Aggregate Recruiting Intensity

Alessandro Gavazza
London School of Economics

Simon Mongey
FRB of Minneapolis & University of Chicago

Gianluca Violante
Princeton University

FRB of Minneapolis
Aggregate recruiting intensity

\[ H_t = A_t V_t^\alpha U_t^{1-\alpha} \]
Aggregate recruiting intensity

\[ H_t = A_t V_t^\alpha U_t^{1-\alpha} \]

The component of \( A_t \) accounted for by firms’ effort to fill vacancies
Aggregate recruiting intensity

\[ H_t = A_t V_t^\alpha U_t^{1-\alpha} \]

The component of \( A_t \) accounted for by firms’ effort to fill vacancies

Macro data

- Large and persistent decline in \( A_t \) in the last recession
- \( Q1: \) How much of the decline in \( A_t \) is accounted for by ARI?
Aggregate recruiting intensity

\[ H_t = A_t V_t^\alpha U_t^{1-\alpha} \]

The component of \( A_t \) accounted for by firms’ effort to fill vacancies

Macro data

- Large and persistent decline in \( A_t \) in the last recession
- Q1: How much of the decline in \( A_t \) is accounted for by ARI?

Micro data (Davis-Faberman-Haltiwanger, 2013)

- In the cross-section, fast growing firms fill vacancies more quickly
- Q2: What is the transmission mechanism from macro shocks to ARI?
Firm-level hiring technology

Random-matching model

\[ h_{it} = q_t v_{it} \]

+ recruiting intensity

\[ h_{it} = q_t e_{it} v_{it} \]

- JOLTS vacancies - \( v_{it} \)

- BLS: “Specific position that exists... for start within 30-days... with active recruiting from outside the establishment”
Firm-level hiring technology

Random-matching model

\[ h_{it} = q_t v_{it} \]

+ recruiting intensity

\[ h_{it} = q_t e_{it} v_{it} \]

- **JOLTS vacancies** - \( v_{it} \)
  - BLS: “Specific position that exists... for start within 30-days... with active recruiting from outside the establishment”

- **Recruitment intensity** - \( e_{it} \)
  1. Shifts the filling rate (or yield) of an open position
  2. Costly on a per vacancy basis
  - An outcome of expenditures on recruiting activities
Recruiting cost by activity


- Average cost per hire (at 100+ employee firms): $3,500
From firm-level to aggregate recruiting intensity

• Aggregation

\[ H_t = q_t \int e_{it} v_{it} \, d\lambda_t^h = q_t V_t^* \]

• Aggregate matching function

\[ H_t = V_t^{*\alpha} U_t^{1-\alpha} = \Phi_t V_t^{\alpha} U_t^{1-\alpha} \]

• Aggregate recruiting intensity

\[ \Phi_t = \left[ \frac{V_t^*}{V_t} \right]^\alpha = \left[ \int e_{it} \left( \frac{v_{it}}{V_t} \right) \, d\lambda_t^h \right]^\alpha \]
Transmission mechanism: two channels
Transmission mechanism: two channels

1. **Composition**: macro shock $\rightarrow$ shift in hiring rate distribution

$$\frac{h}{n} = \bar{q} \downarrow e \downarrow \frac{v}{n}$$

- Slow-growing firms recruit less intensively
- **Great Recession** - large decline in firm entry
Transmission mechanism: two channels

1. **Composition**: macro shock $\rightarrow$ shift in hiring rate distribution

\[ \frac{h}{n} = \bar{q} \quad e \quad \frac{v}{n} \]

- Slow-growing firms recruit less intensively
- **Great Recession** - large decline in firm entry

2. **Slackness**: macro shock $\rightarrow$ slacker labor market

\[ \frac{\bar{h}}{n} = \uparrow q \quad e \quad \frac{v}{n} \]

- Firms substitute away from costly hiring measures
- **Great Recession** - large decline in market tightness
Model
Model

Firm dynamics

• Operate DRS technology
• Idiosyncratic persistent productivity shocks
• Endogenous entry and exit
Model

