Vacancies and Hiring: Establishment-Level Evidence and Aggregate Implications

This lecture does not seek to review the broad theoretical and empirical literatures on vacancies and hiring. Instead, it draws mainly on two of my recent papers with Jason Faberman and John Haltiwanger:

Overview

• First study of vacancies, hires and vacancy yields at the establishment level in a large sample of U.S. employers

Two key analytical tools for interpreting the data

• Simple model of daily hiring dynamics
  – Identifies the job-filling rate for vacant positions, the employer counterpart to much-studied job-finding rate for unemployed workers.

• Generalized matching function defined over unemployment, vacancies and “recruiting intensity” per vacancy
Motivation

Job vacancies are a key concept in many theoretical models ...

– Random search models (Pissarides, 1986; Mortensen-Pissarides, 1994; Pissarides, 2000)
– On-the-job search (Burdett and Mortensen, 1998)
– Directed search and wage-posting models (Moen, 1997, and Acemoglu and Shimer, 2000)

... and empirical studies ...

– Beveridge Curve studies (Blanchard-Diamond, 1989)
– Matching function estimation (Petrongolo-Pissarides)
– Studies of cyclical dynamics (Shimer, 2005)
Motivation

... Yet, few empirical studies consider job vacancies and their connection to hiring at the level of individual employers.

Even at the aggregate level, our knowledge of vacancy behavior is very thin compared to our knowledge of unemployment behavior

– U.S. studies: HWI, JOLTS at aggregate and industry level, small-scale and one-off data sets – e.g., Abraham (1983, 1987) and Holzer (1994)

– Other countries: Several studies use surveys or centralized registers of job openings – e.g., Van Ours and Ridder (1991), Berman (1997), Yashiv (2000) and Sunde (2007)
Outline of Remarks, 1

• JOLTS micro data on hires and vacancies
• A simple model of daily hiring dynamics to identify the job-filling rate for vacancies
• Big CS variation in job-filling rates. Why?
  – Heterogeneity in the efficiency of search and matching
  – Scale economies (or diseconomies) in the hiring technology at the establishment or sectoral level
  – Employers use other instruments, in addition to vacancy numbers, to influence the pace of hiring.
Outline of Remarks, 2

- JOLTS micro data on hires and vacancies
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  - Scale economies (or diseconomies) in the hiring technology at the establishment or sectoral level
  - Employers use other instruments, in addition to vacancy numbers, to influence the pace of hiring.
Outline of Remarks, 3

• Generalized matching function (GMF) defined over unemployment, vacancies, and recruiting intensity per vacancy.
  – Combine evidence with GMF to identify the role of recruiting intensity per vacancy in the cross section
  – Build from micro evidence and GMF to construct a time-series index of recruiting intensity per vacancy
  – Interpret recent breakdown of standard MF as resulting, in part, from large movements in recruiting intensity per vacancy (and in search intensity per unemployed)
The GMF outperforms standard MF (SMF):

1. GMF accounts for CS behavior of job-filling rates. SMF does not.
2. GMF (as constrained by our recruiting intensity index) better accounts for movements over time in job-finding rates and job-filling rates.
3. GMF yields a more stable Beveridge Curve at national and regional levels.
4. Industry-level changes in fill rates, $v-u$ ratios, and recruiting intensity values during and after the 2008-09 recession satisfy restrictions implied by the GMF. They violate restrictions implied by the SMF.
JOLTS Data

• Sample of ~16,000 establishments per month
  – Employment as of pay period covering 12th of month
  – Flow of hires, separations, layoffs, quits during month
  – Stock of vacancies on last business day of month
  – Our micro analysis sample has 577,000 establishment-level observations from January 2001 to December 2006

• Vacancy Definition (Job Openings):
  – “A specific position exists, work could start within 30 days, and [the establishment is] actively seeking workers from outside this location to fill the position.”
  – Broad definition of “actively seeking workers”
Table 1: Outcomes by Industry, Size and Turnover

