Do Falling Iceberg Costs Account for Recent US Export Growth?

George Alessandria
FRB Philadelphia

Horag Choi
University of Auckland

April 2009
Trend in Export Share of Manufacturing Value Added

Year
Export Share (Percent)
0.0 0.1 0.2 0.3 0.4 0.5 0.6
Tariffs
2 4 6 8 10 12 14
Trend in Export Share of Manufacturing Value Added

Year:
- 1959
- 1964
- 1969
- 1974
- 1979
- 1984
- 1989
- 1994
- 1999

Export Share (Percent):
- 0
- 0.1
- 0.2
- 0.3
- 0.4
- 0.5
- 0.6

Tariffs:
- 2
- 4
- 6
- 8
- 10
- 12
- 14

Graph showing the trend in export share and tariffs from 1959 to 1999.
Introduction

Study change in trade costs and trade in puzzling period (87 to 02) through lens of benchmark heterogeneous plant model

- Measure change in iceberg costs ($\Delta \iota$)
- Given $\Delta \iota$ ask: Did US Exports grow too much?
Introduction

Study change in trade costs and trade in puzzling period (87 to 02) through lens of benchmark heterogeneous plant model

- Measure change in iceberg costs ($\Delta \iota$)

- Given $\Delta \iota$ ask: Did US Exports grow too much?
  
  No. Puzzle is that it grew so little!
Introduction

Study change in trade costs and trade in puzzling period (87 to 02) through lens of benchmark heterogeneous plant model

- Measure change in iceberg costs ($\Delta \iota$)

- Given $\Delta \iota$ ask: Did US Exports grow too much?

  No. Puzzle is that it grew so little!

  Model overpredicts exporting & misses shift to small plants
Outline

1. Accounting for trade growth & iceberg costs
2. Model
3. Calibration
4. Results
Consider monopolist selling $d_{it}$ at home & $e_{xit}$ overseas:

$$e_{xit} = \left[ p_{it}^{*} \left( 1 + \iota_t \right) \left( 1 + \tau_t \right) \right]^{-\theta} Y_t^*$$

$$d_{it} = p_{it}^{-\theta} Y_t$$
Trade Growth - representative plant

Consider monopolist selling \( d_{it} \) at home & \( e_{xit} \) overseas:

\[
e_{xit} = \left[ p_{it}^* (1 + \iota_t) (1 + \tau_t) \right]^{-\theta} Y_t^* \\
d_{it} = p_{it}^{-\theta} Y_t
\]

With no price discrimination, \( p_i = p_i^* \), then over time,

\[
\Delta \frac{e_{xit}}{d_{it}} = -\theta [\Delta \iota + \Delta \tau] + \Delta Y^* - \Delta Y
\]

Direct link between trade costs & export growth.
Trade Growth - representative plant

\[
\Delta \frac{\text{ex}_{it}}{d_{it}} - (\Delta Y^* - \Delta Y) = -\theta (\Delta l + \Delta \tau)
\]

Penn World Table:
- ROW-US relative real income \((\Delta Y^* - \Delta Y) \approx 8\) percent

Census of Manufacturers:
- From 1987 to 2002, \(\Delta \text{ex}_{it} / d_{it} \approx 50\) percent
Two approaches to estimate source of trade growth

Yi (2003), $\Delta \iota = 0$, measure $\Delta \tau = -2.5$

$$\theta = -\frac{\Delta \frac{\text{exit}}{d_{it}} - (\Delta Y^* - \Delta Y)}{\Delta \tau} \approx \frac{50 - 8}{2.5} \approx 17$$
Trade Growth - representative plant

Two approaches to estimate source of trade growth

1. Yi (2003), $\Delta \iota = 0$, measure $\Delta \tau = -2.5$

   $$
   \theta = - \frac{\Delta \frac{\text{exit}}{d_{it}} - (\Delta Y^* - \Delta Y)}{\Delta \tau} \approx \frac{50 - 8}{2.5} \approx 17
   $$

2. Anderson & Van Wincoop, $\Delta \iota + \Delta \tau$ unobserved, if $\theta = 5$

   $$
   \Delta \iota + \Delta \tau = - \frac{\Delta \frac{\text{exit}}{d_{it}} - (\Delta Y^* - \Delta Y)}{\theta} \approx -8.5
   $$
Trade Growth - representative plant

Two approaches to estimate source of trade growth

1. Yi (2003), $\Delta \iota = 0$, measure $\Delta \tau = -2.5$

$$\theta = -\frac{\Delta \text{exit}_d}{\Delta \tau} - (\Delta Y^* - \Delta Y) \approx \frac{50 - 8}{2.5} \approx 17$$

2. Anderson & Van Wincoop, $\Delta \iota + \Delta \tau$ unobserved, if $\theta = 5$

$$\Delta \iota + \Delta \tau = -\frac{\Delta \text{exit}_d}{\theta} - (\Delta Y^* - \Delta Y) \approx -8.5$$

Measurement necessary to distinguish explanations.
Trade Growth - plant heterogeneity

Aggregate trade no longer solely determined by trade costs.

Characteristics of plants matter.