Firm dynamics

- Operate DRS technology
- Idiosyncratic persistent productivity shocks
- Endogenous entry and exit

Financial frictions

- Borrowing secured by collateral (macro shock)
- Limits to equity issuance
Model

Firm dynamics
• Operate DRS technology
• Idiosyncratic persistent productivity shocks
• Endogenous entry and exit

Financial frictions
• Borrowing secured by collateral (macro shock)
• Limits to equity issuance

Labor market frictions
• Random matching with homogeneous workers (no OJS)
• Recruiting effort $e$ and vacancies $v$ are costly
Value functions

Let $V(n, a, z)$ be the present discounted value of dividends of a firm with employment $n$, net-worth $a$, and productivity $z$. 

Gavazza-Mongey-Violante, "Aggregate Recruiting Intensity"
Let $V(n, a, z)$ be the present discounted value of dividends of a firm with employment $n$, net-worth $a$, and productivity $z$.

- **Exit exogenously or endogenously**
  \[
  V(n, a, z) = \zeta a + (1 - \zeta) \max \left\{ a, V^i(n, a, z) \right\}
  \]

- **Fire or hire**
  \[
  V^i(n, a, z) = \max \left\{ V^f(n, a, z), V^h(n, a, z) \right\}
  \]
Value functions - Firing

\[ V^f(n, a, z) = \max_{n' \leq n, k, d} \quad d + \beta \int_Z V(n', a', z') \Gamma(z, dz') \]

s.t.

\[ d + a' = \left(zn'^\nu k^{1-v}\right)^\sigma + (1 + r)a - \omega n' - (r + \delta)k - \chi \]

\[ k \leq \varphi a \]

\[ d \geq 0 \]
Value functions - Firing

\[ V^f(n, a, z) = \max_{n' \leq n, k, d} \quad d + \beta \int_{Z} V(n', a', z') \Gamma(z, dz') \]

s.t.

\[ d + a' = (zn'^{\nu}k^{1-\nu})^\sigma + (1 + r)a - \omega n' - (r + \delta)k - \chi \]

\[ k \leq \varphi a \]

\[ d \geq 0 \]

• Define debt: \( b := k - a \)
Value functions - Firing

\[ V^f(n, a, z) = \max_{n' \leq n, k, d} \ d + \beta \int_{Z} V(n', a', z') \Gamma(z, dz') \]

s.t.
\[ d + a' = \left( zn'^{\nu} k^{1-\nu} \right)^{\sigma} + (1 + r)a - \omega n' - (r + \delta)k - \chi \]
\[ k \leq \varphi a \]
\[ d \geq 0 \]

- Define debt: \[ b := k - a \]
- Firms make take-leave offers: \[ \omega = \text{flow value of leisure} \]
Value functions - Hiring

\[
V^h(n, a, z) = \max_{v>0, e>0, k, d} \left( d + \beta \int_{Z} V(n', a', z') \Gamma(z, dz') \right)
\]

s.t.

\[
d + a' = \left( zn'^v k^{1-v} \right)^\sigma + (1 + r) a - \omega n' - (r + \delta) k - \chi - C(e, v, n)
\]

\[
n' - n = q(\theta^*) ev
\]

\[
k \leq \varphi a
\]

\[
d \geq 0
\]
Reverse engineering the hiring-cost function

\[ \log \left( \frac{h}{v} \right) = \log (qe) \]

Slope = 0.82
Reverse engineering the hiring-cost function

\[
C(e, v, n) = \left[ \frac{\kappa_1}{\gamma_1} e^{\gamma_1} + \frac{\kappa_2}{\gamma_2 + 1} \left( \frac{v}{n} \right)^{\gamma_2} \right] v, \quad \gamma_1 \geq 1, \gamma_2 \geq 0
\]

Cost per vacancy

Log vacancy yield - \( \log \left( \frac{h}{v} \right) = \log (qe) \)

Log vacancy rate - \( \log \left( \frac{v}{n} \right) \)

