Firms, Trade and Labor Market Dynamics

Oleg Itskhoki
Itskhoki@Princeton.edu

Elhanan Helpman
EHelpman@Harvard.edu

PRELIMINARY AND INCOMPLETE

ERWIT
Oslo, June 2014
Motivation

• Recent trade models emphasize labor reallocation within sectors, from less to more productive firms
  → trade shocks result in simultaneous job destruction and job creation within sectors
Motivation

• Recent trade models emphasize labor reallocation within sectors, from less to more productive firms → trade shocks result in simultaneous job destruction and job creation within sectors

• In light of this, do labor market frictions:
  1. slow down the adjustment to trade?
  2. lead to a dissipation of gains from trade?
  3. create winners and losers (good jobs and bad jobs)?
Motivation

- Recent trade models emphasize labor reallocation within sectors, from less to more productive firms
  - trade shocks result in simultaneous job destruction and job creation within sectors

- In light of this, do labor market frictions:
  1. slow down the adjustment to trade?
  2. lead to a dissipation of gains from trade?
  3. create winners and losers (good jobs and bad jobs)?

- This paper studies transition dynamics in a version of Melitz model with DMP labor market frictions
  - DMP in a model of large firms with aggregate shocks
  - challenging task due to the size of the state space, $\mathcal{G}_t(h, \theta)$
  - focus on a limiting case with full analytical characterization
Environment

- Two symmetric countries
- Two goods:
  1. homogenous non-traded good
     - numeraire outside good
  2. differentiated traded good
     - large monopolistically competitive firms
     - fully persistent productivity types
- Symmetric DMP labor market frictions in both sectors:
  - random search and CRS matching, no firing costs
  - Nash wage bargaining without commitment
- Perfect mobility of unemployed across sectors
- Free entry in both sectors
- One-time unanticipated bilateral trade liberalization
- Discrete time with very short time periods $\Delta \approx 0$
Main findings

1. Dynamic adjustment to a trade shock features:
   (a) slow transitions in the labor market resulting in misallocation and reduced productivity
   (b) new productive entrants crowded out by slowly shrinking old unproductive incumbents
   (c) depressed trade flows

— Gains in consumer surplus are instantaneous and do not depend on LM frictions
— Constitute the only source of long-run gains from trade
— Due to free entry, as in Atkeson and Burstein (2010)

But LM frictions lead to short-run profit loss, endogenous job destruction and depressed wages in incumbent firms hurt by foreign competition

— temporary and permanent 'bad jobs'
— income losses are increasing in LM frictions, but small
Main findings

1. Dynamic adjustment to a trade shock features:
   (a) slow transitions in the labor market resulting in misallocation and reduced productivity
   (b) new productive entrants crowded out by slowly shrinking old unproductive incumbents
   (c) depressed trade flows

2. This notwithstanding:
   — Gains in consumer surplus are instantaneous and do not depend on LM frictions
   — Constitute the only source of long-run gains from trade
   — Due to free entry, as in Atkeson and Burstein (2010)
Main findings

1 Dynamic adjustment to a trade shock features:
   (a) slow transitions in the labor market resulting in misallocation and reduced productivity
   (b) new productive entrants crowded out by slowly shrinking old unproductive incumbents
   (c) depressed trade flows

2 This notwithstanding:
   — Gains in consumer surplus are instantaneous and do not depend on LM frictions
   — Constitute the only source of long-run gains from trade
   — Due to free entry, as in Atkeson and Burstein (2010)

3 But LM frictions lead to short-run profit loss, endogenous job destruction and depressed wages in incumbent firms hurt by foreign competition
   — temporary and permanent ‘bad jobs’
   — income losses are increasing in LM frictions, but small
Related Literature

• A dynamic version of Helpman and Itskhoki (2010) with focus on transition dynamics

• Trade and labor market dynamics:
  — Davidson, Martin and Matusz (1999)
  — Kambourov (2009), Coşar (2010)

• Labor-macro: Elsby and Michaels (2013), Schaal (2012)
Demand

- Representative family with flow utility $\mathcal{U}(q_0t, Q_t)$ and discount rate $r$

- CES aggregator of differentiated goods:

$$Q = \left( \int_{\omega \in \Omega} q(\omega)^\beta d\omega \right)^{1/\beta}, \quad 0 < \beta < 1$$

