Trade Adjustment Dynamics and the Welfare Gains from Trade

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Are trade dynamics important for welfare?

- Aggregate trade changes *gradually* following a change in trade barriers or relative prices (macro dynamics)
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- Often attributed to producers’ decisions to access or expand their presence in foreign markets (micro dynamics)
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- Recent studies of trade barriers lack micro/macro dynamics
  
  - A rationale is that transition will lower gains (upper bound)
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- Today: Quantify the gains from a change in tariffs in a dynamic model where the macro-dynamics arise from micro-dynamics
  - Transitions substantially increase gains from liberalization
Overview

- Develop GE model with producer level export dynamics
- General model of fixed-variable trade *cost* technology
  - Fixed startup and continuation cost
  - Stochastic iceberg cost that falls with time in the market
- Estimate exporting technology
- Estimate the gains from trade
Are trade dynamics important for welfare? Yes.

- Micro trade dynamics
  - Need time, resources, and luck to become an efficient exporter
  - Model: 2 years to turn profit, 5 years to break even

- Micro dynamics generate macro dynamics
  - Gradual trade growth; consumption overshooting

- Micro dynamics matter for welfare
  - Gain 1.5X larger than sunk-cost model
  - Gain 2.8X larger than no-micro-dynamics model

- Key tradeoff: accumulating varieties vs. exporters
Overview

- Micro exporter dynamics
- Model
- Parameters
- Results
  - Estimates of export technology
  - Transition dynamics after fall in tariffs
Micro exporter facts

1. Not all plants export (22% in US)
2. Exporters are relatively large (5x larger)
3. Exporting is persistent (83% survival)
Micro exporter facts

1. Not all plants export (22% in US)
2. Exporters are relatively large (5x larger)
3. Exporting is persistent (83% survival)
4. New exporters start with low \textit{export intensity}

\[ \text{exs}_{it} = \frac{\text{exports}_{it}}{\text{total sales}_{it}} \]

5. New exporters take time (5yrs) to become like average exports
6. New exporters have high exit rates
Export intensity of Colombian exporters (Ruhl & Willis, 08)
Survival probability of Colombian new exporters (Ruhl & Willis, 08)
Model

- General equilibrium, infinite horizon, 2 country \( \{H, F\} \) model
- Idiosyncratic uncertainty, no aggregate uncertainty
- Heterogeneous plants producing differentiated tradable goods
  - Monopolistic competitors
  - Fixed export costs: startup and continuation
  - Plants are created: endogenous mass of firms
- Exporter life cycle: time to build demand/lower marginal export costs
- Final C/I good combines available differentiated tradables
Model

- Mass $N_t, N_t^*$ differentiated $H$ & $F$ intermediates
- Each variety produced by 1 domestic-owned establishment
  - Idiosyncratic technology shocks: $z, \phi(z'|z)$
  - Fixed export cost: $f = \{f_H, f_L\}$ (paid in labor)
  - Iceberg costs: $\xi = \{\xi_L, \xi_H, \infty\}$
- Measure of establishments: $\varphi_{i,t}(z, \xi, f)$
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- Measure of establishments: $\phi_{i,t}(z, \xi, f)$
- Free entry: hire $f_E$ workers draw $\phi_E(z)$ in $t + 1$
- Exogenous survival: $n_s(z)$
- Timing: fixed costs paid 1 period in advance
Exporting technology

- A nonexporter
  - In current period: $\xi = \infty$
  - Can pay $f = f_H$ to begin exporting next period
  - If so, in next period: draw $\xi'$ w prob. $\rho_{\xi}(\xi'|\infty)$

- An exporter
  - In current period: $\xi < \infty$
  - Can pay $f = f_L$ to continue exporting
  - If so, in next period: draw $\xi'$ w prob. $\rho_{\xi}(\xi'|\xi)$
  - If not: exit raises cost to $\infty$

Our model: $\xi_H > \xi_L$, $f_H > f_L$

Das, Roberts, Tybout (2007): $\xi_H = \xi_L$, $f_H > f_L$

Ghironi and Melitz (2005): $\xi_H = \xi_L$, $f_H = f_L$

Krugman (1980) w/heterogeneity: $\xi_H = \xi_L$, $f_H = f_L = 0$
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Consumer’s problem

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

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

- \( P_t, W_t \) denote price level & real wage

- \( \Pi_t \) sum of home country profits, \( T_t \) lump sum gov’t transfers

- Foreign problem is analogous; foreign variables denoted by *

\[ Q_t = \beta \frac{U_{C,t+1}}{U_{C,t}} = \beta \frac{U_{C,t+1}^*}{U_{C,t+1}^*}, \]

\[ 1 = \beta \frac{U_{C,t+1}}{U_{C,t}} (R_{t+1} + 1 - \delta) = \beta \frac{U_{C,t+1}^*}{U_{C,t}^*} (R_{t+1}^* + 1 - \delta) \]
Competitive final good producers