Slope = 0.82
Reverse engineering the hiring-cost function

\[
\log e = \text{Const.} - \frac{\gamma_2}{\gamma_1 + \gamma_2} \log q(\theta^*) + \frac{\gamma_2}{\gamma_1 + \gamma_2} \log \left(\frac{h}{n}\right)
\]

\[
\log \left(\frac{v}{n}\right) = \text{Const.} - \frac{\gamma_1}{\gamma_1 + \gamma_2} \log q(\theta^*) + \frac{\gamma_1}{\gamma_1 + \gamma_2} \log \left(\frac{h}{n}\right)
\]

Gavazza-Mongey-Violante, "Aggregate Recruiting Intensity"
Reverse engineering the hiring-cost function

\[
\log e = \text{Const.} - \frac{\gamma_2}{\gamma_1 + \gamma_2} \log q(\theta^*) + \frac{\gamma_2}{\gamma_1 + \gamma_2} \log \left( \frac{h}{n} \right)
\]

\[
\log \left( \frac{\nu}{n} \right) = \text{Const.} - \frac{\gamma_1}{\gamma_1 + \gamma_2} \log q(\theta^*) + \frac{\gamma_1}{\gamma_1 + \gamma_2} \log \left( \frac{h}{n} \right)
\]
Value functions - Entry

- **Initial wealth**: Household allocates $a_0$ to $\lambda_0$ potential entrants

- **Productivity**: Potential entrants draw $z \sim \Gamma_0(z)$

- **Entry**: Choice to become incumbent and pay $\chi_0$ start-up costs

\[
V^e(a_0, z) = \max \left\{ a_0, V^i(n_0, a_0 - \chi_0, z) \right\}
\]

Selection at entry based only on productivity $z$

**Life cycle**: slow growth b/c of fin. constraints and convex hiring costs
### Parameter values set externally

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Target</th>
</tr>
</thead>
<tbody>
<tr>
<td>Discount factor (monthly)</td>
<td>$\beta$</td>
<td>0.9967</td>
</tr>
<tr>
<td>Mass of potential entrants</td>
<td>$\lambda_0$</td>
<td>0.02</td>
</tr>
<tr>
<td>Size of labor force</td>
<td>$\bar{L}$</td>
<td>24.6</td>
</tr>
<tr>
<td>Elasticity of matching function wrt $V_t$</td>
<td>$\alpha$</td>
<td>0.5</td>
</tr>
</tbody>
</table>

- Ann. risk-free rate = 4%
- Meas. of incumbents = 1
- Average firm size = 23
- JOLTS
Parameter values set externally

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Target</th>
</tr>
</thead>
<tbody>
<tr>
<td>Discount factor (monthly)</td>
<td>$\beta$</td>
<td>0.9967</td>
</tr>
<tr>
<td>Mass of potential entrants</td>
<td>$\lambda_0$</td>
<td>0.02</td>
</tr>
<tr>
<td>Size of labor force</td>
<td>$\bar{L}$</td>
<td>24.6</td>
</tr>
<tr>
<td>Elasticity of matching function wrt $V_t$</td>
<td>$\alpha$</td>
<td>0.5</td>
</tr>
</tbody>
</table>

Ann. risk-free rate = 4%
Meas. of incumbents = 1
Average firm size = 23
JOLTS

Add to the model

- Heterogeneity in DRS $\sigma \in \{\sigma_L, \sigma_M, \sigma_H\}$
Parameter values set externally

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Target</th>
</tr>
</thead>
<tbody>
<tr>
<td>Discount factor (monthly)</td>
<td>$\beta$</td>
<td>0.9967</td>
</tr>
<tr>
<td>Mass of potential entrants</td>
<td>$\lambda_0$</td>
<td>0.02</td>
</tr>
<tr>
<td>Size of labor force</td>
<td>$\bar{L}$</td>
<td>24.6</td>
</tr>
<tr>
<td>Elasticity of matching function wrt $V_t$</td>
<td>$\alpha$</td>
<td>0.5</td>
</tr>
</tbody>
</table>

