Job Turnover and International Trade: A General Equilibrium Analysis

George Alessandria (Fed Philadelphia)
Horag Choi (University of Auckland)
Alain Delacroix (UQAM)
Nicolas Petrosky-Nadeau (UQAM)

(Preliminary)
The recent literature has focused on the fact that an important benefit of opening to trade is the reallocation of employment towards more productive exporters.

- One aspect of this process is costly churning of workers,
  - there can be a temporary hike in job turnover (post-reform); that could also lead to permanently higher level of turnover.

The literature does not reach definite conclusions on the effect of trade on job turnover.

We build a general equilibrium model of plant-level employment and export dynamics to quantify effect of trade openness on job turnover.

- Model related to both Melitz model of trade and to Hopenhayn model of industry dynamics.
- We reproduce basic employment and export dynamics from the data.
- What happens to job turnover when we remove trade barriers.
Preview of findings:

- For the U.S., we find small rise in JT from big increase in trade,
  - $JT^{SS}$ rises 0.2 points,
  - big welfare effect for consumption.

- Small impact because trade has offsetting effects on $JT$:
  - New exporters sell more (more JT),
  - Stay exporters longer (less JT),
  - New plants start smaller (less JT).

- In transition, $JT_t$ spikes in the short-run.
Empirical literature:

- Rodrik (97), Farber (96) *suggest* a link between increased trade exposure and increased job instability.

- Industry trade orientation and job turnover: Davis, Haltiwanger and Schuh (98); Klein, Schuh and Triest (02); Christev (05); Kletzer (99).

- Exchange rate fluctuations and job displacement: Gourinchas (98, 99); Goldberg, Tracy and Aaronson (99); OECD (07); Haltiwanger et al (04).

- FTA and industry employment losses: Trefler (04).
Model:

- In each country, there is a competitive final goods sector that uses tradable and non-tradable intermediates as inputs.

- Intermediate producers are monopolistic competitors.
  - Thus there is a distribution of intermediate producers over:
    - sector (T, NT),
    - country (H, F),
    - productivity ($z$),
    - export status ($m = 0$ for non-exporters, $m = 1$ for exporters).
Exporting:

- Fixed sunk cost $f_0$ of entering the export market; period cost $f_1$ of staying in the market (units of labor).

\[
\begin{cases} 
\text{Start export if } EV_{\text{exp}} > \text{ sunk cost}, \\
\text{Leave export if } V_{\text{exp}} < \text{ period cost}.
\end{cases}
\]

(induces hysteresis in exporting.)

- Tariff rate $\tau$ and iceberg costs $\xi$. 
Key abstractions:

- Asymmetric countries/sectors: no reallocation due to comparative advantage.

- Business cycles fluctuations: export participation is procyclical (Alessandria-Choi, 07).

- Iceberg costs are exogenous, identical across firms.
Final goods sector: Firms in that sector

\[
\max \Pi_{F,t} = D_t - \sum_{m=0}^{1} \int_{z} \left[ \frac{P_{H,t}(z,m)}{P_t} \right] y_{H,t}^d(z,m) \varphi_{T,t}(z,m) dz \\
- \int_{z} \left[ \frac{(1 + \tau)P_{F,t}(z,1)}{P_t} \right] y_{F,t}^d(z,1) \varphi_{T,t}^*(z,1) dz \\
- \int_{z} \left[ \frac{P_{N,t}(z)}{P_t} \right] y_{N,t}^d(z) \varphi_{N,t}(z) dz,
\]

subject to

\[
\begin{cases}
D_t = D_{T,t}^\gamma \cdot D_{N,t}^{1-\gamma}, \\
D_{T,t} = \left( \sum_{m=0}^{1} \int_{z} y_{H,t}^d(z,m) \frac{\theta-1}{\theta} \varphi_{T,t}(z,m) dz + \int_{z} y_{F,t}^d(z,1) \frac{\theta-1}{\theta} \varphi_{T,t}^*(z,1) dz \right)^{\frac{\theta}{\theta-1}}, \\
D_{N,t} = \left( \int_{z} y_{N,t}^d(z) \frac{\theta-1}{\theta} \varphi_{N,t}(z) dz \right)^{\frac{\theta}{\theta-1}}.
\end{cases}
\]
Non-tradable producers:
All intermediate producers subject to a stochastic process given by\((\phi(z'|z)\), \(\phi_E(z')\) and \(n_d(z))\).

