Cyclical Dynamics in Worker and Job Flows and Vacancies
Overview

• Striking asymmetry in cyclical dynamics of creation and destruction in U.S. manufacturing

• Other sectors and countries:
  – Limited time series coverage (annual data for a 5-10 year periods – see, e.g., Foote (1998) and Boeri
  – Destruction is more volatile than creation in manufacturing in other countries
    • Most recent recession looks to be a bit different.

• Variation across employer characteristics (e.g., size, age)

• Unbalanced restructuring in some economies?
Theory: Business Cycle and Reallocation

- Which way does causality go and/or what is nature of interaction?
  - Blanchard and Diamond (1989, 1990)
  - Davis/Haltiwanger (1990)
  - Mortensen/Pissarides (1994, 1999)
  - Caballero/Hammour (1994, 1996)
  - Campbell/Fisher (2001)
  - Foote (1998)
  - Ramey/Watson (1997)
  - Barlevy (2002)
Common Themes

• **Common features:**
  – Reallocation shocks
  – Frictions:
    • **Search/matching**
      – Two types of matching:
        » Allocation of jobs to plants
        » Allocation of workers to jobs
    • **Capital/labor adjustment costs**
    • **Entry costs**
  – Most common: Incentives for reallocation are cyclically sensitive
    • **Endogenous timing of reallocation/restructuring**
  – Reallocation shocks could generate a recession (Lilien, Davis/Haltiwanger, Blanchard/Diamond)
Efficiency?

• Technological sclerosis and unbalanced restructuring (Caballero and Hammour)

• Sullying effect (Barlevy)

• Sources of inefficiency:
  – Bargaining
  – Hold-up problems
  – Asymmetric information
  – Distortions in credit/product markets

• Growth vs. fluctuations?
Understanding cyclical driving forces

- Aggregate vs. reallocation shocks
- Does timing of reallocation respond in systematic ways to aggregate shocks?
- Is the business cycle caused by reallocation shocks?
- Decomposition of driving forces using a structural VAR
  - Mapping to deep structural parameters?
- Davis and Haltiwanger (AER, 1999) and (JME, 2001)
\[ Y_t = [POS_t, NEG_t] \]
\[ \epsilon_t = [\epsilon_{at}, \epsilon_{st}]' \]
\[ Y_t = A(L)\epsilon_t \]
\[ Y_t = D(L)\eta_t, \quad D(0) = I, \]
\[ \eta_t = [p_t, n_t]' \]
\[ \eta_t = B_0\epsilon_t \]
\[ A(L) = D(L)B_0 \]
\[ p = \epsilon_a + b_{ps}\epsilon_s \]
\[ n = b_{na}\epsilon_a + \epsilon_s \]
\[ p_t = \epsilon_{at} + b_{ps} \epsilon_{st}, \]
\[ n_t = b_{na} \epsilon_{at} + \epsilon_{st}. \]

\[ \sigma_p^2 = \sigma_a^2 + b_{ps}^2 \sigma_s^2, \]
\[ \sigma_n^2 = b_{na}^2 \sigma_a^2 + \sigma_s^2, \]
\[ \sigma_{pn} = b_{na} \sigma_a^2 + b_{ps} \sigma_s^2, \]

\[ b_{ps} = \frac{\sigma_{pn} - b_{na} \sigma_p^2}{\sigma_n^2 - b_{na} \sigma_{pn}}. \]
Remarks on Identification:

- $b_{na} < 0, b_{ps} > 0$ – definitional?

- $b_{na} = -1, b_{ps} = 1$ – traditional?

- $b_{na} < -1, |b_{ps}| < 1$ – emerging theories?
Long run neutrality restrictions

(iv) \[ \sum_{l=0}^{\infty} [A_{11}(l) + A_{21}(l)] = 0 \quad \Rightarrow \quad \sum_{l=0}^{\infty} [D_{11}(l) + D_{21}(l)] + b_{na} [D_{12}(l) + D_{22}(l)] = 0 \]

(v) \[ \sum_{l=0}^{\infty} [A_{12}(l) - A_{22}(l)] = 0 \quad \Rightarrow \quad \sum_{l=0}^{\infty} b_{ps} [D_{11}(l) - D_{21}(l)] + [D_{12}(l) - D_{22}(l)] = 0 \]
A. Implications of Identification for Key Parameters

The graph illustrates the relationship between \( b_{ps} \) and \( b_{na} \) for different values of \( b_{ps} \):

- \( b_{ps} = 1 \)
- \( b_{na} = -1 \)
- \( b_{ps} = 0 \)

The curve shows how \( b_{ps} \) changes with \( b_{na} \) for each specified value of \( b_{ps} \).
B. Implications of Identification for Key Parameters

![Graph showing the relationship between Std Dev of Structural Innovations and $b_{na}$ for different values of $b_{ps}$.