- **Assumption 1**: *The utility function is quasi-linear:*

$$\mathcal{U}(q_0, Q) = q_0 + \frac{1}{\zeta} Q^\zeta, \quad 0 < \zeta < \beta, \quad q_0 \in \mathbb{R}, Q \in \mathbb{R}_+.$$ 

- Period utility is then: $\mathcal{U}_t = I_t + \frac{1-\zeta}{\zeta} Q_t^\zeta$ with expenditure $I_t$
Families and Labor Supply

- Unit-continuum of families with $L$ units of labor:
  - $N$ workers are assigned to differentiated sector
  - $N_0 = L - N$ workers are assigned to outside sector

- Workers can be employed $H$ or unemployed (searching) $U$
  - $s$ is exogenous job separation rate
  - $x$ is job finding rate ($\sim$ labor market tightness)

- **Assumption 2**: Unemployed are mobile across sectors.

- Families pool consumption risk and consume their income (labor income plus distributed profits)
Outside sector

• Hiring cost (Cobb-Douglas matching function):
  \[ b_0 = a_0 x_0^\alpha \]

• Hired worked produces one unit of outside good per unit of time and job is destroyed at rate \( s_0 \)

• Wages are Nash bargained without commitment
Outside sector

- Hiring cost (Cobb-Douglas matching function):
  \[ b_0 = a_0 x_0^\alpha \]

- Hired worked produces one unit of outside good per unit of time and job is destroyed at rate \( s_0 \)

- Wages are Nash bargained without commitment

- **Assumption 3**: \( L \) is large enough that along the equilibrium path \( U_{0t} > 0 \) for all \( t \).

- **Lemma 1**: (i) \((x_0, b_0)\) are constant and satisfy:
  \[ 2(r + s_0) + x_0 \] \[ b_0 = 1 - b_u. \]

  (ii) The value of unemployed is constant and given by:
  \[ rJ_0^U = b_u + x_0 b_0. \]
Differentiated sector

Setup

1. Fixed cost $f_e \Rightarrow$ productivity $\theta \sim G(\theta) = 1 - \theta^{-k}$, $k \geq \frac{\beta}{1-\beta}$

2. Production $y = \theta h$ at fixed cost $f_d$ with revenue:

$$R = \left[1 + \iota \tau^{-\beta} (Q^*/Q)^{-\frac{\beta-\zeta}{1-\beta}}\right]^{1-\beta} Q^{-(\beta-\zeta)} y^\beta \equiv \Theta(\iota; \theta)^{1-\beta} h^\beta$$

3. Export decision $\iota \in \{0, 1\}$ at fixed cost $f_x$ and iceberg cost $\tau$

4. Cost of hiring: $bh$, where $b = ax^\alpha$

5. Stole-Zweibel wage bargaining $\Rightarrow w(h)$

6. Firms die at rate $\delta$ and matches are destroyed at rate $\sigma$

$\Rightarrow$ exogenous separation rate $s \equiv \delta + \sigma$
Differentiated sector I

- Bellman equation for firm $\theta$ with export status $\iota$:

$$J^F(h) = \max_{h'} \left\{ \varphi(h)\Delta - b[h' - (1 - \sigma\Delta)h]^+ + \frac{1 - \delta\Delta}{1 + r\Delta} J^F_+(h') \right\},$$

where $\varphi(h) = R(h) - w(h)h - f_d - \iota f_x$
Differentiated sector I

• Bellman equation for firm $\theta$ with export status $\iota$:

$$J^F(h) = \max_{h'} \left\{ \varphi(h)\Delta - b[h' - (1 - \sigma\Delta)h] + \frac{1 - \delta\Delta}{1 + r\Delta} J^F(h') \right\},$$

where $\varphi(h) = R(h) - w(h)h - f_d - \iota f_x$

• Bellman equation for employed workers:

$$J^E(h) - J^U = w(h)\Delta + \frac{1 - s\Delta}{1 + r\Delta} (J^E(h') - J^U) - \left( J^U - \frac{1}{1 + r\Delta} J^U^+ \right).$$

• Stole-Zweibel bargaining: $J^E(h) - J^U = J^F_h(h)$
Differentiated sector I

• Bellman equation for firm $\theta$ with export status $\iota$:

$$J^F(h) = \max_{h'} \left\{ \varphi(h)\Delta - b[h' - (1 - \sigma\Delta)h]^+ + \frac{1 - \delta\Delta}{1 + r\Delta} J^F(h') \right\},$$

where $\varphi(h) = R(h) - w(h)h - f_d - \iota f_x$

• Bellman equation for employed workers:

$$J^E(h) - J^U = w(h)\Delta + \frac{1 - s\Delta}{1 + r\Delta} (J^E(h') - J^U) - \left( J^U - \frac{1}{1 + r\Delta} J^U \right)$$

