Distance-Based Measures of Globalization in a World with Fragmented Production

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Final WIOD Conference
Causes and Consequences of Globalization
Groningen, 24-26 April 2012
Objective and Motivation

- Empirical trade literature: although long-distance communication has improved and transport costs have fallen, negative effects of distance on trade have not diminished (Cairncross’s, 1997, *The Death of Distance* refuted).
- In contrast to one of major WIOD-results so far: Value Chains become more international (see Timmer et al., 2012)

- To provide indicators of the distances that products travel before they end up consumed or installed as a capital good (their “final destination”)
Estimating Gravity Equations (trends in results over time):

\[ \ln T_{ij} = \alpha_1 \ln GDP_i + \alpha_2 \ln GDP_j + \beta \ln D_{ij} + e_{ij} \]


Computing “Average Distance of Trade”:

(for country \( i \)): \[ adot_i = \frac{\sum_j D_{ij}(T_{ij}/\sum_j T_{ij})}{\sum_j T_{ij}} \]

Carrere & Schiff (2005, *RevueEcon*): in 1962-2000, \( adot \) fell for about 65% of the countries, and the average \( adot \) also decreased
Our Explanation for Puzzle

- Empirical literature does not take domestic trade into account
  - A firm’s decision to relocate an NLD-based factory producing candy for the Dutch market to ITA might actually cause a fall in the Dutch average distance of trade, if Dutch trade would mainly be with CHN or USA.

- Advantage of WIOD: world input-output tables do not only contain international transactions, but also domestic product flows between industries.

- Main result of our study based on “Expected Distance to Final Destination”: Distance has become less important. International trade does not cover more distance than before. The share of international trade in total transactions, however, did increase.
Method
## Expected Distance to Final Destination (I)

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>A-CON</th>
<th>B-CON</th>
<th>Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>(Z_{AA})</td>
<td>(Z_{AB})</td>
<td>(f_{AA})</td>
<td>(f_{AB})</td>
<td>(x_A)</td>
</tr>
<tr>
<td>B</td>
<td>(Z_{BA})</td>
<td>(Z_{BB})</td>
<td>(f_{BA})</td>
<td>(f_{BB})</td>
<td>(x_B)</td>
</tr>
<tr>
<td>Value added</td>
<td>(v_A)</td>
<td>(v_B)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Output</td>
<td>(x_A)</td>
<td>(x_B)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\[
\begin{align*}
\frac{b_{ij}^I}{x_i} &= \frac{Z_{ij}}{x_i} \\
\frac{b_{ij}^F}{x_i} &= \frac{f_{ij}}{x_i} \\
\sum_j b_{ij}^I + \sum_j b_{ij}^F &= 1
\end{align*}
\]

\[
D = \begin{bmatrix} 0 & d_{AB} \\ d_{BA} & 0 \end{bmatrix}
\]

If all \(f_{ij} \geq 0\), the coefficients in \(B^I\) and \(B^F\) can be interpreted as probabilities.
Focus on EDFD for products of country A

In first round of sales:

\[ d_A^1 = 0 \times (b_{AA}^I + b_{AA}^F) + d_{12} \times (b_{AB}^I + b_{AB}^F) \]

and fraction of original dollar still in productive system is

\[ b_{AA}^I + b_{AB}^I \]

In second round of sales:

\[ d_A^2 = b_{AA}^I \times [0 \cdot (b_{AA}^I + b_{AA}^F) + d_{12} (b_{AB}^I + b_{AB}^F)] + b_{AB}^I \times [d_{21} (b_{BA}^I + b_{BA}^F) + 0 \cdot (b_{BB}^I + b_{BB}^F)] \]

and fraction still in system is

\[ b_{AA} b_{AA} + b_{AB} b_{BA} + b_{AA} b_{AB} + b_{AB} b_{BB} \]

Distances over rounds \((d_A^1, d_A^2, d_A^3, \text{etc.})\) can be added to arrive at EDFD
Expected Distance to Final Destination (III)

- Interpretation of general expression obtained:

\[ d = (I - B^I)^{-1}[(D^I \circ B^I)u + (D^F \circ B^F)u] \]

“Ghosh inverse”: Expected number of times the output of the row industry will be sold by the column industry.