The NT-producer chooses \(P_{N,t}(z)\), \(k_{N,t}(z)\) and \(l_{N,t}(z)\) to

\[
V_{N,t}(z) = \max_{y_N,t(z)} \frac{P_{N,t}(z)}{P_t} y_N,t(z) - W_t l_{N,t}(z) - R_t k_{N,t}(z) + n_s(z) Q_t \int_{z'} V_{N,t+1}(z') \phi(z'|z) dz'.
\]

s.t. \(y_{N,t}(z) = e^z \cdot k_{N,t}(z)^\alpha \cdot l_{N,t}(z)^{1-\alpha}\),

\(y_{N,t}(z) = y_{N,t}^d(z)\). (FG-prob.)
The tradable producer chooses $P_{H,t}(z,m)$, $P_{H,t}^*(z,m)$, $k_{T,t}(z,m)$, $l_{N,t}(z)$, $x_t(z,m)$ [materials] and next period’s export status $m'$ to

$$V_{T,t}(z,m)$$

$$= \max \Pi_{T,t}(z,m) - m' W_t[f_1 m + (1 - m)f_0] + n_s(z) Q_t \int_{z'} V_{T,t}(z',m') \phi(z'|z) dz'$$

where

$$\Pi_{T,t}(z,m) = \text{foreign sales + domestic sales}$$

- payments to labor and capital

- payments to other TP.
subject to

\[
\begin{align*}
\text{production with inputs } & k_{T,t}(z,m), l_{N,t}(z), x_t(z,m), \\
x_t(z,m) \text{ aggregate of tradable intermediates,} \\
\text{supply dom. mkt} &= \text{demand by dom. FGP} + \text{dom. TP}, \\
\text{supply foreign mkt} &= \text{demand by foreign FGP} + \text{foreign TP}, \\
\text{total supply} &= \text{dom. supply} + (1 + \xi) \times \text{foreign supply}.
\end{align*}
\]
Exporting decision:

\[
\begin{align*}
\text{Value exporting (t+1):} \\
V_{T,t}^1(z,m) &= \\
&= \max \Pi_{T,t}(z,m) - W_t[f_1 m + (1 - m)f_0] + n_s(z)Q_t \int V_{T,t+1}(z',1)\phi(z'|z)dz', \\

\text{Value not exporting (t+1):} \\
V_{T,t}^0(z,m) &= \max \Pi_{T,t}(z,m) + n_s(z)Q_t \int V_{T,t+1}(z',0)\phi(z'|z)dz',
\end{align*}
\]

thus actual value \( V_{T,t}(z,m) = \max \{V_{T,t}^0(z,m), V_{T,t}^1(z,m)\} \).
The value is increasing in \( z \), given \( m \). Since \( V_T^1 \) intersects \( V_T^0 \) from below, there is for each \( m \) a threshold \( z \) which makes firms indifferent between exporting or not.

We thus have two thresholds, \( z_0 \) and \( z_1 \) that determine when exporting firms stop exporting (\( z_1 \)) and when non-exporting firms start exporting (\( z_0 \)):

\[
V_{T,t}^1(z_{1,t}, 1) = V_{T,t}^0(z_{1,t}, 1) \quad \text{and} \quad V_{T,t}^1(z_{0,t}, 0) = V_{T,t}^0(z_{0,t}, 0).
\]

We have that

\[ z_{1,t} < z_{0,t}. \]

Knowing \((z_0, z_1)\), one can compute a starter rate among non-exporters and a stopper rate among exporters. The starter rate \( n_0 \) decreases with \( z_0 \). The stopper rate \( n_1 \) increases with \( z_1 \).
Figure 1: Establishment Distribution

![Graph showing the distribution of establishments by productivity. The x-axis represents productivity (z), and the y-axis represents the fraction of establishments (%). The graph peaks at a productivity of 0, with a bell-shaped curve indicating that most establishments have productivity close to zero. There is a lower concentration of establishments with very high or very low productivity. There is a death probability (%) on the right y-axis, indicating the proportion of establishments that go out of business. The line labeled "All establishments" shows the overall distribution of establishments across the productivity spectrum.]
Figure 1: Establishment Distribution

- Productivity (z)
- Fraction of establishments (%)
- Death probability (%)

All establishments

Starter threshold
Figure 1: Establishment Distribution

- Stopper threshold
- Starter threshold
- All establishments
Figure 1: Establishment Distribution

- Stopper threshold
- Starter threshold

Fraction of establishments (%)

0
20
40
60
80
100
Death probability (%)

All establishments
Exporters

ACDP (NASME 2008)
Job Turnover and Trade

06/08 15 / 50
Figure 1: Establishment Distribution

- **All establishments**
- **Non-exporters**
- **Exporters**

**Productivity (z)**

**Fraction of establishments (%)**

**Death probability (%)**

- Stopper threshold
- Starter threshold
Figure 1: Establishment Distribution

- **Fraction of establishments (%)**
- **Death probability (%)**

- **All establishments**
- **Non-exporters**
- **Exporters**

- **Productivity (z)**

---

ACDP (NASME 2008)
Entry in the market is given by free entry, i.e.