1. Number of exporters

2. Size of exporters:
   - Tend to be relatively large

Use changes in these margins to infer $\Delta$ trade costs
Trade Growth - plant heterogeneity

Assume $N_t$ plants, $n_t$ exporters w/ same $\iota_t$ & $s_{it} = e_{xit} + d_{it}$

\[
\frac{\text{Exports}_t}{\text{Sales}_t} = \frac{\sum_{i=1}^{n_t} e_{xit}}{\sum_{i=1}^{N_t} s_{it}} = \frac{(1 + \iota_t)^{-\theta} Y^*_t}{Y_t + (1 + \iota_t)^{-\theta} Y^*_t} \cdot \frac{n_t}{N_t} \sum_{i=1}^{n_t} s_{it} \cdot \frac{n_t}{N_t}
\]
Trade Growth - plant heterogeneity

Assume $N_t$ plants, $n_t$ exporters w/ same $\iota_t$ & $s_{it} = e_{it} + d_{it}$

$$\frac{\text{Exports}_t}{\text{Sales}_t} = \frac{\sum_{i=1}^{n_t} e_{it}}{\sum_{i=1}^{N_t} s_{it}} = \frac{(1 + \iota_t)^{-\theta} Y_t^*}{Y_t + (1 + \iota_t)^{-\theta} Y_t^*} \cdot \frac{\sum_{i=1}^{n_t} s_{it}}{n_t} \frac{N_t}{\sum_{i=1}^{N_t} s_{it}} \cdot \frac{n_t}{N_t}$$

Over time

$$\Delta e_{xy} = \Delta \left( \frac{e_{X}}{s^{X}} \right) + \Delta \left( \frac{s^{X}}{s} \right) + \Delta \left( \frac{n}{N} \right)$$

Direct link between $\Delta$ in iceberg costs and export intensity.
Table 1: Export Characteristics and Trade

<table>
<thead>
<tr>
<th>US Plants with 100+ employees</th>
<th>1987</th>
<th>2002</th>
<th>Log Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>EXY</td>
<td>0.061</td>
<td>0.097</td>
<td>0.46</td>
</tr>
<tr>
<td>Intensity</td>
<td>0.100</td>
<td>0.152</td>
<td>0.42</td>
</tr>
<tr>
<td>Premium</td>
<td>1.65</td>
<td>1.35</td>
<td>-0.20</td>
</tr>
<tr>
<td>Participation</td>
<td>0.37</td>
<td>0.47</td>
<td>0.24</td>
</tr>
</tbody>
</table>
Table 1: Export Characteristics and Trade

<table>
<thead>
<tr>
<th></th>
<th>US Plants with 100+ employees</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>EXY</td>
</tr>
<tr>
<td>1987</td>
<td>0.061</td>
</tr>
<tr>
<td>2002</td>
<td>0.097</td>
</tr>
<tr>
<td>Log Change</td>
<td>0.46</td>
</tr>
</tbody>
</table>

- Similar results for all plants
- Changes in intensity affect both premium & participation
- Given small role for $\Delta' s$ in income, attribute all to iceberg costs.
Model

- Baldwin & Krugman (89), Hopenhayn (93), Roberts & Tybout (97), Melitz (03), Das, Roberts, and Tybout (2007)
- $\infty$-horizon
- 2 symmetric countries $\{H, F\}$
- Final non-traded good made w/ tradable & non-tradable intermediates
- Complete asset markets
Model

- Non-tradables: $N_{N,t}, N^*_{N,t}$ differentiated $H$ & $F$ intermediates
  - Differ by technology $z$
  - $\psi_{NT,t}(z)$ denotes measure of plants w/ $z$. 

Tradables: $N_{T,t}, N^*_{T,t}$ differentiated $H$ & $F$ intermediates

- Export costs: start $f_0$, continue, $f_1$ (in labor), iceberg, $\iota_t$.
- Measure of establishments: $\psi_{T,t}(z, \kappa, m)$

Idiosyncratic shocks $\phi(z_0, \kappa_0)$ & exogenous survival $n_s(z, \kappa)$

Free Entry: hire $f_E$ workers

Timing: fixed costs paid 1 period in advance

All plants owned by domestic agents.
Model

- **Non-tradables:** $N_{N,t}, N^*_{N,t}$ differentiated $H$ & $F$ intermediates
  - Differ by technology $z$
  - $\psi_{NT,t}(z)$ denotes measure of plants w/ $z$.

- **Tradables:** $N_{T,t}, N^*_{T,t}$ differentiated $H$ & $F$ intermediates
  - Differ by $z$, export status $m = \{0, 1\}$ & fixed cost $f_m + \kappa$
  - Export costs: start $f_0$, & continue, $f_1$ (in labor), iceberg, $\iota_t$.
  - Measure of establishments: $\psi_{T,t}(z, \kappa, m)$
Model

- Non-tradables: $N_{N,t}, N^*_{N,t}$ differentiated $H$ & $F$ intermediates
  - Differ by technology $z$
  - $\psi_{NT,t}(z)$ denotes measure of plants w/ $z$.

