26th INTERNATIONAL INPUT-OUTPUT CONFERENCE
AND 8th EDITION OF THE INTERNATIONAL SCHOOL OF I-O ANALYSIS
JUNE 25-29, 2018, JUIZ DE FORA, BRAZIL

Evolution of the global value chains of the Mexican industry in the world economy in Input Output Networks: a comparative study between 2000-2014.

Rafael Bouchain Galica., Eric Ramírez Hernández, J. Andrés Ramírez & J. E. Quintero García[1].

Topic: IO Data (3) Annual, Regional, and Multiregional Input-Output Accounts and intra-and international Trade

Abstract

The objective of this paper is to analyze the evolution of the global value chains of the most dynamic Mexican industries in the process of fragmentation of world production, a phenomenon that has altered the nature of world trade. Since the nineties of the last century Mexico has implemented a policy of strengthening the export maquiladora industry in order to stimulate a dynamic industries to take advantage of the competitive link in global value chains, the most favored have been among others the automotive and electronics. The fundamental question is to evaluate the success and limitations of this strategy in the creation of wealth as well as in the design of policies should be implemented to take better advantage of the escalation in global value chains. The work carries out a comparative analysis with the groups of countries that have managed to mount a successful strategy in the global value chains. At present, this study is important in the face of the threat of Donald Trump to restrict the North American market with Mexico and withdraw from NAFTA, the purpose of restructuring the Mexican import market. The study carries out a comparative analysis with the most successful groups of countries such as the Nordic countries, the Asiatic countries and the OECD countries through the OECD WIOT in the period 2000-2014. The method used is the theory of graphs by analyzing GVC, centralities and calculating communities. The novelty in the analysis lies in the use of graph theory in the global value chains, and to identify groups of countries that can represent alternative business partners in the medium term.

[1] Economic Research Institute, UNAM, the authors thank the support of DGAPA-PAPIIT projects:

1. Introduction

Since the 1990s, the world economy has gone through a phase of development dominated by the fragmentation of global production of the most dynamic industries, such as electronics and the automotive industry. This phenomenon presents opportunities and challenges for emerging nations such as Mexico, which have focused on promoting export assembly industries by taking advantage of low costs (particularly salaries), geographic location and other advantages.

The opportunity to take advantage of the global fragmentation of production lies the possibility of progressively advancing in the global value chains offered by the new pattern of world trade. This represents an economic challenge in terms of wealth creation and technological development that has been taken advantage of by some nations such as Asia.

Mexico has successfully developed the automotive and electronics industries, although the process of production escalation in global value chains has been aumented the imported component and requires greater promotion in a way that stimulates endogenous technological development .

Recently, USA President Donald Trump has threatened Mexican exports, particularly those of the automotive industry, arguing a trade deficit and the need to discuss the North American Free Trade Agreement (NAFTA), a key instrument in the development of the export maquila industry in Mexico.

The fragmentation of world production has shown some slowdown (Timmer et al, 2016), so it is important to ask how the Mexican economy can move forward with the export strategy based on the assembly industry of dynamic industries, by the strong integration with the North-amercan economy.

This paper presents the first results of a input-output analysis in a network approach by analyzing the OECD's World Input Output Tables (WIOT) for the period 2000-2014 because it is the most recent database.

Due to the large amount of information that the analysis yields, only some results that will be expanded in the ongoing research are discussed. For now, the results

that show the interdependence between sectors in the purchase of inputs and products are shown, which shows a regional pattern, in particular the countries are grouped into regions according to their importance in the production of the electronic and automotive sectors.

At the end, an experiment based on neural networks is presented, which allows studying the evolution of global value networks over time.

2. The theory of input output networks in the analysis of the global production fragmentation process

The theory of networks in input-output allows us to analyze the main links of purchase sale of products and inputs between the different industries of the economies in what we can call the global factory, this process has been linked to the development of dynamic industries that take advantage of of prices (labor force and inputs) and geographical location to raise profit margins.

In the input outpu networks approach the theory of directed graphs is a good tool to represent the global production networks, the results make evident, the existence of certain regional patterns of interdependence in purchases and sales of inputs and final goods. The results are presented for each industry, electronics and automotive, using the WIOD in the period 2000-2014, although the calculations were made for each WIOT in the period indicated, is emphasized in five-year periods: 2000, 2005, 2010 and 2014.