Add to the model

- Heterogeneity in DRS $\sigma \in \{\sigma_L, \sigma_M, \sigma_H\}$

Calibration strategy

1. Worker flows and labor share
2. Distribution of firm size and firm growth rates
3. Micro-evidence on job-filling and vacancy-posting
4. Entry and exit
5. Leverage for young firms and for aggregate economy
## Parameter values estimated internally

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Target</th>
<th>Model</th>
<th>Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flow of home production $\omega$</td>
<td>1.000</td>
<td>Monthly separation rate</td>
<td>0.033</td>
<td>0.030</td>
</tr>
<tr>
<td>Scaling of match. funct. $\Phi$</td>
<td>0.208</td>
<td>Monthly job-finding rate</td>
<td>0.411</td>
<td>0.400</td>
</tr>
<tr>
<td>Prod. weight on labor $\nu$</td>
<td>0.804</td>
<td>Labor share</td>
<td>0.627</td>
<td>0.640</td>
</tr>
<tr>
<td>Midpoint DRS in prod. $\sigma_M$</td>
<td>0.800</td>
<td>Employment share $n &lt; 50$</td>
<td>0.294</td>
<td>0.306</td>
</tr>
<tr>
<td>High-Low spread in DRS $\Delta \sigma$</td>
<td>0.094</td>
<td>Employment share $n \geq 500$</td>
<td>0.430</td>
<td>0.470</td>
</tr>
<tr>
<td>Mass - Low DRS $\mu_L$</td>
<td>0.826</td>
<td>Firm share $n &lt; 50$</td>
<td>0.955</td>
<td>0.956</td>
</tr>
<tr>
<td>Mass - High DRS $\mu_H$</td>
<td>0.032</td>
<td>Firm share $n \geq 500$</td>
<td>0.004</td>
<td>0.004</td>
</tr>
<tr>
<td>Std. dev. of $z$ shocks $\vartheta_z$</td>
<td>0.052</td>
<td>Std. dev. ann. emp. growth</td>
<td>0.440</td>
<td>0.420</td>
</tr>
<tr>
<td>Persistence of $z$ shocks $\rho_z$</td>
<td>0.992</td>
<td>Mean Q4 emp. / Mean Q1 emp.</td>
<td>75.16</td>
<td>76.00</td>
</tr>
<tr>
<td>Mean $z_0 \sim Exp(\bar{z}_0^{-1})$</td>
<td>0.390</td>
<td>$\Delta \log z$: Young vs. Mature</td>
<td>-0.246</td>
<td>-0.353</td>
</tr>
<tr>
<td>Cost elasticity wrt $e$ $\gamma_1$</td>
<td>1.114</td>
<td>Elasticity of vac. yield wrt $g$</td>
<td>0.814</td>
<td>0.820</td>
</tr>
<tr>
<td>Cost elasticity wrt $v$ $\gamma_2$</td>
<td>4.599</td>
<td>Ratio vac. yield: $n &lt; 50/n \geq 50$</td>
<td>1.136</td>
<td>1.440</td>
</tr>
<tr>
<td>Cost shifter wrt $e$ $\kappa_1$</td>
<td>0.101</td>
<td>Hiring cost (100+) / wage</td>
<td>0.935</td>
<td>0.927</td>
</tr>
<tr>
<td>Cost shifter wrt $v$ $\kappa_2$</td>
<td>5.000</td>
<td>Vacancy share $n &lt; 50$</td>
<td>0.350</td>
<td>0.370</td>
</tr>
<tr>
<td>Exogenous exit probability $\zeta$</td>
<td>0.006</td>
<td>Five year survival rate</td>
<td>0.497</td>
<td>0.500</td>
</tr>
<tr>
<td>Entry cost $\chi_0$</td>
<td>9.354</td>
<td>Annual entry rate</td>
<td>0.099</td>
<td>0.102</td>
</tr>
<tr>
<td>Operating cost $\chi$</td>
<td>0.035</td>
<td>Share of job destruction by exit</td>
<td>0.210</td>
<td>0.340</td>
</tr>
<tr>
<td>Initial wealth $a_0$</td>
<td>10.000</td>
<td>Start-up Debt to Output</td>
<td>1.361</td>
<td>1.280</td>
</tr>
<tr>
<td>Collateral constraint $\varphi$</td>
<td>10.210</td>
<td>Aggregate Debt to Assets</td>
<td>0.280</td>
<td>0.350</td>
</tr>
</tbody>
</table>

