# The Macrodynamics of Sorting between Workers and Firms

## Lise and Robin (2017)

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# Introduction

This paper:

- develops an equilibrium model of on-the-job search with heterogeneous workers and firms and aggregate uncertainty.
- proves that the model is very tractable.
- illustrates the quantitative implications of the model by fitting to US aggregate labor market data from 1951-2012.
- has rich implications for the cyclical dynamics of the distribution of vacancies, unemployed workers, and sorting between heterogeneous workers and firms.

# Advantages

- w.r.t. existing equilibrium search models with heterogeneity: stochastic model is developed.
- w.r.t. the directed search model:
  - two-sided heterogeneity is easily introduced;
  - search frictions generate mismatch at the equilibrium;
  - workers search on the job and employers counter outside offers;
  - decisions about wages and matching are separated.
- w.r.t. wage-posting models: how different workers match with different firms and the interaction between heterogeneity and aggregate shocks are described.

# Model

- Heterogeneous workers $x$ and firms $y$; aggregate state $z_t$
- $B_t(x)$: ***value of unemployment*** to worker $x$ at $t$
- $b(x, z_t)$: how much an unemployed worker $x$ earns at $t$
- $W_{0,t}(x, y)$: value to worker $x$ hired from unemployment by firm $y$; $W_{0,t}(x, y) = B_t(x)$

$$
\begin{aligned}
(1) \quad B_t(x) &= b(x, z_t) \\
&\quad + \frac{1}{1+r} E_t \left[ (1 - \lambda_{t+1}) B_{t+1}(x) + \lambda_{t+1} \int W_{0,t+1}(x, y) \frac{v_{t+1}(y)}{V_{t+1}} \, dy \right] \\
&= b(x, z_t) + \frac{1}{1+r} E_t B_{t+1}(x),
\end{aligned}
$$

- $\lambda_t$: probability an unemployed searcher contacts a vacancy
- $v_t(y)$: number of job opportunities chosen by firm $y$; $V_t = \int v_t(y) dy$

# Model

- $P_t(x, y)$: continuation ***value of a match*** $(x, y)$; $p(x, y, z_t)$ at $t$

$$
\begin{aligned}
(2)\ P_t(x,y) = p(x,y,z_t) \\
&+ \frac{1}{1+r} E_t \Big[ \big(1 - (1-\delta)\mathbf{1}\{P_{t+1}(x,y) \geq B_{t+1}(x)\}\big) B_{t+1}(x) \\
&\quad + (1-\delta)\mathbf{1}\{P_{t+1}(x,y) \geq B_{t+1}(x)\} \Big( (1 - s\lambda_{t+1}) P_{t+1}(x,y) \\
&\quad + s\lambda_{t+1} \int \max\{P_{t+1}(x,y), W_{1,t+1}(x,y',y)\} \frac{v_{t+1}(y')}{V_{t+1}} dy' \Big) \Big]
\end{aligned}
$$

- Incumbent and poaching firms engage in Bertrand competition which grants the worker the second highest bid.
  - If $P_{t+1}(x, y') > P_{t+1}(x, y)$: $x$ moves to firm $y'$ and receives $W_{1,t+1}(x, y', y) = P_{t+1}(x, y)$;
  - If $P_{t+1}(x, y') \leq P_{t+1}(x, y)$: $x$ stays with firm $y$ and receives $W_{1,t+1}(x, y, y') = P_{t+1}(x, y')$

# Model

- ***Match surplus***: $S_t(x, y) = P_t(x, y) - B_t(x)$

$$S_t(x,y) = p(x,y,z_t) - b(x,z_t) + \frac{1-\delta}{1+r} E_t \max\{S_{t+1}(x,y), 0\}.$$

- The surplus depends on time only through $z_t$ and does not depend on the distributions of vacancies, unemployed workers, or worker-firm matches.
- Outside offers do not change the size of the match surplus.
- The surplus function fully characterizes the mobility decision of workers.
  - For an unemployed worker: A match is formed if $S(x, y, z) > 0$
  - For an employed worker: Poaching is successful if $S(x, y, z) > S(x, y', z)$