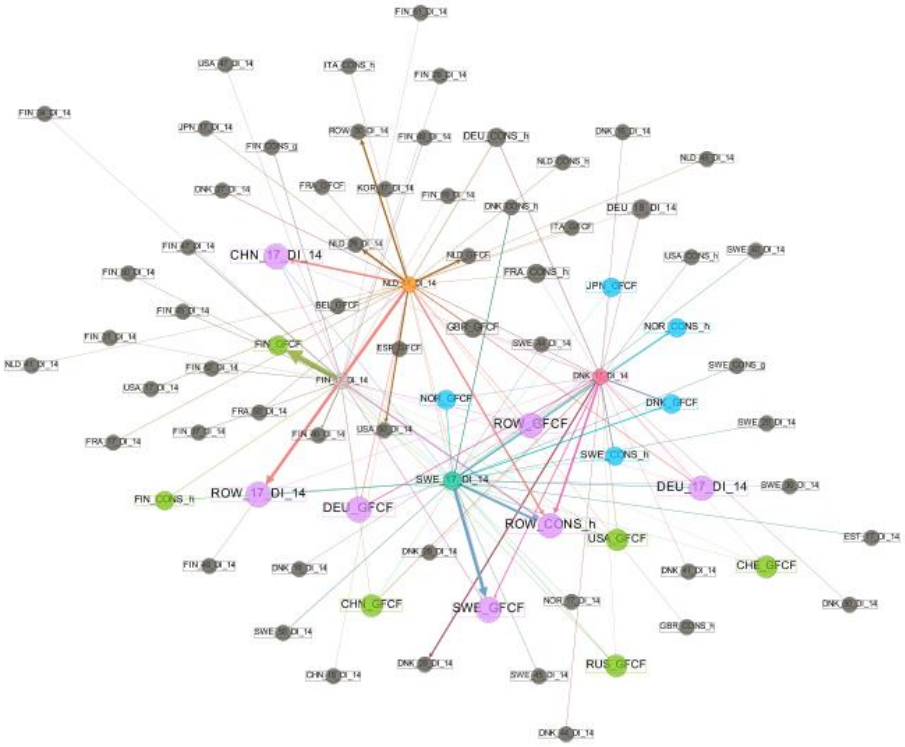
First we present the associated graphs for each industry considered, then some tables showing the interdependence between the main countries in a regional perspective, in the appendix some maps are shown that geographically reflect these interdependencies.

Previous studies have analyzed the national and international components of inputs and outputs in the Global Value Chains (Bouchain, Vázquez y Bouari, 2017), the calculation of the most important centrality indexes and the regional patterns of supply and demand by groups of countries for some industries (Bouchain & Ramírez, 2017), which shows the structure of the specialization patterns of some industries. These analyzes were carried out based on input-output tables (IOT's) and inter-country tables (ICIOT's) of the OECD that contain information for around 60 countries, now the WIOTs that only contain information for 43 countries are analyzed.

3. Regional patterns of the Electronics industry

Here are presented the results for four groups of countries that represent some of the main producers of computers and electronic equipment (sector 17 of the WIOD), these are: the Nordic, some European, the Asians and the NAFTA (which includes to Brazil.

Figure 3.1 Graph associated with the Nordic countries, Denmark, Norway, Finland and Sweden for 2014.



The graph allows you to visualize the main relationships of the Nordic countries with their main partners, to have a better idea is shown in table 3.1 where the inputs to the main partners are shown:

Table 3.1 Major imputs of the Nordic electronic industry				
COUNTRY	DNK	FIN	NOR	SWE
CHN	2.3%	3.9%	1.2%	2.4%
DEU	6.4%	3.8%	2.1%	4.4%
DNK	21.5%	0.6%	1.5%	1.3%
FIN	0.4%	33.7%	0.4%	0.6%
FRA	0.9%	0.6%	0.8%	1.0%
GBR	1.6%	1.1%	2.4%	1.2%
ITA	0.8%	0.5%	0.3%	0.4%
JPN	0.2%	0.2%	0.3%	0.3%
KOR	0.2%	0.3%	0.2%	0.5%
MEX	0.0%	0.1%	0.0%	0.0%
NLD	1.5%	0.7%	0.6%	1.9%
NOR	0.6%	0.2%	33.0%	1.1%
ROW	2.1%	3.1%	1.2%	3.3%
SWE	3.6%	3.3%	3.3%	15.8%
TWN	0.3%	0.4%	0.5%	0.3%
USA	0.9%	3.4%	0.9%	1.0%
SUBTOTAL	43.3%	55.9%	48.9%	35.6%
NORDIC	26.1%	37.9%	38.2%	18.8%

Here a strong endogenous nucleus is shown in the provision of inputs intra-nation as well as among the group of Nordic countries, as well as a large percentage coming from this group of countries, an important integration with Germany, Great Britain, Holland, United States and China.