- Combine domestic and imported intermediates, produce goods for
  - Consumption
  - Investment
  - Input into production by domestic firms

\[
D_t = \left[ \int_s y_{H,t}^d (s) \frac{\theta-1}{\theta} \varphi_{H,t} (s) \, ds + \int_s y_{F,t}^d (s) \frac{\theta-1}{\theta} \varphi_{F,t} (s) \, ds \right]^{\frac{\theta}{\theta-1}}
\]

\[
D_t = C_t + I_t + \int_s x(s) \varphi_{H,t} (s) \, ds
\]
Tradable producers

- Individual state is $s = (z, \xi, f)$

- Production Technology: $y_t(s) = e^z \left[ k_t(s)^{\alpha} l_t(s)^{1-\alpha} \right]^{1-\alpha_x} x(s)^{\alpha_x}$

- Profit, $\Pi_t(s)$, is

$$\max_{P_H, P_H^*, l, k, x} P_{H,t}(s) y_{H,t}(s) + P_{H,t}^*(s) y_{H,t}^*(s) - W_t l_t(s) - R_t k_t(s) - P_t x_t(s)$$

s.t. $y_t(s) = y_{H,t}^d(s) + (1 + \xi) y_{H,t}^{d*}(s)$,
Export decision

\[ V_t(z, \xi, f) = \max \{ V_t^1(z, \xi, f), V_t^0(z, \xi, f) \} \]

\[ V_t^1(z, \xi, f) = \max \Pi_t(z, \xi, f) - W_t f \]

\[ + n_s(z) Q_t \sum_{\xi' \in \{ \xi_L, \xi_H \}} \int_{z'} V_{t+1}(z', \xi', f_L) \phi(z'|z) dz' \rho_{\xi}(\xi'|\xi) \]

\[ V_t^0(z, \xi, f) = \max \Pi_t(z, \xi, f) \]

\[ + n_s(z) Q_t \int_{z'} V_{t+1}(z', \infty, f_H) \phi(z'|z) dz' \]

> With 3 iceberg costs there are three marginal firm types
Free entry

- Hire $f_E$ workers to enter

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

\[
V_t^E = -W_t f_E + Q_t EV_t(z, \infty, f_H) \phi_E(z) \leq 0
\]

$\Rightarrow N_{TE,t}$ new establishments
## Calibration: aggregates

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\sigma$ IES</td>
<td>2</td>
</tr>
<tr>
<td>$\delta$ Capital Depreciation</td>
<td>0.10</td>
</tr>
<tr>
<td>$\beta$ Discounting</td>
<td>0.96</td>
</tr>
<tr>
<td>$\theta$ Elasticity of Subst. (Broda &amp; Weinstein)</td>
<td>5</td>
</tr>
<tr>
<td>$\tau$ Tariff (Anderson and van Wincoop)</td>
<td>0.1</td>
</tr>
<tr>
<td>$\alpha_x$ MFR Gross Output/VA = 2.8</td>
<td>0.81</td>
</tr>
<tr>
<td>$\alpha$ Labor share of income = 66%</td>
<td>0.13</td>
</tr>
</tbody>
</table>
Calibration: establishments

- Target usual plant-level moments: participation rate, starter rate, etc.
- Export technology: $\{\xi_L, \xi_H\}$, $\{\rho(\xi_H|\xi_H), \rho(\xi_L|\xi_L), \rho(\xi_H|\infty)\}$
Calibration: establishments

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- Export technology: \{\xi_L, \xi_H\}, \{\rho(\xi_H|\xi_H), \rho(\xi_L|\xi_L), \rho(\xi_H|\infty)\}
  
  - \rho(\xi_H|\infty) = 1

  - \rho(\xi_H|\xi_H) = \rho(\xi_L|\xi_L) = \rho_\xi

- Micro-dynamic moments
  1. Initial export intensity 1/2 of avg. intensity (Ruhl & Willis 08)
  2. 5 years to reach avg export intensity (Ruhl & Willis 08)
Calibration: establishments

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- Micro-dynamic moments
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Calibration: establishments & exporters

A. Exporter dynamics & characteristics:

1. Overall participation rate = 22.3 (92 Census of Mfrs.)
2. Stopper rate = 17 (ASM)
3. Initial export intensity 1/2 of avg. intensity (Ruhl & Willis 08)
4. 5 years to reach avg. export intensity (Ruhl & Willis 08)