- For $b_{ps}=1$, the Std Dev increases with decreasing $b_{na}$.
- For $b_{ps}=-1$, the Std Dev decreases with decreasing $b_{na}$.
- For $b_{ps}=0$, the Std Dev is constant.

Legend:
- Solid line: Std (Allocative)
- Dashed line: Std (Aggregate)
C. Percent of Net Growth and Job Reallocation Due to Allocative Shocks

\[ b_{ps} = 1 \]
\[ b_{na} = -1 \]
\[ b_{ps} = 0 \]

Percent

-2.3 -1.8 -1.3 -0.8 -0.3

Net (4 Step) Sum (4 Step)
Net (16 Step) Sum (16 Step)
7-Variable system with observable shocks

\[ o = \varepsilon_o + b_{om}\varepsilon_m \]

\[ m = b_{mo}\varepsilon_o + \varepsilon_m \]

\[ a = b_{ao}\varepsilon_o + b_{am}\varepsilon_m + \varepsilon_a + b_{ar}\varepsilon_r \]

\[ r = b_{ro}\varepsilon_o + b_{rm}\varepsilon_m + b_{ra}\varepsilon_a + \varepsilon_r \]

\[ c = b_{co}\varepsilon_o + b_{cm}\varepsilon_m + b_{ca}\varepsilon_a + b_{cr}\varepsilon_r + \varepsilon_c \]

\[ p = b_{po}\varepsilon_o + b_{pm}\varepsilon_m + b_{pa}\varepsilon_a + b_{pr}\varepsilon_r + b_{pc}\varepsilon_c + \varepsilon_p + b_{pn}\varepsilon_n \]

\[ n = b_{no}\varepsilon_o + b_{nm}\varepsilon_m + b_{na}\varepsilon_a + b_{nr}\varepsilon_r + b_{nc}\varepsilon_c + b_{np}\varepsilon_p + \varepsilon_n. \]
Figure 3: Impulse Response Functions for Total Manufacturing, Five-Variable VAR Subsystem

Response to Unit Standard Deviation Positive Oil Shock

Response to Unit St. Dev. Oil Shock: Absolute Change Effect Only

Response to Unit Standard Deviation Negative Oil Shock

Response to Unit Standard Deviation SPREAD Shock
Response to Unit Standard Deviation Positive Oil Shock
Net vs. Reallocation Responses to Oil and other Shocks

- Net employment response to 73 oil price shock is -8 percent at 8 quarters but only -2 percent at 16 quarters.
- Reallocation response is 11 percent at 16 quarters.
- Net response to 79 money shock is -3 percent at 8 quarters, -1.3 percent at 16 quarters -- and reallocation response is 2.7 percent at 16 quarters.
Reallocation Responses to Shocks

• Oil Shocks:
  – positive price shocks cause downturn but negative shocks cause upturns;
  – reallocation dynamics can explain why;

• Credit/Money Shocks:
  – Look more like “traditional” aggregate shock
  – Still asymmetric response of destruction relative to creation -- recessions as reorganizations?
Taking stock...

- Theory and evidence link reallocation (permanent) and cycle
- Evidence for non-manufacturing still unclear
- Theory and evidence has not fully exploited differences by plant characteristics (e.g., size, age)
- Causality difficult
The Establishment-Level Behavior of Vacancies and Hiring

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The views expressed are solely those of the authors and do not necessarily reflect the official positions or policies of the US Bureau of Labor Statistics, the US Bureau of the Census or the views of other staff members.
Introduction

• **Vacancies are an important part of the labor market**
  – Are a key component of worker recruitment, empirically and theoretically
  – Receive little attention in empirical research, mostly due to data limitations
  – As a result, little is known about their behavior

• **Goal for this paper:**
  – Document the micro and macro behavior of vacancy posting and worker recruitment
  – Highlight the behavior of the *vacancy yield* (hires per vacancy)
  – Estimate the behavior of related but unobserved processes
    • Vacancy Flow (data measures stock only)
    • Vacancy Duration and the Job-Filling Rate
    • Hiring *without* a posted vacancy
Motivation

• **Standard labor search theory has several implications for vacancy behavior**
  – Vacancies have a constant “yield” (i.e., return), independent of search intensity or firm characteristics
  – Firms must undergo costly search and recruitment to attract a worker

• **In reality…**
  – With constant returns matching technology, \( h = m(v,u) = \mu v^{1-\alpha} u^\alpha \)
    so the vacancy yield should be counter-cyclical
    \[
    \frac{h}{v} = \mu \left( \frac{v}{u} \right)^{-\alpha}
    \]
  – Vacancies are intangible (unlike the unemployed), so firms may be able to violate the matching function’s Inada conditions (i.e., \( m(0,u) \geq 0 \))
  – Empirically, other factors (sectoral and establishment-specific characteristics) may affect vacancy and hiring behavior
Data