# Fit

- Fit the model to moments of US time series data from 1951:I to 2012:IV

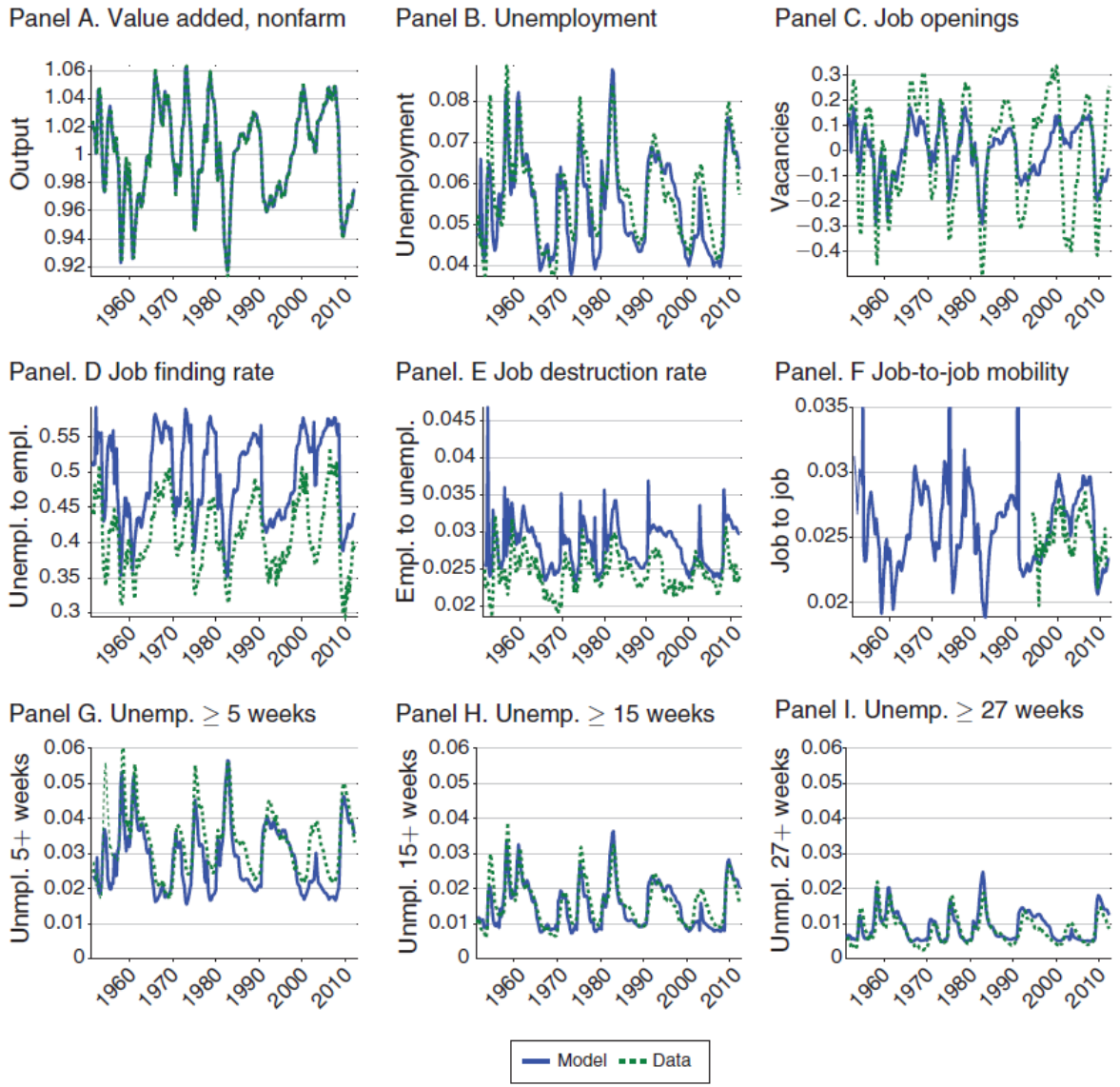


FIGURE 1. DATA AND MODEL PREDICTED TIME SERIES

# Job Creation and Job Separation

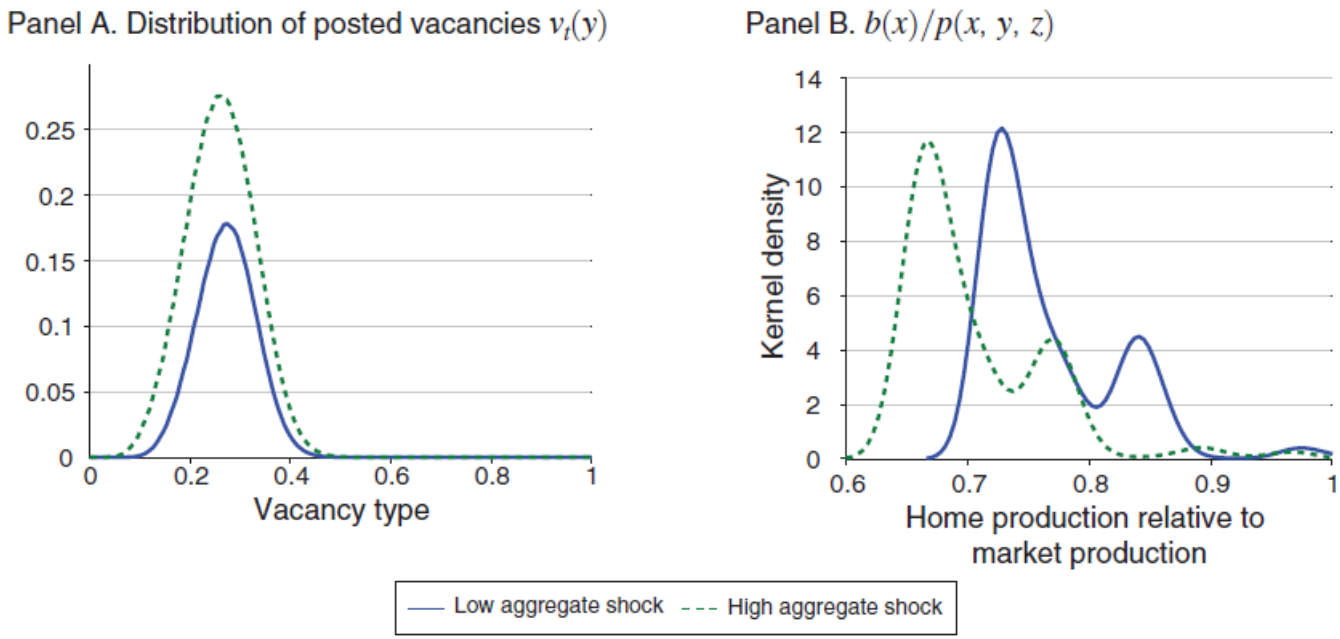


FIGURE 3. EQUILIBRIUM VACANCY CREATION AND HOME, RELATIVE TO MARKET PRODUCTIVITY

*Note:* Low (high) refers to periods when the aggregate state is in the bottom (top) decile of the simulation.

- Moving from a boom to a recession, the number of vacancies contracts everywhere, esp in low-type vacancies
- Overall, market production is substantially higher than home production, esp in high state => more posted vacancies