- Tradables: $N_{T,t}, N^*_{T,t}$ differentiated $H$ & $F$ intermediates
  - Differ by $z$, export status $m = \{0, 1\}$ & fixed cost $f_m + \kappa$
  - Export costs: start $f_0$, & continue, $f_1$ (in labor), iceberg, $\iota_t$.
  - Measure of establishments: $\psi_{T,t}(z, \kappa, m)$

- Idiosyncratic shocks $\phi(z', \kappa' | z, \kappa)$ & exogenous survival $n_s(z, \kappa)$

- Free Entry: hire $f_E$ workers

- Timing: fixed costs paid 1 period in advance

- All plants owned by domestic agents.
Key Abstractions

- Asymmetric countries/sectors
  - US may have comparative advantage in small-scale industries or innovation

- Business-cycle fluctuations
  - Export participation is procyclical (Alessandria-Choi 2007)

- Iceberg costs are exogenous, identical across firms
  - No marketing frictions (Arkolakis 2007 Drozd & Nosal 2007)
Consumer’s Problem

\[ V_{C,0} = \max_{\{C_t, B_t, K_{t+1}\}} \sum_{t=0}^{\infty} \beta^t U(C_t), \]

\[ C_t + K_t + Q_t \frac{B_t}{P_t} \leq W_t L_t + R_t K_{t-1} + B_{t-1} + (1 - \delta) K_{t-1} + \Pi_t, \]

- \( P_t, W_t \) denote price level & real wage,
- \( \Pi_t \) sum of home country profits
- Foreign problem with *

\[ Q_t = \beta \frac{U_{C,t+1}}{U_{C,t}} \frac{P_t}{P_{t+1}}, \quad q_t \equiv \frac{P^*_t}{P_t} = \frac{U^*_t}{U_{C,t}}. \]
Competitive Final Good Producers

- Combine NT & T intermediates to produce final good
- Imports available only from foreign exporters, i.e. \( m^* = 1 \).
  \[ \Rightarrow \] Set of available tradables differs across countries.
Competitive Final Good Producers

\[ \Pi = \max P \cdot D - \sum_{m=0}^{1} \int_{z \times \kappa} P_H(z, \kappa, m) y_H^d(\cdot) \psi_T(\cdot) \]

\[ - \int_{z \times \kappa} (1 + \iota_t) P_F(\cdot) y_F^d(\cdot) \psi_T^*(z, \kappa, 1) - P_N Y_N, \]

subject to:

1. \[ D = Y_T^\gamma Y_N^{1-\gamma} \]

2. \[ Y_T = \left( \int y_H^d(z, \kappa, m) \frac{\theta-1}{\theta} \psi_T(\cdot) + \int y_F^d(z, \kappa, 1) \frac{\theta-1}{\theta} \psi_T^*(\cdot) \right)^{\frac{\theta}{\theta-1}} \]

3. \[ Y_N = \left( \int y_N^d(z) \frac{\theta-1}{\theta} \psi_N(z) \right)^{\frac{\theta}{\theta-1}} \]
Competitive Final Good Producers

\[ \Pi = \max P \cdot D - \sum_{m=0}^{1} \int_{z \times \kappa} P_{H}(z, \kappa, m) y_{H}^{d}(\cdot) \psi_{T}(\cdot) \]

\[ - \int_{z \times \kappa} (1 + i_t) P_{F}(\cdot) y_{F}^{d}(\cdot) \psi_{T}^{*}(z, \kappa, 1) - P_{N} Y_{N}, \]

subject to:

1. \( D = Y_{T}^{\gamma} Y_{N}^{1-\gamma} \)

2. \( Y_{T} = \left( \int y_{H}^{d}(z, \kappa, m) \frac{\theta-1}{\theta} \psi_{T}(\cdot) + \int y_{F}^{d}(z, \kappa, 1) \frac{\theta-1}{\theta} \psi_{T}^{*}(\cdot) \right)^{\frac{\theta}{\theta-1}} \)

3. \( Y_{N} = \left( \int y_{N}^{d}(z) \frac{\theta-1}{\theta} \psi_{N}(z) \right)^{\frac{\theta}{\theta-1}} \)

\[ \Rightarrow \text{Input Demand} \quad y_{H,t}^{d}(z, \kappa, m), y_{N,t}^{d}(z, \kappa, m) \quad \& \quad y_{F,t}^{d}(z, \kappa, 1) \]

\[ \text{Prices} \quad P_{N,t}, P_{T,t}, P_{t} \]
Tradable Producer \((z, m, k)\)

- Hires workers, \(l(z, m, \kappa)\)
- Rents capital \(k(z, m, \kappa)\)
- Buys intermediates available at home: \(x(z, m, \kappa)\)
- Determines markets to serve tomorrow, \(m'(z, m, \kappa)\)
Tradable Producer (z,m,k)

Lag in investing in exporting & ability ⇒ separate decisions:

- For $t$, given markets, $m \in \{0, 1\}$, $\max \Pi_{T,t} (z, \kappa, m)$
- For $t + 1$, invest in exporting, $m' = \{0, 1\}$
Tradable Producer \((z, m, k)\)

