Intermediate Inputs, Firm Size, and Import Content of Production

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Introduction
This paper is about intermediate goods and their joint role in both trade and production processes.
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- Trade in intermediate goods is big: 2/3 of all merchandise flows.

- 60% - 70% of production costs is on intermediate goods.

- We aim to quantify the role of costs attached to importing and exporting while explaining the relationship between firm size, intermediate input imports, and export behavior.
Costs attached to importing and exporting are sizeable and decisive in domestic value-added creation.
Main Preliminary Findings

- Costs attached to importing and exporting are sizeable and decisive in domestic value-added creation.
  - Iceberg costs
  - Adaptation costs
About the Data

Combine two distinct datasets:

- Trade transactions of Turkish manufacturing firms (NACE 15-37) in 2008
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- Trade transactions of Turkish manufacturing firms (NACE 15-37) in 2008
- Industry Census of Turkish manufacturing firms in 2008
Some Regularities

**Figure** : Intermediate Import Ratio By Exporter Status

![Graph showing intermediate import ratio by exporter status. The x-axis represents size percentile (in # value of production), and the y-axis represents the average intermediate import ratio. The graph distinguishes between Exporters and Non_Exporters, with Exporters represented by blue triangles and Non_Exporters by red pluses.](image-url)
Figure: Number of Firms By Size and Exporter Status
**Figure**: Intermediate Import Ratio by Size (Within)
Figure: Number of Imported Varieties vs. Fraction of Firms
Figure: Number of Import Varieties by Size (Within)
Figure: Revenue by Size (Within)
Previous Studies

- Imported intermediate goods and productivity

- Joint analysis of import and export decisions
  Kasahara and Lapham (2012)

- New intermediate goods and product scope
  Goldberg et al. (2010)

- Motives for importing intermediate inputs
  Saygili et al. (2010)
Extend Gopinath and Neiman (2014) by adding exports market and demand shocks
Preliminaries

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- Two countries: home and foreign
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- Two countries: home and foreign

- Continuum of monopolistic firms in both markets

- Production requires two types of input: labor $L$ and a bundle of intermediate inputs $X$

$$Y_i = A_i (L_{p,i})^{1-\mu} X_i^\mu$$
Intermediate Goods

- $Z_i$ and $M_i$ are the bundles of domestic and imported intermediate inputs used by firm $i$, respectively.

$$X_i = [Z_i^\rho + M_i^\rho]^{\frac{1}{\rho}}$$
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$$X_i = [Z_i^\rho + M_i^\rho]^{\frac{1}{\rho}}$$

- where

$$Z_i = \left[ \int z_{ij}^\theta dj \right]^{\frac{1}{\theta}}$$

$$M_i = \left[ \int_{\Omega_i} (bm_{ik})^\theta dk \right]^{\frac{1}{\theta}}$$

$b \geq 1$ is the quality attached to imported inputs.
Sales and Fixed Costs of Importing and Exporting

- $g_i$ is the domestic sales while $g_i^*$ is the exports.

$$Y_i = g_i + g_i^*$$
Sales and Fixed Costs of Importing and Exporting

- $g_i$ is the domestic sales while $g_i^*$ is the exports.

\[ Y_i = g_i + g_i^* \]

- Three kinds of fixed costs: $f_e$, $f_I$, and $f_V$.

\[ F(|\Omega_i|, g_i^*) = [f_I \mathbf{1}_{|\Omega_i| \neq 0} + f_V |\Omega_i|^\lambda + f_e \mathbf{1}_{|g_i^*| > 0}] \]

where $\lambda > 1$. 
Input Prices

\[ P_{X_i} = \begin{cases} 
(P_Z^{\rho-1} + P_{M_i}^{\rho-1})^{\frac{\rho-1}{\rho}} & \text{if firm } i \text{ imports} \\
P_Z & \text{if firm } i \text{ does not import} 
\end{cases} \]
Input Prices

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P_{Z} & \text{if firm } i \text{ does not import} 
\end{cases} \]

\[ P_{M_i} = \left[ \int_{k \in \Omega_i} \left( \frac{p_m}{b} \right)^{\frac{\theta}{\theta-1}} dk \right]^{\frac{\theta-1}{\theta}} = \frac{p_m}{b} |\Omega_i|^{\frac{\theta-1}{\theta}} \]

where \(0 < \theta < 1\).
Unit cost of production for firm $i$ is

$$C_i = \frac{1}{\mu^\mu (1 - \mu)^{1-\mu}} \frac{w^{1-\mu} P_i^{\mu} X_i}{A_i}. $$
Firm’s Problem

Unit cost of production for firm $i$ is

$$C_i = \frac{1}{\mu \mu(1 - \mu)^{1-\mu}} \frac{\omega^{1-\mu} P_{\mu}^i}{A_i}.$$ 

$$m_i = \begin{cases} 
(p_m / P_{M_i})^{\frac{1}{\theta-1}} (P_{M_i} / P_{X_i})^{\frac{1}{\rho-1}} X_i & \text{if firm } i \text{ imports} \\
0 & \text{if firm } i \text{ does not import}
\end{cases}$$
Firm’s Problem Cont...