• Stole-Zweibel bargaining: $J^E(h) - J^U = J^F_h(h)$

• **Lemma 2**: Bargaining wage schedule is:

$$w(h) = \frac{\beta}{1 + \beta} \frac{R(h)}{h} + \frac{1}{2} \Delta u.$$
Differentiated sector II

- Optimal hiring policy:

\[ J^F_h(h') = b \quad \Rightarrow \quad \varphi'(h) = (r + s)b \]
Differentiated sector II

- Optimal hiring policy:
  \[ J_h^F(h') = b \quad \Rightarrow \quad \varphi'(h) = (r + s)b \]

- **Lemma 3**: (a) Equilibrium employment conditional on hiring:
  \[ h = \Phi^{1/\beta} \Theta(t; \theta), \quad \text{where} \quad \Phi \equiv \left[ \frac{\beta}{1 + \beta b_u + [2(r + s) + x]b} \right]^{\beta \over 1 - \beta} \]
  (b) \((x, b)\) are constant and satisfy \(xb = x_0 b_0\), as
  \[ \Delta^U = rJ^U = b_u + xb \]
Differentiated sector II

• Optimal hiring policy:

\[ J_h^F(h') = b \quad \Rightarrow \quad \varphi'(h) = (r + s)b \]

• Lemma 3:  
  (a) Equilibrium employment conditional on hiring:

\[ h = \Phi^{1/\beta} \Theta(\iota; \theta), \quad \text{where} \quad \Phi \equiv \left[ \frac{\beta}{1 + \beta b_u + [2(r + s) + x]b} \right]^{\frac{\beta}{1-\beta}} \]

(b) \((x, b)\) are constant and satisfy \(xb = x_0b_0\), as

\[ \Delta^U = rJ^U = b_u + xb \]

• Lemma 4:  
  Value of an entrant with productivity \(\theta\) and zero employees, if it hires in every future period satisfies:

\[ (r + \delta)J^V(\theta) - \dot{J}^V(\theta) = \max_{\nu \in \{0, 1\}} \left\{ \frac{1 - \beta}{1 + \beta} \Phi \Theta(\nu; \theta) - f_d - \nu f_x \right\} \]

proof
Steady State

- All entrants either exit immediately or produce and hire workers in every future period.

- Free entry condition:
  \[
  \int \max_{\nu \in \{0, 1\}} \left\{ \frac{1 - \beta}{1 + \beta} \Phi \Theta(\nu; \theta) - f_d - \nu f_x, 0 \right\} \, dG(\theta) = (r + \delta)f_e
  \]

- Production and export cutoffs:
  \[
  \frac{1 - \beta}{1 + \beta} \Phi Q^{\frac{\beta - \zeta}{1 - \zeta}} \theta_d^{\frac{\beta}{1 - \beta}} = f_d,
  \]
  \[
  \frac{1 - \beta}{1 + \beta} \tau^{\frac{\beta}{1 - \beta}} \Phi Q^{\ast \frac{\beta - \zeta}{1 - \zeta}} \theta_x^{\frac{\beta}{1 - \beta}} = f_x
  \]

- Additional equilibrium conditions for \( M, H, N \)
Steady-state Comparisons

• **Proposition 1**: In a symmetric Pareto world economy steady state, a reduction in $\tau$ leads to:

  (i) an increase in $Q$, $H$, $M$, with $H/M$ constant, and changes in these variables do not depend on labor market frictions:

  \[
  \left( \frac{Q'}{Q} \right)^\zeta = \frac{H'}{H} = \frac{M'}{M} = \left( \frac{\theta'_d}{\theta_d} \right)^{\frac{\beta \zeta}{\beta - \zeta}}
  \]

  and $\theta_d = \left[ \frac{f_d}{f_e} \cdot \frac{1+(f_d/f_x)^k/(\varepsilon-1)-1-\tau}{k/(\varepsilon-1)-1(r+\delta)} \right]^{1/k}$.

  (ii) Assume $s = s_0$ and $x = x_0$. Then aggregate unemployment and income do not change with $\tau$, and steady state welfare gains from trade do not depend on labor market frictions.