Average distance of trade, including zero distances for domestic sales.

\[ B = \begin{bmatrix} 0.2 & 0.3 \\ 0 & 0.5 \end{bmatrix} \quad (I - B)^{-1} = \begin{bmatrix} 1.25 & 0.75 \\ 0 & 2.00 \end{bmatrix} \]
Geographical Distances

• For each pair of countries: average distance between four largest cities (population-weighted);
• Distances “as the crow flies”;
• Distance to Rest of the World: distance to nearest capital of a non-WIOD country;
• Examples for Germany (in km):

<table>
<thead>
<tr>
<th></th>
<th>NED</th>
<th>FRA</th>
<th>USA</th>
<th>BRA</th>
<th>CHN</th>
<th>JPN</th>
<th>AUS</th>
<th>RoW</th>
</tr>
</thead>
<tbody>
<tr>
<td>DEU</td>
<td>497</td>
<td>910</td>
<td>7111</td>
<td>9392</td>
<td>8101</td>
<td>9099</td>
<td>15654</td>
<td>656</td>
</tr>
</tbody>
</table>

• Distances within countries: zero at first
Results
Expected Distance to Final Destination
(all products, all countries, in km)
Differences between Products

Annual growth rates – NatRes: 5.2%; Manuf: 3.9%; Servi: 3.4%;
<table>
<thead>
<tr>
<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Taiwan</td>
<td>2710</td>
<td>3334</td>
<td>98%</td>
</tr>
<tr>
<td>Luxembourg</td>
<td>1854</td>
<td>2605</td>
<td>95%</td>
</tr>
<tr>
<td>Indonesia</td>
<td>1671</td>
<td>2269</td>
<td>81%</td>
</tr>
<tr>
<td>Australia</td>
<td>1525</td>
<td>2105</td>
<td>80%</td>
</tr>
<tr>
<td>Korea</td>
<td>1491</td>
<td>1966</td>
<td>79%</td>
</tr>
<tr>
<td>Ireland</td>
<td>1462</td>
<td>1908</td>
<td>78%</td>
</tr>
<tr>
<td>China</td>
<td>1445</td>
<td>1567</td>
<td>74%</td>
</tr>
<tr>
<td>Canada</td>
<td>1430</td>
<td>1440</td>
<td>61%</td>
</tr>
<tr>
<td>Malta</td>
<td>1264</td>
<td>1394</td>
<td>58%</td>
</tr>
<tr>
<td>Belgium</td>
<td>1219</td>
<td>1381</td>
<td>55%</td>
</tr>
</tbody>
</table>

EDFD decreased for only 6 (out of 40) countries:
Small countries, with the exception of GBR (-2.2%)
More Exports, or Exports over a Longer Distance?

ENTE: “Expected number of times a product is exported before it is consumed or used as an investment good”. Obtained by specifying a distance matrix with zeros on the main diagonal and ones elsewhere.

The increase of EDFD has been due to fragmentation. The distance covered by the average export flow has decreased slightly.

ENTE-2008: 0.35
Sensitivity analysis: what happens to the trend in EDFD if distance of domestic trade is considered to be the population-weighted average distance between the four largest cities in a country (e.g. Berlin, Hamburg, München and Cologne yield a distance of domestic deliveries in Germany of 433 km)?

Distance might really die, although slowly

Another sign that international trade with nearby partners has increased relatively strongly
Conclusions

- The distance puzzle is a puzzle because of a selection bias: only truly international trade is considered, instead of all trade;
- Especially in recent years, trade with nearby partners has increased (regionalization). More detailed analyses for regions needed;
- Industries and countries vary strongly in terms of their integration into truly global value chains. Results presented in this study hide a lot of potentially interesting heterogeneity.