- **Main Data Source: Job Openings and Labor Turnover Survey (JOLTS – from BLS)**
  - Monthly estimates of hires, separations (broken out by type), and vacancies from representative sample of nonfarm establishments
  - Our sample: ~372,000 establishment-month observations; includes only observations with an observation in the previous month
  - Hires and separations: measured as an over-the-month flow
  - Vacancies: measured as an end-of-month stock
  - Sample covers December 2000 – January 2005

- **CPS Gross Flows and Conference Board Help Wanted Index**
  - Gross flows come from Shimer (2005) and Fallick-Fleischman (2004); used to get measure of hires from worker transitions
  - Help Wanted Index: measure of vacancies based on newspaper ads
  - Both series detrended using low-bandwidth HP filter; HWI adjusted to match mean of JOLTS vacancy data over comparable period
  - Both: cover 1967-2004, are quarterly means of monthly values
Aggregate Evidence - JOLTS

Percent of Employment

- Hires
- Layoffs
- Vacancies
- Quits
Aggregate Evidence – CPS and HWI

Percent of Employment

- Shimer - Hires (Detrended)
- Fallick-Fleischman - Hires
- HWI - Vacancies (Detrended)
Aggregate Evidence – Vacancy Yield

Hires per Vacancy

From Shimer Data
From Fallick-Fleischman Data
From JOLTS
Aggregate Evidence - Summary

• Hires and vacancies are procyclical
  – Vacancies are more responsive to business cycle

• Vacancy yield is countercyclical
  – Yield increases sharply during recessions

• Cross-section:
  – Hires, vacancies, and the yield vary across industries, establishment size
  – High-turnover categories tend to have the highest vacancy yields
Micro Evidence on Hires and Vacancies

<table>
<thead>
<tr>
<th></th>
<th>Percent with $h_t = 0$</th>
<th>Percent with $v_{t-1} = 0$</th>
<th>Percent of $h_t$ with $v_{t-1} = 0$</th>
<th>Percent of $v_{t-1}$ with $h_t = 0$</th>
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</thead>
<tbody>
<tr>
<td><strong>Nonfarm Employment</strong></td>
<td>35.9</td>
<td>46.5</td>
<td>42.3</td>
<td>18.7</td>
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<td><strong>Selected Major Industry</strong></td>
<td></td>
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<tr>
<td>Resources</td>
<td>44.8</td>
<td>65.0</td>
<td>65.1</td>
<td>30.8</td>
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<tr>
<td>Construction</td>
<td>47.4</td>
<td>75.2</td>
<td>67.7</td>
<td>33.3</td>
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<tr>
<td>Manufacturing</td>
<td>34.8</td>
<td>46.4</td>
<td>43.3</td>
<td>15.8</td>
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<td>Retail Trade</td>
<td>44.0</td>
<td>61.0</td>
<td>49.7</td>
<td>22.4</td>
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<tr>
<td>Finance, Insurance &amp;</td>
<td>45.0</td>
<td>50.2</td>
<td>41.6</td>
<td>22.8</td>
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<td>Real Estate</td>
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<tr>
<td>Professional &amp; Business</td>
<td>36.3</td>
<td>43.4</td>
<td>32.3</td>
<td>16.8</td>
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<td>Services</td>
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<tr>
<td>Health &amp; Education</td>
<td>27.6</td>
<td>31.7</td>
<td>25.4</td>
<td>11.0</td>
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<tr>
<td>Leisure &amp; Hospitality</td>
<td>33.6</td>
<td>55.6</td>
<td>48.6</td>
<td>16.6</td>
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<tr>
<td>Government</td>
<td>22.4</td>
<td>25.7</td>
<td>20.6</td>
<td>12.9</td>
</tr>
</tbody>
</table>

- High-turnover industries tend to have
  - Less frequent adjustment
  - More hires without a vacancy
  - More vacancies left unfilled
Vacancy Yield and Establishment Growth

Hires per Vacancy

Unconditional

Controlling for Establishment Fixed Effects

Net Growth (Percent of Employment)
Accounting for Observed Hires & Vacancy Behavior

• The increase in the vacancy yield with growth cannot be the result of time-aggregation alone
  – Something underlying (vacancy duration, intramonth vacancy flows, rate of hiring without vacancies) must also vary with growth
  – In addition, these underlying processes likely also account for time-series movements in the vacancy yield

• To identify underlying processes, we develop a stock-flow model of vacancy posting and worker recruitment
  – Model produces monthly stock-flow equations built up from daily occurrence of hires and vacancies
  – Basic version of model estimates monthly flow of vacancies (for flow-to-flow comparison) and job-filling rate (inverse of vacancy duration)
  – Expanded model allows for heterogeneity, hiring without a vacancy
Basic Stock-Flow Model

