Motivation - Quality Matters

❖ Quality an important determinant of trade flows (Linder 1961)
  ❖ Schott (2004) and Hummels & Klenow (2005) link exporter GDP per capita and product quality
  ❖ Hallack (2006) links product quality to importer GDP per capita
  ❖ Manova & Zhang (2012) show successful exporting firms in China use higher-quality intermediate inputs to produce higher-quality goods and firms vary quality of produces across destination markets

❖ Vertical product differentiation matters and should be modeled
Motivation - Food Markets

- Food markets no longer characterized by homogenous products (Sexton 2013)
  - Food quality matters, and firms in food industry use vertical product differentiation strategies
  - Sunk costs related to production capacity and product quality matter
- Curzi, Raimondi & Olper (2014) investigate impact of trade liberalization on food product-quality
  - Trade liberalization in exporting countries leads to faster upgrading of product quality for products closer to technology frontier
  - On average, EU voluntary food-quality standards have positive effect on rate of quality upgrading
Goals of Analysis

❖ Use modified heterogenous-firms framework allowing for intermediate input markets (Kugler & Verhoogen, 2012)

❖ Extend to focus on food quality and quality of agricultural inputs (Sexton, 2013), the impact of trade liberalization on food product-quality (Curzi et al, 2014)

❖ Examine closely relationship between food product-quality, trade liberalization, and ability of firms to upgrade quality of final goods
Model - Consumers

❖ Consumers:

❖ Utility

\[ U = \left[ \int_{\omega \in \Omega} \left( q(\omega)x(\omega) \right)^{\frac{\sigma-1}{\sigma}} d\omega \right]^{\frac{\sigma}{\sigma-1}} \]  

❖ Demand

\[ x(\omega) = Xq(\omega)^{\sigma-1} \left( \frac{p_o(\omega)}{P} \right)^{-\sigma} \]
Model - Firms

- Firms
  - Intermediate agricultural good $I$ produced via production function:
    \[
    F_I(A, c) = \frac{\bar{A}}{c}
    \]
  - Since intermediate input market is perfectly competitive, then $p_I(c) = c$
Food processors (final good producers) require fixed investment cost $f_e$ to obtain capability $\lambda$, where $\lambda$ is drawn from Pareto distribution with $G(\lambda) = 1 - \left( \frac{\lambda_m}{\lambda} \right)^k$, $0 < \lambda_m \leq \lambda$

Firms must pay fixed costs to enter market, $f$, and also incur fixed cost of exporting $f_x$ in all periods
Model - Firms

- Firms use inputs of capability, intermediate agricultural input and composite input $\phi$ of specific quality
  - $\phi$: additional *tangible* input that affects firm quality choice, i.e., capital equipment required to ensure quality control
- Production function for final good is:

$$ F(n) = \frac{n\lambda^a}{\phi} $$

(4) \hspace{2cm} MC = \frac{\phi p_I(c)}{\lambda^a} \hspace{2cm} MC_x = \frac{\tau \phi p_I(c)}{\lambda^a} $$
Model - Firms

- Food processors constrained by quality choice
- Inputs as complements in determining quality of good (Kremer, 1993; Kugler & Verhoogen, 2012)

\[
q = \left[ \frac{1}{3} (\lambda^b) + \frac{1}{3} (\phi^3) + \frac{1}{3} (c^3) \right]
\]
Model - Firms

- The importance of $b$
  - $b$ is the scope of product-quality differentiation, approximating fixed costs of investment required to translate capability into product quality
  - Additional channel impacting firms’ quality choices, where lower $b$ restricts available quality choices, while higher $b$ has higher available quality choices
Equilibrium