Gavazza-Mongey-Violante, "Aggregate Recruiting Intensity"
## Non-targeted moments

<table>
<thead>
<tr>
<th>Moment</th>
<th>Model</th>
<th>Data</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aggregate dividend / profits</td>
<td>0.411</td>
<td>0.400</td>
<td>NIPA</td>
</tr>
<tr>
<td>Employment share: $\text{growth} \in (-2.00, -0.20)$</td>
<td>0.070</td>
<td>0.076</td>
<td>Davis et al. (2010)</td>
</tr>
<tr>
<td>Employment share: $\text{growth} \in (-0.20, 0.20]$</td>
<td>0.828</td>
<td>0.848</td>
<td>Davis et al. (2010)</td>
</tr>
<tr>
<td>Employment share: $\text{growth} \in (0.20, 2.00)$</td>
<td>0.102</td>
<td>0.076</td>
<td>Davis et al. (2010)</td>
</tr>
<tr>
<td>Employment share: $\text{Age} \leq 1$</td>
<td>0.013</td>
<td>0.028</td>
<td>BDS</td>
</tr>
<tr>
<td>Employment share: $\text{Age} \in (1, 10)$</td>
<td>0.309</td>
<td>0.212</td>
<td>BDS</td>
</tr>
<tr>
<td>Employment share: $\text{Age} \geq 10$</td>
<td>0.678</td>
<td>0.760</td>
<td>BDS</td>
</tr>
</tbody>
</table>

Fig. Average firm lifecycle (i) size, (ii) job creation, (iii) fraction constrained, (iv) leverage
Hire and vacancy shares by size class

A. Hires

B. Vacancies

Model

Data - JOLTS 2002-2007

Gavazza-Mongey-Violante, "Aggregate Recruiting Intensity"
Vacancy and recruitment intensity by age

A. Cohort average growth and recruitment

B. Age distributions

Gavazza-Mongey-Violante, "Aggregate Recruiting Intensity"
Vacancy and recruitment intensity by age

A. Cohort average growth and recruitment

- Growth rate
- Recruiting intensity
- Vacancy rate

B. Age distributions

- Hiring firms
- Recruiting intensity
- Vacant positions

- Young firms exert more recruiting effort in the model
- US? No firm-age in JOLTS. But true, e.g., in Austrian micro-data
Transition dynamics experiments

Trace **transitional dynamics** of the economy in response to:

- Tightening of financial constraint $\downarrow \varphi$
- Size of shock: match max drop in output *(Fernald, 2015)*
  - Requires 75% drop in $\varphi$
- Persistence of shock: match half-life of output decline of 3 years
  - Monthly persistence of $\varphi$ shock of 0.97
Transition dynamics experiments

Trace *transitional dynamics* of the economy in response to:

- Tightening of financial constraint $\downarrow \varphi$
- Size of shock: match max drop in output *(Fernald, 2015)*
  - Requires 75% drop in $\varphi$
- Persistence of shock: match half-life of output decline of 3 years
  - Monthly persistence of $\varphi$ shock of 0.97

*In the paper:* examine also productivity shock

▶ Fig. Macro variables (i) output, (ii) debt/output, (iii) labor productivity, (iv) entry
Transition dynamics in labor market

A. US Data 2008:01 - 2014:01

B. Model - Finance $\varphi$-shock

Log deviation from date 0

Years

Log deviation from date 0

Years

- Vacancies
- Vacancy yield
- Unemployment
- Job finding rate
- Agg. recruiting intensity

Fig. Labor wedge
Impulse response for $\Phi$
Result I:

• Recruiting intensity accounts for \( \approx \frac{1}{3} \) of decline in match efficiency
• Less persistence than empirical match efficiency
Decomposing $\Phi_t$