<table>
<thead>
<tr>
<th></th>
<th>Hires Rate</th>
<th>Separations Rate</th>
<th>Vacancy Rate</th>
<th>Vacancy Yield</th>
<th>Employment Share</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Nonfarm Employment</strong></td>
<td>3.4</td>
<td>3.2</td>
<td>2.5</td>
<td>1.3</td>
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</tr>
<tr>
<td></td>
<td><strong>Selected Industries</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Construction</td>
<td>5.4</td>
<td>5.4</td>
<td>1.7</td>
<td>3.1</td>
<td>5.3</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>2.3</td>
<td>2.6</td>
<td>1.7</td>
<td>1.3</td>
<td>11.3</td>
</tr>
<tr>
<td>Retail Trade</td>
<td>4.5</td>
<td>4.4</td>
<td>2.3</td>
<td>1.9</td>
<td>11.4</td>
</tr>
<tr>
<td>Professional &amp; Business Services</td>
<td>4.6</td>
<td>4.2</td>
<td>3.5</td>
<td>1.3</td>
<td>12.4</td>
</tr>
<tr>
<td>Government</td>
<td>1.6</td>
<td>1.3</td>
<td>1.9</td>
<td>0.8</td>
<td>16.5</td>
</tr>
<tr>
<td></td>
<td><strong>Establishment Size Class</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0-9 Employees</td>
<td>3.4</td>
<td>3.3</td>
<td>2.0</td>
<td>1.6</td>
<td>12.1</td>
</tr>
<tr>
<td>10-49 Employees</td>
<td>4.0</td>
<td>4.0</td>
<td>2.3</td>
<td>1.7</td>
<td>23.2</td>
</tr>
<tr>
<td>50-249 Employees</td>
<td>4.0</td>
<td>3.8</td>
<td>2.6</td>
<td>1.5</td>
<td>28.3</td>
</tr>
<tr>
<td>250-999 Employees</td>
<td>3.1</td>
<td>2.9</td>
<td>2.8</td>
<td>1.1</td>
<td>17.1</td>
</tr>
<tr>
<td>1,000-4,999 Employees</td>
<td>2.1</td>
<td>1.9</td>
<td>3.0</td>
<td>0.7</td>
<td>13.0</td>
</tr>
<tr>
<td>5,000+ Employees</td>
<td>1.7</td>
<td>1.5</td>
<td>2.4</td>
<td>0.7</td>
<td>6.4</td>
</tr>
<tr>
<td></td>
<td><strong>Worker Turnover Category</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>No Turnover</td>
<td>0</td>
<td>0</td>
<td>1.1</td>
<td>0</td>
<td>24.4</td>
</tr>
<tr>
<td>First Quintile</td>
<td>0.5</td>
<td>0.6</td>
<td>1.7</td>
<td>0.3</td>
<td>15.1</td>
</tr>
<tr>
<td>Second Quintile</td>
<td>1.3</td>
<td>1.2</td>
<td>2.6</td>
<td>0.5</td>
<td>15.1</td>
</tr>
<tr>
<td>Third Quintile</td>
<td>2.4</td>
<td>2.2</td>
<td>2.9</td>
<td>0.8</td>
<td>15.1</td>
</tr>
<tr>
<td>Fourth Quintile</td>
<td>4.5</td>
<td>4.3</td>
<td>3.1</td>
<td>1.4</td>
<td>15.1</td>
</tr>
<tr>
<td>Fifth Quintile (highest)</td>
<td>13.5</td>
<td>13.0</td>
<td>4.4</td>
<td>3.1</td>
<td>15.1</td>
</tr>
</tbody>
</table>
Hires

Monthly Hires as a Percent of Employment

- Unconditional
- Controlling for Establishment Fixed Effects

Monthly Employment Growth Rate, Percent
Vacancies

Vacancies as a Percent of Employment

- Unconditional
- Controlling for Establishment Fixed Effects

Monthly Employment Growth Rate, Percent
Vacancy Yields and Establishment Growth Rates in the Cross Section

Does this strong positive relationship merely reflect a bigger flow of unobserved vacancies at more rapidly growing establishments?
## Other Summary Statistics

<table>
<thead>
<tr>
<th>Statistic</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pct. of Employment at Establishments with No Hires in $t$</td>
<td>34.8</td>
</tr>
<tr>
<td>Pct. of Employment at Establishments with No Vacancies at the end of $t-1$</td>
<td>45.1</td>
</tr>
<tr>
<td>Pct. of Vacancies at the end of $t$ at Establishments with No Vacancies at the end of $t-1$</td>
<td>17.9</td>
</tr>
<tr>
<td>Pct. of Hires in $t$ at Establishments with No Vacancies at the end of $t-1$</td>
<td>41.6</td>
</tr>
</tbody>
</table>
45% of employment is at establishments with no vacancies. Another 7% is at establishments with exactly 1 vacancy.
A Model of Daily Hiring Dynamics

Daily laws of motion for flow of hires and vacancy stock:

\[ h_{s,t} = f_t v_{s-1,t} \]

\[ v_{s,t} = [(1 - f_t)(1 - \delta_t)] v_{s-1,t} + \theta_t \]

