International Production Networks and the World Trade Structure

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Aims and motivations (1)

• Increasingly complex organization of global value chains (GVCs) or global production networks (GPNs)
• Important to better understand the geography of GPNs
  – to better understand the division of labor across countries and the position in the «smile curve» (Antràs and Chor, 2013; Baldwin, 2014; Wang et al., 2013)
  – To comprehend the governance and coordination of the GPN (Gereffi et al., 2005)
  – To recognize the scope of shock transmission and business cycle comovements (Acemoglu et al., 2012; Carvalho, 2014)
Aims and motivations (2)

• In this work, we aim to:
  – Detect Global Production Networks using trade data in three relevant sectors
  – Examine the geography of GNPs, comparing different methodologies
  – Assess the relationship between a country’s position in a GPN and relevant economic indicators
Analysis of GPNs

• Trade in intermediate goods and vertical specialization (Arndt and Kierzkowski, 2001; Hummels et al., 2001).
• Inter-country input-output data - WIOD, TiVA (Koopman et al., 2014, Timmer et al. 2014)
• Analysis of FDI and trans-national enterprises (Hanson et al., 2005)
• Case studies (Barbie, iPhone, Boeing)
Analysis of GPNs

• Trade in intermediate goods and vertical specialization (Arndt and Kierzkowski, 2001; Hummels et al., 2001) => our approach is based on the analysis of trade data, using indices of preferentiality and network analysis to study these complex structures

• Inter-country input-output data (WIOD, TiVA) (Koopman et al., 2014, Timmer et al. 2014)

• Analysis of FDI and trans-national enterprises (Hanson et al., 2005)

• Case studies (Barbie, iPhone, Boeing)
Data

• Bilateral trade data from Baci-Cepii database for the year 2007 and 2011, 221 countries

• Sectors:
  – Electronics HS 2002 Code 85
  – Textiles and Apparel HS 2002 Code from 50 to 63
  – Motor Vehicles HS 2002 Code 87

• Disaggregation of trade flows following BEC, distinguishing between intermediate goods and final (consumers and capital) goods => different matrices of bilateral trade flows for each sector

• Assumption that both types of trade flows characterize a GPN
Regionalization in the GPN of Electronics

The world trade matrix of electronic goods shows a significant and stable degree of trade regionalisation, different according to goods’ category, high especially in intermediate goods. A similar picture occurs for motor vehicles and textiles and apparel.
Regionalization in the GVC of Electronics

A different measure of regionalization, Newman (2003) homophily index, shows a very similar picture.
Revealed trade preference index

\[ RTP_{ij} = \frac{(HI_{ij} - HE_{ij})}{(HI_{ij} + HE_{ij})} \]

where

\[ HI_{ij} = \frac{S_{ij}}{V_{ij}} = \frac{(T_{ij} / T_{iw})}{(T_{oj} / T_{ow})} \]

i.e. the ratio between a partner country’s share of the reporting country’s total trade \((S_{ij})\) and its weight in total trade of the rest of the world \((V_{ij})\);

\[ HE_{ij} = \frac{(1 - S_{ij})}{(1 - V_{ij})} \]

i.e. the intensity of trade relations between country \(i\) and all the other countries except country \(j\)

- This index is an indicator of relative bilateral trade intensity and it ranges from minus one (no bilateral trade) to one (only bilateral trade) and is equal to zero in the case of geographic neutrality (Iapadre and Tironi, 2009).
- \(RTP\) indices can also be used to map the intensity of intra-regional trade.
Regionalization in the GVC of Electronics

Trade regionalisation (measured by introversion indices) is significant in all geographic areas, and generally more pronounced in less developed / more isolated regions.
Regionalization in the GVC of Textiles

Trade introversion is lower than in the other sectors, particularly in regions that are connected to external value chains.
Regional trade by categories in the three main regions
Eastern Asia pattern of trade preferences
China’s network of intermediate suppliers in Electronics
EU pattern of trade preferences
Uneven distribution of preferential partners
Italy’s revealed trade preferences
Italy’s network of intermediate suppliers in Textiles
Network of preferential trade

• Countries are nodes and links are preferential trade flows (link exist if RTP > 0)
• Binary and directed network
• Topological indicators:
  – Density: by definition at world level the network can never be complete, but this could happen at regional level
  – Clustering: reciprocity and «triangles» in preferences, high in some regions (EU, NAFTA), much lower in others
  – Assortativity: preference for dissimilar countries, asymmetry in preferences
  – Centralization: concentration of preferences toward a specific country in a region, generally fairly low
Centralization of preferences in selected regions

Centralization indices - 2011

<table>
<thead>
<tr>
<th>Region</th>
<th>Electronics</th>
<th>Motorvehicles</th>
<th>Textiles</th>
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<tbody>
<tr>
<td>European Union</td>
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<tr>
<td>NAFTA</td>
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<tr>
<td>Eastern Asia</td>
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</table>
Germany’s network of intermediate suppliers in Electronics
Correlation between position in GVN and economic indicators (1)

<table>
<thead>
<tr>
<th>Dependent variable: Authority index</th>
<th>Dependent variable: Hubness index</th>
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</thead>
<tbody>
<tr>
<td>Gross Export % of GDP</td>
<td>0.00728  ***</td>
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<tr>
<td></td>
<td>(0.0018)</td>
</tr>
<tr>
<td>GDP</td>
<td>0.00005  ***</td>
</tr>
<tr>
<td></td>
<td>(0.00004)</td>
</tr>
<tr>
<td>OECD Dummy</td>
<td>-0.03998  **</td>
</tr>
<tr>
<td></td>
<td>(0.01849)</td>
</tr>
<tr>
<td>Textile Dummy</td>
<td>0.04088  *</td>
</tr>
<tr>
<td></td>
<td>(0.0218)</td>
</tr>
<tr>
<td>Electronic Dummy</td>
<td>-0.02277</td>
</tr>
<tr>
<td></td>
<td>(0.02244)</td>
</tr>
<tr>
<td>R-squ.</td>
<td>0.46</td>
</tr>
<tr>
<td>N. observ.</td>
<td>168</td>
</tr>
</tbody>
</table>

Higher authority or hubness in GVN is positively and significatively correlated with higher share of export (at sector level).
Higher centrality in GVN is positively and significantly correlated with higher share of DVA in export (at sector level) especially when controlling for participation to GVN.
Conclusions

• Trade related to GPNs is still quite regionalized, but with relevant exceptions and «bridges»
• Global production networks display different characteristics across sectors and regions
• Network analysis can provide additional information on the structure of global production networks
• Position of countries within such networks is correlated to some indicators of performance in international markets