



Colombian liberalization and integration to world trade markets: Much ado about nothing

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DISCLAIMER

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TAKE HOME MESSAGES...

- We focus on assessing the evolution of Colombia's importance in the world trade network (WTN) from 1995 to 2016.
- Colombia increased the number of trading partners and the absolute value of exports and imports, but failed to attain a more central role in the WTN.
- When compared to a group of regional peer countries (Brazil, Chile, Mexico, and Peru), and China and USA as trade leading countries, Colombia's ranking as a central node in the WTN did not improve substantially or even deteriorated, whereas Chile and Peru improved their rank remarkably.



OUTLINE

- Motivation
- Objective
- Methodology and data
 - Network analysis → Centrality
 - Data
- Main results
 - Degree centrality
 - Strength centrality
 - Authority and hub centrality
 - Trade integration index
- Final remarks



MOTIVATION

- Trade liberalization and the fragmentation of production across countries are two fundamental changes that have reshaped world trade in the last decades.
- In the dawn of the nineties, Colombia implemented a development plan called “The Peaceful Revolution” that changed the economy’s growth strategy from the domestic market to foreign markets and from import substitution to exports.
- Average nominal protection decreased from 44% to 12% between 1989 and 1992; moreover, export subsidies shrank from 22% in 1989 to 7% in 1994 and 4% in 2006.
- Bilateral and multilateral trade agreements were also part of the new growth strategy.



➤ Trade agreements:

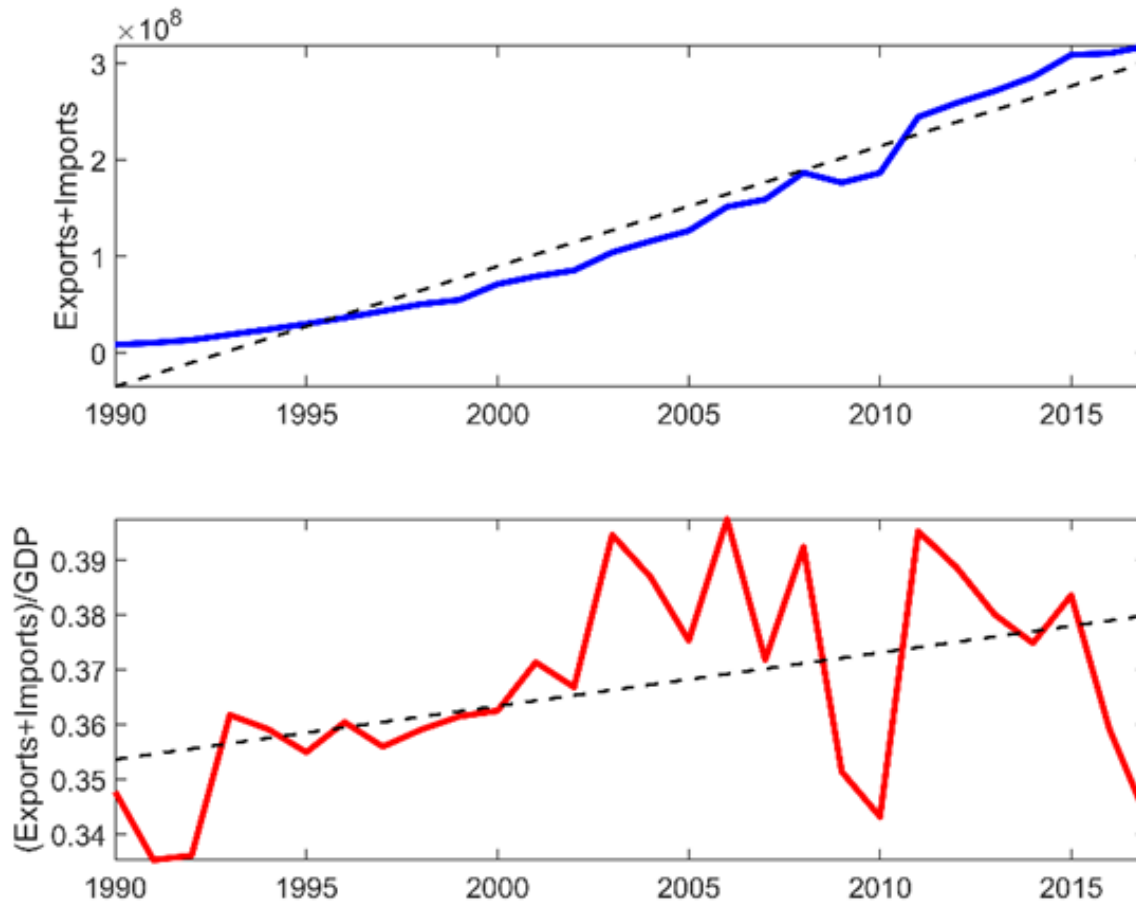
Agreement	Countersigner(s)	Signed / Expiration
Andean Free Trade Zone ^a	Bolivia, Ecuador and Venezuela	1993
Andean Trade Preference Act	United States	1991 / 2001
Group of Three	Mexico and Venezuela	1994 / 2006
Andean Trade Promotion Drug Eradication Act	United States	2002 / 2011
Free Trade Agreement ^b	Chile	2006
Free Trade Agreement	Guatemala, Honduras and Salvador	2007
Free Trade Agreement	Canada	2008 ^c
Free Trade Agreement	Switzerland ^c , Liechtenstein ^c , Norway ^d and Iceland ^d	2008
Free Trade Agreement	United States	2011 ^e
Free Trade Agreement	European Union and Peru	2012 ^f
Pacific Alliance	Chile, México and Peru	2012 ^g
Free Trade Agreement	South Korea	2013 ^h
Free Trade Agreement	Costa Rica	2013 ^h

