

Description of international trade using a complex network model

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July 21, 2018

Introduction

- World Trade Network as a graph
- Methodological decisions involve in this representation
- Expressions of the New International Division of labor by node centralities and clustering.

Overview

1 Methodology

2 Results

Data

Bilateral aggregated data of trade between countries, by year.

sources:

- Gleditsch 1950-2000¹
- WTO. 1997-2011²

¹<http://privatewww.essex.ac.uk/~ksg/exptradegdpp.html>

²<https://comtrade.un.org/>

Bilateral trade

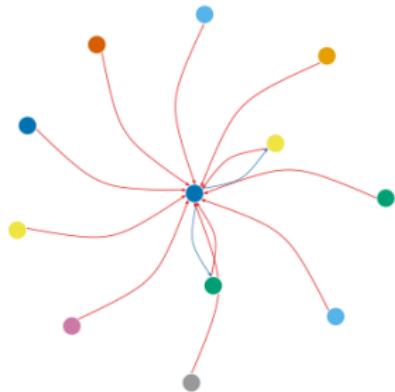
$$a_{ij} = \begin{cases} 1 & \text{if } \frac{x_{ij}}{x_{i\cdot}} \geq u \\ 0 & \text{else} \end{cases}$$

x_{ij} : Total trade between countries i-j

$x_{i\cdot}$: Total trade of country i

- Two countries are connected if there is *enough* trade between them.
- This can be either exports or imports.
- The graph is directed, so $a_{ij} \neq a_{ji}$.

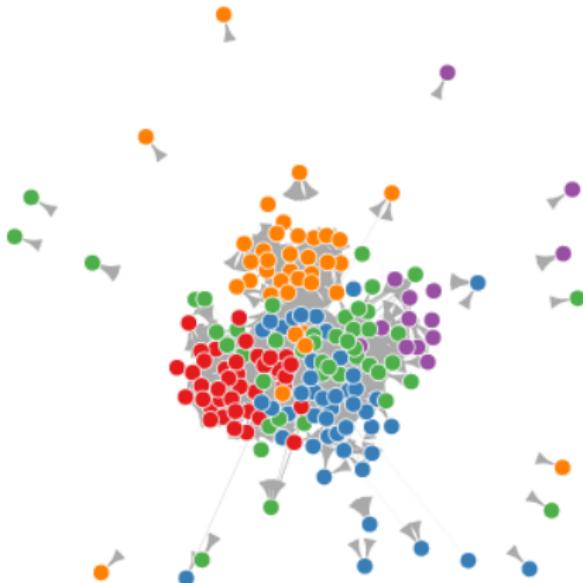
Producers & Consumers



- From the point of view of a country, there can not be many relevant countries. It can not have many **out edges**
- But they may be relevant from the point of view of other countries. They can have many **in edges**
- Therefore, with the **export** data, the central nodes will be **relevant as consumers**
- With **import** data, central nodes will be **relevant as producers**

Producers & Consumers

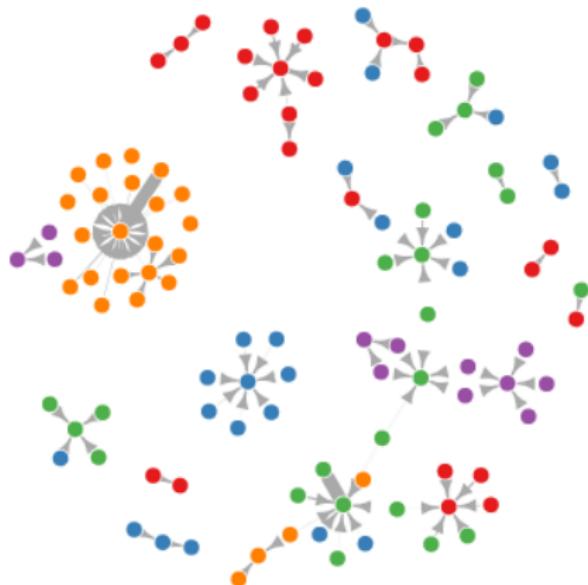
● Europe ● Asia ● Africa ● Americas ● Oceania



