A Comparison of Armington Elasticity Estimates in the Trade Literature

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Overview

1. Introduction

2. Review of Methodologies

3. Comparison of Study Estimates
   - Study-Level Analysis
   - Sector-Level Analysis

4. Conclusion
Introduction

- The Armington elasticity plays an essential role in trade policy analysis
  - Knowledge of elasticity, along with trade shares, sufficient to quantify response in trade flows (Arkolakis et al, 2012)
  - Value of Armington elasticity has significant effect on welfare gains or losses in simulations (McDaniel and Balistreri, 2003)
- There are many empirical studies that estimate this parameter:
- This presentation explores patterns within and across studies by analyzing estimates at the study and sector level. Estimates across studies are compared using a common concordance.
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Demand and supply for a differentiated good can be represented with the following log-linear system of equations ($\theta < 0$, $\omega > 0$):

\[ \ln(q_t) = \alpha + \theta \ln(p_t) + \epsilon_t \]  
\[ \ln(q_t) = \gamma + \omega \ln(p_t) + \mu_t \]  

If the demand error ($\epsilon_t$) is uncorrelated with the supply error ($\mu_t$), then the demand ($\theta$) and supply ($\omega$) elasticity parameters are related by the following hyperbolic function:

\[ (\theta - b)(\omega - b) = \left( \frac{b}{b_r} - 1 \right)(b_r \ast b) \]
Broda and Weinstein (2006) reduce computation time by only searching for parameter values within a plausible parameter space. They estimate elasticities at different levels of aggregation and find that more disaggregated sectors appear to produce higher elasticity values.


Feenstra et al. (2018) apply this methodology to the import-domestic elasticities using a unique set of U.S. production data. They find that for between two-thirds and three-quarters of goods sampled, there is no significant difference between import-domestic and import-import elasticities.

Soderbery (2018) uses variation in prices and quantities across multiple markets to identify heterogeneous supply elasticities.
This method uses price variation from differing trade costs to identify the Armington elasticity. Elasticities are obtained by estimating a simple gravity equation of trade, with bilateral trade flows $X_{ij}$, fixed effects $\alpha_i$, and trade costs $\tau_{ij}$:

$$\ln(X_{ij}) = \alpha_i + \alpha_j + (1 - \sigma) \ln(\tau_{ij}) + \epsilon_{ij}$$

Hertel et al. (2007) and Caliendo and Parro (2015) are two studies that employ this method.
This method leverages the structural relationship between the price-cost markup and the elasticity of substitution in industries with monopolistic competition (as in Krugman (1980) and Melitz (2003)).

Under a monopolistic competition market structure, a firm’s markup equals the reciprocal of the substitution elasticity:

\[
\frac{1}{\sigma} = \frac{p - c}{p}
\]

Ahmad and Riker (2019) use publicly available data from the 2012 Economic Census to compute industry markups with the following equation:

\[
\frac{1}{\sigma} = \frac{TR - TVC}{TR}
\]
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## Summary of Armington Elasticity Estimates Across Studies

<table>
<thead>
<tr>
<th>Study</th>
<th>Method</th>
<th>Armington Interval</th>
<th>Level of Aggregation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reinert and Roland-Holst (1992)</td>
<td>Import price</td>
<td>$\sigma$ from [0.1, 3.0], Median=0.97</td>
<td>163 sectors, BEA classification</td>
</tr>
<tr>
<td>Gallaway et al. (2003)</td>
<td>Import price</td>
<td>$\sigma$ from [1.0, 5.0], Median=0.9</td>
<td>4-digit US SIC level</td>
</tr>
<tr>
<td>Broda and Weinstein (2006)</td>
<td>System of equations</td>
<td>$\sigma$ from [1.2, 17.1], Median=3.1</td>
<td>10-digit HTS, and 3-5 digit SITC</td>
</tr>
<tr>
<td>Hertel et al. (2007)</td>
<td>Trade costs</td>
<td>$\sigma$ from [1.8,34.4], Median=6.5,</td>
<td>5-digit SITC agg to 40 GTAP sec</td>
</tr>
<tr>
<td>Caliendo and Parro (2015)</td>
<td>Trade costs</td>
<td>$\sigma$ from [0.4,51.0], Median=3.9</td>
<td>2-digit ISIC Rev. 3</td>
</tr>
<tr>
<td>Ossa (2015)</td>
<td>System of equations</td>
<td>$\sigma$ from [1.5,25.1], Median=2.93</td>
<td>SITC Rev 3</td>
</tr>
<tr>
<td>Soderbery (2015)</td>
<td>System of equations</td>
<td>$\sigma$ from [1.0,131], Median=1.9</td>
<td>8 and 10-digit HTS</td>
</tr>
<tr>
<td>Soderbery (2018)</td>
<td>System of equations</td>
<td>$\sigma$ from [1.3,3312.3], Median=2.9</td>
<td>4-digit HS</td>
</tr>
<tr>
<td>Ahmad and Riker (2019)</td>
<td>Markup</td>
<td>$\sigma$ from [1.3,11.6], Median=2.5</td>
<td>4 and 6-digit NAICS</td>
</tr>
</tbody>
</table>

