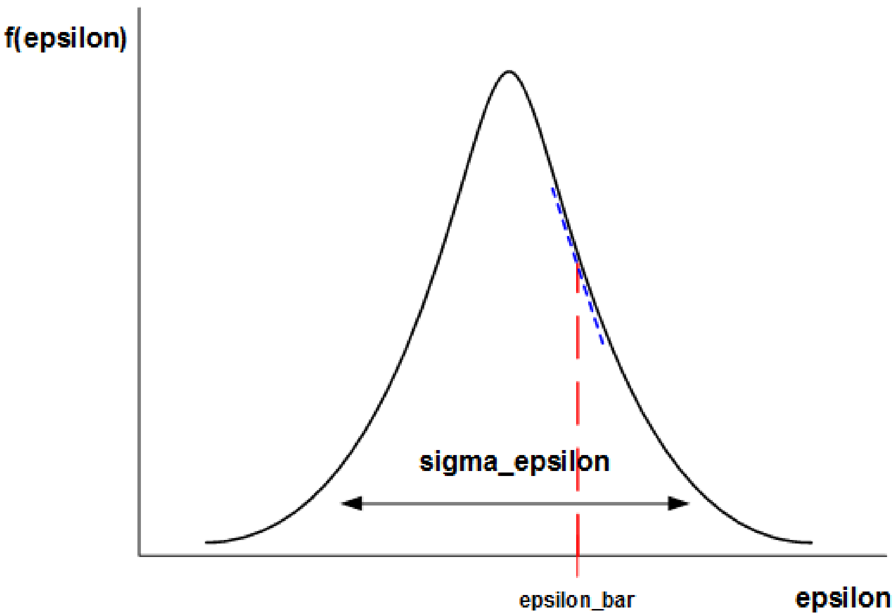
Warm-up example

U[-1.2, 1.2] **ρ = 0.1**
r = 0.01
$\eta(\varepsilon)$ = 0.58

Compared to 2.9 empirical elasticity


f(epsilon)
sigma_epsilon
epsilon_bar
epsilon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U[-1.2, 1.2] ρ = 0.1, r = 0.01, $\eta(\varepsilon)$ = 0.58

Compared to 2.9 empirical elasticity

- Two micro data sources to measure σ_{ε}^{*}
  - Short-term training cost dispersion (EOPP: Employment Opportunity Pilot Project)
  - Wage dispersion for new hires

CALIBRATION

- **Quantitative DSPE example**

- **Distribution of training costs assumed log-normal**
  - **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 MPL (which is endogenous in the GE model)**

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  - In our model implies the SD is 40% of worker's long-run MPL (which is endogenous in the GE model)
- 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)
  - Nobody has negative training costs → skewed distribution

CALIBRATION

- **Quantitative DSPE example**
- **Conventional parameters**
  - **r = 0.01**
  - **Standard quarterly TFP process (ρ_z = 0.95, σ_z = 0.007)**
- **Outside option b**
- **b = 0**
- **Doesn't matter at all for efficient allocations!**

