Slow to Hire, Quick to Fire: Employment Dynamics with Asymmetric Responses to News

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“Causes and Macroeconomic Consequences of Uncertainty”
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Motivation

- Cyclical changes in employment growth distributions
  - aggregate: conditional aggregate volatility
  - firm level: cross-sectional dispersion

What is the link?
- Correlated shocks? Cross-section ('micro') vs aggregate ('macro')

This paper: asymmetric responses to news
- generate simultaneous changes in volatility and dispersion from symmetric and homoskedastic shocks

Plan for the talk
- explain basic mechanism for countercyclical volatility and dispersion
- use establishment-level & aggregate data to test other implications
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Key mechanism

Model ingredients

1. Firms choose labor given dispersed noisy signals about future profits
   - noisy signals about future aggregate TFP
   - e.g. current idiosyncratic TFP due to persistence

2. Firms respond more to bad signals than to good signals
   - Physical adjustment costs – hiring is more costly than firing
   - Information processing – with ambiguous signal quality, firms optimally respond as if bad signals more precise

Bad aggregate shock:
   - more firms get negative signals & respond strongly
   - lower mean signal
   - → strong decrease in aggregate employment
   - higher cross-sectional dispersion

Model predictions for employment growth

1. time series: countercyclical aggregate volatility and negative skewness
2. cross-section: countercyclical dispersion and negative skewness
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- Model predictions for employment growth
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A simple model

- Continuum of firms
  - beginning of period: get signal about future profits & choose net hiring
  - end of period: TFP realized

- Firm $i$’s log productivity and signal:

  $$ z^i_t = a_t + b^i_t - \frac{1}{2} \left( \sigma^2_a + \sigma^2_b \right) $$

- Dispersed noisy signals

  $$ s^i_t = z^i_t + \sigma_\varepsilon \varepsilon^i_t $$

- Decision rule for net hiring $n^i_t \equiv \Delta \log L^i_t$

  $$ n^i_t = \gamma^*_t s^i_t; \quad \gamma^*_t = \begin{cases} \gamma & \text{if } s^i_t < 0 \\ \bar{\gamma} & \text{if } s^i_t \geq 0 \end{cases} $$
Hiring decision rule

Asymmetric Employment Decision Rule

Normal signal distribution

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Average employment growth

- Average over strong negative and weak positive responses

\[
\bar{n}_t = \int n_t^i di = \int_{-\infty}^{0} \gamma s_t^i f(s_t^i) ds_t^i + \int_{0}^{\infty} \gamma s_t^i f(s_t^i) ds_t^i
\]

\[
= \gamma M^- E[s_t^i | s_t^i < 0] + \gamma (1 - M^-) E[s_t^i | s_t^i > 0]
\]

\[
s_t^i \sim N \left( a_t + b_t^i - \frac{1}{2} \left( \sigma_a^2 + \sigma_b^2 \right), \sigma_b^2 + \sigma_\varepsilon^2 \right)
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Average employment growth

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\bar{n}_t = \int n_t^i di = \int_{-\infty}^0 \gamma s_t^i f(s_t^i) ds_t^i + \int_0^\infty \gamma s_t^i f(s_t^i) ds_t^i
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s_t^i \sim N \left( a_t + b_t - \frac{1}{2} (\sigma_a^2 + \sigma_b^2), \sigma_b^2 + \sigma_\varepsilon^2 \right)
\]

- Effects of changes in aggregate component of TFP
  - if \( a_t \downarrow \), more firms respond strongly to the bad \( s_t^i \), so \( \bar{n}_t \downarrow \) by more
  - if \( a_t \uparrow \), more firms respond weakly to the good \( s_t^i \), so \( \bar{n}_t \uparrow \) by less

\[\implies \text{negative skewness in time-series of aggregate} \bar{n}_t\]
\[\implies \text{countercyclical aggregate volatility clustering}: \text{aggregate} \bar{n}_t \text{more volatile in periods of negative} a_t\]
Cross-sectional dispersion

- Cross-sectional quartiles of \( n_t^i \) monotonic in those of TFP signals

\[
Q^n_3 = c\gamma^*(Q^s_3)Q^s_3; \quad Q^n_1 = c\gamma^*(Q^s_1)Q^s_1
\]

\[
Q^s_3 = E(s^i) + 0.67\sqrt{\text{Var}(s^i)}; \quad Q^s_1 = E(s^i) - 0.67\sqrt{\text{Var}(s^i)}
\]
Cross-sectional dispersion