- Where \( s \) indexes days, \( f_t \) is the daily job-filling rate in month \( t \), \( \delta_t \) is the rate at which unfilled vacancies lapse, and \( \theta_t \) is the daily flow of new vacancies.
Solving for the job-filling rate and vacancy flows

Use laws of motion to derive two equations relating end-of-month vacancy stock and hires flow during month, both observed, to two unknowns, \( \{ f_t, \theta_t \} \).

\[
v_t = (1 - f_t - \delta_t + \delta_t f_t)^\tau v_{t-1} + \theta_t \sum_{s=1}^{\tau} (1 - f_t - \delta_t + \delta_t f_t)^{s-1}
\]

\[
H_t = f_t v_{t-1} \sum_{s=1}^{\tau} (1 - f_t - \delta_t + \delta_t f_t)^{s-1} + f_t \theta_t \sum_{s=1}^{\tau} (\tau - s)(1 - f_t - \delta_t + \delta_t f_t)^{s-1}
\]

Given data on \( \delta_t, v_t, v_{t-1}, H_t \), and a value for \( \tau \), solve numerically for \( f_t \) (daily job-filling rate) and \( \theta_t \) (daily flow of new vacancies).
<table>
<thead>
<tr>
<th>Selected Industries</th>
<th>Daily Job-Filling Rate (%)</th>
<th>Monthly Flow of Vacancies (% of Emp.)</th>
<th>Mean Vacancy Duration (Days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nonfarm Employment</td>
<td>5.0</td>
<td>3.4</td>
<td>20.0</td>
</tr>
<tr>
<td>Construction</td>
<td>12.1</td>
<td>5.4</td>
<td>8.3</td>
</tr>
<tr>
<td>Retail Trade</td>
<td>7.3</td>
<td>4.5</td>
<td>13.7</td>
</tr>
<tr>
<td>Government</td>
<td>3.2</td>
<td>1.6</td>
<td>31.4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Number of Employees</th>
<th>Daily Job-Filling Rate (%)</th>
<th>Monthly Flow of Vacancies (% of Emp.)</th>
<th>Mean Vacancy Duration (Days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10-49</td>
<td>6.6</td>
<td>4.0</td>
<td>15.2</td>
</tr>
<tr>
<td>250-999</td>
<td>4.1</td>
<td>3.1</td>
<td>24.1</td>
</tr>
<tr>
<td>5,000+</td>
<td>2.6</td>
<td>1.7</td>
<td>38.9</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Worker Turnover Quintiles (H+S)</th>
<th>Daily Job-Filling Rate (%)</th>
<th>Monthly Flow of Vacancies (% of Emp.)</th>
<th>Mean Vacancy Duration (Days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Highest</td>
<td>11.4</td>
<td>14.0</td>
<td>8.7</td>
</tr>
<tr>
<td>Middle</td>
<td>3.0</td>
<td>2.4</td>
<td>32.8</td>
</tr>
<tr>
<td>Lowest</td>
<td>1.1</td>
<td>0.4</td>
<td>87.9</td>
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</table>
### Mean Vacancy Duration (Number of Working days) By Industry and Time Periods

<table>
<thead>
<tr>
<th></th>
<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Resources</td>
<td>11.9</td>
<td>14.0</td>
<td>14.9</td>
<td>19.0</td>
<td>19.5</td>
</tr>
<tr>
<td>Construction</td>
<td>7.7</td>
<td>8.7</td>
<td>5.9</td>
<td>6.0</td>
<td>8.9</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>17.3</td>
<td>20.9</td>
<td>17.6</td>
<td>23.4</td>
<td>28.9</td>
</tr>
<tr>
<td>Wholesale and Retail Trade</td>
<td>14.2</td>
<td>15.8</td>
<td>14.5</td>
<td>15.9</td>
<td>19.9</td>
</tr>
<tr>
<td>Warehouse, Transportation and Utilities</td>
<td>18.3</td>
<td>17.3</td>
<td>15.8</td>
<td>18.1</td>
<td>23.0</td>
</tr>
<tr>
<td>Information</td>
<td>26.7</td>
<td>35.3</td>
<td>29.4</td>
<td>41.2</td>
<td>34.1</td>
</tr>
<tr>
<td>Financial Services</td>
<td>27.6</td>
<td>32.5</td>
<td>26.2</td>
<td>33.8</td>
<td>37.7</td>
</tr>
<tr>
<td>Professional &amp; Business Services</td>
<td>18.2</td>
<td>20.1</td>
<td>19.1</td>
<td>18.5</td>
<td>19.7</td>
</tr>
<tr>
<td>Health and Education</td>
<td>36.8</td>
<td>34.3</td>
<td>31.2</td>
<td>31.6</td>
<td>33.2</td>
</tr>
<tr>
<td>Leisure and Hospitality</td>
<td>13.8</td>
<td>14.7</td>
<td>12.5</td>
<td>13.3</td>
<td>16.2</td>
</tr>
<tr>
<td>Other Services</td>
<td>21.8</td>
<td>18.7</td>
<td>21.6</td>
<td>19.2</td>
<td>19.3</td>
</tr>
<tr>
<td>Total Non-Farm</td>
<td>19.1</td>
<td>20.0</td>
<td>18.8</td>
<td>19.9</td>
<td>22.6</td>
</tr>
</tbody>
</table>
Vacancy Flows and Job-Filling Rate Relationships to Employer Growth Rates