- Profit maximization yields following:

\[
\begin{align*}
(7a) & \quad c^*(\lambda) = p_l^*(\lambda) = \lambda^3 \\
(7b) & \quad \phi^*(\lambda) = \lambda^3 \\
(7c) & \quad q^*(\lambda) = \lambda^b \\
(7d) & \quad p_o^*(\lambda) = \left(\frac{\sigma}{\sigma - 1}\right) \lambda^{2b - a} \\
& \quad p_{o,x}^*(\lambda) = \left(\frac{\sigma}{\sigma - 1}\right) \tau \lambda^{2b - a} \\
(7e) & \quad r^*(\lambda) = \left(1 + Z \tau^{1-\sigma}\right) \left(\frac{\sigma - 1}{\sigma}\right)^{\sigma - 1} \lambda^\eta XP^\sigma, \quad \eta \equiv (\sigma - 1) \left[\frac{b}{3} + a\right]
\end{align*}
\]
Comparative Statics

❖ Comparative statics regarding effects of parameters on firm size and final good quality choice

\[ \frac{\partial \ln r^*}{\partial \tau} = \frac{(1 - \sigma) Z \tau^{-\sigma}}{(1 + Z \tau^{1-\sigma})^2} < 0, \quad \text{and} \quad \frac{\partial \ln q^*}{\partial \tau} = \frac{b(1 - \sigma) Z \tau^{-\sigma}}{\eta(1 + Z \tau^{1-\sigma})^2} < 0 \]

\[ \frac{\partial \ln r^*}{\partial b} = \frac{(\sigma - 1)}{3} \ln \lambda > 0, \quad \text{and} \quad \frac{\partial \ln q^*}{\partial b} = \ln \lambda > 0 \]

\[ c^*(\lambda) = \phi^*(\lambda) = \lambda^3 \]
Comparative Statics

- Comparative statics imply:
  - Firms’ size (i.e., revenue) and the quality choice of final good increase with falling trade costs
  - A firm that is better able to translate capability into quality produces higher-quality goods and is larger
  - Trade costs negatively impact quality choice
Comparative Statics

Figure 1: Impact of tariffs and ability to upgrade quality on quality choice
Comparative Statics

- Comparative statics examining impact of trade liberalization and ability to translate capability on export entry cutoff point

\[
\frac{\partial \ln \lambda^*}{\partial \ln \tau} = \frac{k(1-\sigma)}{\eta} \frac{\lambda_m}{\delta f_e(k-\eta)} \left( \frac{f}{f_x} \right)^{k-\eta} \frac{k}{\eta} \frac{1}{\tau} < 0
\]

\[
\frac{\partial \ln \lambda_x^*}{\partial \ln \tau} = \frac{\sigma - 1}{\eta} \lambda^* \left( \frac{f_x}{f} \right)^{\frac{1}{\eta}} \frac{1}{\tau} \frac{\sigma - \eta - 1}{\eta} > 0
\]

- (11) states falling trade costs induce most productive non-exporting firms to enter export market, and least productive firms forced out of market, as exporting firms now capture larger market share

- Classic heterogenous-firms result (see Melitz, 2003)
Comparative Statics

- Comparative statics examining impact of trade liberalization and ability to translate capability on market entry cutoff point

\[
\frac{\partial \lambda^*}{\partial b} = 3k\tau^{3+a} \left( \frac{\lambda_m f}{\delta f_e} \right)^{-k} \left[ \left( \ln \left( \frac{f}{f_X} \right) - (\sigma - 1)\ln \tau \right) \left( \frac{f}{f_X} \right)^{\frac{1}{\eta}} \right] \rho \Lambda^2
\]

(12a)

\[
\frac{\partial \lambda^*}{\partial b} = -\lambda^* \left[ \frac{\sigma - 1}{3\eta^2} \left( \frac{f}{f_X} \right)^{\frac{1}{\eta}} \tau^{\frac{\sigma - 1}{\eta}} \left( \ln \left( \frac{f}{f_X} \right) + (\sigma - 1)\ln \tau \right) \right]
\]

(12b)

\[\rho = \left( \frac{f}{f_X} \right)(3a + b), \quad \Lambda = 3(\eta - k)\]