Recruiting effort policy

$$e = \text{Const.} \times q(\theta^*) \frac{\gamma_2}{\gamma_1 + \gamma_2} \times \left( \frac{h}{n} \right)^{\frac{\gamma_2}{\gamma_1 + \gamma_2}}$$

Aggregate recruiting intensity

$$\Phi = \left[ \int e \left( \frac{\nu}{V} \right) d\lambda^h \right]^\alpha$$

Decomposition

$$\Delta \log \Phi = -\alpha \frac{\gamma_2}{\gamma_1 + \gamma_2} \Delta \log q(\theta^*) + \alpha \Delta \log \left[ \int \left( \frac{h}{n} \right)^{\frac{\gamma_2}{\gamma_1 + \gamma_2}} \left( \frac{\nu}{V} \right) d\lambda^h \right]$$

- Slackness effect
- Composition effect
Decomposing $\Phi_t$

Result II:

• **Slackness effect** is dominant
Decomposing $\Phi_t$

Result III:

- **Composition effect** is roughly zero
- Why? Constrained vs. unconstrained firms
Result IV

- Constrained high-scale firms explain flat vacancy yields of large firms
Summary

Results

I. Recruiting intensity explains $\frac{1}{3}$ of decline in match efficiency

II. Dominant: Slack labor markets reduce need for costly recruiting

III. Strong GE forces limit the role of the composition effect

IV. Constrained high-scale firms explain vacancy yields by size
Summary

Results

I. Recruiting intensity explains 1/3 of decline in match efficiency

II. Dominant: Slack labor markets reduce need for costly recruiting

III. Strong GE forces limit the role of the composition effect

IV. Constrained high-scale firms explain vacancy yields by size

Extensions

1. Sectoral composition plays sizable role

2. Construct an easy-to-measure index of aggregate recruiting intensity

3. Relationship to Kaas & Kircher (2015)
1. Sectoral composition

A. Sector component: \( \phi_{\gamma_1+\gamma_2} \frac{\psi_t}{V_t} \)

B. Sectoral composition effect

Result

- Sectoral composition effect adds 15% to decline in \( \Phi_t \) (0.20 → 0.23)
- It adds some persistence too
- Driven by (i) Hospitality, (ii) Construction, (iii) Manufacturing
2. Approximate index of aggregate recruiting intensity

DFH provide an easy-to-compute index of aggregate recruiting intensity

\[
\log \Phi_t = \log \left( \frac{H_t}{V_t} \right) - \log q_t
\]

\[
\frac{d \log \Phi_t}{d \log \left( \frac{H_t}{N_t} \right)} = \frac{d \log \left( \frac{H_t}{V_t} \right)}{d \log \left( \frac{H_t}{N_t} \right)} - \frac{d \log q_t}{d \log \left( \frac{H_t}{N_t} \right)}
\]

(a) Use firm-level elasticity for first term, \( \xi = 0.82 \)

(b) Assume second term is small

\[
\frac{d \log \Phi_t}{d \log \left( \frac{H_t}{N_t} \right)} \approx \xi
\]

\[
d \log \Phi_t^{DFH} = \xi \times d \log \left( \frac{H_t}{N_t} \right)
\]
2. Approximate index of aggregate recruiting intensity

Return to model based decomposition

\[
\log \Phi_t = -\alpha \frac{\gamma_2}{\gamma_1 + \gamma_2} \log q(\theta_t^*) + \alpha \log \left[ \int \left( \frac{h_{it}}{n_{it}} \right)^{\frac{\gamma_2}{\gamma_1 + \gamma_2}} \left( \frac{v_{it}}{V_t} \right) d\lambda_t^h \right]
\]

slackness effect

composition effect
2. Approximate index of aggregate recruiting intensity

Return to model based decomposition

\[
\log \Phi_t = -\alpha \frac{\gamma_2}{\gamma_1 + \gamma_2} \log q(\theta^*_t) + \alpha \log \left[ \int \left( \frac{h_{it}}{n_{it}} \right)^{\gamma_2} \left( \frac{v_{it}}{V_t} \right) d\lambda^h_t \right]
\]

 slackness effect

 composition effect

GMV

(a) Model tells us the composition effect is approximately zero

\[
d \log \Phi_t^{GMV} = \alpha \frac{\gamma_2}{\gamma_1 + \gamma_2} \times (1 - \alpha) \times d \log \theta^*_t
\]