- Monthly Vacancy Flow Rate (Left Axis)
- Daily Job-Filling Rate (Right Axis)
- Daily Job-Filling Rate, Controlling for Establishment Fixed Effects

Monthly Employment Growth Rate, Percent

Percent of Employment

Daily Job-Filling Rate
Is It Just “Lucky” Employers Growing Faster?

Stochastic nature of job filling induces a positive relationship between realized employment growth and job-filling rates at the establishment level.

• “Lucky” employers fill jobs faster and, as a result, grow faster.
• To quantify this effect, we simulate hires and employment growth at the establishment level for fitted values of \( f, \theta, \delta \), and the distribution of vacancies, allowing parameters and vacancy distributions to vary freely by employer size class.
• **Result:** Luck effect is much too small to explain the observed C-S relationship between job-filling rate and growth rate:
  – Luck alone \( \Rightarrow \) job-filling rate rises by 2 percentage points in moving from 0% to 10% monthly growth rate.
  – It rises by another 1 point in moving from 10 to 30%.
Is it just the luck effect? No

Fill Rate

- Empirical Job-Filling Rate
- Simulated Rate, New Vacancies Allotted in Proportion to Establishment Vacancies
- Simulated Rate, New Vacancies Allotted in Proportion to Establishment Employment

Monthly Employment Growth Rate (Percent)
Fill Rate and Gross Hires Rate by Growth Rate Bin

Note: The figure plots the relationship of the log daily job-filling rate to the log gross hires rate across growth rate bins in [-.3, .3] and the hires-weighted least squares regression fit of the bin-level data. Bin-level fill rates estimated from establishment-level data sorted into bins after removing mean establishment growth rates.
Job-Filling Rate and Gross Hires Rate by Sector

- Log Daily Fill Rate
- T = Turnover Quintile
- I = Industry
- S = Size Class

\[ y = 0.80x - 0.30 \]
\[ R^2 = 0.80 \]
Key Conclusion: Hires Are Very Far From Proportional to Vacancies in the Cross Section

Three Possible Explanations

• Heterogeneity in the efficiency of search and matching.

• Scale economies (or diseconomies) in the hiring technology at the establishment or sectoral level.

• Employers use other instruments, in addition to vacancy numbers, to influence the pace of hiring.
Key Conclusion: Hires Are Very Far From Proportional to Vacancies in the Cross Section

Three Possible Explanations

• Heterogeneity in the efficiency of search and matching. Cannot explain evidence in slide 23

• Scale economies (or diseconomies) in the hiring technology at the establishment or sectoral level. Analysis and evidence below show this explanation does not take us very far

• Employers use other instruments, in addition to vacancy numbers, to influence the pace of hiring. Supported by analysis and evidence below
Generalized Matching Function

\[ H_{et} = \mu \left( \frac{v'_t}{u_t} \right)^{-\alpha} q(v_{et}, x_{et}), \text{ where } \sum_e q(v_{et}, x_{et}) = v'_t \]

- Job-filling rate is now \( f_{et} = \tilde{f}_t q(v_{et}, x_{et}) / v_{et} \)
- For \( q(v_{et}, x_{et}) \equiv v_{et} \), aggregation delivers standard Cobb-Douglas matching function
- For \( q(v_{et}, x_{et}) \equiv v_{et} \tilde{q}(x_{et}) \), the hiring function satisfies CRS in vacancies at the micro level, and differences in \( f_{et} \) identify the effects of employer actions on other margins.
Quantifying the Roles of Other Instruments and Scale Economies