- When home production is very close to market production, more in the low state, mismatched workers are at risk of endogenous separation

# Feasible Matches and Sorting

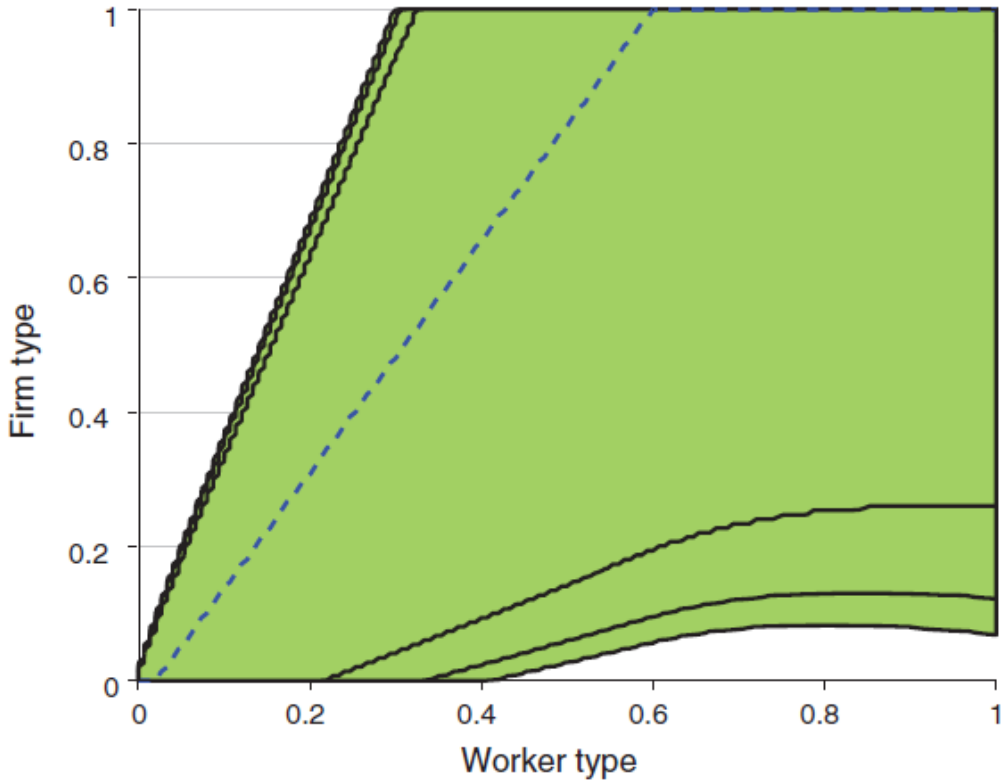


FIGURE 4. CYCLICALITY OF FEASIBLE MATCHES

- The matching set is cone-shaped and sorting is strongly positive.
- Lower-type workers have fewer employment opportunities, and workers with shorter employment tenure are more cyclically sensitive.
- The firms' minimum worker type fluctuates substantially less than the workers' lowest firm type => matches between low-type firms and high-type workers are most at risk of endogenous separations.