For \(t\), given markets, \(m = \{0, 1\}\)

\[
\Pi_{T,t}(\cdot) = \max_{k,l,x} \frac{P_{H,t}(\cdot) y_{H,t}(\cdot)}{P_t} + m \frac{P^*_{H,t}(\cdot) y^*_{H,t}(\cdot)}{P_t}
\]

\[
- W_t l_{T,t}(\cdot) - R_t k_{T,t}(\cdot) - P_{T,t} x(\cdot),
\]

\(\text{st} : y_H + y^*_H = e^z \left[ k_T^\alpha(\cdot) l_T^{1-\alpha}(\cdot) \right]^{1-\alpha} x(\cdot)^{\alpha}
\]

\[
\Rightarrow P_{T,t}(\cdot), P^*_{T,t}(\cdot), k_{T,t}(\cdot), l_{T,t}(\cdot), x(\cdot)
\]
Tradable Producer \((z, m, k)\) - Export Decision

\[
V_{T,t}(z, \kappa, m) = \Pi_{T,t}(z, \kappa, m) + \max \{ V^1_t(z, \kappa, m), V^0_t(z, \kappa, m) \}
\]

\[
V^1_t(z, \kappa, m) = -W_t(\kappa + f_m) + n_s(z) \text{EQ}_t V_{T,t+1}(z', \kappa', 1 | z, \kappa)
\]

\[
V^0_t(z, \kappa, m) = n_s(z) \text{EQ}_t V_{T,t+1}(z', \kappa', 0 | z, \kappa)
\]

\[
\Rightarrow m'_t(z, \kappa, m) = 1 \text{ iff }
\]

\[
W_t(f_m + \kappa) \leq n_s(z) \text{EQ}_t \left[ V_{T,t+1}(z', \kappa, 1 | \cdot) - V_{T,t+1}(z', \kappa, 0 | \cdot) \right]
\]
Non-tradable Producer \((z)\)

\[
\Pi_{N,t}(z) = \max_{l,k} \frac{P_{N,t}(z) y_{N,t}(z)}{P_t} - W_t l_{N,t}(z) - R_t k_{N,t}(z),
\]

\[st : y_N(z) = e^z k_N^\alpha(z) l_N^{1-\alpha}(z)\]

\[
\Rightarrow P_{N,t}(z), k_{N,t}(z), l_{N,t}(z)
\]

\[
V_{N,t}(z) = \Pi_{N,t}(z) + EQ_t V_{N,t+1}(z'|z),
\]
Free Entry

- Hire $f_E$ workers
- Draw technology $\phi_E(z)$, produce in $t + 1$

$$V^E_{T,t} = -W_t f_E + Q_t E V_{T,t+1}(z, \kappa, 0) \phi_E(z, \kappa) \leq 0$$

$$V^E_{N,t} = -W_t f_E + Q_t E V_{N,t+1}(z) \phi_E(z) \leq 0$$

$\Rightarrow N^E_{N,t}, N^E_{T,t}$, establishments enter.
Summary of Export Participation Decision

Assume no shocks to fixed cost ($\kappa = 0$)
Figure 1: Establishment Distribution

The graph shows the distribution of productivity (z) among establishments. The x-axis represents productivity (z), while the y-axis indicates the fraction of establishments (%). The distribution is bell-shaped with a peak around productivity (z) = 0.5, indicating a concentration of establishments with a productivity close to the mean. The starter threshold is marked by a vertical dashed line, suggesting a cutoff point for establishment viability or growth potential. The graph also highlights 'All establishments' and 'Starter threshold' areas, emphasizing the range of productivity levels and the proportion of establishments below or above the threshold.
Figure 1: Establishment Distribution

Stopper threshold

Starter threshold

All establishments
Figure 1: Establishment Distribution

- Stopper threshold
- Starter threshold

- All establishments
- Non-exporters
- Exporters

Productivity (z)

Fraction of establishments (%)

Death probability (%)

All establishments
Non-exporters
Exporters
Stopper threshold
Starter threshold

0
0.5
1
1.5
2
-2
-1.5
-1
-0.5
0
0.5
1
1.5
2
0
20
40
60
80
100
0
20
40
60
80
100
0
20
40
60
80
100
3
2.5
2.0
1.5
1.0
0.5
0.0
-2
-1.5
-1
-0.5
0
0.5
1
1.5
2
Figure 1: Establishment Distribution

- **Stopper threshold**
- **Starter threshold**

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

Fraction of establishments (%)

Death probability (%)

- **All establishments**
- **Birth**
- **Non-exporters**
- **Exporters**
Calibration

Target 1987 economy

1. Trade costs in 2002

2. Exporter characteristics & dynamics

3. Establishment characteristics & dynamics
Calibration - trade costs and export intensity

\[
\frac{\iota_t}{1 - \iota_t} = (1 + \iota)^{-\theta}
\]

\[\Rightarrow \] Given \(\theta\) & export intensity \(\iota_t\), can infer \(\iota\) in 1987 & 2002

- \(\iota_{87} = 0.54\) and \(\iota_{02} = 0.41\)

- Anderson & Van Wincoop (04) find \(\iota \approx 0.65\), include fixed costs

- Division of trade costs into transport vs. tariffs matters mostly for welfare
Calibration - Targets