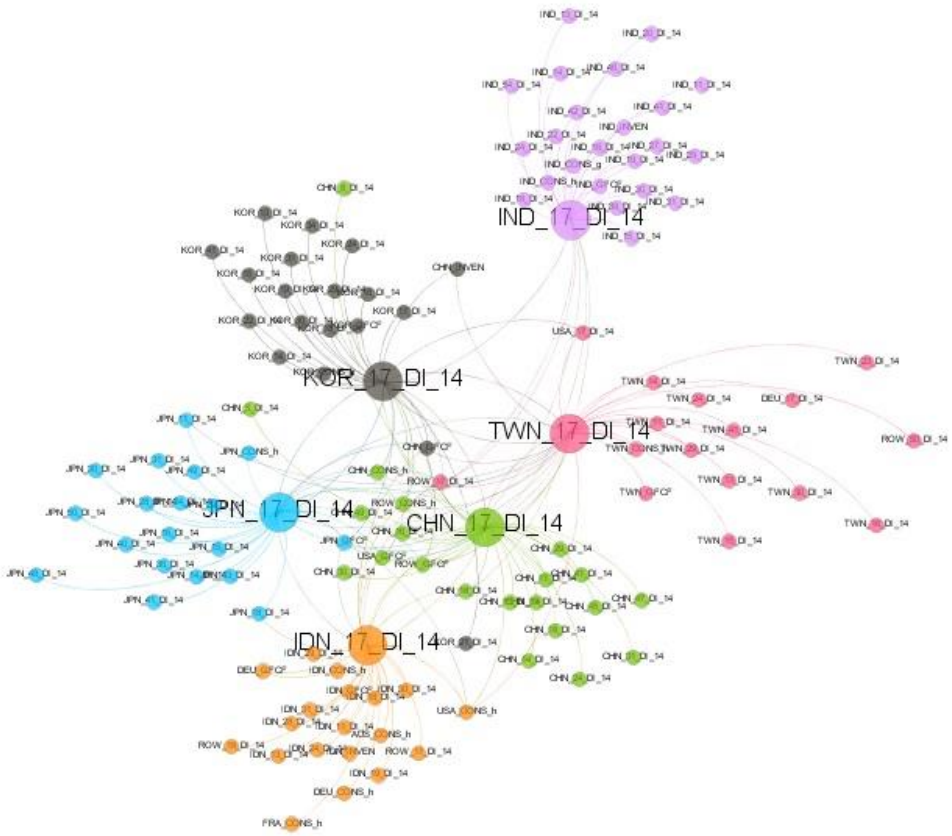
Table 3.2 shows the proportion of the main inputs of selected European countries, as well as an important endogenous pattern in the provision of electronic inputs (mainly Russia).

Table 3.2 Major imputs of the European electronic industry							
COUNTRY	DEU	FRA	ESP	GBR	ITA	RUS	TUR
CHN	2.6%	2.4%	2.1%	4.3%	2.5%	1.0%	8.9%
DEU	30.0%	4.5%	3.8%	3.5%	5.9%	1.6%	4.8%
ESP	0.2%	1.1%	32.4%	0.4%	0.5%	0.1%	0.5%
FRA	1.3%	29.6%	3.6%	1.3%	2.5%	0.3%	1.4%
GBR	0.8%	0.9%	0.9%	26.9%	0.9%	0.3%	0.8%
ITA	0.8%	2.4%	1.6%	0.6%	39.5%	0.4%	1.1%
JPN	1.2%	0.4%	0.4%	0.6%	0.3%	0.1%	0.5%
KOR	0.6%	0.3%	0.2%	0.6%	0.3%	0.3%	2.9%
NLD	1.1%	0.9%	0.9%	1.5%	1.4%	0.2%	1.2%
ROW	4.3%	3.3%	1.7%	3.6%	2.2%	1.8%	5.9%
RUS	0.1%	0.1%	0.0%	0.1%	0.1%	56.2%	0.5%
TUR	0.1%	0.2%	0.2%	0.2%	0.2%	0.2%	39.4%
USA	1.4%	1.1%	0.4%	1.5%	0.6%	0.2%	0.8%
TOTAL	44.7%	47.4%	48.5%	45.4%	56.9%	62.8%	68.9%

Some selected European countries show an important relationship with Germany and to a lesser extent with China, although their intra-European dependence is important.

Asian nations show more integrated patterns. The associated graph is:

Figure 3. Graph associated with the Asian countries, 2014.



In contrast, Table 3.3 is shown.3 shows the results for Asian countries.