Firm $i$ receives demand shock $s_i$ in the foreign market.

$$g_i^*(s_i, p_i) = \begin{cases} 
\frac{1}{\varepsilon - 1} s_i p_i & \text{if firm } i \text{ exports} \\
0 & \text{if firm } i \text{ does not export}
\end{cases}$$
Firm's Problem Cont...

Firm $i$ receives demand shock $s_i$ in the foreign market.

$$
g^*_i(s_i, p_i) = \begin{cases} 
    s_i p_i \frac{1}{\epsilon-1} & \text{if firm } i \text{ exports} \\
    0 & \text{if firm } i \text{ does not export}
\end{cases}$$

$$
p_i = \begin{cases} 
    \frac{C_i}{\epsilon} & \text{in the domestic market} \\
    \tau \frac{C_i}{\epsilon} & \text{in the foreign market}
\end{cases}$$
Firm’s Problem Cont...

Firm $i$ receives demand shock $s_i$ in the foreign market.

$$g_i^*(s_i, p_i) = \begin{cases} 
  s_i p_i^{\frac{1}{\epsilon} - 1} & \text{if firm } i \text{ exports} \\
  0 & \text{if firm } i \text{ does not export}
\end{cases}$$

$$p_i = \begin{cases} 
  \frac{C_i}{\epsilon} & \text{in the domestic market} \\
  \tau \frac{C_i}{\epsilon} & \text{in the foreign market}
\end{cases}$$

Firm has to decide about being an exporter and an importer, as well as, the number of varieties to import.

$$\Psi = \max_{\Omega_i, g_i, g_i^*} \{ \Pi_i - wF(|\Omega_i|, g_i^*) \}$$
F.O.C.

\[
\frac{\partial \psi}{\partial \Omega} = W(1 - \varepsilon)(1 + l(g^* > 0) s T^{\varepsilon-1}) \frac{\partial p(\Omega)^{\varepsilon}}{\partial \Omega} - \lambda w f \nu \Omega^{\lambda-1} = 0
\]
\[
\frac{\partial \psi}{\partial \Omega} = W(1 - \varepsilon)(1 + I(g^* > 0)sT^{\varepsilon \theta}) \frac{\partial p(\Omega)}{\partial \Omega}^{\varepsilon - 1} - \lambda wf_{v, \Omega}^{\lambda - 1} = 0
\]

\[
\Rightarrow \kappa \frac{\mu \varepsilon}{\varepsilon - 1} \frac{\theta - 1}{\theta} \left( \frac{p_m}{b} \right)^{\frac{\rho}{\rho - 1}} P_X^{\frac{\mu \varepsilon}{\varepsilon - 1} + \frac{\rho}{1 - \rho}} = \lambda wf_{v, \Omega}^{\lambda - \frac{\theta - 1}{\theta}} \frac{\rho}{\rho - 1}
\]

where

\[
\kappa = W(1 - \varepsilon)(1 + I(g^* > 0)sT^{\varepsilon \theta})^{\varepsilon \theta} \left( \frac{w^{1 - \mu}}{A\mu(1 - \mu)(1 - \mu)} \right)^{\varepsilon - 1}.
\]
Some Discussions

- Relative expenditures on imported and domestic intermediate inputs

\[ \frac{E_m}{E_Z} = \frac{(p_m)\frac{\rho}{\rho-1}(b)\frac{1}{\theta-1} - \frac{1}{\rho-1}}{(P_Z)\frac{\rho}{\rho-1}} \Omega \frac{\theta-1}{\theta} \frac{\rho}{\rho-1} \]

- Responses

\[ \frac{\partial(E_m/E_Z)}{\partial \Omega} > 0, \quad \frac{\partial(E_m/E_Z)}{\partial p_m} < 0, \quad \frac{\partial(E_m/E_Z)}{\partial P_Z} > 0 \]
Calibration

- Each firm is a tuple of shocks \((A_i, s_i)\)

- Targeting moments from the data calibrate the vector of parameters \(\Theta\).

\[\Theta = \{\theta, \rho, b, \mu, \lambda, f_e, f_u, f_l, \tau, w, p_m, \sigma_s, \text{corr}, W, P_Z, \epsilon\}\]
## Simulation Parameters