Table 1. Colombian bilateral and multilateral trade agreements. ^a Formerly, Andean Community, signed in 1969. ^b Formerly, Acuerdo de Complementación Económica, signed in 1994. ^c Valid from 2011. ^d Valid from 2014. ^e Valid from 2012. ^f Valid from 2013. ^g Valid from 2015. ^h Valid from 2016. Source: authors' elaboration.



Source: Authors' compilation.

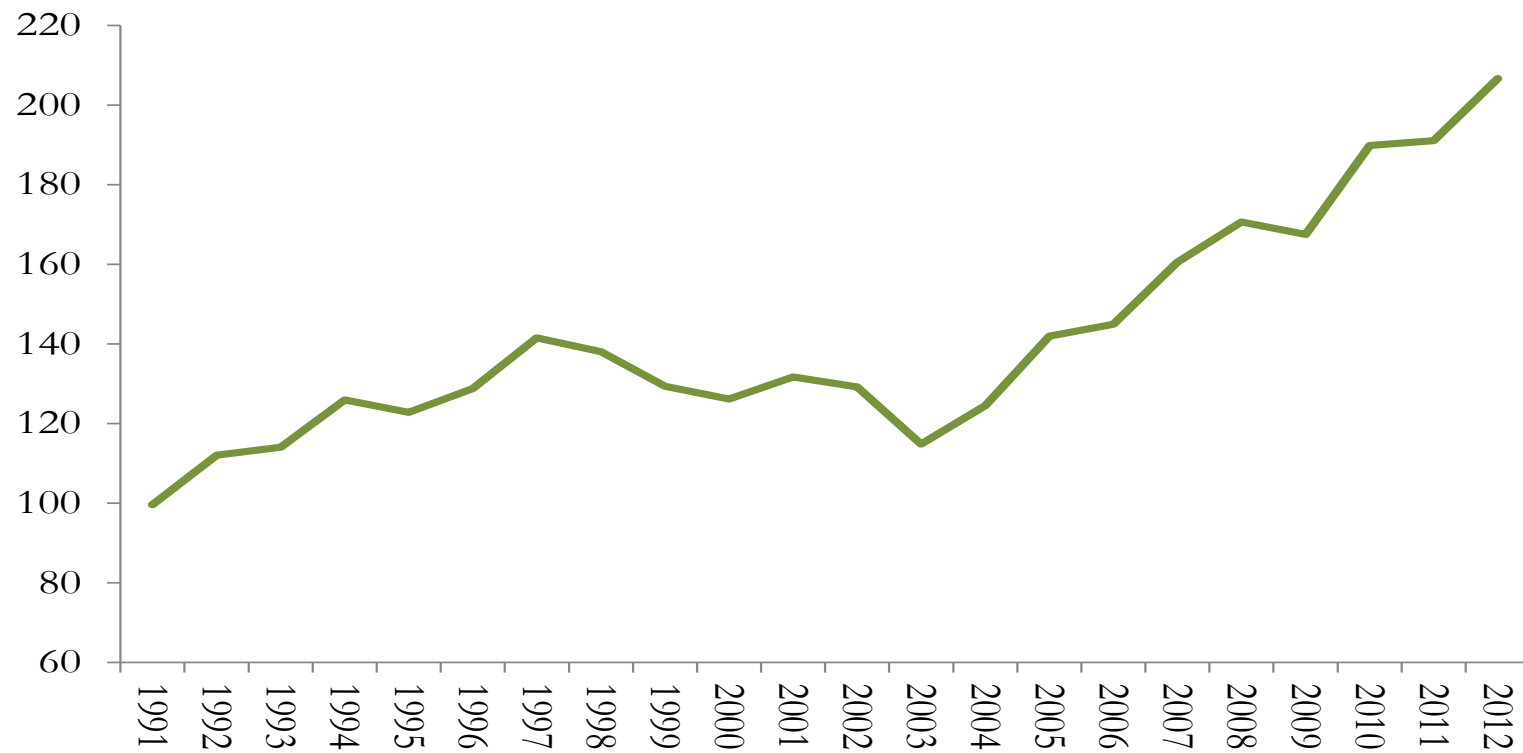
- By standard indicators, trade openness increased:



