What shifts the Beveridge Curve? Recruitment Effort and Financial Shocks

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Shift in the Beveridge Curve

U.S. Beveridge Curve

Unemployment rate
Vacancy rate

2003:1–2007:12
2008:1–2013:10
Mechanism

- **Normal times**
  1. Firms heterogeneous in productivity, size and debt.
  2. Firms borrow to satisfy a non-negativity constraint on dividends.
  3. Firms can default and exit. Face loan premiums.
  4. Hiring firms participate in frictional labor markets in which they post vacancies \( v_{it} \) with recruitment effort \( e_{it} \).
  5. Faster growing firms fill vacancies faster
    - Davis, Faberman and Haltiwanger (2013)
  6. Job creation dominated by young firms
    - Haltiwanger, Jarmin and Miranda (2012)
• **Financial crisis** ↔ **Increased premium on loans**

1. Young firms constrained \(\implies\) Less growth
2. Lower value of firms \(\implies\) ↓Entry / ↑Exit
3. Lower recruitment effort \(\implies\) Persistent fall in the efficiency of the *measured* aggregate matching function. Outward shift in the Beveridge curve.
4. Older firms less affected \(\implies\) ↓Hiring rather than ↑Separations.
Today

1. Present model
2. Discuss calibration
3. Features of the model
   - Firm dynamics
   - Comparison of steady states
   - Recessions due to changes in productivity
**Firms - Default**

**Value** Let $\Pi(n, b, z)$ be the present discounted value of dividends after realisation of productivity and exit shock, before the exit / default decision.

- Problem of an incumbent
  - **Choice:** *Stay and repay*, or *Exit and default*
    
    \[ \Pi(n, b, z) = \max \{ \Pi^s(n, b, z), 0 \} \]

- Conditional on staying
  - **Choice:** *Hire* or *Fire*
    
    \[ \Pi^s(n, b, z) = \max \{ \Pi^f(n, b, z), \Pi^h(n, b, z) \} \]
Firms - Firing

- **Choice**: *Firm size* $n'$ *and level of debt* $b'$

  \[
  \Pi^f(n, b, z) = \max_{n', b'} D^f + \beta \sum_{z' \in \mathbb{Z}} P(z, z')(1 - \delta) \Pi(n', b', z')
  \]

  \[
  D^f = zn'^\alpha - w(n', b', z)n' - \chi + Q(n', b', z)b' - b
  \]

  \[
  n' \in [n, n]
  \]

  \[
  D^f \geq 0
  \]
Firms - Hiring

- **Choice** *Firm size* $n'$, *level of debt* $b'$, *recruitment effort* $e$, *vacancies* $v'$

\[
\Pi^h(n, b, z) = \max_{n', b', e, v} D^h + \beta \sum_{z' \in Z} P(z, z')(1 - \delta)\Pi(n', b', z')
\]

\[
D^h = zn'^\alpha - w(n', b', z)n' - \chi - C(e, v, n) + Q(n', b', z)b' - b
\]

\[
n' - n = qev
\]

\[
n' > n
\]

\[
e \in [0, 1]
\]

\[
D^h \geq 0
\]

- **Two-stage problem:**
  1. **Stage I** Choose target employment level $n'$
  2. **Stage II** Choose positions to open $v$, and recruitment effort $e$
Recruitment problem

\[ C(n, n') = \min_{e,v} C(e, v, n) = \left[ \frac{\kappa}{\gamma_2 + 1} \left( \frac{v}{n} \right)^{\gamma_2} + \frac{c}{\gamma_1} e^{\gamma_1} \right] v \]