• Measure of welfare: $GT' = \frac{(l'-l)+\frac{1-\zeta}{\zeta}(Q')^\zeta}{\frac{1-\zeta}{\zeta}Q^\zeta} = \left( \frac{Q'}{Q} \right)^{\zeta}$
Dynamic Gains

- Consider a one-time unanticipated and permanent reduction in trade cost, $\tau' < \tau$

- **Proposition 2**: Along the transition path, $Q_t \geq Q'$. If there is entry in every period, then $Q_t \equiv Q'$.

- **Proof**: $b_t = b$ and $\tau_t = \tau'$. Two cases: (i) Continuous entry. Then free entry implies $E J^V(\theta) = \text{const}$, and thus $Q_t = Q'$. (ii) No entry for $t \in [0, T_e)$. Then $\dot{Q}_t < 0$ and $Q_{T_e} = Q'$.

- Intuition: entry acts as a buffer
Dynamic Gains

- Consider a one-time unanticipated and permanent reduction in trade cost, $\tau' < \tau$

- **Proposition 2**: *Along the transition path, $Q_t \geq Q'$. If there is entry in every period, then $Q_t \equiv Q'$.***

- **Proof**: $b_t = b$ and $\tau_t = \tau'$. Two cases: (i) Continuous entry. Then free entry implies $E J^V(\theta) = const$, and thus $Q_t = Q'$. (ii) No entry for $t \in [0, T_e)$. Then $\dot{Q}_t < 0$ and $Q_{T_e} = Q'$. ■

- Intuition: entry acts as a buffer

- **Corollary**: Dynamic gains in consumer surplus are instantaneous and do not depend on labor market frictions!
Dynamic Gains

- Consider a one-time unanticipated and permanent reduction in trade cost, $\tau' < \tau$

- **Proposition 2**: Along the transition path, $Q_t \geq Q'$. If there is entry in every period, then $Q_t \equiv Q'$.

- **Proof**: $b_t = b$ and $\tau_t = \tau'$. Two cases: (i) Continuous entry. Then free entry implies $\mathbb{E}J^V(\theta) = const$, and thus $Q_t = Q'$. (ii) No entry for $t \in [0, T_e)$. Then $\dot{Q}_t < 0$ and $Q_{T_e} = Q'$.

- Intuition: entry acts as a buffer

- **Corollary**: Dynamic gains in consumer surplus are instantaneous and do not depend on labor market frictions!

- **Income $I$ changes in general**:
  1. decrease in the aggregate value of firms
  2. decrease in the value of employed at shrinking firms
  3. endogenous separation into unemployment (firing)
Dynamic Adjustment

- With entry, gains in CS do not depend on $G_t(h, \theta)$

- Yet, productivity, trade and income all depend on it
Cutoffs: Incumbents vs Entrants
<table>
<thead>
<tr>
<th>Moment</th>
<th>Parameter</th>
<th>Value</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Discount rate</strong></td>
<td>$r$</td>
<td>0.05</td>
<td></td>
</tr>
<tr>
<td><strong>Exogenous separation rate</strong></td>
<td>$s$</td>
<td>0.2</td>
<td>$s_0 = s$</td>
</tr>
<tr>
<td>— Labor force attrition rate</td>
<td>$\sigma$</td>
<td>0.175</td>
<td></td>
</tr>
<tr>
<td>— Firm death rate</td>
<td>$\delta$</td>
<td>0.025</td>
<td></td>
</tr>
<tr>
<td><strong>Job finding rate</strong></td>
<td>$x$</td>
<td>2</td>
<td>$a_0 = a = 0.12$</td>
</tr>
<tr>
<td><strong>Relative elasticity of matching</strong></td>
<td>$\alpha$</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td><strong>Unemployment benefit</strong></td>
<td>$b_u$</td>
<td>0.4</td>
<td></td>
</tr>
<tr>
<td><strong>Pareto shape parameter</strong></td>
<td>$k$</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td><strong>CES within sector</strong></td>
<td>$\varepsilon$</td>
<td>4</td>
<td>$\beta = 3/4$</td>
</tr>
<tr>
<td><strong>Semi-elasticity across sectors</strong></td>
<td>$\zeta$</td>
<td>2</td>
<td>$\zeta = 1/2$</td>
</tr>
<tr>
<td><strong>Employment share in the traded sector</strong></td>
<td></td>
<td>14%</td>
<td>$L = 10, f_d = 0.05$</td>
</tr>
<tr>
<td><strong>Fraction of exitors</strong></td>
<td></td>
<td>25%</td>
<td>$(r + \delta)f_e/f_d = 2.7$</td>
</tr>
<tr>
<td><strong>Fraction of exporters</strong></td>
<td></td>
<td>12%</td>
<td>$f_x/f_d = 1$</td>
</tr>
<tr>
<td><strong>Fraction of output exported</strong></td>
<td></td>
<td>16%</td>
<td>$\tau = 1.75$</td>
</tr>
<tr>
<td><strong>Trade liberalization</strong></td>
<td></td>
<td></td>
<td>$\tau' = 1.375$</td>
</tr>
<tr>
<td>— Fraction of exporters</td>
<td></td>
<td>26%</td>
<td></td>
</tr>
<tr>
<td>— Fraction of output exported</td>
<td></td>
<td>27%</td>
<td></td>
</tr>
</tbody>
</table>
Adjustment Patterns
Regions in the parameter space