Let \( q(v_{et}, x_{et}) \equiv v_{et}^\gamma \tilde{q}(x_{et}) \) so that job-filling rate becomes \( f_{et} = \tilde{f}_t v_{et}^{\gamma-1} \tilde{q}(x_{et}) \)

Taking logs and differentiating in the CS \( \Rightarrow \)

\[
\frac{d \log(f_{et})}{d \log(\tilde{H}_{et})} = \frac{d \log(\tilde{f}_t)}{d \log(\tilde{H}_{et})} + (\gamma - 1) \frac{d \log(v_{et})}{d \log(\tilde{H}_{et})} + \frac{d \log(\tilde{q}(x_{et}))}{d \log(\tilde{H}_{et})}
\]

\[
0.820 = 0 + (\gamma - 1)(0.13) + \frac{d \log(\tilde{q}(x_{et}))}{d \log(\tilde{H}_{et})}
\]

To preclude a role for employer actions on other margins requires a scale economy parameter value of \( \gamma \approx 6.3 \).
Estimating Scale Economies in the Establishment-Level Hiring Technology

- **Basic idea**: Exploit differences in establishment-level scale of vacancies and hiring across industry-size cells to estimate returns to scale in employer hiring technology.

- **Do NOT** use time variation, because it is contaminated by the intensity, \( x \). Control for cell-level growth rate for same reason.

- Control for differences in matching efficiency across industries and across employer size classes.

- Instrument using level of employment to deal with potential division bias.
Scale-Economy Regressions

\[ \ln f_{is} = \ln \tilde{f} + (\gamma - 1) \ln v_{is} + \ln q(x_{is}) + \epsilon_{is} \]

Mean Job-Filling Rate in Industry i and size class s

Average Time Effect

Mean Number of Vacancies (Stock) per establishment in Industry i and size class s

Scale-Economy Parameter: Elasticity of job-filling rate with respect to the (average) number of vacancies per Establishment

Sectoral differences in matching efficiency and average recruiting intensity: include industry and size fixed effects and industry-size mean employment growth rates as Controls.
1. Estimated on industry-size class data pooled over the 2001-06 period.
2. N=70 in all regressions. 5 or 6 size classes per industry (12).
3. All regressions include industry and size class fixed effects and the employment growth rate in the industry-size cell.
4. IV is 2SLS using log(Employment Level) as the instrument.
Aggregate Implications

GMF with CRS at the employer-level implies:

\[
H_t = \sum_e H_{et} = \mu \left( \frac{v_t'}{u_t} \right)^{-\alpha} \sum_e \nu_{et} \tilde{q}(x_{et}) = \mu \left( \frac{v_t'}{u_t} \right)^{-\alpha} \nu_t' = \mu v_t^{1-\alpha} u_t^\alpha q_t^{1-\alpha},
\]

where \( \bar{q}_t = \sum_e (v_{et} / v_t) \tilde{q}(x_{et}) \) and \( \nu_t' = v_t \bar{q}_t \).

\[
\Delta \log H = \alpha \Delta \log u + (1 - \alpha) \Delta \log v + (1 - \alpha) \Delta \log \bar{q}
\]

Working Hypothesis: \[
\frac{\Delta \log \bar{q}}{\Delta \log H} = \frac{\Delta \log q_{et}}{\Delta \log H_{et}} = 0.820
\]
Effective vacancies equal this index value times the number of measured vacancies.
National Index of Recruiting Intensity Per Vacancy, January 2001 to August 2014

Source: Dice Hiring Indicators at http://dicehiringindicators.com
Public and Private Sector Recruiting Intensity Indices
January 2001 to August 2014

Private Sector (left axis)

Public Sector (right axis)

Decennial Census Hiring
**Aggregate Performance: GMF vs. SMF**

1. The GMF, as augmented and constrained by our recruiting intensity index:
   a. Helps explain major recent breakdown in SMF
   b. Yields a more stable Beveridge Curve at national and regional levels than SMF
   c. Better explains movements over time in job-filling rates at national and regional levels than SMF
   d. Better explains movements over time in job-finding rates at national and regional levels than SMF

2. Industry-level changes in fill rates, $v-u$ ratios, and recruiting intensity values during and after the 2008-09 recession satisfy restrictions implied by the GMF. They violate restrictions implied by the SMF.
The GMF accounts for about 30 percent of the gap between empirical and SMF-implied vacancy yield that opens up from 2007 to 2009.
The GMF accounts for about 30 percent of the gap between empirical and SMF-implied vacancy yield that opens up from 2007 to 2009.

