Asymmetric Trade Costs: Agricultural Trade among Developing and Developed Countries

2017.12.4

Jihyun Eum*, Ian Sheldon**, Stanley Thompson**
*BOK Economic Research Institute
**Ohio State University
Introduction

- Low **agricultural** trade value (less than US$ 2 tril.) compared to **manufacturing** goods (US$ 13 tril.) in 2013

**Research Question**
- Search reasons why developing countries trade fewer agricultural products
- Analyze two main causes: (1) productivity differences (2) high trade costs

**Contribution**
- Examine cross-country differences in productivity and trade costs using a neo-Ricardian trade model
- Estimate elasticity of trade for agricultural sector
- Asymmetric trade costs are found between North and South
Summary

Related studies

- Productivity differences: Gollin et al. (2013), Lagakos and Waugh (2013)
- Tombe (2015) and Xu (2015)

Findings

- Low value of trade elasticity in ag sector, implying high power of degree of comparative advantage
- Asymmetric trade cost is main cause of low bilateral trade share between North and South
Productivity is a random draw from country-specific probability distribution

- Country $i$ has average productivity $T_i$ (location of the distribution) & dispersion of productivity $\theta$
- $\theta$ indicates degree of comparative advantage’s power on trade patterns

$$F_i(z) = \exp \left\{ -T_i z_i^{-\theta} \right\}$$

Trade share

- Exporter $i$ and importer $n$
- Trade share is the probability that $i$ offers the lowest price to $n$

$$\Pr[P_{ni}(j) \leq P_{ni} \forall l \neq i] = \frac{T_i (Y_i \tau_{ni})^{-\theta}}{\sum_{i=1}^{N} T_i (Y_i \tau_{ni})^{-\theta}} = \frac{X_{ni}}{X_n}$$
Model

- **Equilibrium**
  - **Price index**
    \[
    P_n = \left[ \Gamma \left( \frac{\theta + 1 - \gamma}{\theta} \right) \right]^{1/(1-\sigma)} \left[ \sum_{i=1}^{N} T_i (\gamma_i \tau_{ni})^{-\theta} \right]^{-1/\theta} \quad \text{where} \quad \theta > \sigma - 1
    \]
  - **Trade share across countries**
    \[
    \ln \left( \frac{X_{ni}/X_n}{X_{nn}/X_n} \right) = \frac{T_i}{T_n} \left( \frac{r_i}{r_n} \right)^{-\theta} \tau_{ni}^{-\theta}
    \]

- **Constraints: Trade balance and aggregated production requirements**
  \[
  \sum_{i \neq n} X_{in} = \sum_{i \neq n} X_{ni}
  \]
  \[
  Y_i = \sum_{n=1}^{N} X_{ni}
  \]
Empirical Analysis

- Estimation of trade elasticity

\[
\left( \frac{X_{ni}/X_n}{X_{ii}/X_i} \right) = \left( \frac{P_i \tau_{ni}}{P_n} \right)^{-\theta}
\]

where \( \ln \left( \frac{P_i \tau_{ni}}{P_n} \right) = \frac{\max 2 \{ \ln P_n(j) - \ln P_i(j) \}}{(1/J) \sum_{j=1}^{J} (\ln P_n(j) - \ln P_i(j))} \)

- Estimation of destination effects: define \( \theta \) as 2.5

\[
\left( \frac{X_{ni}/X_n}{X_{nn}/X_n} \right) = S_i - S_n - \theta(b_{ni} + l_{ni} + RTA_{ni} + \sum_r d_{rni} + e x_i + u_{ni})
\]

\[
= \tilde{S}_i - \hat{S}_n - \theta(b_{ni} + l_{ni} + RTA_{ni} + \sum_r d_{rni} + u_{ni})
\]

where \( \bar{S}_i = \hat{S}_i - \theta \hat{e} x_i \)

- Effects on trade costs: \( e^{\left( -\frac{1}{\theta} \right) \beta} - 1 \)
## Empirical Analysis