- These results are ambiguous in sign, due to other parameters
Comparative Statics

- (12a) is dependent on this condition:

\[
\frac{\partial \lambda^*}{\partial b} < 0 \text{ when } k < \eta + \gamma, \text{ and vice versa}
\]

\[
\gamma = -\frac{\eta}{\sigma - 1} \left( 1 + \left( \frac{f}{f_X} \right)^{\frac{\eta-k}{\eta}} \frac{1}{\tau^{3a+b}} \right) \sqrt{\ln \left( \frac{f}{f_X} \right) - (\sigma - 1) \ln \tau} > 0
\]

- The impact of \( b \) depends on shape of the distribution of firms, \( k \), i.e., market structure
Comparative Statics

Figure 2: Cumulative distribution of the Pareto distribution, based on $k$. 

Note:
$k_1 < k_2 < k_3 < \infty$
Comparative Statics

- (12b) is dependent on this condition:

\[
\frac{\partial \lambda^*_x}{\partial b} < 0 \text{ when } \ln \left( \frac{f}{f_x} \right) + (\sigma - 1) \ln \tau > 0, \text{ and vice versa}
\]

- The impact of \( b \) depends on extent that \( f_x > f \). If \( f \to f_x \), then export rents outweigh fixed costs of exporting given an increased \( b \). If \( f_x >> f \), then fixed costs of exporting outweigh export rents, leading to export exit.
Data

❖ Source: Chile’s Encuesta Nacional Industrial Anual (ENIA), an unbalanced panel data set. Industry-level tariff rates from TRAINS database (WITS).


❖ Sample size: 11,196 observations, approximately 1,600 food-processing firms per year in the sample.
# Data

## Table 1 – Summary Statistics

<table>
<thead>
<tr>
<th>Variable</th>
<th>N</th>
<th>Mean</th>
<th>St. Dev</th>
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<td>ln(LaborCost)</td>
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</table>

Note: Size is constructed as the ln(Gross Value of Production)
Figure 3: In-Sample Cumulative Distribution of $\lambda$ (Productivity)
Empirical Specifications

❖ Export Entry:

$$\Pr(\text{Export}_{i,j} = 1|\text{Export}_{i,j-1} = 0) = \alpha + \beta_1 \cdot c + \beta_2 \cdot \phi + \gamma \cdot b + \delta \cdot \Delta \tau + \mu \cdot \lambda + \kappa \cdot X + \epsilon$$

❖ Market Exit:

❖ Specification forthcoming: depends on how ENIA tracks firm exit

❖ Quality Choice:

$$q = \alpha + \beta_1 \cdot c + \beta_2 \cdot \phi + \gamma \cdot b + \delta \cdot \Delta \tau + \mu \cdot \lambda + \kappa \cdot X + \epsilon$$

❖ Changes in Size:

$$\Delta \text{Size} = \alpha + \beta_1 \cdot c + \beta_2 \cdot \phi + \gamma \cdot b + \delta \cdot \Delta \tau + \mu \cdot \lambda + \kappa \cdot X + \epsilon$$
### Table 3 - Summarized Results

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<td>K/L Ratio</td>
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<th>$F = 168.33$</th>
<th>$F = 16.97$</th>
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<td>$R^2$</td>
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Conclusion

❖ Theoretical model adapts heterogenous-firms framework to food industry context

❖ Firms that remain in the market select higher quality and are larger given falling trade costs and increased ability to upgrade quality, and use concurrently higher-quality inputs

❖ Trade liberalization forces the least productive firms out of the market while most productive non-exporters enter the export market

❖ Impact of ability to upgrade quality dependent on the market structure: distribution of firms in the market and structure of fixed costs matter

❖ Empirical analysis currently provides mixed evidence: results cast doubt on quality constraint, but generally support the impact of $b$ on firm characteristics and market structure