s.t. \( n' - n \geq qev \)
Identification

- Solution: $q = \mu \theta^{-\phi}$

\[
\begin{align*}
\log \left[ \frac{v}{n} \right] &= \Omega \left( \frac{c}{\kappa} \right) + \frac{\phi \gamma_1}{\gamma_1 + \gamma_2} \log \theta + \frac{\gamma_1}{\gamma_1 + \gamma_2} \log \left( \frac{n' - n}{n} \right) \\
\log \left[ \frac{h}{v} \right] &= -\Omega \left( \frac{c}{\kappa} \right) - \frac{\phi \gamma_1}{\gamma_1 + \gamma_2} \log \theta + \frac{\gamma_2}{\gamma_1 + \gamma_2} \log \left( \frac{n' - n}{n} \right) \\
C(n, n') &= \frac{\Gamma(\kappa)}{1 + \gamma_2} \left( \frac{v}{n} \right)^{\gamma_2} v
\end{align*}
\]

1. $\gamma_2/\gamma_1$ Davis, Faberman and Haltiwanger (2013)
   \[ \varepsilon_{f,g} = \frac{\gamma_2}{\gamma_1 + \gamma_2} = 0.82 \]
2. $\gamma_2$ Controls the increasing returns to scale in vacancies.
3. $\kappa$ Total cost of hiring
4. $c/\kappa$ Mean vacancy rate
Potential entrants

- **State** Draw $z \sim \text{Exp} (\xi)$
- **Choice**: *Enter* or *Stay out*

$$\Pi^0 (z) = \max \{ \Pi^s (n, 0, z) - \chi_0, 0 \}$$
Banks

- **Competitive banks**
  - Intermediate funds at cost $\varphi$
  - Deposits earn risk-free rate $R = \bar{Q}^{-1}$
  - Price per unit loans: $Q(n', b', z)$
  - Default: (i) Fixed cost of default $\zeta$, (ii) no repayment
  - *Expected return on loan* is equal to *riskless return paid on deposits*

\[
Q(n', b', z) = \bar{Q}(1-\varphi) \left( Pr[\text{Repay}|n', b', z] - \frac{\zeta}{b'} Pr[\text{Default}|n', b', z] \right)
\]

- **Premium** $\bar{Q}/Q(n', b', z)$ increases with

\[\uparrow \varphi, \uparrow \zeta, \uparrow Pr[\text{Default}|n', b', z], \downarrow b'\]
# Calibration

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A. Household</strong></td>
<td></td>
</tr>
<tr>
<td>Discount rate</td>
<td>$\beta$</td>
</tr>
<tr>
<td>Size of labor force</td>
<td>$\bar{L}$</td>
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<tr>
<td><strong>B. Firms</strong></td>
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<tr>
<td>Cost function</td>
<td>$\gamma_2$</td>
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<tr>
<td>Initial labor</td>
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<tr>
<td>Measure potential entrants</td>
<td>$M_0$</td>
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<tr>
<td><strong>C. Labor market</strong></td>
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<tr>
<td>Matching function</td>
<td>$\phi$</td>
</tr>
<tr>
<td>Bargaining power</td>
<td>$\eta$</td>
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<tr>
<td><strong>D. Productivity</strong></td>
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### Calibration

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<thead>
<tr>
<th>Parameter</th>
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<th>Target</th>
<th>M</th>
<th>D</th>
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<td><strong>A. Household</strong></td>
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<td>Utility of leisure</td>
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<td>Monthly JD rate</td>
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<td>Decreasing returns</td>
<td>$\alpha$</td>
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<td>Labor share</td>
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<td>Emp share age 0</td>
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<td>Cost constant</td>
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<td>Hire-costs / q’ly wages</td>
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<td>Ratio</td>
<td>$\kappa/c$</td>
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<td>Agg. vacancy rate</td>
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<td>Fixed cost of hiring</td>
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<td>Estab ann $</td>
<td>g</td>
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<td>Operating cost</td>
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<td>Survive 5yrs</td>
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<tr>
<td>Constant</td>
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<td>Monthly job find rate</td>
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<td>.45</td>
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<td>$z_0 \sim \text{Exp}(\xi)$</td>
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<td>$\sigma(\log n)$ (annual, cont.)</td>
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<td>AR(1) persistence</td>
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<tr>
<td>Frac $N$ in $n &gt; 500$</td>
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| Non-targetted              |       |                                 |      |      |
| Unemployment rate          |       |                                 | 0.063| 0.052|
| Estabs $n > 500$           |       |                                 | 0.005| 0.004|
| JC by entrants             |       |                                 | 0.135| 0.331|
| Elasticity: Wage and size  |       |                                 | 0.130| 0.100|
| Coeff variation $n$        |       |                                 | 6.424| 6.100|
Results