- With the real data.
- At a 1% threshold, this phenomenon is not visually clear.
- At a 20% threshold, we can see some important nodes with lots of **in** edges

Producers & Consumers

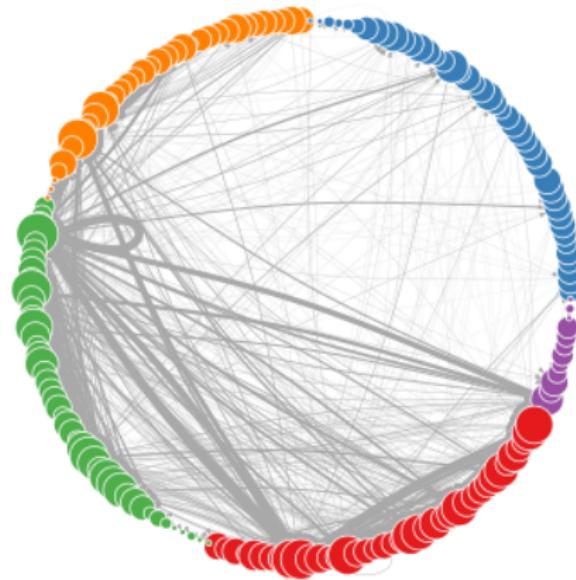
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Graph representation

● Europe ● Asia ● Africa ● Americas ● Oceania
2011, Threshold 1%

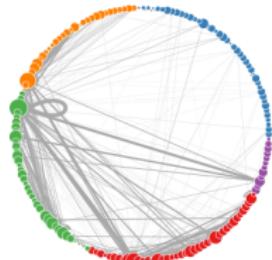


Graph representation

● Europe ● Asia ● Africa ● Americas ● Oceania
2011, Threshold 1%



2011, Threshold 5%

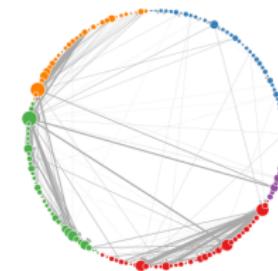


Graph representation

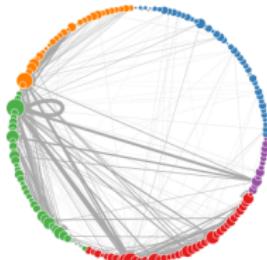
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2011, Threshold 1%



2011, Threshold 10%



2011, Threshold 5%

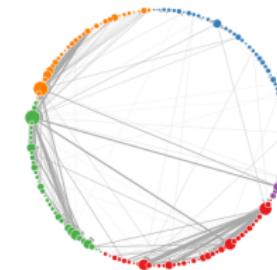


Graph representation

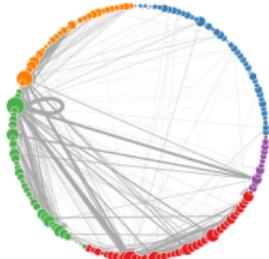
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2011, Threshold 1%



