Firm Heterogeneity, Non-Tariff Measures, and International Trade Agreements: The Case of US-EU TTIP Agreement on Beef Trade

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The Case of US-EU TTIP Agreement on Beef Trade

Ph.D. Dissertation Summary
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Emerging international trade agreements

- Hormone ban on beef in the EU
  - U.S. beef exporters sell hormone-free beef into the EU market

- Non-Hormone Treated Cattle (NHTC) Program
  - Pay for on-site visits by the Agricultural Marketing Service (AMS)
  - Segregate the production process
  - Adapt packaging

- Reducing NTMs on beef exports from the U.S. to the EU
Catching up with the trade theory

• Armington-based CGE models do not
  • explain trade growth along the extensive margin
  • account for heterogeneity across firms
  • account for fixed costs of entering a market

• The firm heterogeneity model of Melitz (2003)
  • is able to explain micro-level findings on firm heterogeneity
  • provides additional insights on trade mechanisms

• A need for readily accessible policy-oriented CGE model featuring firm heterogeneity
Recent research

- Stylized models that experiment with aggregate industries
  - Zhai (2008)
  - Balistreri and Rutherford (2013)
  - Dixon, Jerie and Rimmer (2015)
  - Oyamada (2014)

- We need parameterization at a more disaggregated and policy-relevant scale
Roadmap

• Model overview
• Empirical challenges
• Policy analysis
• Conclusions and future prospects
Introducing firm heterogeneity into GTAP

• We build on the monopolistically competitive GTAP model developed by Swaminathan and Hertel (1996)

• We endogenize factor neutral productivity shifters of the production function (ao in GTAP)
  • Productivity is linked to endogenous productivity thresholds
  • Productivity is partitioned into domestic and export markets

• Our model allows for
  • comprehensive treatment of intermediate input trade
  • flexible treatment of the factor composition of fixed costs
  • exploring the implications of entry and exit of firms in the domestic and export markets,
  • welfare decomposition that explicitly shows the productivity, variety, and scale effects.
The Melitz Model

Potential Entrants

Pay set-up costs

Enter

Random productivity draw

Low relative to the threshold

Firm dies

High relative to the threshold

Firm survives

Afford fixed export costs to region s?

No

Domestic only

Yes

Export to region s
Firm profit – productivity threshold

- Profit of a firm in industry $i$ from sales to region $s$

$$\Pi_{irs} = \left[ \frac{P_{irs}}{T_{irs}} - \frac{C_{ir}}{\Phi_{irs}} \right] Q_{irs} - W_{ir} F_{irs}$$

**Variable profit**

**Fixed trade costs**

Small $\Phi$: low productivity, high costs
Large $\Phi$: high productivity, low costs

- Profit of the marginal firm determines the productivity threshold for entering market $s$

$$\Pi_{irs} \left( \Phi_{irs}^* \right) = 0$$

- where $\Phi_{irs}^*$ is the productivity threshold for a firm that exports product $i$ from region $r$ to $s$. 

$i$: Industry
$r$: Source
$s$: Destination
Industry profit – firm entry/exit

• Industry profit in sector $i$ of region $r$

\[
\Pi_{ir} = \sum_{s} N_{irs} \Pi_{irs} - N_{ir}^p W_{ir} H_{ir}
\]

Total Profit

from Sales

Fixed Set-up

Costs

• Zero profits condition determines the endogenous number of firms in the industry due to entry/exit of firms

\[
N_{irs} = N_{ir}^p \left[1 - G(\Phi_{irs}^*)\right] = N_{ir}^p \left(\Phi_{irs}^*\right)^{-\gamma_i}, \quad \gamma_i > 0
\]

• where $1 - G(\Phi_{irs}^*)$ is the probability of being active in the $r$-$s$ bilateral trade.

$i$: Industry

$r$: Source

$s$: Destination
Endogenous productivity change

Effects of reducing NTMs on the exporter

Probability Density of Firm Productivity

Domestic Market

Export Market

Firm Exit

Firm Entry

Domestic Threshold (DT)

Export Threshold (XT)

Source: Adapted from Greenaway and Kneller (2007)
Parameterization of the model

- Two key parameters in firm heterogeneity
  - shape parameter of Pareto distribution, $\gamma$
  - elasticity of substitution across varieties, $\sigma$
  - with a mathematical constraint, $\gamma > \sigma - 1$

- Can we still use Armington elasticities?