Reduction in trade costs, \( \frac{\tau - \tau'}{\tau - 1} \)
Unemployment duration, \( \frac{1}{x} \)

No Entry

Overshooting

No Exit

or Firing

No Exit

or Firing

Exit

No

Firing

Exit and

Some Firing

Exit and

All Firing

0 0.2 0.4 0.6 0.8 1
0 0.1 0.2 0.3 0.4 0.5

0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1
0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1

18 / 23
Firm Employment: Before and After

Frictional labor market (6 months duration)
Firm Employment: Before and After

Time to exit or steady state

Productivity $\theta$

Time to steady state (years) $\hat{T}(\theta)$

$\bar{T}$
Firm Employment: Before and After

Flexible labor market (1/2 months duration)
Aggregate dynamics

Productivity

\[ \frac{Q}{H} \]

Time, \( t \)

Productivity, \( \frac{Q}{H} \)
Aggregate dynamics

Trade

![Graph showing aggregate dynamics with time on the x-axis and exports/Q on the y-axis. The graph displays a steady increase in exports/Q over time.]
Good and Bad Jobs

Changes in firm values

![Graph showing changes in firm value, $J_F(\theta)$, against firm productivity, $\theta$. The graph illustrates the impact of changes in productivity on firm values, with distinct points indicating specific values of $\theta$.](image)
Good and Bad Jobs
Changes in firm and employment values

\[
\begin{align*}
\text{Firm productivity, } \theta & \quad \text{Change in value} \\
& \quad \theta_d, \tilde{\theta}_d, \theta'_d, \theta'_x
\end{align*}
\]
Gains from Trade

- Gains from trade are measured as:

\[
GT = \frac{\Delta I + \frac{1-\zeta}{\zeta}(Q')^\zeta}{\frac{1-\zeta}{\zeta}Q^\zeta}
\]

and

\[
GT^{CS} = (Q'/Q)^\zeta
\]

- \(\Delta I = \Delta^F + \Delta^E + \Delta^U\) is the change in the NPV of income:
  1. \(\Delta^F\): change in the value of Firms
  2. \(\Delta^E\): change in the value of Employed
  3. \(\Delta^U\): loss in value from separations into Unemployed

- Decomposition of Gains from Trade:

<table>
<thead>
<tr>
<th></th>
<th>(GT^{CS})</th>
<th>(GT)</th>
<th>(\Delta^F)</th>
<th>(\Delta^E)</th>
<th>(\Delta^U)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(x = 2)</td>
<td>9.50%</td>
<td>8.61%</td>
<td>-0.58%</td>
<td>-0.31%</td>
<td>—</td>
</tr>
<tr>
<td>(x = 5)</td>
<td>9.50%</td>
<td>8.70%</td>
<td>-0.41%</td>
<td>-0.39%</td>
<td>—</td>
</tr>
<tr>
<td>(x = \infty)</td>
<td>9.50%</td>
<td>9.50%</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
</tbody>
</table>
Gains from Trade

\[ \frac{G}{T} = \frac{s}{(x + s)} \]

Sectoral unemployment, \( u = \frac{s}{(x + s)} \)
• Trade liberalization with a frictional labor market results in lengthy transitions with:
  — misallocation of labor and reduced productivity
  — depressed value of trade
  — bad jobs and good jobs
  — but instantaneous gains from trade and gains in consumer surplus independent from the extent of LM frictions

