The Large Volatility and the Slow Recovery of the Job-Finding Rate

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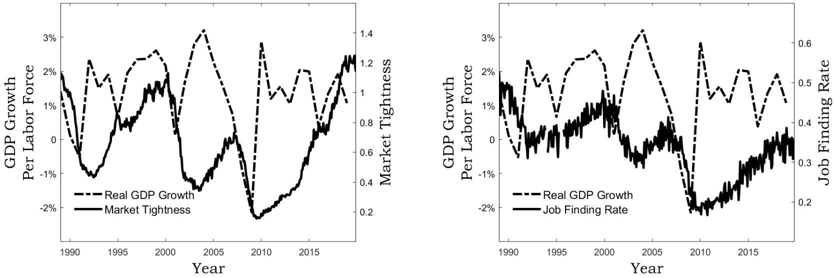
Motivation

- The job-finding rate exhibits large volatility and slow recovery
  - Contradict textbook search-and-matching model:
    - Volatility: Shimer puzzle
    - Convergence: Know little
- Important to understand the slow recovery
  - Guide for empirical work
  - Policy to accelerate recovery

The Large Drop and Slow Recovery



(a) Labor Market Tightness (b) Job-Finding Rate

Figure: Aggregate Shock, Market Tightness, and Job-Finding Rate

What I Do

- The goal of the paper is two-fold:
  1. Derive analytic expression for job-finding rate volatility and convergence
     - In a class of efficient search-and-matching model a la Kehoe et al. 2020
     - Nest the textbook search-and-matching model

Results: The Job-Finding Rate Convergence

- Convergence is fast in the perfect foresight equilibrium
  - Half life is 3 month under standard parameterization
- Rational expectation equilibrium:
  - Transmission almost entirely through the aggregate shock
  - The job-finding rate co-moves with the shock

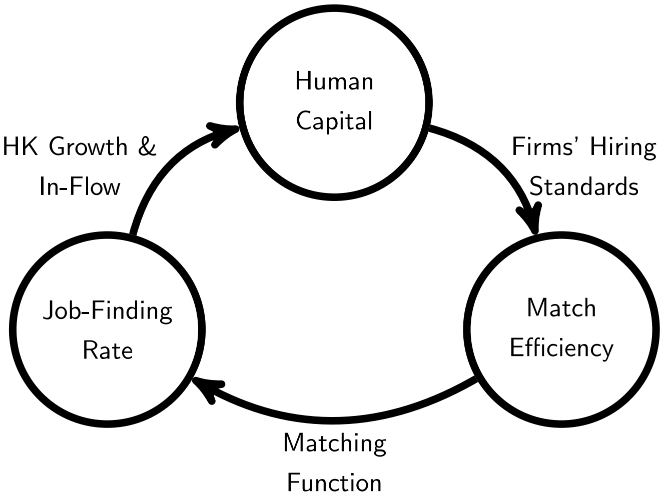
What I Do Cont.

2. Extend the model to generate slow convergence

   - Two types of workers with human capital:
     - No-Depreciation (ND)
     - Fast-Depreciation (FD)

     $\rightarrow$ Endogenous unemployment pool composition
   - Match quality shock and firms' hiring standards
     $\rightarrow$ Endogenous match efficiency which depends on human capital
   - Complementarity between human capital and match efficiency
     $\rightarrow$ Multiple equilibria

Model Intuition



Results: Dynamics

- Dynamics depend on shock size
  - Small shock: recover to initial steady state
  - Large shock:
    - ND workers: Recover
    - FD workers: Diverge to "corner equilibrium"
      $\rightarrow$ Lower match efficiency and job-finding rate
- The relation between match efficiency and the unemployment pool
  - More low match efficiency worker $\rightarrow$ Low aggregate match efficiency
    E.g. Barnichon et al. 2015
  - Negative match efficiency shock $\rightarrow$ Low match efficiency worker

Results: Recovery

- To recover from the corner equilibrium
  - Positive aggregate shock
  - Human capital shock
- Timing of policy intervention is important:
  - Small early intervention is sufficient
  - Late intervention more difficult because human capital too low

Literature

- Search-and-matching model: Kehoe et al. 2020
- Match efficiency: Barnichon et al. 2005
- Firms' hiring standards: Sedláček 2014
- Human capital loss during unemployment: Ortego-Marti 2017abc

Overview

1. Introduction
2. The Economy
3. Equilibrium
4. Characterizing the Job-Finding Rate Elasticity
5. A Model with Two Types of Workers
6. Quantitative Analysis

The Economy

A Class of Efficient Search-and-Matching Model

- Directed search with human capital z: Continuous time Kehoe et al. 2020
- Human capital growth depending on labor force status

$$\frac{dz_{j,t}}{z_{j,t}} = g_j dt, \quad j = e, u$$

- Job-finding rate λ_{wt}, vacancy-filling rate λ_{vt}
- Labor market exit rates ϕ_e and ϕ_u
- Separation rate δ
- Labor market entry ζ
- Aggregate shock

$$\frac{dA_t}{A_t} = g_a dt + \sigma_a dW_{a,t}$$

Consumption

- Consumption:

$$C_t = A_t \int z e_t(z) dz + b A_t \int z u_t(z) dz - \kappa A_t \int z v_t(z) dz$$