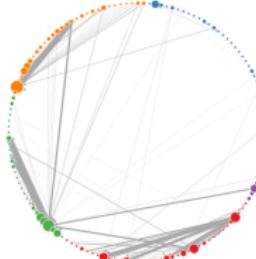
2011, Threshold 10%



2011, Threshold 5%

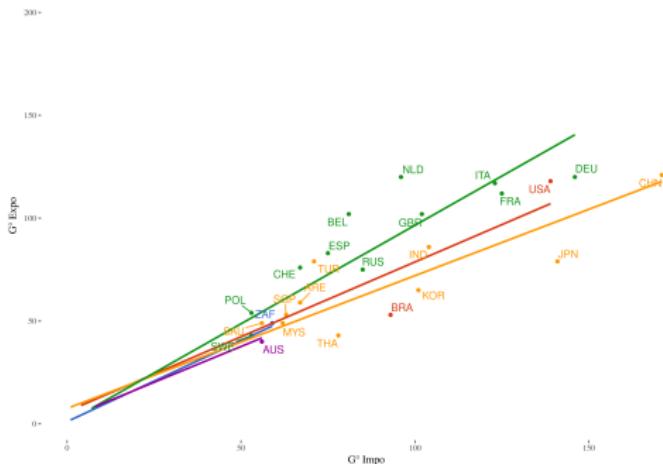


2011, Threshold 15%



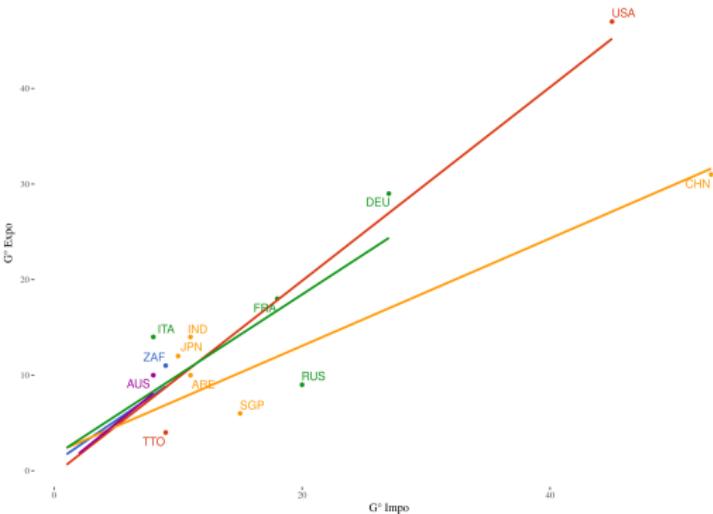
Exports and Imports correlation I

Degree Centrality in the graph of imports respect to the graph of exports



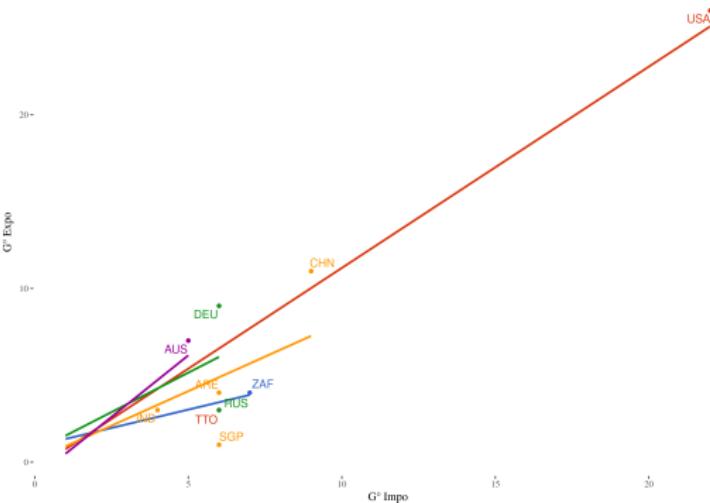
- 1% Threshold: Weak dependency network.
- Europe has bigger role as a consumer.
- Asia has more centrality as a producer.

Exports and Imports correlation II



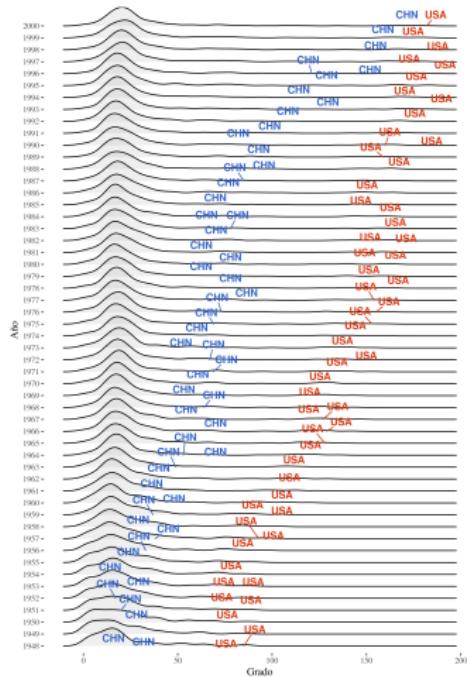
- 10% Threshold
- USA and Germany begin to separate from the rest of the nodes, with more importance as consumers.
- China does also, but as a producer.