Recruiting intensity accounts for about 30% of gap that opens up between empirical & SMF-implied vacancy yield from 2007-2009.
Recruiting Intensity Index (Micro $q$) Related to Solow Residual Implied by SMF (Macro $q$), Jan 2001 to Dec 2011

Least Squares Fit

$q^{micro} = 0.01 + 0.24q^{macro}$

s.e. = 0.03, $R^2 = 0.91$

Variation in recruiting intensity is $1/4^{th}$ as large as SMF residual variation.
Regressions of log unemployment rate on log vacancy rate (SMF) or log effective vacancy rate (GMF)

<table>
<thead>
<tr>
<th>Aggregation Level of Unemployment and Vacancy Data</th>
<th>Time-Series Standard Deviation, Log Unemployment Rate</th>
<th>RMSE of Residuals in Regression on Log Vacancy Rate, Standard Matching Function</th>
<th>Percent Reduction in RMSE Using Log Effective Vacancy Rate, Generalized Matching Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>National Data</td>
<td>0.30</td>
<td>0.13</td>
<td>20.7</td>
</tr>
<tr>
<td>Northeast</td>
<td>0.27</td>
<td>0.17</td>
<td>17.2</td>
</tr>
<tr>
<td>Midwest</td>
<td>0.28</td>
<td>0.14</td>
<td>13.0</td>
</tr>
<tr>
<td>South</td>
<td>0.30</td>
<td>0.16</td>
<td>18.4</td>
</tr>
<tr>
<td>West</td>
<td>0.34</td>
<td>0.19</td>
<td>23.8</td>
</tr>
</tbody>
</table>

A similar analysis shows the effective tightness ratio (GMF) substantially improves on the \( v-u \) ratio (SMF) in explaining movements in the job-finding rate at national and regional levels.
Generalized Matching Function: Implications for Industry-Level Changes

• Our generalized matching function yields the following expression for the job-filling rate:

\[ f_t = \mu (v/u)_t^{-\alpha} q_t^{1-\alpha} \]

• Given a uniform elasticity, this expression yields the following restriction across the industry-level changes in fill rates, \(v-u\) ratios, and recruiting intensities:

\[ \frac{\Delta \ln f_{it}}{\Delta \ln (v/u)_{it}} = (1 - \alpha) \frac{\Delta \ln q_{it}}{\Delta \ln (v/u)_{it}} - \alpha. \]
Industry-Level Changes, 1

**Job-Filling Rate vs. V-U Ratio**

Mild evidence against the equal slope implication of the standard matching function.
Industry-Level Changes, 2

Recruiting Intensity vs. V-U Ratio

Strong evidence against the flat slope implication of the standard matching function in the post-recession period.
Evaluating the Restriction Implied by the Generalized Matching Function:

- For the recession period, the figures above give $\frac{\Delta \ln f}{\Delta \ln (v/u)} = -0.49$ and $\frac{\Delta \ln q}{\Delta \ln (v/u)} = 0.04$. Plugging into

\[
\frac{\Delta \ln f_{it}}{\Delta \ln (v/u)_{it}} = (1 - \alpha) \frac{\Delta \ln q_{it}}{\Delta \ln (v/u)_{it}} - \alpha \implies \alpha = 0.51
\]

- For the post-recession, $\frac{\Delta \ln q}{\Delta \ln (v/u)} = 0.31$: Plugging this value into the first equation and evaluating at $\alpha = 0.51$ implies a value of -0.35 for $\frac{\Delta \ln f}{\Delta \ln (v/u)}$, close to actual value of -0.28.

- So the data satisfy the GMF-implied restriction.
Contributions to Changes in Job-Filling Rates and Recruiting Intensity During and After the Great Recession

<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>Percent Change, Relative to 2007Q4</td>
<td></td>
<td>39.0</td>
<td>-22.0</td>
<td>-21.8</td>
<td>5.9</td>
</tr>
<tr>
<td>Selected Industry</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Construction</td>
<td>4.7</td>
<td>43.0</td>
<td>41.9</td>
<td>2.4</td>
<td>27.6</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>9.0</td>
<td>12.5</td>
<td>16.2</td>
<td>11.6</td>
<td>22.3</td>
</tr>
<tr>
<td>Professional &amp; Business Services</td>
<td>12.6</td>
<td>8.9</td>
<td>5.0</td>
<td>14.2</td>
<td>44.2</td>
</tr>
<tr>
<td>Leisure &amp; Hospitality</td>
<td>10.1</td>
<td>9.4</td>
<td>4.6</td>
<td>24.1</td>
<td>8.9</td>
</tr>
<tr>
<td>Health and Education</td>
<td>14.6</td>
<td>4.6</td>
<td>3.6</td>
<td>7.2</td>
<td>-0.6</td>
</tr>
<tr>
<td>Government</td>
<td>17.4</td>
<td>1.6</td>
<td>4.3</td>
<td>6.2</td>
<td>-15.6</td>
</tr>
</tbody>
</table>