B. Establishment dynamics & heterogeneity:

5. Entrant 5-yr survival = 37 (Dunne et al. 89)
6. Birth labor share = 1.5 (Davis, et al. 96)
7. Exit labor share = 2.3 (Davis, et al. 96)
8. Establishment and employment distribution (92 Census)
Calibration: establishments & exporters

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Benchmark estimate of the exporting technology

- Entry cost 40% larger than continuation cost: \( \frac{f_H}{f_L} = 1.4 \)

- High iceberg cost 62% larger than low iceberg cost (1.72 vs. 1.07)

- Iceberg cost very persistent: \( \rho (\xi_H | \xi_H) = 0.92 \)

<table>
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<th>Common parameters</th>
<th>Benchmark</th>
<th>Sunk-cost</th>
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<tr>
<td>( \frac{f_H}{f_E} )</td>
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</tr>
<tr>
<td>( \rho \xi )</td>
<td>0.916</td>
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1-year survival rate (not targeted)
Profits (net/entry cost) of marginal starters

\[
\frac{(E\pi_{x,t} - f)}{f_H}
\]

Many new exporters exit before turning a profit.
Alternative model: Sunk cost export technology

- **Restriction:** \( \xi_H = \xi_L \)

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- \( f_H/f_L = 3.9 \)

- In benchmark model, high survival rate arises because producers don’t want to go through growth process again — not sunk costs.
Profits (net/entry cost) of marginal starters

\[
\frac{(E\pi_{x,t} - f)}{f_{H}^{bench}}
\]
Cumulative profits of marginal starters
3 experiments

1. Benchmark: $\xi_H > \xi_L$, $f_H > f_L$

2. Sunk cost: $\xi_H = \xi_L$, $f_H > f_L$

3. No cost: $\xi_H = \xi_L$, $f_H = f_L = 0$

- Consider unanticipated global tariff reduction, $\tau = 0.1 \rightarrow \tau = 0$
Aggregate export dynamics

Useful to look at dynamics of trade elasticity

\[ \varepsilon_t = -\frac{\ln(IMD_t/IMD_{t-1})}{\ln((1 + \tau_t)/(1 + \tau_{t-1}))}. \]  

where

\[ IMD_t = \frac{(1 + \tau_t) \int s P_{F,t}(s) y_{F,t}(s) \varphi_{F,t}(s) ds}{\int s P_{H,t}(s) y_{H,t}(s) \varphi_{H,t}(s) ds}. \]

Short-run elasticity is \( \theta - 1 \)
Dynamics following elimination of 10 percent tariff

Trade elasticity

![Graph showing dynamics after elimination of 10 percent tariff. The graph illustrates the change in trade elasticity over time, with a rapid increase in the first few years followed by a more gradual approach to a steady state.]
Dynamics following elimination of 10 percent tariff

Aggregate dynamics
The benchmark model

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\[
\bar{\varepsilon}_t = (1 - \beta) \sum_{t=0}^{\infty} \beta^t \varepsilon_t.
\]
Source of overshooting

- With capital accumulation overshooting is surprising.
- Tariffs lead to an overaccumulation of establishments relative to free trade steady state.
- These establishments can be converted at a low cost to exporters.
Source of overshooting

- With capital accumulation overshooting is surprising
- Tariffs lead to an overaccumulation of establishments relative to free trade steady state
- These establishments can be converted at a low cost to exporters
- Plant creation dynamics key to overshooting
- Experiment: force $N_t = 1$
Dynamics following elimination of 10 percent tariff

Aggregate Output

![Graph showing dynamics following elimination of 10 percent tariff. The graph indicates a significant increase in aggregate output in the short term, followed by a gradual decline to reach the benchmark by year 40.]
The sunk-cost model

- Literature has focused on sunk costs as a source of persistent exporting.

- Sunk cost model misses out on aspects of new exporter dynamics.

- Ask: How well does this simpler dynamic model of exporter approximate trade/welfare predictions of the benchmark model?
The sunk-cost model

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- Sunk cost model misses out on aspects of new exporter dynamics.

- Ask: How well does this simpler dynamic model of exporter approximate trade/welfare predictions of the benchmark model?

- Answer: Not so good on trade, pretty good on consumption/welfare.
Trade elasticity

Year
Percent change
Benchmark
Sunk-cost
No-cost

Year
0 20 40 60 80 100
Percent change
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Benchmark
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The sunk-cost model

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$$\bar{\varepsilon}_t = (1 - \beta) \sum_{t=0}^{\infty} \beta^t \varepsilon_t.$$
How important is endogenous exporting?

- Krugman (1980): all firms export

- Requires two main changes
  1. Change $\theta$ to get LR trade elasticity
  2. Add adjustment friction to get dynamics of trade elasticity
Modified Krugman (1980) model

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