### Panel A

<table>
<thead>
<tr>
<th></th>
<th>Effect on trade cost ($\theta=2.5$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$Dist_1$</td>
<td>-13.75*** (0.437)</td>
</tr>
<tr>
<td>$Dist_2$</td>
<td>-15.38*** (0.299)</td>
</tr>
<tr>
<td>$Dist_2$</td>
<td>-18.21*** (0.208)</td>
</tr>
<tr>
<td>$Dist_2$</td>
<td>-20.18*** (0.161)</td>
</tr>
<tr>
<td>$Dist_2$</td>
<td>-21.83*** (0.106)</td>
</tr>
<tr>
<td>$Dist_2$</td>
<td>-22.41*** (0.153)</td>
</tr>
<tr>
<td>Border</td>
<td>1.74*** (0.456)</td>
</tr>
<tr>
<td>Language</td>
<td>0.823*** (0.215)</td>
</tr>
<tr>
<td>RTA</td>
<td>3.286*** (0.225)</td>
</tr>
</tbody>
</table>

### Panel B

<table>
<thead>
<tr>
<th>Destination</th>
<th>Source</th>
<th>Effect on cost</th>
<th>Destination</th>
<th>Source</th>
<th>Effect on Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Canada</td>
<td>3.377</td>
<td>12.69</td>
<td>-0.99</td>
<td>Argentina</td>
<td>-0.927</td>
</tr>
<tr>
<td>China</td>
<td>3.511</td>
<td>14.45</td>
<td>-1.00</td>
<td>Bangladesh</td>
<td>-7.689</td>
</tr>
<tr>
<td>Germany</td>
<td>1.009</td>
<td>8.62</td>
<td>-0.97</td>
<td>Brazil</td>
<td>-1.777</td>
</tr>
<tr>
<td>France</td>
<td>1.038</td>
<td>9.05</td>
<td>-0.97</td>
<td>Nigeria</td>
<td>-8.447</td>
</tr>
<tr>
<td>Rep. of Korea</td>
<td>0.921</td>
<td>1.93</td>
<td>-0.54</td>
<td>Thailand</td>
<td>1.390</td>
</tr>
<tr>
<td>USA</td>
<td>5.212</td>
<td>17.15</td>
<td>-1.00</td>
<td>Senegal</td>
<td>0.573</td>
</tr>
<tr>
<td>UK</td>
<td>1.930</td>
<td>7.08</td>
<td>-0.94</td>
<td>Zimbabwe</td>
<td>0.137</td>
</tr>
</tbody>
</table>

Obs #: 9,709 / (128 countries) / Adj R square: 0.523
Empirical Analysis

- Bilateral trade flow data for agricultural products among 128 countries for the year 2013
- Geographic barriers (distance, language, border, RTA) follow expectations
- Destination effects reflect a unit cost for a producer with the average technology level: North and South are similar in terms of unit production costs
- Effects on trade costs decrease in GDP per capita
- State of technology (average productivity) increase in GDP per capita
Empirical Analysis

- Effects on trade costs decrease in GDP per capita
Empirical Analysis

- State of technology (country’s average productivity) is defined as:
  \[ \ln T_i \equiv \hat{S}_i + \theta \ln r_i \]

- Country’s average productivity increase with GDP per capita
Empirical Analysis

- Asymmetric trade costs

\[ \tau_{ni} = \exp\left(-\frac{b_{ni}}{\theta}\right) \times \exp\left(-\frac{i_{ni}}{\theta}\right) \times \exp\left(-\frac{\hat{r}t_{ani}}{\theta}\right) \times \exp\left(-\frac{\hat{d}_{rni}}{\theta}\right) \times \exp\left(-\frac{\hat{e}x_{i}}{\theta}\right) \]

- Developing countries’ trade costs towards developed is greater than that of developed towards developing
  - \( \tau_{us-zbw} = 6 \) vs. \( \tau_{zbw-us} = 31672 \)
Conclusion

- Based on estimated trade elasticity, effects of relative average productivity differences and asymmetric bilateral trade costs on trade shares are estimated
  - Value of trade elasticity is lower than that of other sectors, implying comparative advantage plays a significant role

- Relative productivity differences and trade costs explain low trade flow in agricultural sector from developing countries
  - South trades fewer agricultural goods due to relatively higher bilateral trade costs
  - Relatively higher trade costs as well as differences in productivity are main cause of low trade flow