INTRODUCTION

- Maritime transportation is very important for international trade.
- The international trade network has evolved into complex global value chains (GVCs).
- Different to the common bilateral analysis, Statistical Network Analysis captures trade network effects.
- Previous analyses do not consider: GVCs, global crises, transportation linkage.
- This work:
  - Rich Data from the Global Trade Analysis Project (GTAP)
  - Novel representation of the Maritime Multi-commodity International Trade Network (MM-ITN) replicates GVCs
  - Suite of Statistical Network Analysis tools
  - Evolution of the MM-ITN clearly illustrated
  - Impact of global crises described from a network perspective
  - Economic policy provided

DATA AND NETWORK REPRESENTATION

<table>
<thead>
<tr>
<th>National</th>
<th>Input/Output Tables</th>
<th>Database (3.6 GB)</th>
<th>G(N, A) MM-ITN in year t ∈ T</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>Set of nodes, N = {i = k, j ∈ K, c ∈ C}</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A'</td>
<td>Set of arcs in year t ∈ T, A' = {(i, j); i, j ∈ N, w'ij &gt; 0}</td>
<td></td>
<td></td>
</tr>
<tr>
<td>w'ij</td>
<td>Total value exports sector k from region μ (i = μ, j ∈ N) to region δ used by sector s (j = δ, s ∈ N) in year t ∈ T</td>
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</tr>
</tbody>
</table>

- Global crises reduce trade and generate restrictive trade policies
- Financial Crisis in Asia
- Dot-com bubble
- Removal textile and apparel exports quotas
- Great Recession 2007-2009

STATISTICAL NETWORK ANALYSIS

- Degree
  - Sustained expansion (1995-2007) consistent with broadly liberal trade policies leading to global integration.
  - 1997 Asian crisis did not have major global trade repercussions.
  - 2001 crisis has had a small negative effect until 2003 (crisis related to the services side).
  - Minor fall from 2004 to 2005: In 2005, MFA (Multi-Fiber Arrangement) quotas that restricted imports from developing to developed countries were removed. Just before their removal (2000-2005), the developed countries had restrictions in these sectors fearing negative effects on their domestic industry.
  - 2007 degree peak declines until 2008: recession in this period. Two factors summarize the implications of this global crisis: (1) overall reduction in demand, and (2) trade restrictions spread to protect domestic production.
  - Strength
    - Clear expansion of maritime global trade that is not masked by inflation (constant prices).
    - The 1997 crisis had a small negative effect on strength. Reductions on average strength continue in 2004-2005 and 2007-2009 as consequence of the crises in these periods (explained before).
    - The increment in the fraction of nodes with low strength in recent years is a sign of maritime-trade diversification.
  - Betweenness Centrality
    - GVCs are vulnerable to strategic attacks/disruptions due to the low number of central economic geographies.
    - Recent years show an increase in the fraction of central nodes indicating that the MM-ITN is more decentralized and resilient as compared to earlier years.
    - However, the small fraction of central nodes still makes it susceptible to disruptions. The U.S. and other developed countries lost some centrality during 2007-2009.

RESULTS AND DISCUSSION

- • ANNS and Homophily
  - Sectors in maritime GVCs tend to connect randomly with a small tendency for high-trade nodes to connect with many other lower-trade nodes (disassortative behavior).
  - There is a prominent decrease of this trend in recent years due to trade restrictions from developed to developing countries (2007-2009 crisis).
- • Clustering and Community Detection
  - Clustering indicates that close trade blocks have opened to maritime GVCs that are more interrelated and complex.
- • Specific Analysis of the MM-ITN
  - USA and Germany (sectors: machinery/equipment, chemicals/rubber/plastics, and motor vehicle parts) have the higher number of import/export partners. Food products are also important for USA, machinery/equipment, chemicals/rubber/plastics in UK, France, and Italy have high degree. Partnerships increased after the 1997 Asian crisis but the beginning of the dot-com bubble crisis (2000) slows down this behavior. A small recovery is dramatically reduced after 2001. 2005 quotas removal and the big 2007-09 recession significantly impacted their partnerships. These common sectors with high degree have large scope in maritime GVCs.

CONCLUSIONS

- Crises have larger effects in trade value (strength) than connectivity (degree).
- Centrality is reducing at different economic geographies enhancing global resilience.
- Maritime GVCs conform a disassortative (hub-spoke) structure, where weaker traders tend to connect to stronger ones.
- Small clusters opened over time promoting global integration into fewer complex GVCs.
- Final demand in USA dominates over years with the highest strength. However, final demand in China approaches USA and have replaced Japan, UK, and Germany.
- USA and other important countries are slowly losing centrality in GVCs.

Implications:
- • Policy efforts are needed to strengthen trade from a network perspective.
- • Maritime infrastructures need to evolve accounting for global trade networks.
- • Maritime transportation facilitation will take new forms.
- • Final demand from emerging countries gains importance for trade policy and infrastructure improvements (China’s example).