- Measures
  - Employment $e_t(z)$
  - Unemployment $u_t(z)$
  - Vacancy $v_t(z)$
- Production:
  - Employed $A_t z$
  - Unemployed $bA_t z$
- Vacancy posting cost $\kappa A_t z$

Preference

- A family maximizes expected discounted utility

$$\mathbb{E}_0\left[\int_0^\infty e^{-\beta t}\frac{(C_t - X_t)^{1-\alpha}}{1-\alpha}dt\right]$$

  where X_t is exogenous habit
- Stochastic discount factor:

$$Q_t = e^{-\beta t}(C_t - X_t)^{-\alpha}$$

- Define the surplus consumption ratio $S_t = (C_t - X_t)/C_t$

$$Q_t = e^{-\beta t}(S_t C_t)^{-\alpha}$$

- Directly specify the log surplus consumption ratio $s_t = \log(S_t)$

$$ds_t = (1-\rho_s)(s - s_t)dt + \sigma_a \lambda_a(s_t)dW_{a,t}$$

The Competitive Search Equilibrium

Submarket and Worker's Value Function

- Submarket indexed by $(z, W_t(z))$
  - $W_t(z)$ chosen by the firms
- Matching technology:

$$m(u_t, v_t) = Bu_t^{\eta} v_t^{1-\eta}$$

- Let $M_t(z)$ be post-match value for a worker

$$(\delta + \phi_e)M_t(z) = \delta U_t(z) + \mathbb{E}_t \left[dM_t(z_t) + M_t(z) \frac{dQ_t}{Q_t} \right]$$

where $U_t(z)$ is the value of unemployment

$$\begin{aligned}(\lambda_{wt}(z) + \phi_u)U_t(z) =& bA_t z + \lambda_{wt}(z)(M_t(z) + W_t(z)) \\ &+ \mathbb{E}_t \left[dU_t(z_t) + U_t(z) \frac{dQ_t}{Q_t} \right]\end{aligned}$$

Firm's Value Function

- Let $Y_t(z)$ be the revenue of a firm in submarket z

$$(\delta + \phi_e) Y_t(z) = A_t z + \mathbb{E}_t \left[dY_t(z_t) + Y_t(z) \frac{dQ_t}{Q_t} \right]$$

- In the symmetric equilibrium, the optimal choice of $W_t(z)$ is

$$\eta[Y_t(z) - W_t(z)] = (1 - \eta)[W_t(z) + M_t(z) - U_t(z)]$$

- This is equivalent to the Nash bargaining condition

- Free entry condition:

$$\kappa A_t z = \lambda_{vt}(\theta_t(z))[Y_t(z) - W_t(z)]$$

Equilibrium

- The value functions are linear in z:

$$Y_t(z) = Y_t z, \quad W_t(z) = W_t z, \quad M_t(z) = M_t z, \quad U_t(z) = U_t z$$

- Define
  - $\mu_{et} = Y_t + M_t$ the total value of a match
  - $\mu_{ut} = U_t$ the joint outside option

Dynamic System

- The economy is characterized by the following six equations

- $r_{ft} = -\mathbb{E}_t\left(\frac{dQ_t}{Q_t}\right)$ the risk-free rate
- $Z_{et} = \int z e_t(z) dz$, $Z_{ut} = \int z u_t(z) dz$ aggregate human capital
- The system has the same structure as a RBC model

Dynamic System

- The economy is characterized by the following six equations

$$\left[(\delta + \phi_e - g_e) - \mathbb{E}_t\left(\frac{dQ_t}{Q_t}\right)\right]\mu_{et} = A_t + \delta\mu_{ut} + \mathbb{E}_t(d\mu_{et})$$

$$\left[(\eta\lambda_{wt} + \phi_u - g_u) - \mathbb{E}_t\left(\frac{dQ_t}{Q_t}\right)\right]\mu_{ut} = bA_t + \eta\lambda_{wt}\mu_{et} + \mathbb{E}_t(d\mu_{ut})$$

- $r_{ft} = -\mathbb{E}_t\left(\frac{dQ_t}{Q_t}\right)$ the risk-free rate
- $Z_{et} = \int ze_t(z)dz$, $Z_{ut} = \int zu_t(z)dz$ aggregate human capital
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$$\kappa A_t = (1-\eta)\lambda_{vt}(\mu_{et} - \mu_{ut})$$

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Dynamic System

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$$
\begin{aligned}
&\left[(\delta + \phi_e - g_e) - \mathbb{E}_t\left(\frac{dQ_t}{Q_t}\right)\right]\mu_{et} = A_t + \delta\mu_{ut} + \mathbb{E}_t(d\mu_{et}) \\
&\left[(\eta\lambda_{wt} + \phi_u - g_u) - \mathbb{E}_t\left(\frac{dQ_t}{Q_t}\right)\right]\mu_{ut} = bA_t + \eta\lambda_{wt}\mu_{et} + \mathbb{E}_t(d\mu_{ut}) \\
&\kappa A_t = (1-\eta)\lambda_{vt}(\mu_{et} - \mu_{ut}) \\
&\frac{\mathrm{d}Z_{et}}{\mathrm{d}t} = (g_e - \phi_e - \delta)Z_{et} + \lambda_{wt}Z_{ut} \\
&\frac{\mathrm{d}Z_{ut}}{\mathrm{d}t} = (g_u - \phi_u - \lambda_{wt})Z_{ut} + \delta Z_{et} + \zeta \\
&ds_t = (1-\rho_s)(s - s_t)dt + \sigma_a\lambda_a(s_t)dW_{a,t}
\end{aligned}
$$