<table>
<thead>
<tr>
<th></th>
<th></th>
<th>1987</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Participation of plants w/ 100+ employees</td>
<td>0.37</td>
</tr>
<tr>
<td>2</td>
<td>Exporter Stopper Rate 87-92, ASM</td>
<td>0.17</td>
</tr>
<tr>
<td>3</td>
<td>Entrant 5-year exit rate</td>
<td>0.362</td>
</tr>
<tr>
<td>4</td>
<td>Employment share of births</td>
<td>0.015</td>
</tr>
<tr>
<td>5</td>
<td>Employment share of deaths</td>
<td>0.023</td>
</tr>
<tr>
<td>6</td>
<td>Export Participation distribution</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Employment distributions</td>
<td></td>
</tr>
</tbody>
</table>

Two stages:

- Given $\rho_K, \rho_\varepsilon, \sigma_\varepsilon$, pick $f_0, f_1, \lambda, n_{d0}, \mu_E$, match 1 to 5 observations
- Choose $\rho_K, \rho_\varepsilon, \sigma_\varepsilon$ to match 6 & 7 (minimize distance)
## Calibration - Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\theta$</td>
<td>Elasticity of Substitution</td>
<td>5</td>
</tr>
<tr>
<td>$\rho$</td>
<td>Persistence of Idiosyncratic shock</td>
<td>0.69</td>
</tr>
<tr>
<td>$\sigma^2_{\epsilon}$</td>
<td>Variance of Idiosyncratic shock</td>
<td>$0.33^2$</td>
</tr>
<tr>
<td>$\lambda$</td>
<td>Exit shock</td>
<td>2.02</td>
</tr>
<tr>
<td>$n_{d0}$</td>
<td>Constant exit rate</td>
<td>2.25</td>
</tr>
<tr>
<td>$\mu_E$</td>
<td>Productivity disadvantage young firms</td>
<td>0.335</td>
</tr>
<tr>
<td>$\rho_\kappa$</td>
<td>Probability of no fixed cost</td>
<td>0.94</td>
</tr>
<tr>
<td>$f_E$</td>
<td>Entry Cost</td>
<td>2.25</td>
</tr>
<tr>
<td>$f_0$</td>
<td>Startup export cost</td>
<td>0.219</td>
</tr>
<tr>
<td>$f_1$</td>
<td>Continuation cost</td>
<td>0.028</td>
</tr>
</tbody>
</table>
Model Fit by Employment Size

<table>
<thead>
<tr>
<th>Squared sum of residuals (%)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Establishments</td>
<td>5.2</td>
</tr>
<tr>
<td>Employment share</td>
<td>4.2</td>
</tr>
<tr>
<td>Export participation</td>
<td>0.4</td>
</tr>
</tbody>
</table>
Figure 2: Plant Characteristics by Employment Size

(a) Establishment Share

Employees per establishment

Percent (log scale)

DATA

MODEL
Figure 2: Plant Characteristics by Employment Size

(b) Employment Share
Figure 2: Plant Characteristics by Employment Size

(c) Export Participation

Data Model

Employees per establishment

Percent

1-99  100-249  250-499  500-999  1,000-2,499  2,500+

DATA
MODEL
Change iceberg costs to match intensity

1. Steady State
2. Dynamics
### Table 4: Change in Export Characteristics and Trade

<table>
<thead>
<tr>
<th></th>
<th>Export Share</th>
<th>Intens.</th>
<th>Prem</th>
<th>$\frac{n}{N}$</th>
<th>N</th>
<th>L</th>
<th>$s^{2500+}$</th>
<th>$s^{&lt;99}$</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Data</strong></td>
<td>0.46</td>
<td>0.42</td>
<td>-0.20</td>
<td>0.24</td>
<td>-2.0</td>
<td>-17.0</td>
<td>-5.4</td>
<td>2.9</td>
</tr>
<tr>
<td><strong>Model</strong></td>
<td>0.80</td>
<td>0.42</td>
<td>-0.22</td>
<td>0.59</td>
<td>-3.3</td>
<td>-0.5</td>
<td>0.1</td>
<td>-1.0</td>
</tr>
</tbody>
</table>

- Overpredicts exports and export participation
Figure 3: Change in Plant Characteristics by Employment Size

(c) Export Participation
<table>
<thead>
<tr>
<th></th>
<th>Export Share</th>
<th>Intens.</th>
<th>Prem</th>
<th>( \frac{n}{N} )</th>
<th>N</th>
<th>L</th>
<th>( s^{2500+} )</th>
<th>( s^{&lt;99} )</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Data</strong></td>
<td>0.46</td>
<td>0.42</td>
<td>-0.20</td>
<td>0.24</td>
<td>-2.0</td>
<td>-17.0</td>
<td>-5.4</td>
<td>2.9</td>
</tr>
<tr>
<td><strong>Model</strong></td>
<td>0.80</td>
<td>0.42</td>
<td>-0.22</td>
<td>0.59</td>
<td>-3.3</td>
<td>-0.5</td>
<td>0.1</td>
<td>-1.0</td>
</tr>
</tbody>
</table>

- Overpredicts exports and export participation
- Predicts shift away from small plants
Figure 3: Change in Plant Characteristics by Employment Size