# Equilibrium Distribution of Matches

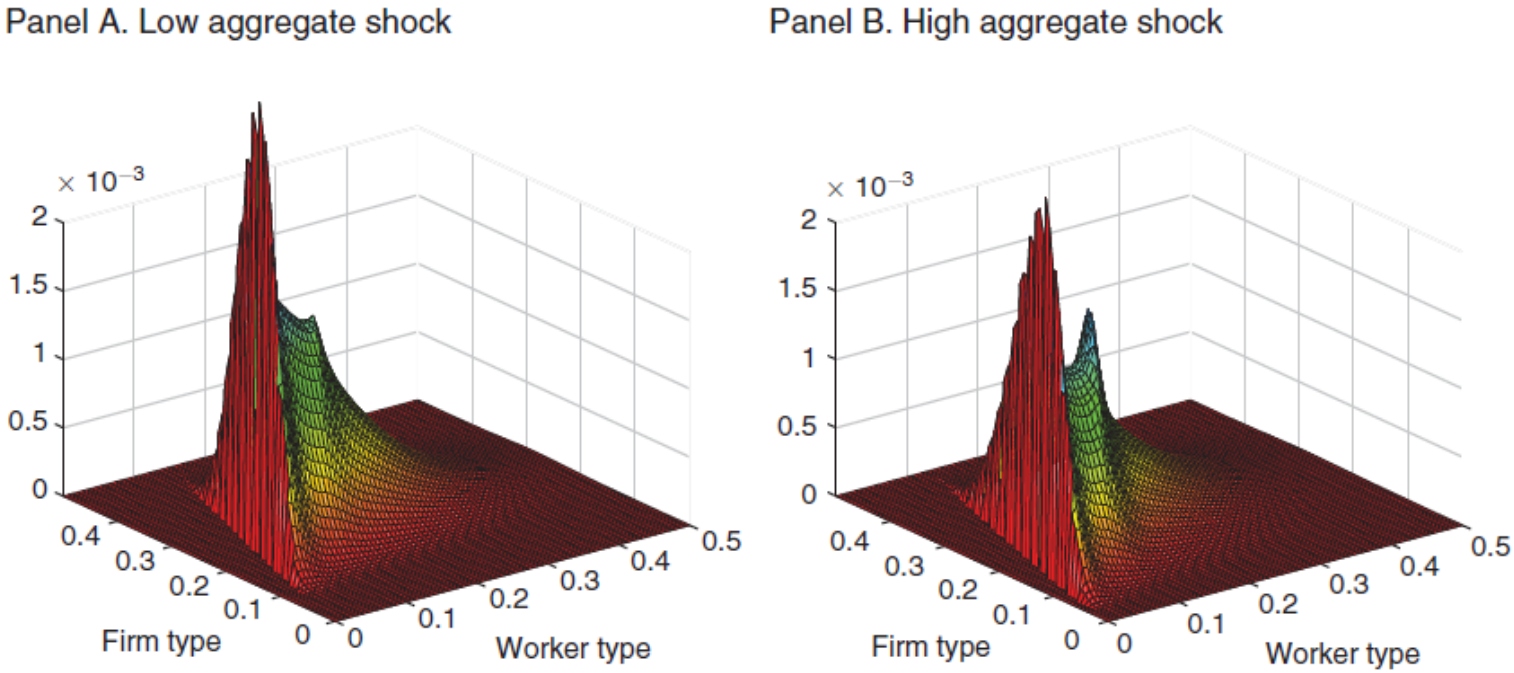


FIGURE 5. JOINT DISTRIBUTION OF WORKER-FIRM MATCHES BY AGGREGATE STATE

- Substantial mass along the boundary relating to the firms' minimum worker type.
- Fewer matches at the boundary in the good states: workers move more quickly to their preferred matches through on-the-job search.
- On-the-job search results in the second ridge, the center of which corresponds to the optimal job for each worker.