- $r_{ft} = -\mathbb{E}_t\left(\frac{dQ_t}{Q_t}\right)$ the risk-free rate
- $Z_{et} = \int z e_t(z)dz$, $Z_{ut} = \int z u_t(z)dz$ aggregate human capital
- The system has the same structure as a RBC model

The Job-Finding Rate and the Value Functions

- The free-entry condition relates the job-finding rate to the value functions

$$\log(\lambda_{wt}) = \chi + \left(\frac{1-\eta}{\eta}\right) \log\left(\frac{\mu_{et}-\mu_{ut}}{A_t}\right)$$

- $\frac{\mu_{et}-\mu_{ut}}{A_t}$ is the benefit of opening a vacancy

- The elasticity is large iff $\frac{\mu_{et}-\mu_{ut}}{A_t}$ responds to the shock

$$\mathbb{E}_t \begin{bmatrix} d\mu_{et} \\ d\mu_{ut} \end{bmatrix} = \left(\underbrace{\begin{bmatrix} \delta + \phi_e - g_e & -\delta \\ -\eta\lambda_{wt} & \eta\lambda_{wt} + \phi_u - g_u \end{bmatrix}}_{B_1:\ \text{search model}} + \underbrace{\begin{bmatrix} -\mathbb{E}_t\left(\frac{dQ_t}{Q_t}\right) & 0 \\ 0 & -\mathbb{E}_t\left(\frac{dQ_t}{Q_t}\right) \end{bmatrix}}_{B_2:\ \text{preference}} \right) \begin{bmatrix} \mu_{et} \\ \mu_{ut} \end{bmatrix} + \begin{bmatrix} -A_t \\ -bA_t \end{bmatrix}$$

Characterizing the Job-Finding Rate Elasticity and Convergence

The Risk-Free Rate

Lemma

The risk-free rate to a first order approximation in the log surplus consumption ratio s_t is

$$r_{ft} = -\mathbb{E}_t\left(\frac{dQ_t}{Q_t}\right) \approx -[a_Q + b_Q(s_t - s)]$$

where

$$a_Q = -\beta - \alpha g_a + \frac{1}{2}\alpha\sigma_a^2\left(\frac{\alpha}{S^2} + 1\right) \text{ and } b_Q = \alpha(1-\rho_s) - \frac{\alpha\sigma_a^2(\alpha + S - 1)}{S^2}$$

- With CRRA preference $Q_t = e^{-\beta t}C_t^{-\alpha}$, $b_Q = 0$

$$r_{ft} = -\beta - \alpha g_a$$

- If no growth in productivity $g_a = 0$

$$r_{ft} = -\beta$$

Characterizing the Job-Finding Rate Elasticity

Proposition

The elasticity of the job-finding rate with respect to the log surplus consumption ratio s_t near $s_t = s$ is

$$\frac{\partial \log(\lambda_{wt})}{\partial s_t} = \underbrace{\frac{b_Q e^{\Theta_1}}{1-\rho_s}}_{\text{Preference}} \underbrace{\left[\frac{c_h}{-(\gamma_h + a_Q + \Theta_2)} + \frac{c_l}{-(\gamma_l + a_Q + \Theta_2)} \right] \overline{\mu}^{-1}}_{\text{Search Model}}$$

where $\gamma_h < \gamma_l < 0$ are two eigenvalue of the matrix B_1, c_l and c_h are weights of the eigenvalues, and $\overline{\mu}$ is the long-run average match surplus without shocks.

- The job-finding rate elasticity can be decomposed into

$$\text{Preference} \times \big(\text{Short-Run Benefit} + \text{Long-Run Benefit} \big)$$

Potential Source of Large Elasticity: Search Model

- The search model part can be decomposed into

$$\text{Short-run Benefit} + \text{Long-run Benefit}$$

- The benefits reflect the expected discount value of vacancy creation
- The Short-run benefit is always small:
  - Discount by job-finding, which is around 0.46 per month
- In the textbook search-and-matching model, long-run benefit $= 0$
  - Long-run discount rate is the same across employment status $=$ labor market exit rate
- Conclusion: small job-finding rate elasticity in the textbook model

Potential Source of Large Elasticity: Search Model

- Large job-finding elasticity needs differential long-run discount
  - Human capital growth
  - Labor market exit rate

Corollary

Differential human capital growth rates or labor market exit rates can lead to positive long-run benefits and hence large job-finding rate elasticity

Parameter Values and the Job-Finding Elasticity

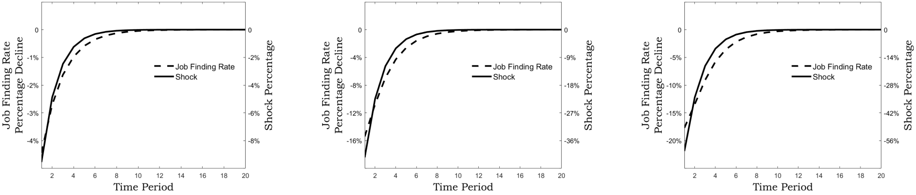
- The job-finding rate elasticity depends on human capital growth rates
- Cannot generate large elasticity if HK depreciates fast during unemployment
  - Empirically: 20% workers with wage growth $<$ -20%
    $\rightarrow$ Job-finding rate 10% more volatile
  - Numerically: Job-finding rate elasticity halved

Corollary

The model cannot generate large job-finding rate elasticity if the human capital depreciation is large during unemployment.