(a) Establishment Share

Change in establishment (%)

Employment of an establishment

Data

Model

Red diamonds: Data
Blue line: Model

Y-axis: Change in establishment (%)
X-axis: Employment of an establishment

Categories:
- 1-99
- 100-249
- 250-499
- 500-999
- 1000-2499
- 2500+

Graph shows the change in establishment share across different employment size categories, comparing data points to the model predictions.
Figure 3: Change in Plant Characteristics by Employment Size

(b) Employment Share

Data
Model

Change in employment share (%) vs. Employment of an establishment

Data
Model
Table 4: Change in Export Characteristics and Trade

<table>
<thead>
<tr>
<th></th>
<th>Export Share</th>
<th>Intens.</th>
<th>Prem</th>
<th>( \frac{n}{N} )</th>
<th>N</th>
<th>L</th>
<th>( s^{2500+} )</th>
<th>( s^{&lt;99} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data</td>
<td>0.46</td>
<td>0.42</td>
<td>-0.20</td>
<td>0.24</td>
<td>-2.0</td>
<td>-17.0</td>
<td>-5.4</td>
<td>2.9</td>
</tr>
<tr>
<td>Model</td>
<td>0.80</td>
<td>0.42</td>
<td>-0.22</td>
<td>0.59</td>
<td>-3.3</td>
<td>-0.5</td>
<td>0.1</td>
<td>-1.0</td>
</tr>
</tbody>
</table>

- Overpredicts exports and export participation
- Predicts shift away from small plants
- Underpredicts fall in manufacturing employment and plant size
  - Plant size fell 15% in data, but in model increase 2.8%
Missing out on average plant size

- Model misses out on change in plant size (+ 2.8 vs - 15.0)
- Rescale model to match data, keep export decision constant
Helps in tails, but not center, doesn’t affect export participation
Helps in tails, but not center, doesn’t affect export participation
Exporter Dynamics

- Explore whether steady state comparisons may overstate results

- Suppose, unanticipated drop from $\iota_{87}$ to $\iota_{02}$
  - Note that exporter intensity rose only 0.3 percent from 97 to 02.
Transition dynamics very fast in export participation
Conclusions

From $\Delta$ in exporter characteristic & participation, we infer:

1. Iceberg costs fell 25%, from 55% to 41%.

2. $\Delta$ in Iceberg costs accounts for 175 percent of export growth, $\Rightarrow$ Puzzle is that trade didn’t grow more.

3. Changing structure of manufacturing drag on trade growth
   - Change in size distribution contradicts theory.
Calibration

Annual: \( \beta = 0.96, \delta = 0.1, \)

\[
u(c) = \frac{c^{1-\sigma}}{1-\sigma} \quad \sigma = 2
\]

\[
y(z) = e^z (k^x l^{1-\alpha})^{1-\alpha_x} x_m^{\alpha_x} \quad \alpha = 0.26,
\]

\( \alpha_x = 0.80 \Rightarrow \text{gross output} = 2.8 \times \text{value added} \)

\[
D = Y_T^\gamma Y_N^{1-\gamma} \quad \gamma = 0.21 \Rightarrow \text{mfr VA of 21%}
\]
Calibration - establishment heterogeneity

Shocks to $z$ and $\kappa$ independent

$\phi(z' | z) : z' = \rho_\varepsilon z + \varepsilon, \varepsilon \sim N \left(0, \sigma_\varepsilon^2\right)$

$\phi_E (z) : z' = -\mu_E + \varepsilon_E, \varepsilon_E \sim N \left(0, \frac{\sigma_\varepsilon^2}{1-\rho^2}\right)$

$n_d (z) : 1 - n_s (z) = \max \left\{0, \min \left\{\lambda e^{-\lambda e^z} + n_{d0}, 1\right\}\right\}$

$\phi_\kappa (\kappa) : \text{two states } \kappa = \left\{0, \infty\right\}, \rho^L_\kappa = 1 - \rho^H_\kappa = \rho_\kappa$
- initial cost drawn from ergodic distribution

$\Rightarrow 8$ parameters $\{f_0, f_1, \lambda, n_{d0}, \mu_E, \rho_\varepsilon, \sigma_\varepsilon, \rho_\kappa\}$
Preview of Results

Using Melitz model, we find:

1. Iceberg costs fell by 1/4, from 55 percent to 41 percent.

2. Fall in iceberg costs should have increased trade 75 percent more
   - Puzzle is that trade grew so slowly!

3. Slow export growth result of a shift towards smaller plants
   - With smaller plants $\Rightarrow$ fewer exporters
   - Contradicts key prediction of Melitz model

4. Reallocation of labor from traded to non-traded less than data.
Related Literature - Trade Growth

1. Empirical:
   - Baier & Bergstrand (01) - 75% tariffs, 25% transport costs
   - Bernard & Jensen (05) - important role of entry & intensity US exports from 87 to 92.
   - Hummels (06) - documents drop in air/ocean freight charges.
   - Bernard, Jensen, Schott (07) - falling trade costs increase likelihood of exporting

2. Theoretical
   - Yi (03) - more back-forth trade of intermediates
   - Melitz (03), Ruhl (03) - # of exporters rose w/ drop in tariffs
Table 1: Export Characteristics and Trade