Source: Banco de la República. Authors' calculations.

... However, efforts towards an exports-oriented growth strategy encountered two main obstacles:

- 1) The tariff reduction process established at the beginning of the nineties was concomitant with a significant growth of non-tariff regulations (Index)...



Source: García et al. (2014).

2) The quality of institutions and infrastructure was an impediment to trade (Logistics Performance Index, LPI)...

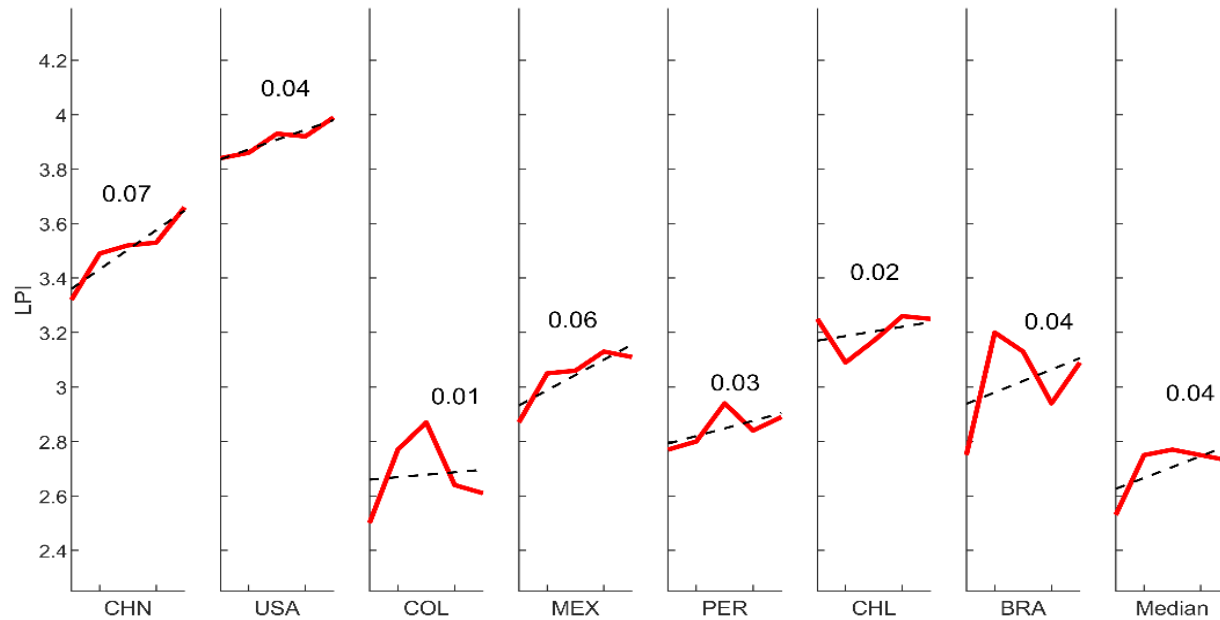


Figure 2. Logistics Performance Index (LPI), 2007-2016. Due to availability limitations, data corresponds to years 2007, 2010, 2012, 2014, 2016 (in the horizontal axis). The higher the index, the higher the performance in trade logistics. The dashed lines correspond to the linear regression on time series as a representation of their overall trend; the regression is in its standard form $y = \alpha + \beta x$, where x and y correspond to time (horizontal axis) and LPI (vertical axis), respectively, and the slope (β) is reported for comparison purposes. Source: authors' elaboration, based on World Bank data.



Source: Authors' calculations.

OBJECTIVE

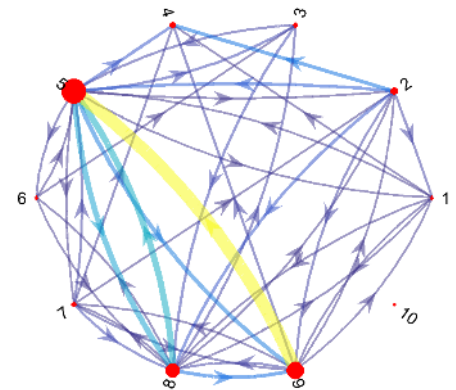
- **To study the evolution of Colombian liberalization and integration to world trade from 1995 to 2016.**
- Our approach departs from traditional studies that rely on analyzing a country's trade dynamics in isolation. We measure a country's importance in the WTN by means of calculating its network centrality.
- Questions we address:
 - How has the relative importance of Colombia in the WTN evolved?
 - How does Colombia rank against a benchmark comprising some of her regional peers and other trade leading countries?