Job-Finding Rate Convergence

- I derive the half-life in the perfect foresight equilibrium
  - Constant human capital
  - Job-finding rate near the steady-state value
- Conclusion: Half-life around 3 months
- This implies that the job-finding rate co-moves with the aggregate shock
  - If there is no other state variables
- Numerically study importance of other state variables (human capitals)



(a) Small Shock (b) Medium Shock (c) Large Shock

Figure: Convergence of Job-Finding Rate

Job-Finding Rate Elasticity and Convergence: Summarize

- Model: two mismatch with the data:
  - Job-finding rate elasticity small if human capital depreciates fast
  - Job-finding rate co-moves with the aggregate shock

A Model with Two Types of Workers

Model Extension

I make two addition to the model:

1. Two types of workers
   - ND workers: no human capital depreciation during unemployment
   - FD workers: fast human capital depreciation
   - Rubinstein et al. (2006): 20% of workers have 22% wage loss per annum
2. Endogenous match efficiency more
   - Driven by firms' hiring standards + match quality shock: Sedláček 2014
   - Firms' hiring standards depend on human capital: Quintini (2011), Pollmanm-Schult (2005)

Model Extension

- Two types of workers n, f
  - Submarkets are defined by (n, z) and (f, z)
  - Job-finding rate is

$$\lambda_{j,wt}(z) = \overline{m}_{j,t}(z)\theta_{j,t}^{1-\eta}, \quad j \in \{n, f\}$$

- Match efficiency:

$$\overline{m}_{j,t}(z) = B_{j,t}\mathbb{P}(q_j z \geqslant p_j), \quad q_j \sim N(a_{j,q}, \sigma_{j,q}), \quad j \in \{n, f\}$$

  - p_j is firms' hiring standards
  - q_j is match quality shock
  - Only part of the matches will be formed
  - $B_{j,t}$ could vary with the aggregate shock
- Match efficiency is endogenous
  - Depends on workers' human capital
  - Time varying with the aggregate shock

Value Function and Aggregation

- All the value functions are the same except for the expected revenue:

$$(\delta + \phi_e) Y_{j,t}(z) = A_t q_j z + \mathbb{E}_t \left[dY_{j,t}(z_t) + Y_{j,t}(z) \frac{dQ_t}{Q_t} \right], \quad j \in \{n, f\}$$

- Aggregate consumption is

$$\begin{aligned} C_t = & n_t \left(A_t \int \chi_n(z) z e_{nt}(z) dz + b A_t \int z u_{nt}(z) dz - \kappa A_t \int z v_{nt}(z) dz \right) \\ & + f_t \left(A_t \int \chi_f(z) z e_{ft}(z) dz + b A_t \int z u_{ft}(z) dz - \kappa A_t \int z v_{ft}(z) dz \right) \end{aligned}$$

  where $\chi_j(z) \equiv \mathbb{E}(q_j | q_j z \geqslant p_j)$: expected match quality

- The model cannot aggregate linearly
  - Aggregate consumption depends on the distribution
  - Matching function depends on the distribution

Aggregation Cont.

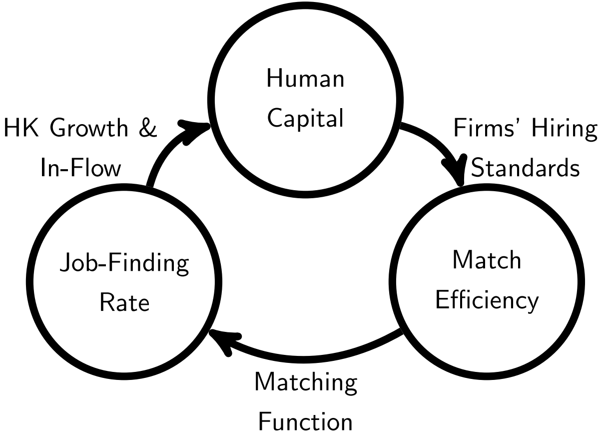
- Simplification:
  Match efficiency depends only on aggregates:

$$\overline{M}_{j,t} = B_{j,t}\mathbb{P}[q_j(Z_{j,et} - Z_{j,ut}) \geqslant p_j] \in \left[\underline{B}_j, \overline{B}_j\right], \quad q_j \sim N(a_{j,q}, \sigma_{j,q}), \quad j \in \{n, f\}$$