Mean vacancy duration in Construction: 8 days prior to the recession, 3 days at the trough.
Further Extending the GMF

- My remarks on Krueger and Mueller (2011 BPEA) consider a GMF of the form
  \[ H_t = \mu [s_t U_t]^\alpha [q_t V_t]^{1-\alpha} \]

- Using evidence from their paper on how search time varies with unemployment spell duration and CPS time-series data on mean unemployment spell duration, I construct an index of average search intensity per unemployed person.

- Movements in search intensity per unemployed and recruiting intensity per vacancy explain 70% of the gap between empirical and SMF-implied job-finding rate and that opens up from 2006 to 2010.
Figure 3. Indexes of Search Intensity per Unemployed Worker and Recruiting Intensity per Vacancy, January 2001–February 2011

Recruiting intensity per vacancy (right scale)

Search intensity per unemployed worker for $\beta = 1.54$ (left scale)
Other Work Measuring the Jobseeker Input to the Matching Function

See Veracierto (2011) and Hall and Schulhofer-Wohl (2013) for fuller efforts to construct better measures of the jobseeker input (U) to the matching function. They start from the first-order fact that most new hires are NOT from the pool of unemployed workers.

Textbook Equilibrium Search Model

• No role for “recruiting intensity” per vacancy
• Pissarides (2000, chapter 5) extends standard model to incorporate variable recruiting intensity per vacancy
  – Costs per vacancy are increasing and convex in intensity
  – His hiring technology and matching function are consistent with our generalized matching function (micro CRS case)
• *Optimal recruiting intensity is insensitive to aggregate conditions and same for all employers in the cross-section.* Why? Employers use vacancies to vary hires, and choose intensity to minimize cost per vacancy.
• Rejected by our CS evidence, specifically positive relationship of job-filling rates to employer growth and hires rate.
• Cannot explain role of recruiting intensity at aggregate level.
A major role for recruiting intensity per vacancy is not fatal to standard equilibrium search models with random matching, but it calls for re-evaluation of widely used building blocks in the standard model.

- Dropping the standard free-entry condition for new jobs (and dispensing with the convenient result that equilibrium vacancy value is 0) leads to a meaningful role for recruiting intensity per vacancy. See Davis (2001), “Quality Distribution of Jobs ...”

- The CS evidence on slides 19 and 22 is hard to square with the basic mechanism stressed by mismatch models.

- Directed search models are readily compatible with the CS evidence, because these models come built-in with an extra recruiting margin, typically in the form of posted offer wages. See Kass and Kircher (2013).
Are All Hires Mediated through Vacancies? A Specification Test

Number of hires in month \( t \) accounted for by the flow of new vacancies in \( t \):

\[
H^\text{NEW}_t = \sum_s (\tau - s)(1 - f_t - \delta_t + \delta_t f_t)^{s-1}
\]

So, according to the model, the percent of hires in \( t \) accounted for by establishments with no vacancies at start of month is:

\[
E_t^\text{NoVac} \frac{H^\text{NEW}_t}{H_t}
\]

where the first variable is the employment share at establishments with no vacancies at start of month.
**Model Specification Test Results**

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percent of Hires in ( t ) by Establishments with No Vacancies at end of ( t-1 )</td>
<td>41.6</td>
</tr>
<tr>
<td>Percent Implied by Model for Alternative Sectoral Breakdowns</td>
<td></td>
</tr>
<tr>
<td>Size Class (6) by Worker Turnover Rate (6) – 36 cells</td>
<td>27.0</td>
</tr>
<tr>
<td>Industry (12) by Size Class (2) by Worker Turnover (6) Rate – 144 cells</td>
<td>26.7</td>
</tr>
<tr>
<td>Industry (2) by Size Class (6) by Worker Turnover Rate (15) – 180 cells</td>
<td>27.4</td>
</tr>
</tbody>
</table>

\[
27.4/41.6 = 66\%
\]
Our model of daily hiring accounts for about 2/3 of hires at establishments with no vacancies at start of month. So a big share of hires are not mediated through vacancies.
Some Directions for Research