Exports and Imports correlation III



- 20% Threshold: Strong dependency network
- Considering this type of relations, USA has much more centrality.
- South Africa appears for the first time as a central node.

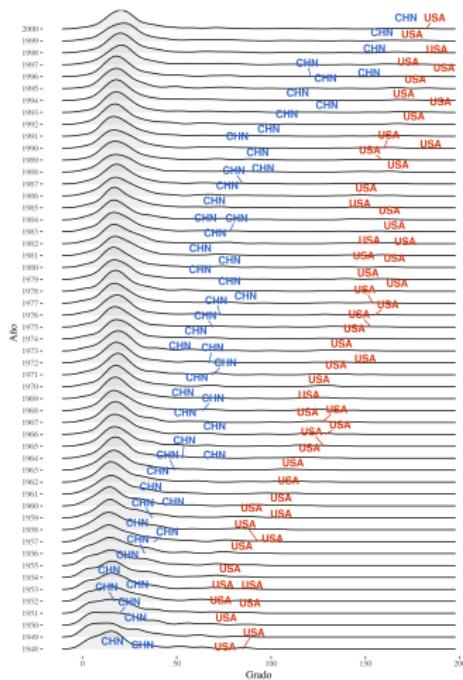
China-USA 1950-2000 & 1997-2011



We can see evolution in time of the degree centrality distribution, and the place of China and USA in that kernel.

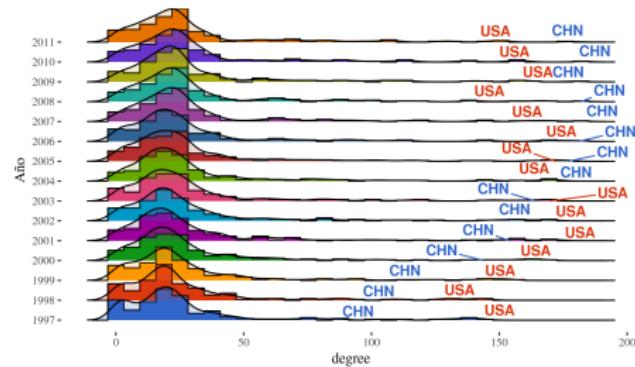
Degree.Threshold 1%. Imports

China-USA 1950-2000 & 1997-2011



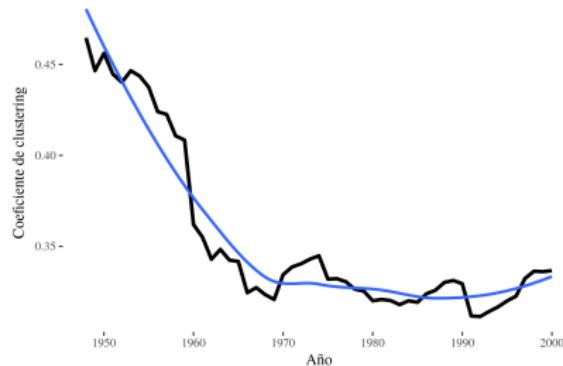
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Degree Threshold 1%. Imports