- Linear solution exists as before
- Consistent with firms' hiring standards
  - Numerically equivalent to the disaggregate version if log-linearizing the model
- Captures two features:
  1. Pro-cyclical match efficiency: $\mathbb{P}[q_j(Z_{j,et} - Z_{j,ut}) \geqslant p_j]$ increasing in $Z_{j,et}$
  2. Counter-cyclical match quality:
     - $\chi_{j,t} = \mathbb{E}\left[q_j | q_j\left(Z_{j,et} - Z_{j,ut}\right) \geqslant p_j\right]$ decreasing in $Z_{j,et}$
     - Firms accept better match to compensate lower human capital *on average*

Complementarity and Multiple Equilibria

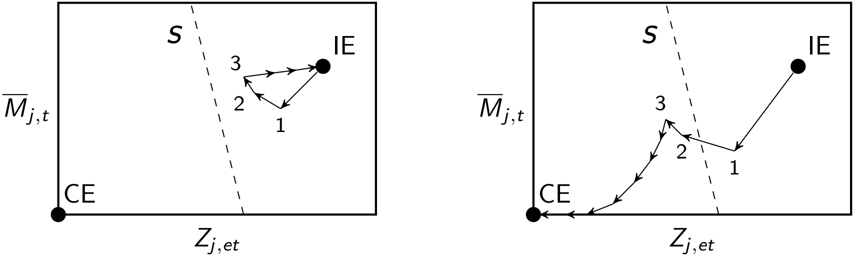
- Complementarity between the match efficiency and human capital:



- The complementarity results in multiple equilibria
  - Could stuck in an equilibrium with low match efficiency and job-finding rate

Interaction with Aggregate Shock

- I illustrate the dynamics when interacting with the aggregate shock
- Denote the interior equilibrium IE and the corner equilibrium CE
- Assume the aggregate shock lasts for three period
- Dynamics differ with shock sizes



(a) Small Shock (b) Large Shock

Figure: The Model Dynamics

Quantitative Analysis

Match Efficiency Functional Form

- The match efficiency is

$$\overline{M}_{j,t} = B_{j,t}\mathbb{P}[q_j(Z_{j,et} - Z_{j,ut}) \geqslant p_j] \in \left[\underline{B}_j, \overline{B}_j\right], \quad q_j \sim N(a_{j,q}, \sigma_{j,q}), \quad j \in \{n, f\}$$

- I assume the functional form of $B_{j,t}$

$$B_{j,t} = B_j(\mu_{j,et} - \mu_{j,ut}), \quad j \in \{n, f\}$$

$\rightarrow$ affected by the aggregate shock via match surplus

- State variables: s_t, $Z_{j,et}$, $Z_{j,ut}$

- I approximate the match efficiency using global Chebyshev polynomial

Model Calibration: Calibrated Parameters

Table: Parameterization

Panel A: Parameters		Panel B: Moments		
Endogenously Chosen		*Targeted*	Data	Model
g_a, mean productivity growth (%p.a.)	2.22	Mean productivity growth (%p.a.)	2.22	2.22
σ_a, s.d. productivity growth (%p.a.)	1.84	S.d. productivity growth (%p.a.)	1.84	1.84
B_n, match efficiency, ND workers	0.545	Mean job-finding rate, ND workers	0.46	0.46
B_f, match efficiency, FD workers	0.355	Mean job-finding rate, FD workers	0.31	0.31
κ, hiring cost	0.975	Mean unemployment rate	5.9	5.9
β, time preference factor	0.001	Mean risk-free rate (%p.a.)	0.92	0.92
S, mean of state S_t	0.057	S.d. risk-free rate (%p.a.)	2.31	2.31
α, inverse EIS	5	Maximum Sharpe ratio (p.a.)	0.45	0.45
$\sigma_{q,n}$, match quality variance, ND workers	0.35	S.d. job-finding rate, ND workers	6.66	6.63
$\sigma_{q,f}$, match quality variance, FD workers	0.48	S.d. job-finding rate, FD workers	8.10	8.10

Model Calibration: Assigned Parameters

Table: Parameterization

Panel A: Parameters		Panel B: Moments		
Assigned		*Results*	Data	Model
b, home production parameter	0.6	Autocorr job-finding rate	0.94	0.98
δ, separation rate	0.028	S.d. unemployment rate	0.75	0.77
η, matching function elasticity	0.5	Autocorr unemployment rate	0.97	0.98
$\phi_{n,f}$, labor market exit rate	0.0028	Corr unemployment, job-finding rate	-0.96	-0.98
ρ_s, persistence of state	0.9944			
$g_{n,e}, g_{f,e}$, employed HK growth (%p.a.)	3.5			
$g_{f.u}$, unemployed HK growth (%p.a.)	-22			

Aggregate Job-Finding Rate

- The aggregate job-finding rate is

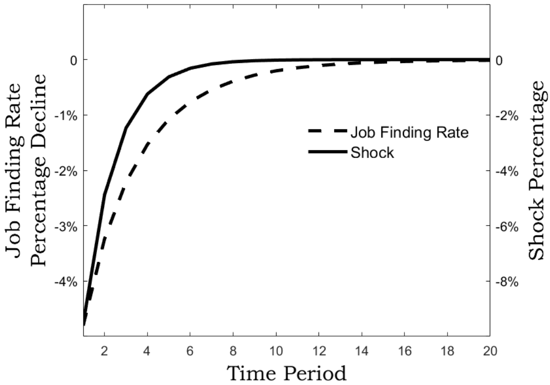
$$\lambda_{wt} = \frac{\xi_t}{1+\xi_t}\lambda_{f,wt} + \frac{1}{1+\xi_t}\lambda_{n,wt}, \quad \xi_t = \frac{u_{f,t}}{u_{n,t}}$$