- Cross-sectional quartiles of $n^i_t$ monotonic in those of TFP signals

$$Q^3_n = c\gamma^*(Q^s_3)Q^s_3; \quad Q^1_n = c\gamma^*(Q^s_1)Q^s_1$$

$$Q^s_3 = E(s^i) + 0.67\sqrt{\text{Var}(s^i)}; \quad Q^s_1 = E(s^i) - 0.67\sqrt{\text{Var}(s^i)}$$

- Interquartile range $IQR \equiv Q^3_n - Q^1_n$ countercyclical
Illustrative time-series

- Red: Aggregate TFP
- Blue: Aggregate Hiring
- Green: Cross-sectional IQR

Time

Aggregate Hiring

Cross-sectional IQR
Illustrative time-series

- Aggregate TFP
- Aggregate Hiring
- Cross-sectional IQR

Negative skew
Illustrative time-series

- Aggregate TFP
- Aggregate Hiring
- Cross-sectional IQR

Higher aggregate volatility
Data

- Census data on U.S. manufacturing establishments
- Annual data 1972-2009
  - 55k obs. per year; 2.1m total
- Employment: sum of production and non-production workers
  - Other information: output, hours, capital, investment, industry, ...
- Here: Focus on employment changes: $n^i_t \equiv \Delta \log(Emp^i_t)$
Employment growth – aggregate and cross section

- Time-series skewness of aggregate employment growth:

\[
Skewness_{Aggr} = \frac{\frac{1}{T} \sum_{t}^{T} (\bar{n}_t - \bar{n})^3}{Vol^{3/2}} = -1 \text{ in data}
\]
Employment growth – aggregate and cross section

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\text{Skewness}_{\text{Aggr}} = \frac{1}{T} \sum_{t=1}^{T} (\bar{n}_t - \bar{n})^3 \quad \frac{Vol_{t}^{3/2}}{Vol_{t}^{3/2}} = -1 \text{ in data}
\]

- Cross-sectional skewness across establishments

\[
\text{Skewness}_t = \frac{1}{N} \sum_{i=1}^{N} (n^i_t - \bar{n}_t)^3 \quad \frac{Vol_{t}^{3/2}}{Vol_{t}^{3/2}}
\]

  - Data: \( \text{Skewness}_t = -0.4 \) on average; it’s negative in almost all years
Employment growth – aggregate and cross section

- Time-series skewness of aggregate employment growth:

\[ Skewness_{Aggr} = \frac{\frac{1}{T} \sum_{t}^{T} (\bar{n}_t - \bar{n})^3}{Vol^{3/2}_t} = -1 \text{ in data} \]

- Cross-sectional skewness across establishments

\[ Skewness_t = \frac{\frac{1}{N} \sum_{i=1}^{N} (n_{it}^i - \bar{n}_t)^3}{Vol^{3/2}_t} \]

▷ Data: \( Skewness_t = -0.4 \) on average; it’s negative in almost all years

- Cross-sectional dispersion across establishments.

\[ IQR_t = Q_3(n_{it}^i) - Q_1(n_{it}^i) \]

▷ Data: countercyclical \( IQR \)
▷ average = 13%, one quarter of the year in NBER recession it ↑ to 17%
▷ doubles in fully recessionary years

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Micro-level evidence

- Time-series skewness of individual establishment

\[ \text{Skewness}^i = \frac{\frac{1}{T_i} \sum_{t=T_i}^i (n_t^i - \bar{n}^i)^3}{(\text{Volatility}^i)^{\frac{3}{2}}} \]
Micro-level evidence

- Time-series skewness of \textit{individual} establishment

\[ Skewness^i = \frac{1}{T^i} \sum_{t}^{T^i} (n^i_t - \bar{n}^i)^3 \]
\[ (Volatility^i)^{\frac{3}{2}} \]

- Data: on average establishment growth is negatively skewed over time

\[ \frac{1}{N} \sum_{i=1}^{N} Skewness^i = -0.5 \]
Micro-level evidence

- Time-series skewness of *individual* establishment

\[
Skewness^i = \frac{\frac{1}{T^i} \sum_{t=1}^{T^i} (n^i_t - \bar{n}^i)^3}{(Volatility^i)^{\frac{3}{2}}}
\]

- Data: on average establishment growth is negatively skewed over time

\[
\frac{1}{N} \sum_{i=1}^{N} Skewness^i = -0.5
\]