<table>
<thead>
<tr>
<th></th>
<th>EXY</th>
<th>Intensity</th>
<th>Premium</th>
<th>Participation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1987</td>
<td>0.051</td>
<td>0.100</td>
<td>6.42</td>
<td>0.085</td>
</tr>
<tr>
<td>2002</td>
<td>0.084</td>
<td>0.151</td>
<td>4.82</td>
<td>0.115</td>
</tr>
<tr>
<td>Log Change</td>
<td>0.49</td>
<td>0.42</td>
<td>-0.29</td>
<td>0.36</td>
</tr>
</tbody>
</table>

Based on Census of Manufacturers
Sensitivity - elasticity of substitution T/NT

\[ D = \left[ a D_T^{\frac{\gamma-1}{\gamma}} + (1 - a) D_N^{\frac{\gamma-1}{\gamma}} \right]^{\frac{\gamma}{\gamma-1}} \]

Lowering \( \gamma \)

- Lowers tradable employment & # plants, but less than data
- But, no impact on plant size distribution.
- Suggests globalization has small impact on decline in mfring.
Figure 5: Tradable Sector and Elasticity of Substitution

[Graph showing the relationship between Elasticity of Substitution (T/NT) and Percent Change in Employment, Plants, and Plant Size.]
Evolution of establishment distribution

- $\Psi_t = (\psi_t, \psi_t^*)$
- Given entry & export decision $m_t^l (z, \kappa, m), m_t^*l (z, \kappa, m)$, idiosyncratic shocks $\phi$:

$$
\Psi_{t+1} = T \left( \Psi_t, N_t^E, N_t^{E*} \right)
$$

Labor used in production

$$
L_{P,t} = \int_{z \times m} l_t (z, m)
$$
Figure 2: Export Intensity by Employment Size (1987)

DATA

MODEL

Employees per establishment

Percent

DATA

MODEL

1-99
100-249
250-499
500-999
1,000-2,499
2,500+

13
12
11
10
9
8
7
6
Figure 2: Export Intensity by Employment Size (2002)
Missing out on average plant size

- Model misses out on change in plant size (+ 2.9 vs - 15.0)
- Rescale model to match data, keep export decision constant
Change in Average Plant Size of All Manufacturing Firms

Year
Laspeyres Even weights Paasche Unweighted
Change in Average Plant Size from 1972
-0.4 -0.3 -0.2 -0.1 0

How much have trade costs declined?

Estimate trade costs using Feenstra data.

\[ \text{Trade costs}_t = \sum_{i=1}^{N} \alpha_i (\tau_{it} + \iota_{it}) \]

\(\alpha_i\) - country i export weight in 2000/01
\(\tau_{it}\) - Ng/World Bank study of tariffs
\(\iota_{it}\) - Country fixed effect based on cif/fob import data (SITC)

Drops of about 10.2 points vs. 13.6 points from exporter data.
Thanks for having me in to visit.

This is joint work with Horag Choi at the University of Auckland. Our main focus is on trying to better understand how the US has become more integrated with the ROW through international trade. A picture may help to explain.

Here I’ve plotted the trend in share of manufacturing output exported relative to manufacturing value added over the 40 year period from 1959 to 1999. You can see that US exports have grown a lot – from less than 10 percent of sectoral value added to over 40 percent. This growth has been a bit uneven. It seemed to accelerate in the mid to late 80s. One possible explanation for this growth is that it reflects a decline in trade costs, making trade relatively cheaper. Indeed we see that there has been a fairly large drop in tariffs (these are from Yi 2003). However, the timing of the growth in trade doesn’t really match up. Trade costs fell a lot in the early period, but trade didn’t really take off until much later. Yi has argued that this poses a challenge for standard representative agent models since it implies that the elasticity of trade with respect to trade costs has accelerated.
So, growing integration in goods is a key characteristic of post war economic growth, yet the relation between trade and some observed measures of trade costs seems puzzling. So in this paper we want to revisit the question of what are the barriers to trade and how are they changing? Some aspects of trade costs are determined by policy, so understanding the impact of these policies is central to evaluating them. Doing so, also allows us to evaluate models of trade.

So, in this paper we revisit trade through the Melitz model of international trade. This is a model of heterogeneous monopolistically competitive producers facing fixed costs of exporting. We focus on the puzzling period of high trade growth and small decline in observed tariffs. In part because it’s a puzzle and in part because this is the only period for which we have data on exporter characteristics to discipline the model.

Slide 4 - preview of results
A) Using this model, we can infer the change in marginal trade costs, iceberg costs, these are the cost of trade that are proportional to the value of the goods being exported. Find they fell by a quarter from about 55 percent to 41 percent.
B) Find in this model, trade should have grown 75 percent more than it did. So, we reinterpret the puzzling period from a different angle. Puzzle is that trade grew so little.
C) The reason, we didn’t see more trade is that there was in the tradable sector, which we associate with manufacturing, there was a shift to relative small scale producers that did not export. This is the opposite prediction of the model, falling trade costs should reallocate production to bigger plants. Thus, we’re left with two very different puzzle.
D) Finally, given that we’ve got a GE model of trade, we can relate the sectoral reallocation induced by falling trade costs to that in the data away from manufacturing. Even when traded goods are close to complements, the model generates a very small reallocation of employment away from mfr.