# Business-Cycle Dynamics of Matches

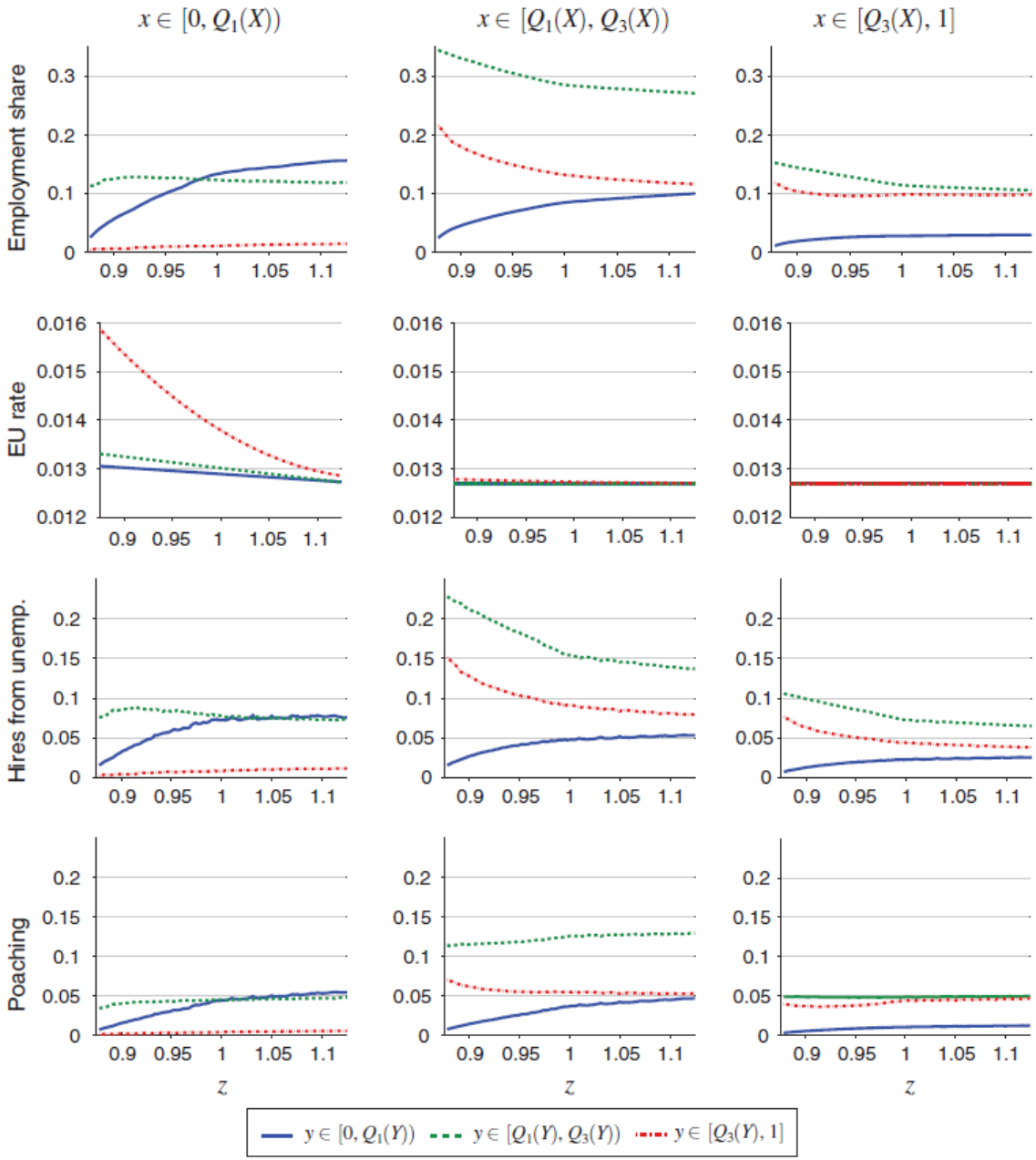


FIGURE 6. EMPLOYMENT SHARES, SEPARATION RATES, AND HIRING SHARES BY AGGREGATE SHOCKS

# Business-Cycle Dynamics of Matches

- Employment share: Expansion is largely the result of low-/medium-type worker, low-type firm pairs.
- Job separation rate: Low-type workers are the most susceptible in recession, esp those matched with high-type firms; High-type workers are completely shielded.
- Share of hires: In recession, low-type firms hire less and medium-/high-type firms hire relatively more medium-/high-type unemployed workers.

# Extension

- This model does not make any predictions about wages
- => Is this model able to also match wage data?
- => incorporate more direct empirical measures of worker and firm heterogeneity, such as measures based on education, occupation, wages, value added, and other conditional measures available in matched employer-employee data.