\[
\begin{align*}
V_{T,t}^E &= -W_t f_E + Q_t \int_{z'} V_{t+1}(z',0) \phi_E(z') dz' = 0, \quad \text{tradable entry}, \\
V_{N,t}^E &= -W_t f_E + Q_t \int_{z'} V_{t+1}(z') \phi_E(z') dz' = 0, \quad \text{non-tradable entry}.
\end{align*}
\]
Calibration:

- \( \theta \) to match producer markup of 25%, also consistent with US trade-weighted import elasticity (as in Broda and Weinstein (2006)).
- Tariff rate of 8% mid-point of tariff and non-tariff barriers in industrialized countries.
- Transportation cost \( \xi \) set to match exporters’ export to sales ratio of 13%.
- Tradable share \( \gamma \) set to match manufacturers’ nominal value added relative to industry GDP.
- Labor share in production technology to match labor share of income.
- Share of materials into production determines ratio of gross output to value added in manufacturing.
- Entry cost \( f_E \) so that total mass of establishments \( (N_T + N_N) \) normalized to 2.
The underlying stochastic process is given by: \( z' = \rho z + \epsilon \); for entrants, \( z' = \mu_E + \varepsilon_E \). The death rate is

\[ n_d(z) = \max\{0, \min\{\lambda e^{-\lambda z} + n_{d0}, 1\}\} \]

\([n_d(z)\) is decreasing in \(z\)].

The parameters of the stochastic processes \((\rho, \sigma, \mu_E, \lambda, n_{d0})\) and the export cost parameters \((f_0, f_1)\) are set to match:
- exporter rate [22.3%],
- exporter output premium (avg. exp. shipment rel. to non-exp. shipment) [5.6%],
- stopper rate [17%],
- entrants labor share [1.5%],
- Shutdown establishments’ labor share [2.3%],
- five-year exit rate of entrants [37%],
- Establishment employment and size distributions (to pin \(\sigma\) down).
- Calibration tight on:
  - establishment distribution,
  - exporter persistence.

- overstates:
  - how export participation rises with size,
  - Big miss on JT (55% vs. 10%),
  → results robust in lower turnover calibration however.
Simulations:

- We study the steady state relation between job turnover and trade, by varying trade costs $\xi$.

- We examine the transition dynamics to a large cut in trade costs.
• Contributions from entrants fall as new plants start out smaller.

• More JT from continuing firms.

• The net effect is small.
**Intuition:**

- Trade barriers affect the level of competition plants face at home. Reducing tariffs reduces domestic sales as foreign competitors come in. Also, big domestic plants demand more labor, and push wages up. This has a negative effect on entry by small firms.

- Shocks move firms across employment levels and export status:
  - Decision of whether to export or not / decision of how much to export: both affect $JT$.
  - Reducing tariffs decreases $z_0$ and $z_1$, thus increasing the starter rate and decreasing the stopper rate: more entry, less exit. Plants stay in export market longer.
  - Reducing tariffs increases foreign sales and employment changes associated with a switch.
Non-linear Relation Between Trade & Turnover:

More trade (lower barriers)

- \( \frac{\text{Exports}}{\text{Sales}} \) rise \( \Rightarrow \Delta' s \) in exporting increase hiring/firing.
- But \( \Delta' s \) in exporting may increase/decrease.

\[
\Delta \text{status} = \left\lfloor \frac{N_x}{N} \right\rfloor \downarrow \Pr(\text{stop}) \downarrow \left(1 - \frac{N_x}{N}\right) \uparrow \Pr(\text{start})
\]

- Share of plants exporting rises (\(N_x/N\)).
- More non-exporters start.
- Fewer exporters stop.
Transitions:

Consider an unanticipated cut in tariffs from 12 percent to zero.

- Long run impact on
  - Job turnover up 0.1 percentage point
  - Exports/Nominal GDP rises from 4.9 percent to 10.9 percent.

- Substantially more job turnover initially.
Dynamics of job turnover

Percentage points

Time

Job Creation
Job Destruction
Entrants
Exitters

ACDP (NASME 2008)
Job Turnover and Trade
06/08 43 / 50
Conclusion:

- We built model with plant employment and export dynamics. We used it to look at the effect of removing trade barriers on turnover.

- We find little effect of trade reform on total turnover in the long-run, but there is an initial spike in the short-run.
  - Startups are smaller,
  - Export dynamics have offsetting effects on job turnover of continuing plants.
- Caveat: we do not look at the costs associated with job loss.

- As of yet, the model overpredicts job turnover. Less volatile model misses establishment & exporter distributions. Another source of heterogeneity may be needed. Coming closer to job turnover requires labor adjustment costs & shocks to fixed costs.

- Future research: can trade reform have an effect for the turnover of various categories of firms: exporters, firms in tradable sector...