• Assessing performance of GMF in other countries
• Incorporating recruiting intensity into theories of labor market flows and unemployment
  – E.g., Kaas and Kircher (2013)
• Better measures of the jobseeker input to matching
  – E.g., Veracierto (2011), Hall & Schulhofer-Wohl (2013), and Mukoyama, Patterson and Sahin (2013)
• Aggregate implications of sectors with atypical frictional characteristics, e.g., outsized role of Construction in recent years (I’m working on this)
• Hires not mediated through vacancies (I’m working on this)
• Need for data that supports direct measures of recruiting intensity and recruiting methods – a richer JOLTS
Extra Slides
The Quits Rate time series is rescaled to have the same variance and mean as the Vacancies to Unemployment Ratio. Short Term Unemployment is the sum of individuals who have been unemployed for 26 weeks or less.
### Mean Vacancy Duration by Establishment Size

#### Selected Time Periods

<table>
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<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>1-9</td>
<td>19.3</td>
<td>18.3</td>
<td>17.3</td>
<td>19.8</td>
<td>12.8</td>
<td>16.5</td>
<td>18.9</td>
<td>23.6</td>
<td>85%</td>
</tr>
<tr>
<td>10-49</td>
<td>15.2</td>
<td>14.9</td>
<td>17.5</td>
<td>16.2</td>
<td>13.0</td>
<td>15.7</td>
<td>19.2</td>
<td>20.4</td>
<td>57%</td>
</tr>
<tr>
<td>50-249</td>
<td>15.7</td>
<td>16.9</td>
<td>19.4</td>
<td>18.3</td>
<td>15.3</td>
<td>17.9</td>
<td>21.0</td>
<td>19.9</td>
<td>31%</td>
</tr>
<tr>
<td>250-999</td>
<td>21.0</td>
<td>21.9</td>
<td>25.7</td>
<td>24.9</td>
<td>18.0</td>
<td>24.5</td>
<td>24.2</td>
<td>25.3</td>
<td>41%</td>
</tr>
<tr>
<td>1000-4999</td>
<td>36.2</td>
<td>35.0</td>
<td>44.2</td>
<td>35.6</td>
<td>30.7</td>
<td>34.3</td>
<td>37.7</td>
<td>36.5</td>
<td>19%</td>
</tr>
<tr>
<td>5000+</td>
<td>47.4</td>
<td>43.7</td>
<td>37.1</td>
<td>39.6</td>
<td>40.6</td>
<td>55.1</td>
<td>56.4</td>
<td>58.1</td>
<td>43%</td>
</tr>
</tbody>
</table>

### Recruiting Intensity Index

#### By Establishment Size and Time Period

<table>
<thead>
<tr>
<th></th>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>1-9</td>
<td>0.99</td>
<td>1.10</td>
<td>1.06</td>
<td>0.98</td>
<td>0.95</td>
<td>0.95</td>
<td>0.94</td>
<td>0.86</td>
<td>-9%</td>
</tr>
<tr>
<td>10-49</td>
<td>1.05</td>
<td>1.10</td>
<td>1.07</td>
<td>0.95</td>
<td>0.89</td>
<td>0.91</td>
<td>0.92</td>
<td>0.92</td>
<td>3%</td>
</tr>
<tr>
<td>50-249</td>
<td>1.09</td>
<td>1.07</td>
<td>1.09</td>
<td>0.93</td>
<td>0.81</td>
<td>0.90</td>
<td>0.92</td>
<td>1.00</td>
<td>23%</td>
</tr>
<tr>
<td>250-999</td>
<td>1.06</td>
<td>1.07</td>
<td>1.07</td>
<td>0.91</td>
<td>0.83</td>
<td>0.94</td>
<td>1.00</td>
<td>1.03</td>
<td>24%</td>
</tr>
<tr>
<td>1000-4999</td>
<td>1.06</td>
<td>1.06</td>
<td>0.99</td>
<td>1.04</td>
<td>0.84</td>
<td>0.94</td>
<td>0.96</td>
<td>1.05</td>
<td>26%</td>
</tr>
<tr>
<td>5000+</td>
<td>0.97</td>
<td>1.11</td>
<td>1.38</td>
<td>1.13</td>
<td>0.76</td>
<td>0.78</td>
<td>0.83</td>
<td>0.90</td>
<td>19%</td>
</tr>
</tbody>
</table>