- Depends on the unemployment composition
  - If more FD workers in the unemployment pool
    $\rightarrow$ Job-finding rate behaves like FD workers'

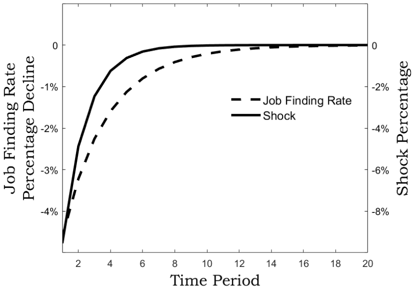
Convergence of the Job-Finding Rate

- I study the convergence of the aggregate job-finding rate
  - Vary size of the shock
  - Fix half-life of the shock to be 2 months

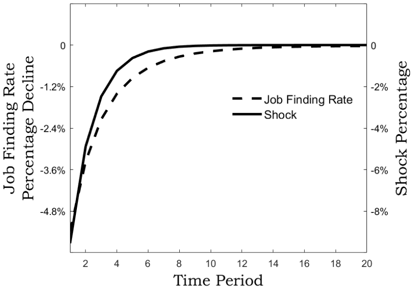
    $\rightarrow$ Shock is 5% of the initial value in 6 months
- Small shock: 5% decline in the job-finding rate



Convergence: Small Shock



(a) ND Worker



(b) FD Worker

Figure: Convergence of Job-Finding Rate: Small Shock

Convergence: Medium Shock

- Increase the size of the shock so that the job-finding rate decline by 15%
- Job-finding rate: large decline and slow recovery
- Human capital decline leads to lower match efficiency and job-finding rate

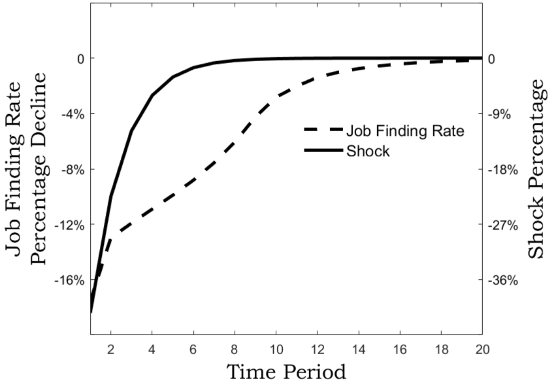
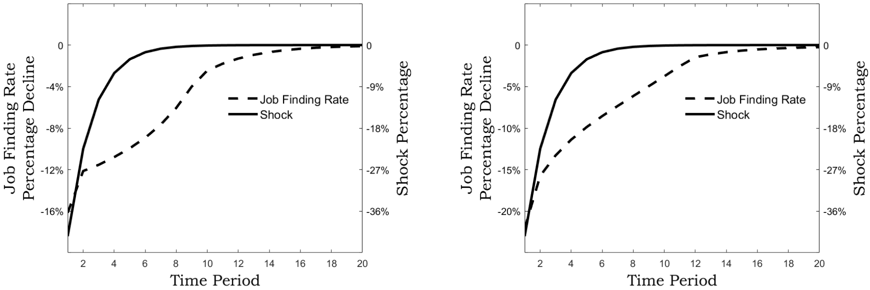


Figure: Aggregate

Convergence: Medium Shock Cont.



(a) ND Worker (b) FD Worker

Figure: Convergence of Job-Finding Rate: Medium Shock

Convergence: Large Shock

- Increase the size of the shock so that the job-finding rate decline by 25%
- Job-finding rate diverges to the corner equilibrium

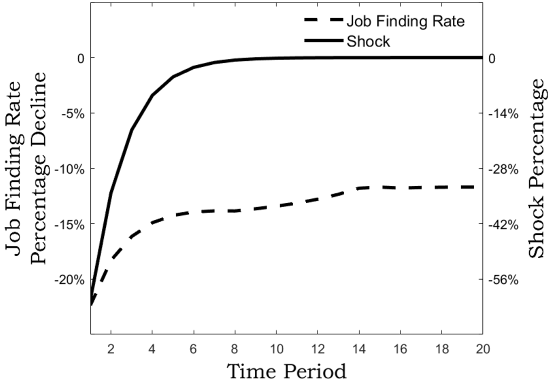
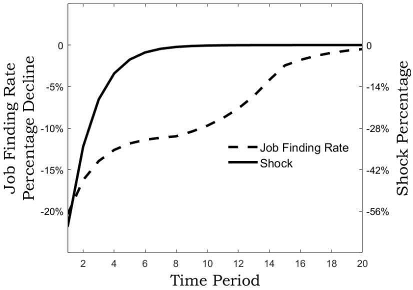
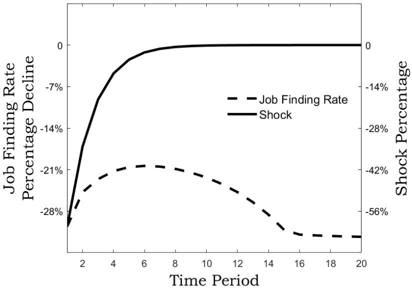


Figure: Aggregate

Convergence: Large Shock Cont.