- Estimation method, level of aggregation, and data source all contribute to heterogeneity across studies.
- Time-series approaches (import price) tend to have smaller estimates than cross-sectional approaches.
- Trade cost method tends to have higher estimates on average (Head and Mayer, 2014).
Elasticity Estimates by 3-digit NAICS Sectors

<table>
<thead>
<tr>
<th>Sector</th>
<th>Method/Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Food</td>
<td>Schreiber (2020)</td>
</tr>
<tr>
<td>Primary Metal</td>
<td>Schreiber (2020)</td>
</tr>
<tr>
<td>Petroleum and Coal Products</td>
<td>Schreiber (2020)</td>
</tr>
<tr>
<td>Apparel</td>
<td>Schreiber (2020)</td>
</tr>
<tr>
<td>Textile Mills</td>
<td>Schreiber (2020)</td>
</tr>
<tr>
<td>Beverage and Tobacco Product</td>
<td>Schreiber (2020)</td>
</tr>
<tr>
<td>Plastics and Rubber Products</td>
<td>Schreiber (2020)</td>
</tr>
<tr>
<td>Transportation Equipment</td>
<td>Schreiber (2020)</td>
</tr>
<tr>
<td>Leather and Allied Product</td>
<td>Schreiber (2020)</td>
</tr>
<tr>
<td>Textile Product Mills</td>
<td>Schreiber (2020)</td>
</tr>
<tr>
<td>Machinery</td>
<td>Schreiber (2020)</td>
</tr>
<tr>
<td>Chemical</td>
<td>Schreiber (2020)</td>
</tr>
<tr>
<td>Furniture and Related Product</td>
<td>Schreiber (2020)</td>
</tr>
<tr>
<td>Wood Product</td>
<td>Schreiber (2020)</td>
</tr>
<tr>
<td>Paper</td>
<td>Schreiber (2020)</td>
</tr>
<tr>
<td>Nonmetallic Mineral Product</td>
<td>Schreiber (2020)</td>
</tr>
<tr>
<td>Electrical Equipment, Appliance and Component</td>
<td>Schreiber (2020)</td>
</tr>
<tr>
<td>Fabricated Metal Product</td>
<td>Schreiber (2020)</td>
</tr>
<tr>
<td>Computer and Electronic Product</td>
<td>Schreiber (2020)</td>
</tr>
<tr>
<td>Printing and Related Support Activities</td>
<td>Schreiber (2020)</td>
</tr>
</tbody>
</table>
Sector-Level Analysis, Continued

Nonmetallic Mineral Product
Electrical Equipment, Appliance and Component
Fabricated Metal Product
Computer and Electronic Product
Printing and Related Support Activities
Machinery
Chemical
Furniture and Related Product
Wood Product
Animal Production and Aquaculture
Crop Production
Paper
Forestry and Logging
Beverage and Tobacco Product
Plastics and Rubber Products
Transportation Equipment
Leather and Allied Product
Textile Mills
Food
Primary Metal
Fishing, Hunting and Trapping
Petroleum and Coal Products
Apparel
Textile Mills
Oil and Gas Extraction

HTS10 from Soder (15)  NAICS 6 from A/R (19)  HTS4 from Soder (18)  HTS10 from B/W (06)  GTAP from HHIK (07)
Broda and Weinstein (2006) and Soderbery (2015) have the same level of sectoral aggregation (HTS10) and similar estimation strategy. Plotting estimates for both studies shows weak relationship.
Introduction

Review of Methodologies

Comparison of Study Estimates
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- Sector-Level Analysis

Conclusion
Conclusion

- The Armington elasticity plays an essential role in trade policy analysis, yet there are still many open questions in the literature on what parameter values to use in policy analysis.
- Visual inspection shows heterogeneity across studies:
  - Trade cost method estimates are highest across all sectors analyzed.
  - Commodities tend to have highest elasticities, differentiated products have lowest average elasticities, consistent with basic economic theory.
  - Weak correlation between Broda and Weinstein (2006) and Soderbery (2015) studies at same level of aggregation and similar methodology.
Thank you!