 - Is the evolution of Colombia's importance in the WTN consistent with the policies and institutional changes implemented for about two decades?



METHODOLOGY: NETWORK ANALYSIS

- Aim: Describing and understanding an underlying system, focused on capturing the system's structure (Börner et al., 2007).
- Process: network sampling, measurement, and visualization.
- Network analysis basics:
 - Network: representation of a system –a set of elements related by their links.
 - In our case, countries as nodes or vertexes; exports as links or edges.
 - The most common numerical representation is the adjacency matrix (non-weighted or weighted).
 - The most common visual representation is a graph

$$A_{ij} = \left\{ \begin{array}{l} 1 \text{ if there is an edge from } i \text{ to } j, \\ 0 \text{ otherwise.} \end{array} \right\}$$



NETWORK ANALYSIS → CENTRALITY

- Centrality quantifies how important nodes (i.e. countries) are in a networked system (Newman, 2010). The centrality of a country in the WTN is a function of the number and intensity of its trade relations with other countries, along with the importance of those countries for the WTN.
- Centrality measures :
 - **Degree**: number of edges connected to a node or country (in-, out-)
 - **Strength**: weight of edges connected to a node or country (in-, out-)
 - **HITS** (Hypertext Induced Topic Search): yields two separate but interdependent centrality measures:
 - **Hub**: importance as originator of links (i.e. as exporter)
 - **Authority**: importance as receiver of links (i.e. as importer)
- **Trade integration index** (TII): calculated from HITS's hub and authority centrality.