• Basic model builds up from daily rate of hiring, evolution of vacancies
  \[ h_{s,t} = f_t v_{s-1,t} \]
  \[ v_{s,t} = (1 - \delta_t) v_{s-1,t} + \theta_t - h_{s,t} \]
  
  – Where \( f_t \) is the job-filling rate and \( \theta_t \) is the average daily flow of vacancies

• The model yields the following two equations for the monthly data, with two unknowns, \( \{f_t, \theta_t\} \), which we can solve numerically
  \[ v_t = (1 - f_t - \delta_t)^\tau v_{t-1} + \theta_t \sum_{s=1}^{\tau} (1 - f_t - \delta_t)^{s-1} \]
  \[ H_t = f_t v_{t-1} \sum_{s=1}^{\tau} (1 - f_t - \delta_t)^{s-1} + f_t \theta_t \sum_{s=1}^{\tau} (\tau - s)(1 - f_t - \delta_t)^{s-1} \]
Basic Model Results – CPS and HWI Data

Rate
(Percent of Employment)

Vacancy Flow Rate (left axis)

Vacancy Stock (left axis)

Daily Fill Rate (right axis)

Fill Rate
(Probability)
Expanded Stock-Flow Model

• Expanded model
  – Allows some hires, η_t, to come from “unposted” vacancies
  – Differentiates between establishments starting the month with and without a vacancy posted; assumes heterogeneity in their flows θ_t = {θ_t^0, θ_t^p}

• The expanded model yields four equations and four unknowns, \{f_t, \theta_t, \theta_t^0, \eta_t\}, which we can again solve numerically

\[ v_t = (1 - f_t - \delta_t)^\tau v_{t-1} + \theta_t \sum_{s=1}^\tau (1 - f_t - \delta_t)^{s-1} \]
\[ H_t = f_t v_{t-1} \sum_{s=1}^\tau (1 - f_t - \delta_t)^{s-1} + f_t \theta_t \sum_{s=1}^\tau (\tau - s)(1 - f_t - \delta_t)^{s-1} + \tau \eta_t \]
\[ v_t^0 = \theta_t^0 \sum_{s=1}^\tau (1 - f_t - \delta_t)^{s-1} \]
\[ H_t^0 = f_t \theta_t^0 \sum_{s=1}^\tau (\tau - s)(1 - f_t - \delta_t)^{s-1} + \tau \eta_t \]
Summary of Model Estimation

• Basic Model
  – Job-filling rate averages 5.5 percent, implying average vacancy duration of 18 days
  – Vacancy flow rate averages 3.4 percent of employment per month
  – Job-filling rate (like the vacancy yield) is strongly countercyclical

• Expanded Model
  – Qualitatively similar results, though average durations are longer (30 days)
  – Flow rate for those starting with vacancies nearly double rate for those not (2.7 percent versus 1.4 percent)
  – Hires from “unposted” vacancies 1.2 percent of employment, or 36 percent of all hires!
Summary of Model Estimation – Cont’d

• Both Models
  – Heterogeneity across industries and establishment size; high turnover categories tend to have…
    • Higher job-filling rates (and thus lower durations)
    • Higher vacancy flow rates
    • Greater hires rates from “unposted” vacancies
    • A greater share of hires from “unposted” vacancies
  – Based on estimates predicted from allowing only one parameter to vary freely at a time…
    • Movements in the job-filling rate account for much of the cyclical variation in hires and vacancies, particularly in the basic model
    • When the model is expanded, the fill rate, the flow rate and hires from “unposted” vacancies roughly equally account for cyclical movements in hires and vacancies
Expanded Model Results – Estimates vs. Growth

**Rate**
(Percent of Employment)

- Monthly Flow Rate, Positive Previous Stock (Left Axis)
- Monthly Flow Rate, No Previous Stock (Left Axis)
- Hires Rate from Unposted Vacancies (Left Axis)
- Daily Fill rate (Right Axis)

**Fill Rate**
(Probability)
Conclusions

• The micro and macro evidence suggests the vacancy yield gives important information on recruiting behavior
  – The yield is countercyclical, and varies widely across industries, across establishments, and as a function of establishment growth

• Our stock-flow model unearths rich dynamics underlying worker recruitment and vacancy posting
  – Movements in hires and vacancies are due in large part to a countercyclical job-filling rate
  – Over one-third of hires occur without a vacancy posting

• Heterogeneity exists in all patterns across establishments
  – High-turnover establishments tend to have high vacancy yields, high fill rates, and a greater share of hires from “unposted” vacancies
  – Vacancy yields, job-filling rates, vacancy flow rates, and the rate of hires from “unposted” vacancies all increase nonlinearly with establishment growth