• Quantitatively modest disruptions in the labor market
Conclusion

• Trade liberalization with a frictional labor market results in lengthy transitions with:
  — misallocation of labor and reduced productivity
  — depressed value of trade
  — bad jobs and good jobs
  — but instantaneous gains from trade and gains in consumer surplus independent from the extent of LM frictions

• Quantitatively modest disruptions in the labor market

• Strong assumptions to relax next:
  1. Linear hiring costs
  2. Frictionless free entry
  3. Perfect mobility across sectors
  4. No idiosyncratic productivity shocks
  5. Symmetric countries
Outside sector
Characterization (Proof of Lemma 1)

1. $U_0 > 0$ ensures entry of firms (i.e., vacancy posting)
   \[ \Rightarrow \quad J_0^V \equiv 0 \quad \text{and} \quad J_0^F = b_0 \]

2. Then Nash bargaining results in:
   \[ J_0^E - J_0^U = J_0^F = b_0 \]

3. Surplus from employment satisfies:
   \[
   (r + s_0)J_0^F = (1 - w_0) + \dot{J}_0^F, \\
   (r + s_0 + x_0)(J_0^E - J_0^U) = (w_0 - b_u) + (\dot{J}_0^E - \dot{J}_0^U)
   
   \text{Has unique stationary solution} \quad (x_0, b_0) \quad \text{with} \quad \dot{b}_0 = 0
   
4. Finally, the value of unemployed and equilibrium wage are:
   \[
   rJ_0^U = b_u + x_0 b_0, \\
   w_0 = b_u + (r + s_0 + x_0)b_0.
   \]
• First order condition (sS rule):

\[
\frac{1 - \delta \Delta}{1 + r \Delta} J_{h,+}^F (h') = \begin{cases} 
  b, & \text{when } h' > (1 - \sigma \Delta) h, \\
  \in [0, b], & \text{when } h' = (1 - \sigma \Delta) h, \\
  0, & \text{when } h' < (1 - \sigma \Delta) h,
\end{cases}
\]

• Envelope theorem:

\[
J_{h}^F (h) = \varphi'(h) \Delta + \frac{1 - s \Delta}{1 + r \Delta} J_{h,+}^F (h')
\]

• Combining the two, conditional on hiring, and with \( b = \text{const} \):

\[
\varphi'(h) = \frac{(r + s) b}{1 - \delta \Delta}
\]
Proof of Lemma 3
Value of an Entrant

1. The value of a hiring entrant \((h' > (1 - \sigma \Delta)h)\)

\[
J^F(h) = \varphi(h)\Delta + (1 - \sigma \Delta)h - bh' + \frac{1 - \delta \Delta}{1 + r\Delta} J^F_+(h')
\]

2. Optimal hiring is given by:

\[
\frac{1 + r\Delta}{1 - \delta \Delta} b_{-1} = \varphi'(h)\Delta + (1 - \sigma \Delta)b
\]

3. Combining (1) and (2):

\[
\left( J^F(h) - \frac{1 + r\Delta}{1 - \delta \Delta} b_{-1}h \right) = \left( \varphi(h) - \varphi'(h)h \right) \Delta + \left( \frac{1 - \delta \Delta}{1 + r\Delta} J^F_+(h') - bh' \right)
\]

\[
= \frac{1 - \beta}{1 + \beta} \Theta \varphi^1 - f_d - \xi f_x
\]

\[= \frac{1 - \beta}{1 + \beta} \Phi \Theta - f_d - \xi f_x
\]
Additional Equilibrium Conditions

Steady State

- With two symmetric countries:
  \[ Q^\zeta = M \Phi \int^{\infty}_{\theta_d} \Theta(\nu(\theta); \theta)) dG(\theta), \]
  \[ H = \Phi \frac{1-\beta}{\beta} Q^\zeta \]

- Additionally, under Pareto productivity distribution:
  \[ \frac{H}{M} = \frac{2k(r + \delta)f_e}{b_u + [2(r + s) + x]b} \]

- \[ N = \frac{x+s}{x} H \] and \[ N_0 = L - N \]
Job Creation and Unemployment

Differentiated-sector hires (quarterly)
Job Creation and Unemployment

Differentiated-sector unemployment (quarterly)
Job Creation and Unemployment

Differentiated-sector unemployment (monthly)

\[ \hat{T}(\tilde{\theta}'_d) \]

\[ \hat{T}(\theta_d) \]

\[ \hat{T}(\tilde{\theta}_d) \]
Job Creation and Unemployment

Increase in sectoral unemployment on impact