(b) Elasticity of \( \theta^*_t \) to \( \theta_t \) from transition dynamics

\[
d \log \Phi_t^{GMV} = \alpha \frac{\gamma_2}{\gamma_1 + \gamma_2} \times (1 - \alpha) \varepsilon_{\theta^*,\theta} \times d \log \theta_t
\]
2. Approximate index of aggregate recruiting intensity

![Graph showing trends in aggregate recruiting intensity with different measures: Aggregate match efficiency, DFH measure of recruiting intensity, GMV measure of recruiting intensity, and GMV + Sectoral component. The x-axis represents years from 2001 to 2016, and the y-axis represents log aggregate recruiting intensity. The graph illustrates the changes in recruiting intensity over time.]

**KK model**

\[
\Phi_{t}^{KK} = \int \frac{q(\theta_{mt})}{\bar{q}(\theta_t)} \frac{v_{mt}}{V_t} \, dm
\]

The reason why [recruiting intensity] is **pro-cyclical** in our model is that \(q\) is concave, and the cross-sectional dispersion in \(\theta_{mt}\) is **counter-cyclical**

KK model

\[ \Phi_t^{KK} = \int \frac{q(\theta_{mt})}{\bar{q}(\theta_t)} \frac{v_{mt}}{V_t} \, dm \]

The reason why [recruiting intensity] is pro-cyclical in our model is that \( q \) is concave, and the cross-sectional dispersion in \( \theta_{mt} \) is counter-cyclical

Our model

\[ \Delta \log \Phi_t = -\alpha \frac{\gamma_2}{\gamma_1 + \gamma_2} \Delta \log q(\theta_t^*) + \alpha \Delta \log \left[ \int \left( \frac{h_{it}}{n_{it}} \right)^{\frac{\gamma_2}{\gamma_1 + \gamma_2}} \left( \frac{v_{it}}{V_t} \right) \, d\lambda_t^h \right] \]

Dispersion effect is present but small

- \( \varphi_t \) shock delivers 45% increase in SD of growth rates, as in data

\[ \downarrow \Phi_t, \text{ since } \frac{\gamma_2}{\gamma_1 + \gamma_2} < 1 \text{ but close to 1} \]
Equilibrium

- **Aggregate state** $S_t = (\lambda_t, U_t, Z_t, \varphi_t)$

1. Measure of firms evolves via decision rules and $z$ process

2. Labor market flows are equalized at $\theta^*_t$: $U_{t+1}^{\text{flows}} = U_{t+1}^{\text{demand}}$

\[
U_{t+1}^{\text{flows}} = U_t - H(\theta^*_t, S_t) + F(\theta^*_t, S_t) - \lambda_{e,t} n_0
\]

\[
U_{t+1}^{\text{demand}} = \bar{L} - \int n'(n, a, z, S_t) \, d\lambda_t
\]

- **Stationary equilibrium**: measure is stationary, and $S = (\lambda, U, Z, \varphi)$
Average life cycle of firms in the model

A. Average size

B. Job creation and destruction

C. Fraction of firms constrained

D. Average leverage

Gavazza-Mongey-Violante, "Aggregate Recruiting Intensity"
Labor wedge - Financial shock

1 - \tau_t = N_t^{1+\varphi} \frac{C_t}{Y_t}

Gavazza-Mongey-Violante, "Aggregate Recruiting Intensity"
Transition dynamics - Macro

A. Productivity $Z$-shock

B. Finance $\varphi$-shock

Debt/Output ($B_t^+/Y_t$)  Labor Productivity ($Y_t/N_t$)  Entry

Gavazza-Mongey-Violante, "Aggregate Recruiting Intensity"