Slide 5: Let me give you a roadmap of the talk. I’ll start by going over the relationship between trade costs and trade flows in a couple of models. Introduce a way of accounting for trade growth with heterogeneous plants. Next, I’ll go over the model of trade flows Calibrate and see how it does at explaining the data.
Slide 6: Obviously, there are other people who have done work measuring trade costs and/or relating them to the growth in trade. Probably most closely related is the paper by Kei-Mu Yi. As I already hinted at, he argues that standard models can not explain trade growth and thus we need to consider a framework with trade in intermediates that cross borders multiple times to explain the growth in world trade. What the standard model in international trade is has changed, and so we’re going to essentially revisit his analysis and come up the opposite conclusion.

Slide 7: I find it useful to start by presenting a simple framework to relate trade costs to trade flows. First, let’s consider the old representative plant framework. Think of there being many identical plants each selling at home and overseas facing similar demand functions in each market. The only difference is that goods shipped overseas incur tariffs and trade costs. With no price discrimination, over time the change in the ratio of exports to domestic sales will be determined by the change in trade costs and relative income.

Slide 8: So there is a very direct link between a change in trade costs and trade flows which we can take to the data. Now, its easy to measure things like export shares. The PWT reports...
Slide 9: Now, with this information and a measure of the change in trade costs we can figure out what the elasticity of trade is. This is the approach that Yi takes in his article. He observes that tariffs fell about 2.5 percentage points and assumes that iceberg costs were constant. Thus, he finds an elasticity of trade flows with respect to tariffs of about 17.5, which is much higher than existing estimates of the elasticity of demand. For this reason he argues we need a new model of trade. An alternate approach, consistent with that of Anderson and Van Wincoop is to take the elasticity as given and use it to back out the change in trade costs. Doing this we find that trade costs fell by about 8.5 points. Without better measurement, we can not distinguish between trade costs falling a little or a lot and consequently we can not evaluate our models of trade.

Slide 10: So, we want to take an alternate approach in which there is no longer just a one to one relation between trade costs and trade flows. So, we turn to models with plant heterogeneity. In these models the characteristics of plants determine aggregate trade flows. Since not all plants export and exporters are much larger than non exporters. So, we call on experience from other research and models.
For plants with technology in this range, export participation will depend on the history of shocks and hence past investments in export capacity.

Can we use the BLS mass layoff data to identify a change in the exit rate of big firms?

Is the rise in export intensity by big firms consistent with fixed cost model. The 1997 Economic Census contains a table showing the industries removed from the Census of Manufactures and the industries added (based on the transition from SIC to NAICS). The industries added are organized around small establishments with average employment of 7 per establishment (22839 and 153628) such as retail bakeries, furniture stores and dental labs. The industries dropped averaged about 25 employees per establishment (36870 and 822958) and were primarily organized around printing/publishing.

It will probably be easier to try to adjust the 1997 and 2002 data rather than make the 1987 and 1992 data better. This means we need to subtract the added industries (which is easy to do since there are industry reports - http://www.census.gov/prod/www/abs/manu-ind2002.html). Adding the subtracted guys might be tougher though.

<table>
<thead>
<tr>
<th>Establishment size</th>
<th>Employment</th>
<th>Establishments</th>
</tr>
</thead>
<tbody>
<tr>
<td>87 to 92</td>
<td>3.3%</td>
<td>-4.4%</td>
</tr>
<tr>
<td>92 to 97</td>
<td>1.9%</td>
<td>3.6%</td>
</tr>
<tr>
<td>97 to 02</td>
<td>-3.3%</td>
<td>-12.7%</td>
</tr>
<tr>
<td>Total</td>
<td>1.9%</td>
<td>-13.5%</td>
</tr>
</tbody>
</table>

Based on Census of Manufactures data from 1947 to 2002, plant size has fallen from 59.4 to 41.8 employees (not adjusting for changes in the coverage of manufacturing). If I just look at the largest plants (2500+) this was 544 in 1963 and has since fallen to 236 in 2002. When I compare establishment statistics from the 2005 ASM with those from the 1993 ASM, for the same years I find differences in the statistics. Part of this is due to what is included in manufacturing and part of this is how the surveys treat auxiliary workers.

I spoke to Rogerson about the paper. He had four comments. First, and most important, he thought that we needed to change the punchline to saying something about how others have argued that the puzzle is not that trade has grown too much, but that trade has grown too little. He thought that using the model to back out changes in the underlying structure was a fine, but less snappy exercise. Second, he thought that our intensity argument relating to trade costs was not quite right - he expected growth in intensity to be related to serving more markets. I told him that intensity does not change much by establishment size, suggesting that the extensive margin for existing exporters is not that important. Third, he thought that it could be that firms could be opening more plants rather than serving foreign markets entirely from existing plants - basically arguing we should maybe think of the firm as the unit of observation. Last, he thought we should try to relate changes in establishment size to changes in trade integration - either imports or exports.