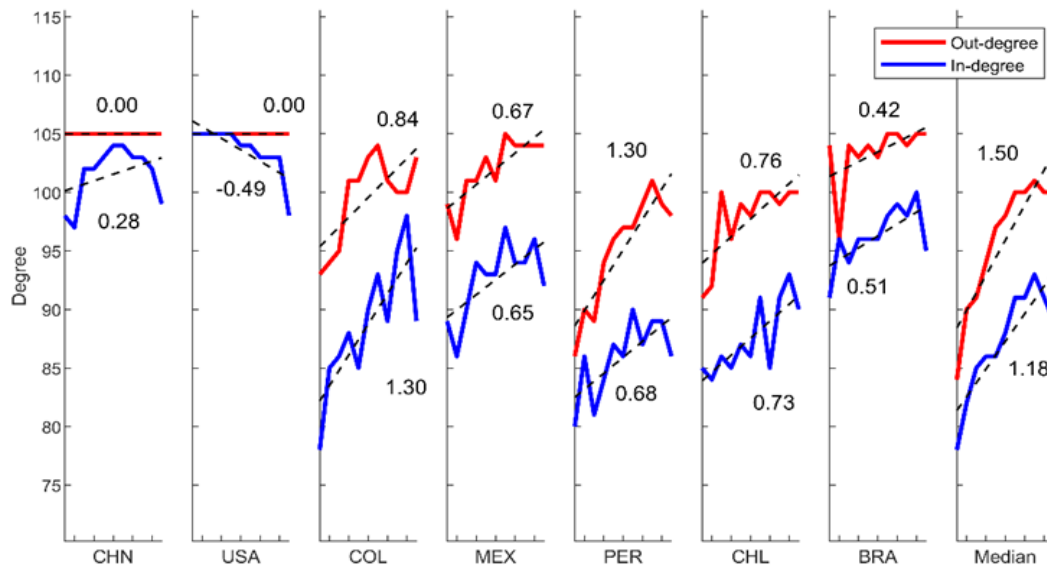
DATA

- Source: Exports (FOB) from UN-Comtrade Dataset (<http://comtrade.un.org/>)
- Period: 1995 to 2016 (22 periods)
- Frequency: Annual
- Setup: maximizing the number of countries while avoiding biases due to non-reporting countries
 - Eleven biennial periods: avoid non-consecutive non-reporting by interesting players (e.g. Czech Republic, Ecuador, Russia, ... Venezuela).
 - Eleven equally-sized networks: discarding countries that do not report in all biennial periods (106 countries out of 163, about 93,13% of total world trade).
- ❖ *We do not filter trade relations by their value or the size of the country; we attempt to preserve and acknowledge the importance of all trade linkages.*



MAIN RESULTS-DEGREE CENTRALITY

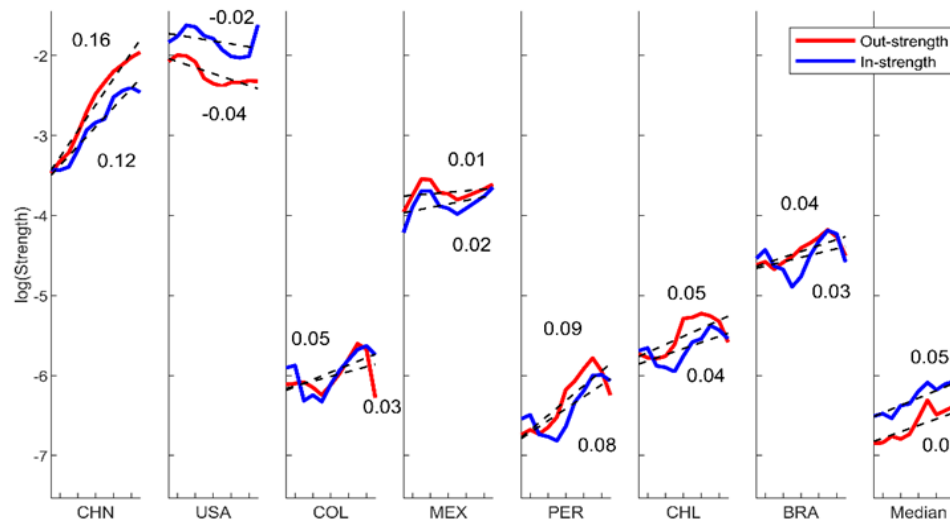
- **Out-degree:** The number of exports destinations is higher and has increased as well, but at a slower pace –as evident from the linear trend’s slope.
- **In-degree:** The number of countries exporting to Colombia has increased along the period albeit three marked decreases in 2003-2004, 2009-2010, and 2015-2016.