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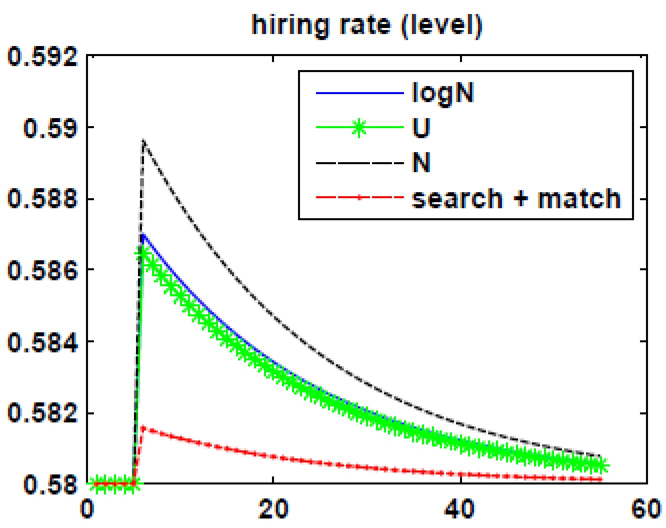
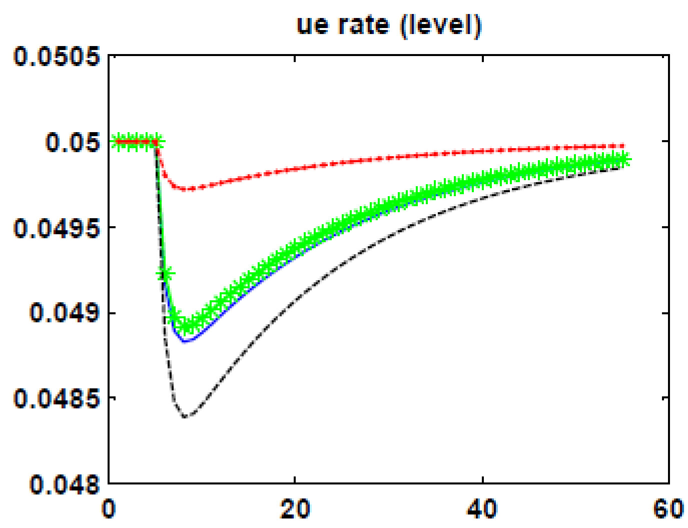
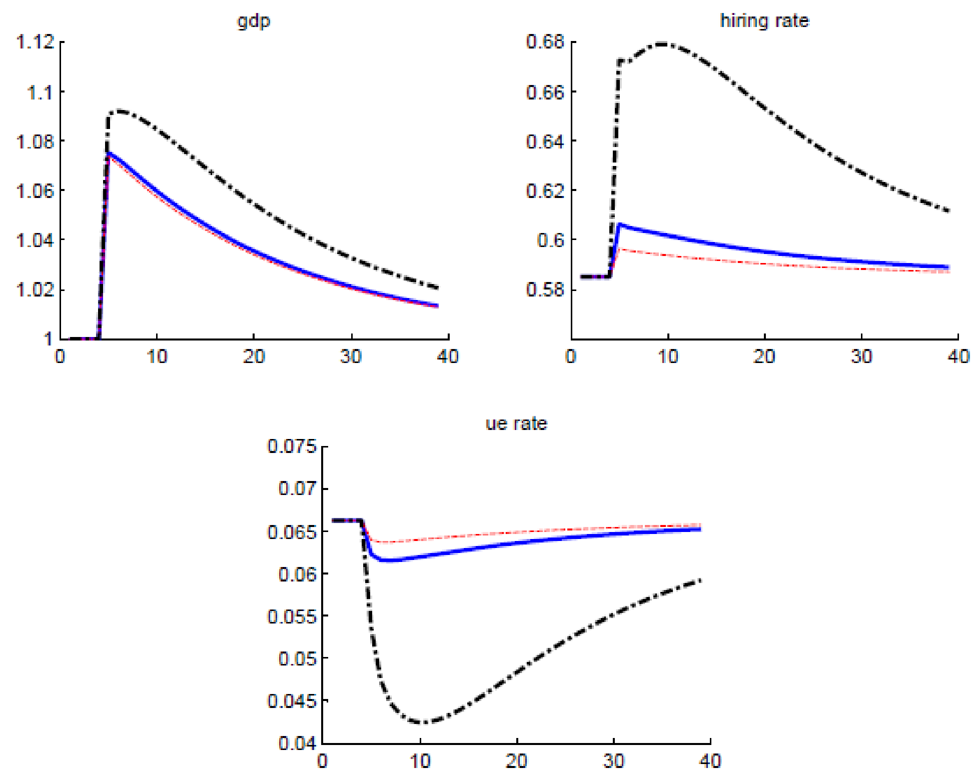




CALIBRATION

- Quantitative DSPE example
- Conventional parameters
  - $r = 0.01$
  - Standard quarterly TFP process ($\rho_z = 0.95$, $\sigma_z = 0.007$)
- Outside option $b = 0$
- Various σ_ε values
  - = 0.2
  - = 0.4 (Barron et al)
  - = 0.6 (wage dispersion)



Sequential Search

SELECTION AND SEQUENTIAL SEARCH

- **The model readily admits sequential search (e.g., McCall (1970), Mortensen (1970))**