New International Division of labour -I

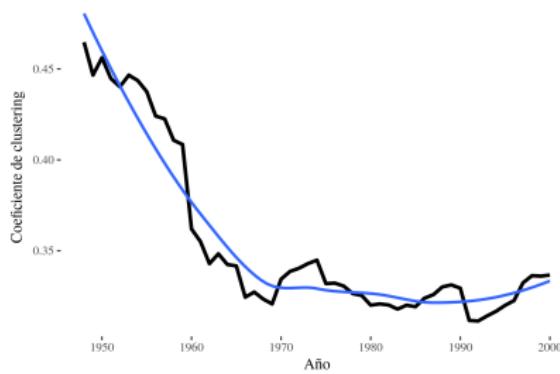
Global measures



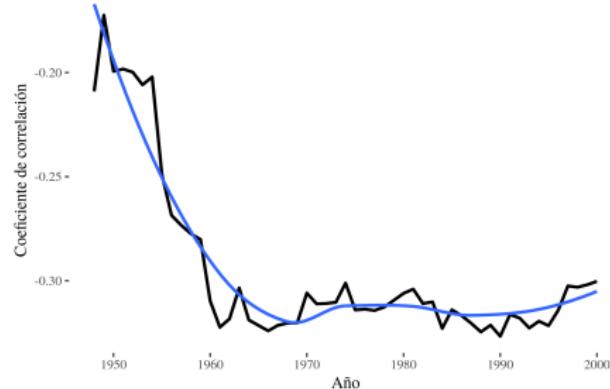
Clustering coefficient
The network reduce it's
regionalisms

New International Division of labour -I

Global measures



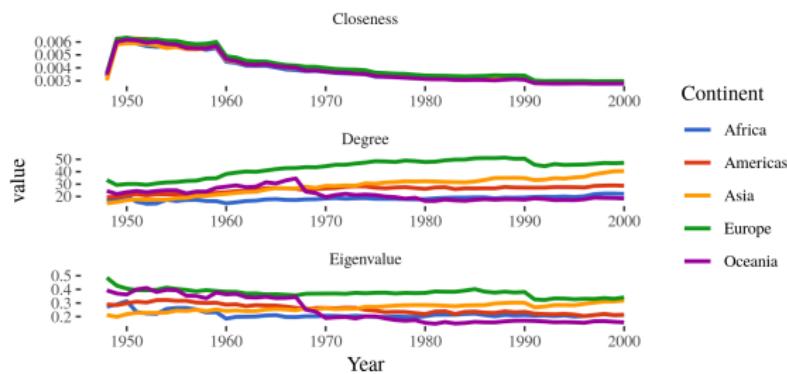
Clustering coefficient
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Correlation
Trade connections grows
between central and non-central
countries

New International Division of labour -II

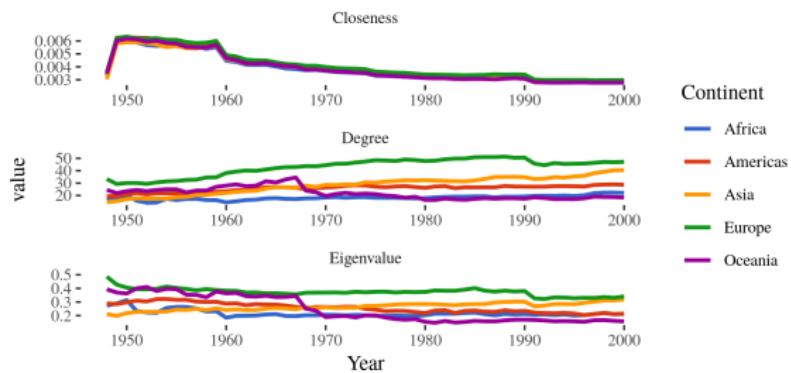
Countries evolution



- Closeness is a robust measure of the graph
- Asia goes from de last place to the second in Eigenvalue and Degree centrality
- Oceania goes from de second place to the last in Eigenvalue and Degree centrality