Source: Authors' calculations.

MAIN RESULTS-STRENGTH CENTRALITY

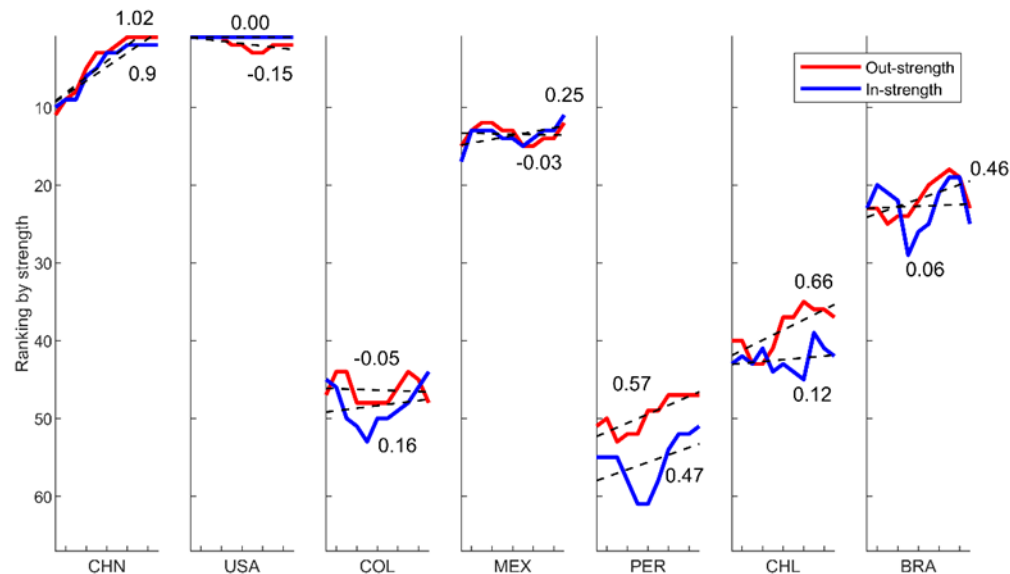
- **Out-and-in strength centrality:** Colombia's contribution to WTN's exports and imports both display an upward trend. Nevertheless, the upward trend in out-strength hinders that from beginning to end of the period under analysis the value of exports actually declined.
- In most biennial periods the benchmark countries, as well as for China, behaved as net exporters since the out-strength measure exceeded the in-strength measure.



Source: Authors' calculations.

RANKING-STRENGTH CENTRALITY

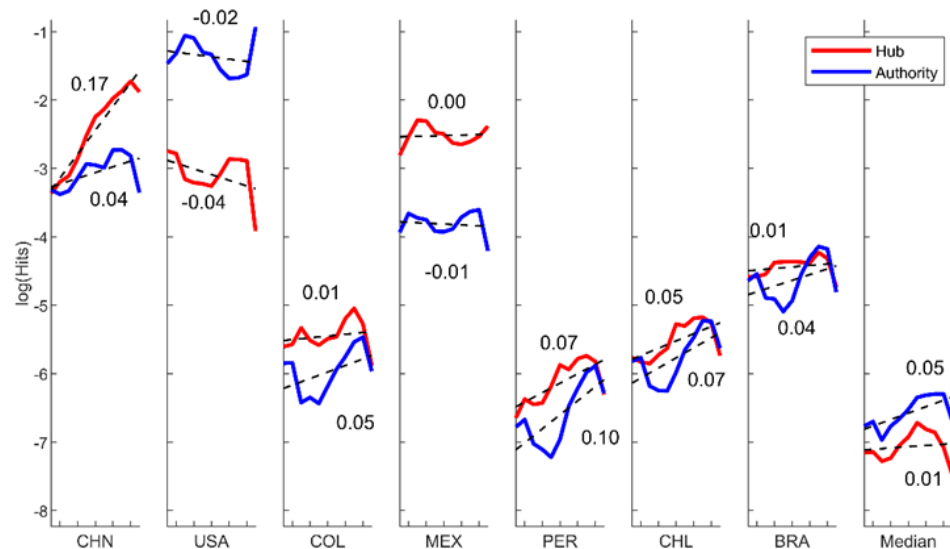
- Chile, Peru and Brazil exhibit increases in their out-strength ranking. On the other hand, Colombia's out-strength ranking has a downward trend that is below that of all her regional peers, which all exhibit upward trends.
- Colombia's in-strength ranking improves more than her out-strength ranking, and that improvement surpasses that of all regional peers but Mexico and Peru.