- Elasticity estimates in traditional gravity equations when firm heterogeneity is present confound demand-side and supply-side effects
An alternative approach

• Current approaches in the literature
  • Use existing elasticity estimates to infer shape parameters from firms’ sales distributions
  • Present parameter estimates for industries at the aggregated level

• Studies with disaggregated level of industries
  • Spearot (2015): Country level data, GTAP industry definition, only estimates shape parameters

• Alternative approach
  • Country-level data
  • Use the shape parameter information to infer the elasticity of substitution
Two stage estimation

- Export participation equation

\[
Pr(T_{rst} = 1) = \alpha_0 - \delta \gamma \ln D_{rs} + E_r + E_s + E_t + \alpha_4 \theta_{rs} + \alpha_5 \psi_{rst} + \eta_{rst}
\]

- Export flows equation

\[
\ln M_{rst} = \beta_0 - \delta (\sigma - 1) \ln D_{rs} + E_r + E_s + E_t + \beta_4 \psi_{rst} + \epsilon_{rst}
\]

- Solving for the elasticity of substitution

\[
\frac{-\delta \gamma}{-\delta (\sigma - 1)} = \frac{\gamma}{(\sigma - 1)}
\]

Data from Spearot (2015)

- Variables:
  - \(r\): Source
  - \(s\): Destination
  - \(t\): Year
### Elasticity of substitution for beef

<table>
<thead>
<tr>
<th></th>
<th>Beef Industry</th>
</tr>
</thead>
<tbody>
<tr>
<td>Export Participation (1\textsuperscript{st} Stage)</td>
<td>$-\delta \gamma$</td>
</tr>
<tr>
<td>Export Flows (2\textsuperscript{nd} Stage)</td>
<td>$-\delta(\sigma-1)$</td>
</tr>
<tr>
<td>Shape Parameter</td>
<td>$\gamma$</td>
</tr>
<tr>
<td>Elasticity of Substitution (Melitz)</td>
<td>$\sigma$</td>
</tr>
<tr>
<td>GTAP Armington Elasticity</td>
<td>$\sigma$</td>
</tr>
</tbody>
</table>

- Elasticity of substitution for beef in firm heterogeneity is considerably lower than the GTAP Armington elasticity for beef.
Model calibration in firm heterogeneity is feasible only for a certain set of parameter estimates.

Mathematical conditions restrict the parameter space from above.

Feasible parameter space for beef

- Model calibration in firm heterogeneity is feasible only for a certain set of parameter estimates.
- Mathematical conditions restrict the parameter space from above.

Feasible Parameter Space

(3.78, 4.21)
Policy scenarios

• GTAP Version 9
• 5 regions and 13 sectors (heterogeneous beef and manufacturing)
• How to model NTMs?
  • Transferring rents (tariff equivalent)
  • Saving resources (efficiency of inputs)
• Reducing \textbf{fixed costs of exporting} beef from the US to the EU
• Abstracting from tariff-rate quotas (TRQ)
Firm entry and productivity in the US beef industry

- Productivity threshold for the US-EU beef trade decreases
- Average industry productivity for beef increases in the US
Welfare implications of fixed cost reduction

- Global welfare gain
- The EU benefits more than the US
Welfare decomposition in the US and the EU

- Significant productivity and scale effects in the US and EU
- Modest terms of trade effects
Ignoring heterogeneity in manufactures

- Same shock
- The US gains relatively more when only beef is heterogeneous
- The EU gains relatively less when only beef is heterogeneous
- Stronger terms of trade effects
Implications and future prospects

• Model structure has important policy implications

• Firm heterogeneity module of GTAP allows for
  • Endogenous industry productivity
  • Reallocation of firm shares in domestic and export markets
  • Additional sources of welfare due to productivity, variety and scale effects

• Empirical work should focus on estimating the elasticity and shape parameter pair

• Next steps
  • Identification of parameters
  • Incorporation of TRQs
References


External Images

(1) http://rr1farms.com/images/NHTC%20seal.jpg

(2) http://chestsculpting.com/images/Organic%20Meat.jpg