New International Division of labour -II

Countries evolution



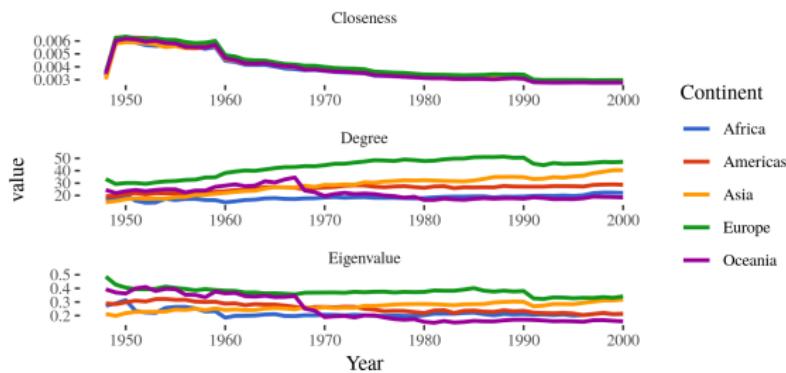
Continent

- Africa
- Americas
- Asia
- Europe
- Oceania

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New International Division of labour -II

Countries evolution



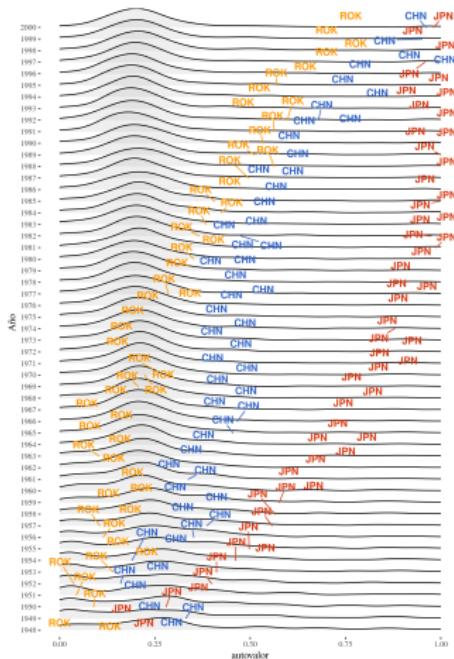
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New International Division of labour -III