Source: Authors' calculations.

HITS: AUTHORITY AND HUB CENTRALITY

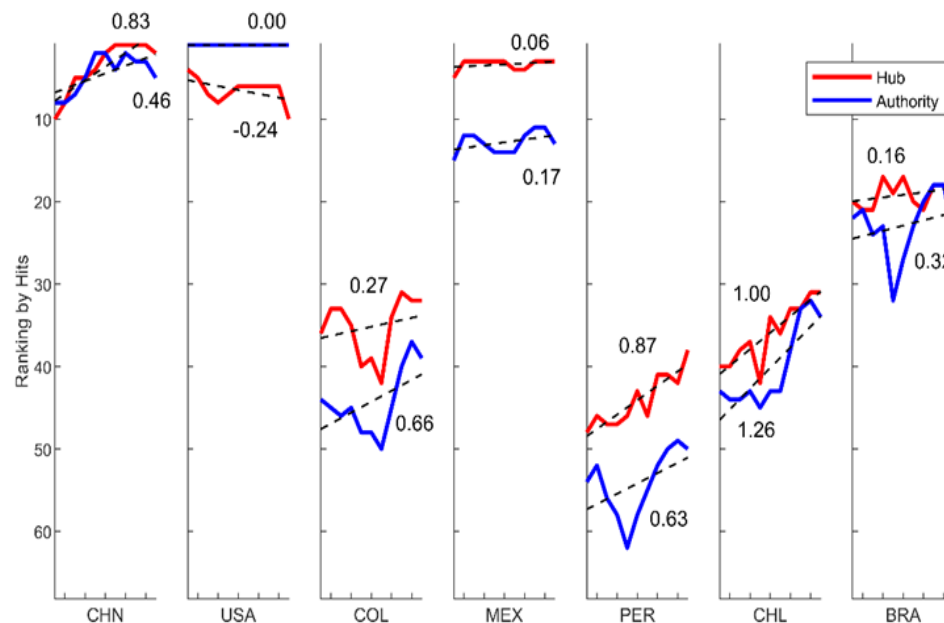
- **Hub centrality:** Tends to be higher than authority centrality; that is, it tends to be more important as exporter to key global importers than as importer from key global exporters.
- **Authority centrality:** It is lower than Chile's, Mexico's and Brazil's, and higher than Peru's and the median of countries in the WTN.
- Regarding hub centrality, Colombia displays a negligible upward trend.



Source: Authors' calculations.