(a) ND Worker



(b) FD Worker

Figure: Convergence of Job-Finding Rate: Large Shock

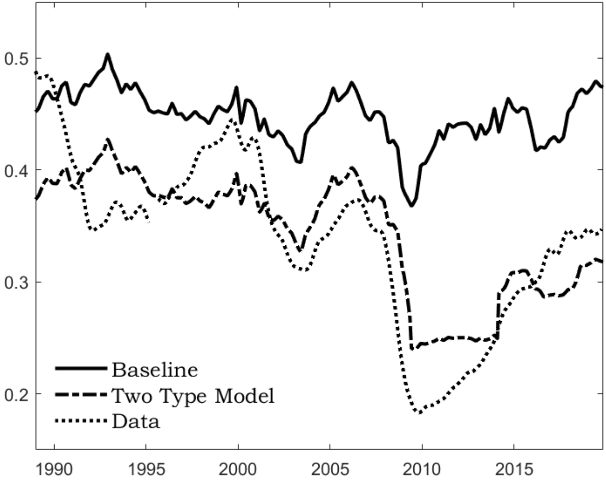
Ergodic Distribution

- The model features local determinacy
  - Implication: ergodic distribution figure
- The ND workers are in the corner equilibrium 8% of the time
- The FD workers 14% of the time
- Overall average time in recession: 9%
  - Data from 1989 to 2019: 10%

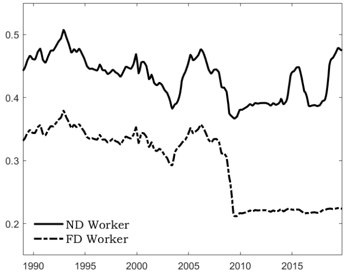
Job-Finding Rate Path

- I feed in the aggregate productivity shock time series
  - The baseline model
  - The two-type model
- Start the model at the steady state
- Compare with the empirical job-finding rate path

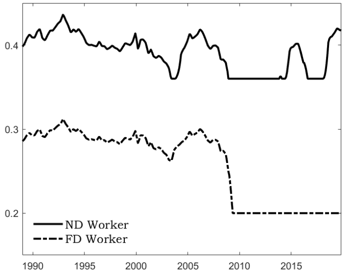
Job-Finding Rate Path Cont.



Job-Finding Rate Path by Workers' Type



(a) Job-Finding Rate



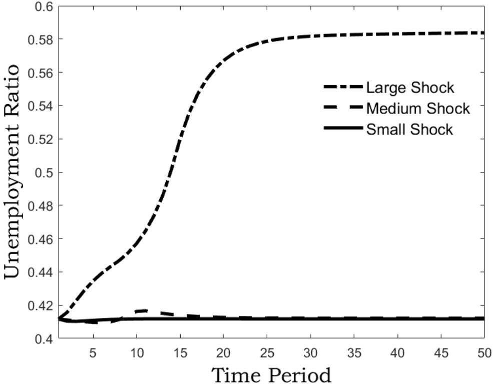
(b) Match Efficiency

Comparison Between the Two Types of Workers

- The two types of workers behave differently under large shock
  1. Initial decline in job-finding rate:
     - Determined by job-fining rate elasticity
     - Larger outflow of employed human capital
  2. Human capital depreciation during unemployment
     - Slower inflow of unemployed human capital

Unemployment Pool Composition

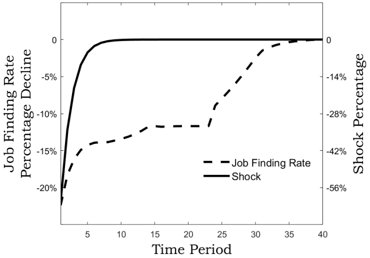
- The unemployment pool slowly dominated by the FD workers



- Barnichon et al 2015: long-term unemployment drives low match efficiency
- My model: low match efficiency could drive long-term unemployment

Recovery From the Corner Equilibrium

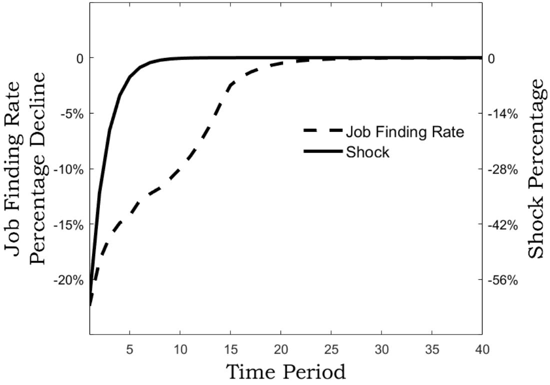
- Two shocks can recover the economy
  - Positive aggregate shock
  - Human capital shock
- Experiment: 3% human capital increase at month 24