<table>
<thead>
<tr>
<th></th>
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<tbody>
<tr>
<td>(\theta)</td>
<td>0.67</td>
<td>elasticity of substitution within intermediate input groups</td>
</tr>
<tr>
<td>(\rho)</td>
<td>0.52</td>
<td>elasticity of substitution between intermediate input groups</td>
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<tr>
<td>(b)</td>
<td>2</td>
<td>quality attached to imported intermediate varieties</td>
</tr>
<tr>
<td>(\mu)</td>
<td>2/3</td>
<td>cost share of intermediate inputs</td>
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<td>(\lambda)</td>
<td>2.33</td>
<td>curvature of the convex adjustment cost</td>
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<td>(f_e)</td>
<td>0.3</td>
<td>entry cost for the export market</td>
</tr>
<tr>
<td>(f_v)</td>
<td>0.0003</td>
<td>scale parameter for the adjustment cost</td>
</tr>
<tr>
<td>(f_I)</td>
<td>0.0001</td>
<td>entry cost for the import market</td>
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<tr>
<td>(\tau)</td>
<td>1.2</td>
<td>iceberg cost</td>
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<td>(w)</td>
<td>60</td>
<td>wage</td>
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<tr>
<td>(p_m)</td>
<td>20</td>
<td>unit price of imported intermediate varieties</td>
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<td>(\sigma)</td>
<td>0.5</td>
<td>std. dev. for the demand shocks</td>
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<tr>
<td>(corr)</td>
<td>0.8</td>
<td>correlation between the demand and productivity shocks</td>
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<tr>
<td>(W)</td>
<td>1000</td>
<td>demand shifter</td>
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<td>(P_Z)</td>
<td>2</td>
<td>price of the domestically produced intermediate inputs</td>
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<tr>
<td>(\epsilon)</td>
<td>0.75</td>
<td>elasticity of substitution between intermediate input groups</td>
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Export Decisions

Exports Decisions over the State Space

A  s

Export Decision

0  0.2  0.4  0.6  0.8  1

5  10  15  20  25  30  35  40  50  60  70  80
Import Decisions over the State Space
Figure: Intermediate Import Ratios, Exporters
Model Fit

Figure: Intermediate Import Ratios, Non-Exporters
Figure: Average Number of Imported Varieties by Firm Size, Exporters
Figure: Average Number of Imported Varieties by Firm Size, Non-Exporters
**Model Fit**

Figure: Number of Imported Varieties by the Fraction of Firms - Data
**Figure**: Number of Imported Varieties by the Fraction of Firms - Model
Revenue Decomposition

Revenue and Its Decomposition across Markets (Ranked by Revenue Size)
The Impact of Imported Intermediate Varieties on Revenue
How Sizeable are the Trade Costs?

Table: Sunk and Fixed Costs of Trade

<table>
<thead>
<tr>
<th>tau</th>
<th>f_e</th>
<th>f_I</th>
<th>f_v</th>
<th>lambda</th>
<th>F_e/R</th>
<th>F_v/R</th>
<th>T/R</th>
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<td>1.2</td>
<td>0.3</td>
<td>0.0001</td>
<td>0.0003</td>
<td>2.33</td>
<td>0.000175</td>
<td>0.1928</td>
<td>0.1452</td>
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<td>1.08</td>
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<td>2.33</td>
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<td>1.2</td>
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<td>2.33</td>
<td>0.000175</td>
<td>0.1928</td>
<td>0.1452</td>
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<tr>
<td>1.2</td>
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<td>2.33</td>
<td>0.000163</td>
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<td>0.1452</td>
</tr>
<tr>
<td>1.2</td>
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<td>0.0003</td>
<td>2.1</td>
<td>0.007825</td>
<td>0.05392</td>
<td>0.14</td>
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Notes: This table shows the magnitudes of trade-related costs where $F_e = \sum_i I(E_i = 1)w_f e$, $F_I = \sum_i I(l_i = 1)w_f i$, $F_v = \sum_i I(l_i = 1)w_f v|\Omega_i|^\lambda$, $T = \sum_i (\tau - 1)p_i g_i^*, R = \sum_i p_i Y_i$.
Next Step and Further Research

- Counterfactual experiments regarding cost items $f_e, f_I, f_v, \tau$ and input prices

- Behavioral transitions of firms in response to some cost alleviations

- Level effects of alleviating some fixed or sunk cost elements
Next Step and Further Research

- Counterfactual experiments regarding cost items $f_e, f_I, f_U, \tau$ and input prices

- Behavioral transitions of firms in response to some cost alleviations

- Level effects of alleviating some fixed or sunk cost elements

Further Research

- Getting closer to a general equilibrium analysis

- Studying the nature of the adjustment costs
How the import and export decision interact with each other?
Conclusion

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- The impact of imported intermediates on economic activity
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- Policy suggestions
Thank You.