HITS' RANKING: AUTHORITY AND HUB CENTRALITY

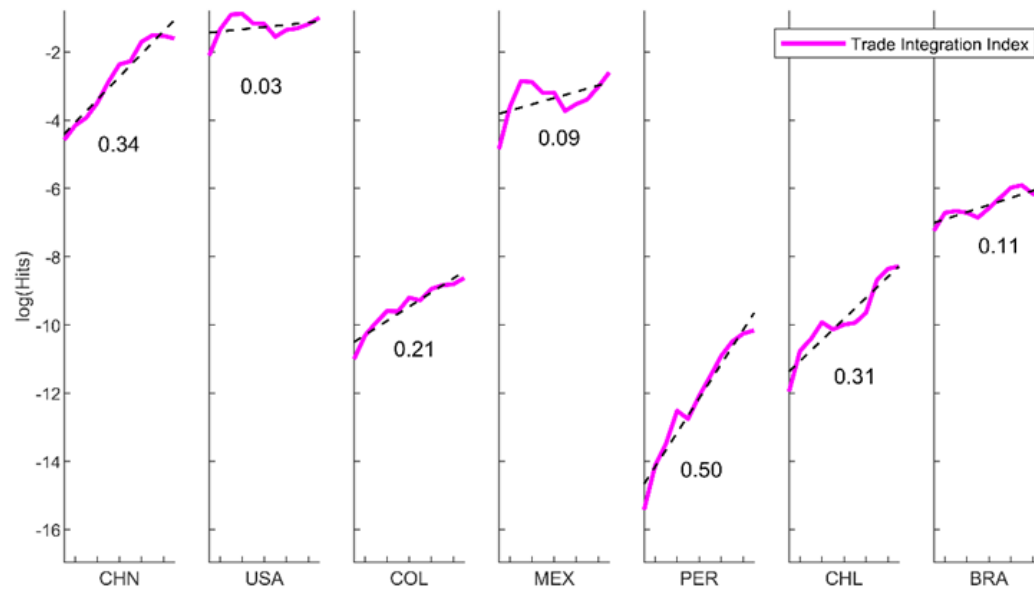
- China and the United States hold the highest rankings among the countries in the figure.
- Colombia's ranking by hub centrality is akin to that of Chile, lower than Mexico's and Brazil's, and higher than Peru's.
- Colombia's ranking by authority centrality is lower than her peers, except than Peru's.



Source: Authors' calculations.

TRADE INTEGRATION INDEX

- TII: Colombia's integration to the WTN has improved. However, consistent with the three dimensions of centrality, improvement is subpar to that of Peru and Chile, and unsatisfactory for closing the gap with those peers that have been better integrated since the dawn of the nineties (Mexico and Brazil).



Source: Authors' calculations.

FINAL REMARKS...

- The three dimensions of network importance share a common outcome: although Colombia openness increased, her integration to world trade markets did not improve noticeably.
- As for her ranking in the WTN, it improved slightly as importer but worsened as exporter.
- Policy implications
 - Colombia needs to revise to what extent past policies and institutional changes can be amended to correct the meager improvement in integration when compared to her peers and the WTN.
 - It is of utmost importance to revise how the most successful peers (i.e. Peru and Chile) attained such improvement, and to evaluate whether it is feasible and desirable to replicate their strategy.
- Pending issues
 - Analyzing trade sectors individually.



Thanks!



Appendix A.1 Network centrality analysis formulae

Network centrality analysis formulae	
$k_i^{in} = \sum_{j=1}^n A_{ji}$ <p>In-degree</p>	$k_i^{out} = \sum_{j=1}^n A_{ij}$ <p>Out-degree</p>
$s_i^{in} = \sum_{j=1}^n W_{ji}$ <p>In-strength</p>	$s_i^{out} = \sum_{j=1}^n W_{ij}$ <p>Out-strength</p>
$a = \Gamma^1(W^T W)$ <p>Authority</p>	$h = \Gamma^1(W W^T)$ <p>Hub</p>

$$TII_i = \frac{\frac{a_i}{\sum_{i=1}^n a_i} \times \frac{h_i}{\sum_{i=1}^n h_i}}{\sum_{i=1}^n \left(\frac{a_i}{\sum_{i=1}^n a_i} \times \frac{h_i}{\sum_{i=1}^n h_i} \right)}$$

Trade Integration index

Where,

1. A_{ij} is a directed adjacency matrix, $A_{ij} = \begin{cases} 1 & \text{if there is an edge from } i \text{ to } j, \\ 0 & \text{otherwise} \end{cases}$
2. W_{ij} is a directed and weighted adjacency matrix
3. n is the number of participants in the network
4. Γ^1 is the first (principal) eigenvector (i.e. column vector) of matrix Σ , in which $\Sigma = \Gamma \Lambda \Gamma^T$
5. $0 \leq TII_i \leq 1$
6. $\sum_{i=1}^n TII_i = 1$

Source: Authors' design, based on Bonacich (1972), Newman (2010) and León et al. (2018).