1. Firm dynamics
2. Comparing steady states
3. Recessions due to changes in productivity
1. Firm dynamics

A. Average size

B. Average productivity

C. Average Effort (hiring)

D. Ineffective Vacancy Rate \( \frac{V-V^*}{V} \)
1. Firm dynamics

A. Cohort job creation and destruction

- 1. Job creation Rate
- 2. Job destruction Rate

B. Type of destruction

- 1. Fires by continuing firms
- 2. Layoffs due to exit
2. Steady states
3. Recession

I. DATA (2001)
- Monthly data. 1 = Aug '08
- Log deviations of variables
- Scaled by the log deviation of labor productivity from HP trend

II. MODEL
- Transition dynamics for a level change in productivity
- Log deviations of variables
- Scaled by the log change in labor productivity
3. Recession

I. DATA (2001)

II. MODEL

Vacancy–yield: H/V  Match efficiency  Unemployment rate  Vacancy rate  Market tightness: θ
3. Recession

I. DATA (1 = Aug−01)

II. DATA (1 = Jan−08)

Conclusion

- Presented a model of firm dynamics with search frictions
- Recruitment effort
- Replicate facts at the firm and aggregate level
- Next:
  - Iron out calibration
  - Calibrate model with borrowing
  - Work on empirical facts regarding vacancy yields and establishment age
Extra slides

[Previous presentations]
The Beveridge Curve

- Pairs of \((U, V)\) consistent with a stationary equilibrium in the labor market

\[
\frac{s(1-u)}{{}^{\text{Separations}}} = AV^\alpha U^{1-\alpha}
\]

- Shift in the BC ⇔ persistent fall in aggregate matching efficiency \(A\)
  1. Mismatch ↑
  2. Worker’s search effort ↓
  3. **Firm’s recruitment effort** ↓
Two facts...

1. **Firm distribution in the recent recession**
   - The recession saw heavily restricted entry and growth of small / young firms.

2. **Firm level hiring**
   - When hiring, firms use margins other than vacancies to convert vacancies into hires. Fast growing firms use these margins more extensively. Davis, Faberman and Haltiwanger (QJE, 2013)

- **Why is a quantitative model of this channel important?**
  - **Policy** Suggests focus on promoting growth of small / young firms. Independent of mismatch, change in ‘natural rate’ arguments.
  - **Theory** Linking financial crises to labor markets.
Fact: Growth rates and job-filling rates

- **Fact** Job-filling rate \( f_{it} = q_t e_{it} \) is increasing in the growth rate \( g_{it} \). Davis, Haltiwanger and Faberman (QJE, 2013)

\[
\log f_{i,t} = -4.2 + 0.82 \log g_{it}
\]
Fact: Young firm Job Creation

- **Fact** Young firm job-creation fell by more relative to that of old firms and has remained below trend.
Model - Ingredients

Model Expand on Elsbey and Michaels (2013)

- [✓] Firm level heterogeneity in size and productivity $x = (n, z)$
- [✓] Multi-worker firms with decreasing returns $F(n, z) = zn^\alpha$
- [✓] Search framework $h = q(\theta)v$
- [✓] Calibrated to match wide range of cross-sectional facts
- [+] Recruitment effort $h = q(\theta)ev$
- [+] Constraint on dividends $D \geq 0$
- [+] Debt $x = (n, b, z)$
- [+] Default and endogenous price of debt $Q(n', b', z)$
1. Firm level hiring