- **Suppose Poisson meetings *N* occur during a quarter**
- **Baseline considered: *N* = 1**

- **For *N* ≥ 1 meetings during period, job-acceptance*$_i$* condition modifies to**

$$\eta(\tilde{\varepsilon}_t) = m(\tilde{\varepsilon}_t) \cdot \sum_{j=1}^{N} (1 - m(\tilde{\varepsilon}_t))^{j-1}$$

- $\eta(\tilde{\varepsilon}_t)$ **is probability that a searching worker accepts a job within a quarter**
- $m(\tilde{\varepsilon}_t)$ **is chance that a searching worker accepts a particular contact *m* during a quarter**

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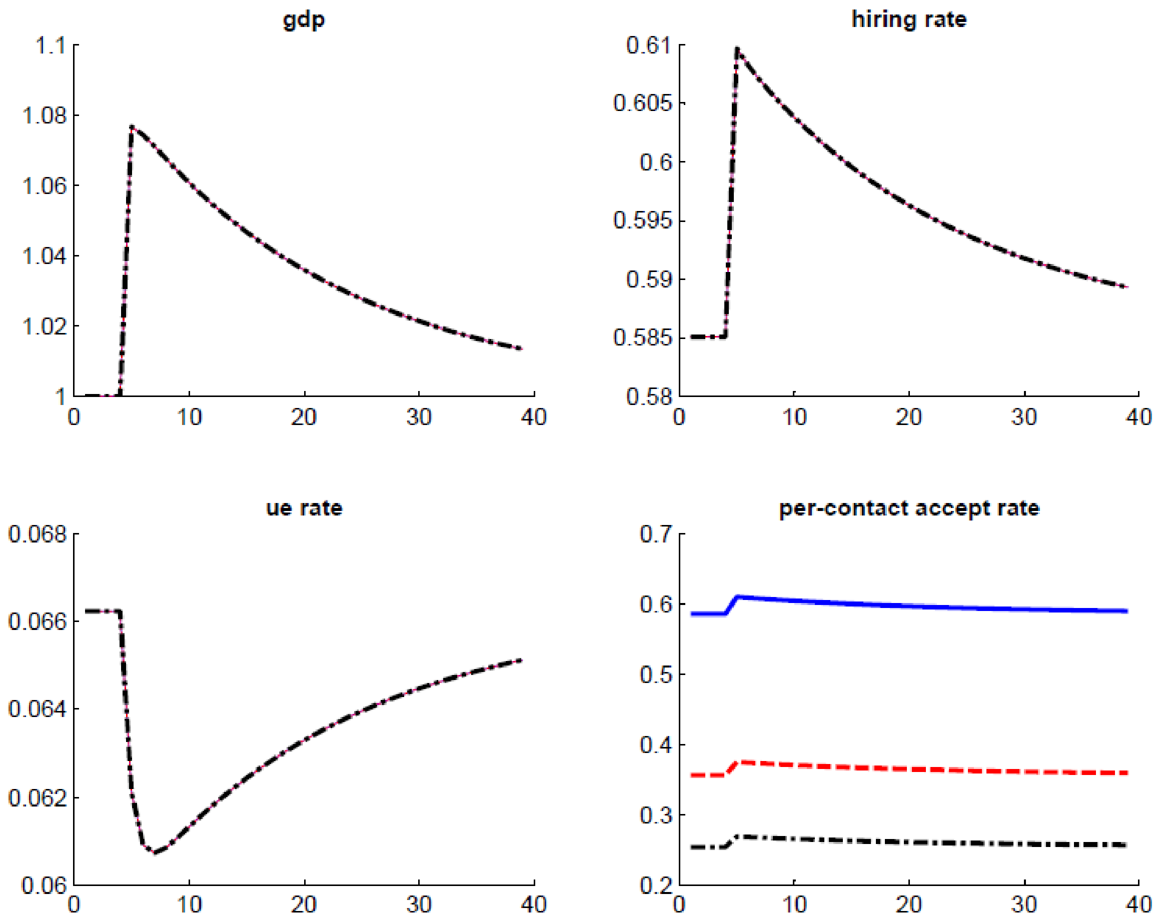
  - ***m* = 1 →** $\eta(\tilde{\varepsilon}_t) = m(\tilde{\varepsilon}_t)$
  - ***m* = 2 →** $\eta(\tilde{\varepsilon}_t) = m(\tilde{\varepsilon}_t)\left\{1 + \left(1 - m(\tilde{\varepsilon}_t)\right)\right\}$
  - ***m* = 3 →** $\eta(\tilde{\varepsilon}_t) = m(\tilde{\varepsilon}_t)\left\{1 + \left(1 - m(\tilde{\varepsilon}_t)\right) + \left(1 - m(\tilde{\varepsilon}_t)\right) \cdot \left(1 - m(\tilde{\varepsilon}_t)\right)\right\}$