- Recovery similar to the Great Recession
  - Human capital captures anything other than aggregate technology
    E.g. (search) effort
  - Consistent with Manovskii et al. 2014
    Recovery due to the end of UI extension

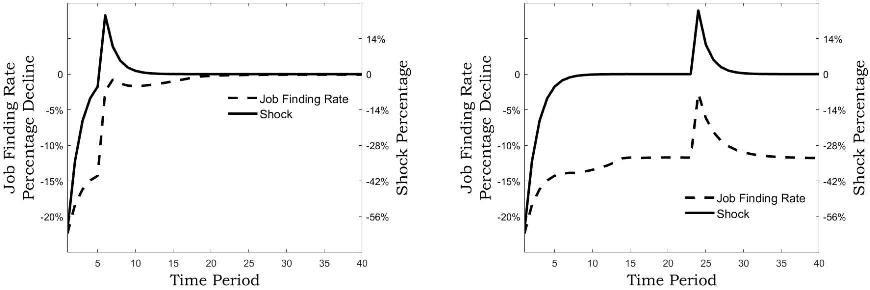
Timing of Policy Intervention

- Timing of policy intervention is important
  - Smaller early intervention sufficient
  - Human capital has not declined by much
- Comparison: 0.5% human capital shock at month 6



Recovery By Positive Aggregate Shock

- Positive technology shock can recover the economy
- Early intervention more effective
  25% positive shock in month 6 versus 24



(a) Early Shock (b) Late Shock

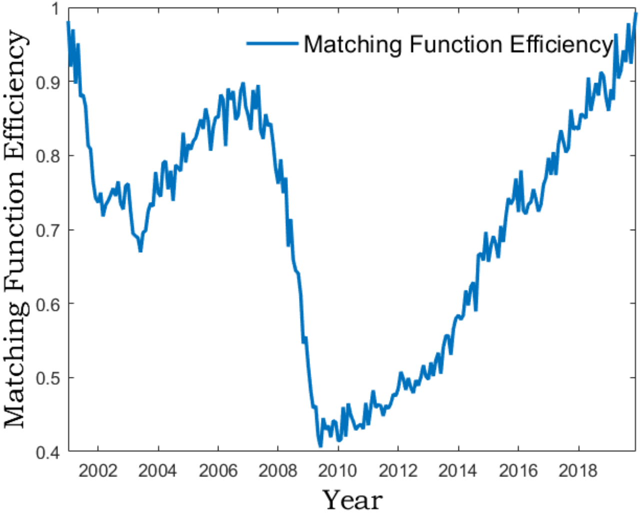
Figure: Recovery by Aggregate Shock

Conclusion

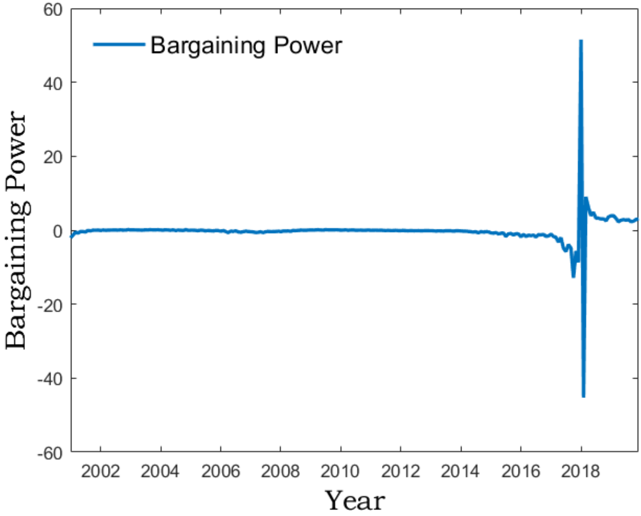
1. Search-and-matching model with constant match efficiency
   - Derive job-finding rate elasticity and convergence
   - Elasticity too small if human capital depreciates fast
   - Convergence too fast
   - Transmission depends entirely on the aggregate shock
2. Extension: Two types of workers + firms' hiring standards
   - Endogenous match efficiency
   - Multiple equilibria
   - Slow recovery due to human capital decline
     $\rightarrow$ Lower match efficiency and job-finding rate
   - Could stuck in the corner equilibrium
   - Recovery from the corner equilibrium
     $\rightarrow$ Early intervention important

Appendix

Match Efficiency Variation

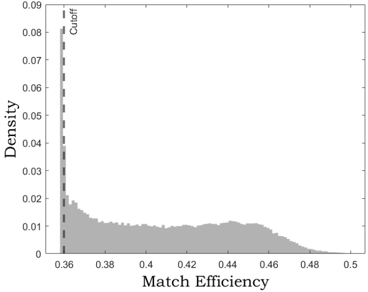


Bargaining Power Variation

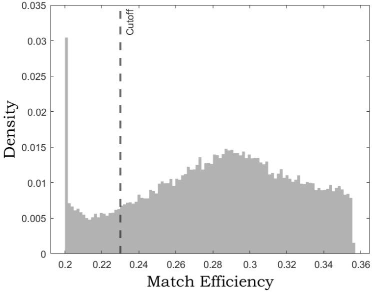


back

Ergodic Distribution Cont.



(a) ND Workers



(b) FD Workers

back