- no evidence of time-series skewness in individual TFP innovations $\omega^i_t$

Table: Time-series volatility and skewness of a typical establishment

<table>
<thead>
<tr>
<th>Variable</th>
<th>$d \log(TFP^i_t)$</th>
<th>$\omega^i_t$</th>
<th>$n^i_t$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Skewness</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unweighted</td>
<td>$-0.05$</td>
<td>$-0.02$</td>
<td>$-0.18$</td>
</tr>
<tr>
<td>Employment-weighted</td>
<td>$-0.12$</td>
<td>$-0.04$</td>
<td>$-0.50$</td>
</tr>
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</table>
Empirical test for asymmetric responses

- Model-based test: does establishment's employment growth respond asymmetrically to signals about future shocks?
- Estimate establishment-level TFP $z_t^i$ and recover TFP innovations $\omega_t^i$
- Current unobserved signals show up in average future innovations
  \[ n_t^i = \alpha + \beta_{pos}\omega_{t+1}^i + \beta_{neg}\omega_{t+1}^i \mathbb{I}\{\omega_{t+1}^i < 0\} + \theta X_t^i + c^i + y_t + \epsilon_t^i \]
  - Estimates: $\hat{\beta}_{pos} = +0.025^{***}$, $\hat{\beta}_{neg} = +0.099^{***}$
    A typical positive TFP shock increases employment by 0.5%.
    A typical negative TFP shock decreases employment by 2.5%.
- Could it be frictions? Hiring/firing cost?
  ⇒ evidence on hiring frictions suggests only small role
  
- Hiring cost
Model candidates for asymmetry

1. Physical adjustment cost
2. Information processing
   - firm decision makers are ambiguous about quality of signals:
     \[ s_t^i = z_t^i + \sigma_{\varepsilon,t} \varepsilon_t^i; \quad \sigma_{\varepsilon,t} \in [\sigma_{\varepsilon}, \sigma_{\varepsilon}] \]
   - hiring decision based on ‘worst case’ expected profits
   - expected profits depend on signal’s precision
   - worst-case precision: high for bad news, low for good news

\[ n_t^i = \gamma_t^* s_t^i; \quad \gamma_t^* \equiv \frac{\text{var}(z_t^i)}{\text{var}(z_t^i) + (\sigma_{\varepsilon,t}^*)^2} = \begin{cases} \bar{\gamma} & \text{if } s_t^i < 0 \\ \gamma^* & \text{if } s_t^i \geq 0 \end{cases} \]

- How to distinguish?:
  - proxies for physical adjustment cost
  - asset prices: ambiguity implies predictable excess returns
Objective: endogenous joint changes in distributions
- volatility and skewness in aggregate and firm-level employment growth
- from symmetric and homoskedastic shocks
- model of asymmetric decision rules

Key mechanism
- firms receive dispersed noisy signals
- firms optimally respond more to bad than to good signals

The asymmetric response generates:
- countercyclical aggregate and cross-section
- negative skewness in the time-series and cross-section
- model’s key properties consistent with micro and macro data
Appendix: Asymmetric responses & hiring costs

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<td>Firms w/ pos. shock</td>
<td>+0.5%***</td>
</tr>
<tr>
<td></td>
<td>(0.1%)</td>
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<td>Firms w/ pos. shock &amp; hiring constraint</td>
<td></td>
</tr>
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<td>Firms w/ neg. shock</td>
<td>-2.5%***</td>
</tr>
<tr>
<td></td>
<td>(0.3%)</td>
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<tr>
<td>$N$</td>
<td>1,416k</td>
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Firms with positive shock, hiring constraint

*Back to Estimates*
Appendix: Asymmetric responses & hiring costs

- Model-based test: does establishment’s employment growth respond asymmetrically to signals about future shocks?
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- Current unobserved signals show up in average future innovations

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$$n^i_t = \alpha + \beta_{pos} \omega^i_{t+1} + \beta_{cstr} \omega^i_{t+1} \mathbb{I}\{\omega^i_{t+1} > 0\} + \beta_{neg} \omega^i_{t+1} \mathbb{I}\{\omega^i_{t+1} < 0\} + ...$$

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<tr>
<td>Firms w/ pos. shock</td>
<td>+0.5%***</td>
<td>+0.7%***</td>
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<tr>
<td></td>
<td>(0.1%)</td>
<td>(0.2%)</td>
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<tr>
<td>Firms w/ pos. shock &amp; hiring constraint</td>
<td>-0.2%</td>
<td>(0.4%)</td>
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<tr>
<td>Firms w/ neg. shock</td>
<td>-2.5%***</td>
<td>-2.8%***</td>
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