SELECTION AND SEQUENTIAL SEARCH

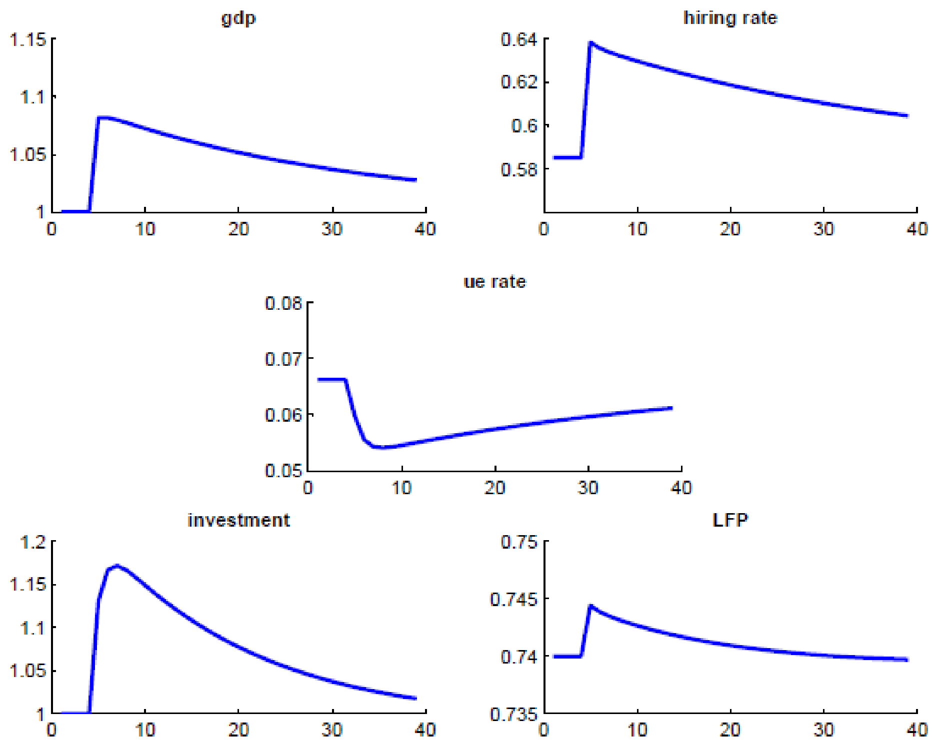
- $m = 1$
- $m = 2$
- $m = 3$



General Equilibrium

GENERAL EQUILIBRIUM

- ❑ Endogenous labor supply (endogenous LFP)
- ❑ Physical capital investment
- ❑ (hence MRSs and MRTs nest textbook RBC model)



SUMMARY

- **Large fluctuations in labor markets induced by aggregate TFP**
  - **Does NOT require any particular wage decentralization scheme**
- **(General equilibrium model works the same way – see Table 2)**
- **Tractable to model in DSPE**

- **Seems a clever way of calibrating σ_ε**
- **More up-to-date data than 1982 EOPP?**
- **Use of wage dispersion data as upper bound?**

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- More up-to-date data than 1982 EOPP?
- Use of wage dispersion data as upper bound?
- Labor selection and labor matching complementary mechanisms
  - Selection stresses cross-sectional issues
    (“I hope this new worker integrates into the job easily”)
  - Sequential search and DMP search + matching stress intertemporal issues
    (“I hope we find any suitable candidates at all”)