- **Standard matching model of firm level hiring**

\[ h_{i,t} = q(\theta_t)v_{i,t}, \quad \theta_t = \left( \int v_{i,t} d\lambda_t \right) / U_t = V_t / U_t \]

\[ f_{i,t} = h_{i,t} / v_{i,t} = q(\theta_t) \]
1. Firm level hiring

- **Standard matching model of firm level hiring**

\[
\begin{align*}
    h_{i,t} &= q(\theta_t) v_{i,t}, \quad \theta_t = \left( \int v_{i,t} d\lambda_t \right) / U_t = V_t / U_t \\
    f_{i,t} &= h_{i,t} / v_{i,t} = q(\theta_t)
\end{align*}
\]

- **Fact** (Davis, Faberman, Haltiwanger, QJE 2013)

\[
    \log f_{i,t} = \beta_0 + 0.82 \log g_{i,t}
\]

*Under the standard matching framework* \( \beta_1 = 0 \).

- **Theory** Kass and Kircher (2011) is the only paper to match this, but with counterfactual implications for wage dispersion / unemployment duration.
1. Firm level hiring

- Modified matching model of firm level hiring

\[ h_{i,t} = q(\theta_t^*) e_{i,t} v_{i,t}, \quad \theta_t^* = \left( \int e_{i,t} v_{i,t} d\lambda_t \right) / U_t = V_t^* / U_t \]

- Implications for measured aggregate match efficiency \( \Phi_t \)

\[ H_t = q(\theta_t^*) \tilde{V}_t = \left[ \frac{V_t^*}{V_t} \right]^{1-\phi} U_t^\phi V_t^{1-\phi} \]

\[ \Phi_t = \left[ \int e_{i,t} \frac{v_{i,t}}{V_t} d\lambda_t \right]^{1-\phi} \]

1. Cross-section \( f_{i,t} = q(\theta_t^*) e_{i,t} \) so if \( e_{i,t} \) is increasing in \( g_{i,t} \) this model may be consistent with DFH.

2. Time-series A shift in \( \lambda_t \) away from high \( g_{i,t} \) firms reduces \( \Phi_t \).
2. Firm distribution in the recession

- **Fact** The 2007-2009 recession lead to depressed firm entry and a shift in the firm *age* distribution

**Notes:** Entry and exit rate are in DFH form. Historical recessions are 1980, 1991, 2000. Employment normalized to 100, unfiltered, annual data. Source: Business Dynamics Survey
2. Firm distribution in the recession

- **Fact** The 2007-2009 recession lead to a shift in the firm size distribution

<table>
<thead>
<tr>
<th>Size</th>
<th>Number of Firms 2007</th>
<th>% Change number of firms 2007-2009</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-49</td>
<td>5,095,512</td>
<td>-3.96</td>
</tr>
<tr>
<td>50-499</td>
<td>219,845</td>
<td>-4.98</td>
</tr>
<tr>
<td>500+</td>
<td>20,658</td>
<td>-1.95</td>
</tr>
</tbody>
</table>

**Notes:** Source: Business Dynamics Survey
2. Firm distribution in the recession

- **Fact** The 2007-2009 recession lead to a different shift in the **employment distribution** over firms relative to past recessions.

Proposed mechanism

\[ \Phi_t = \left[ \int e(g_{i,t}) \frac{V_{i,t}}{V_t} d\lambda_t \right]^{1-\phi} \]

1. Aggregate shock which adversely affects entry and young firms
   - Suppose this is a financial shock, previous recessions caused by TFP
2. Decreased entry, high exit of young firms
3. Shift in distribution of firms and employment to large, old, low growth firms
4. Decrease in aggregate match efficiency
5. Outward shift in Beveridge curve

**Aim** Examine the validity (magnitudes) of this channel in a quantitative framework.