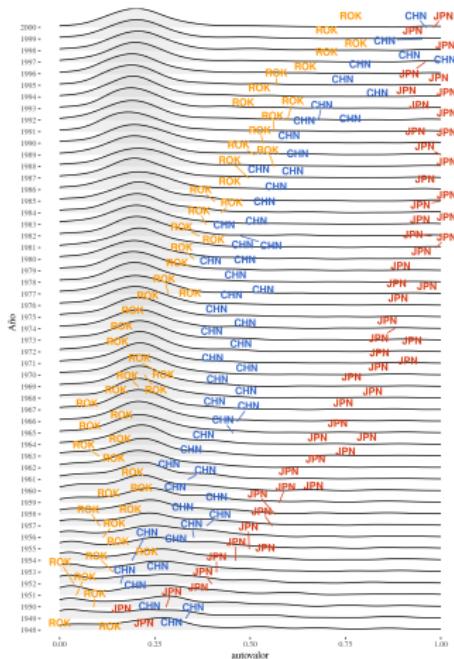
Asia's role



Eigenvalue

New International Division of labour -III

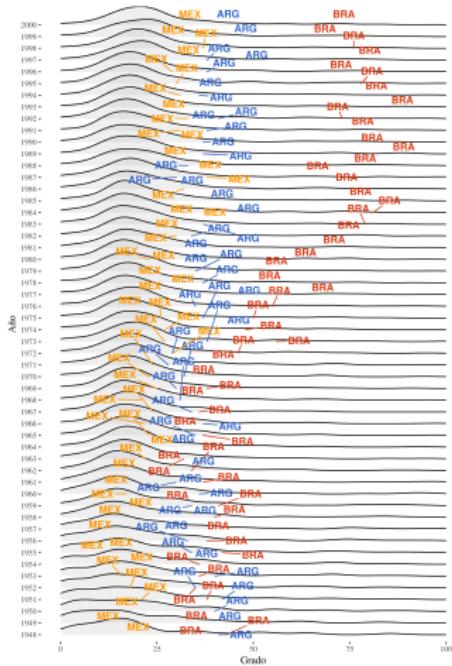
Asia's role



Eigenvalue

New International Division of labour -IV

Latin America

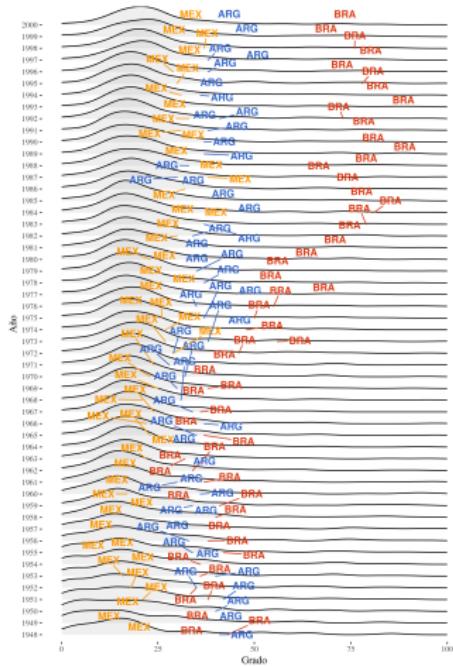


- From the 80's, Brazil increases its commercial links with the rest of the world.
- Argentina and Mexico maintain their relative position in the period

Degree

New International Division of labour -IV

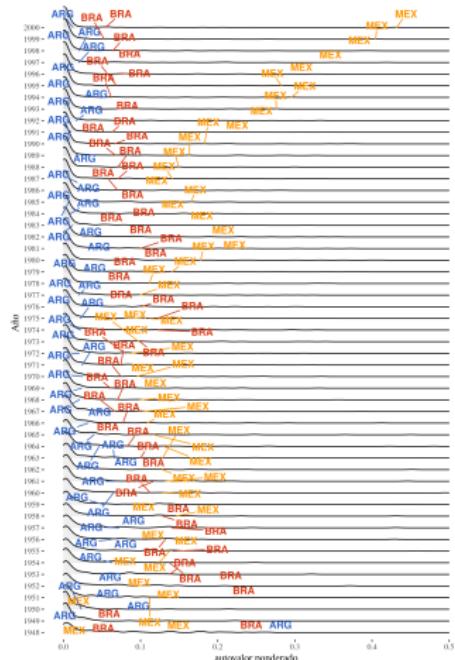
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New International Division of labour -IV

Latin America

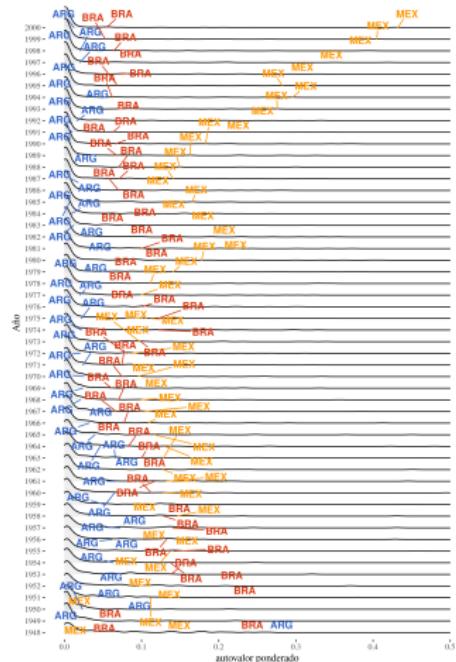


- If we see the Weighted Eigenvalue centrality, which consider the centrality of the countries partners, Mexico grows strongly from the 90's
- This may be due to its relationship with the USA

Weighted Eigenvalue

New International Division of labour -IV

Latin America



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Conclusions

- Network analysis have a great potential to describe Word Trade.
- We find that Europe and the United States play a more important role as consumers than as producers
- We also find that Asia, and China in particular, has a more central role in the world market in the last 60 years.
- Code:
www.github.com/DiegoKoz/grafo_comercio_agregado

The End