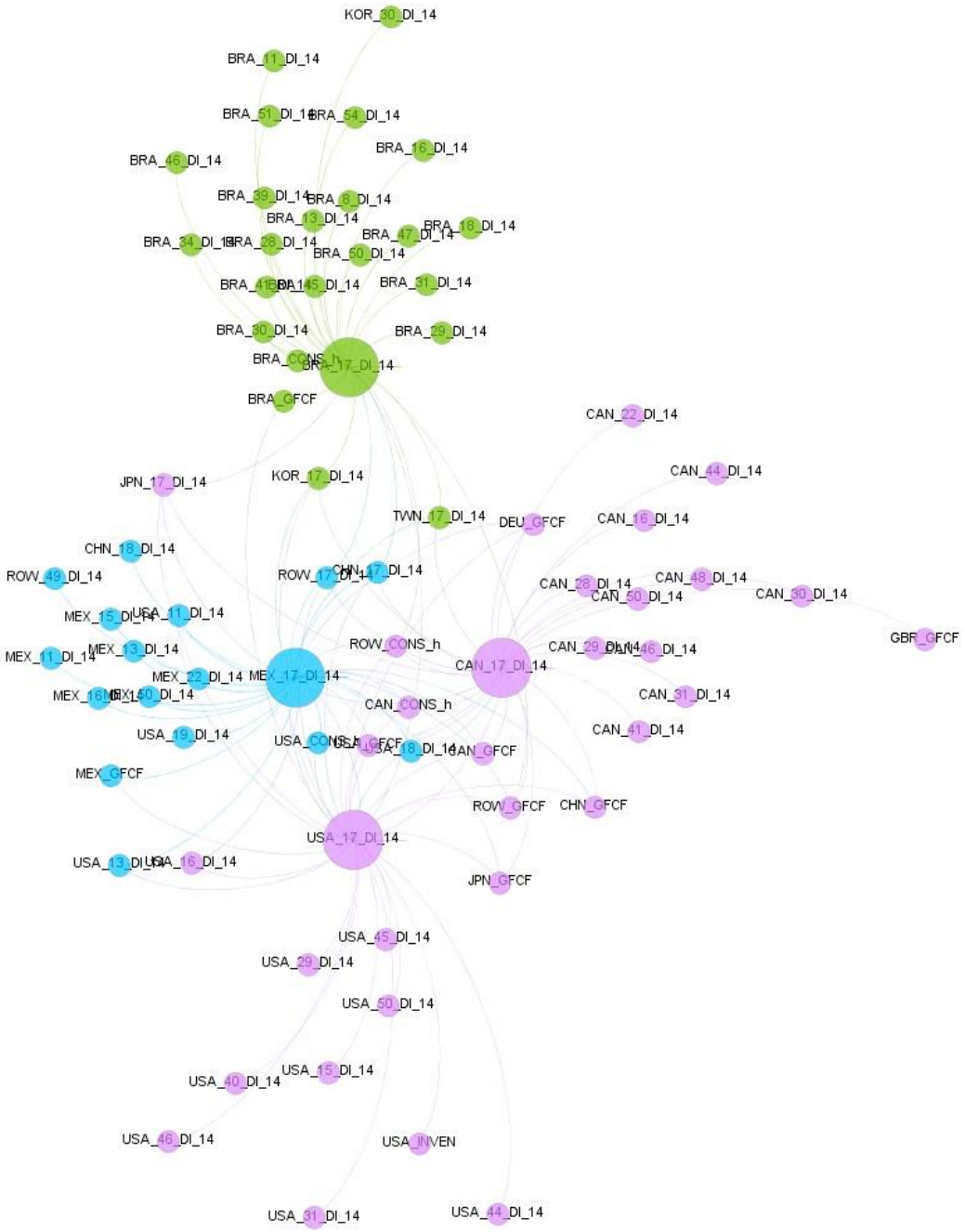
Table 3.3 Major imputs of the Asian electronic industry

COUNTRY	CHN	IDN	IND	JPN	KOR	TWN
CHN	69.1%	6.3%	3.6%	3.3%	6.8%	6.6%
FIN	0.0%	0.3%	0.1%	0.0%	0.0%	0.0%
IDN	0.0%	43.0%	0.1%	0.2%	0.1%	0.1%
IND	0.0%	0.3%	61.7%	0.0%	0.1%	0.0%
JPN	1.0%	3.8%	0.5%	49.9%	2.9%	4.3%
KOR	2.3%	1.4%	1.3%	1.0%	50.9%	2.8%
ROW	6.5%	13.2%	3.7%	4.1%	4.6%	9.6%
TWN	2.5%	0.6%	0.3%	1.7%	1.6%	35.0%
USA	0.3%	0.6%	0.5%	0.5%	1.3%	1.1%
Total general	81.7%	69.6%	72.0%	60.7%	68.4%	59.4%

It shows a high degree of integration within each country and at the level of the Asian region and to a lesser extent with the USA.

Below is the graph for NAFTA plus Brazil.

Figure 3.4: Graph associated with the NAFTA countries plus Brazil. 2014.



Highlights the hight level of inter-country integration of countries being high for Brazil, Canada and USA, although the latter country has a strong integration of inputs from Mexico. In turn, Mexico has a low integration inward and a high dependence on the USA and China. The high integration of Canada's NAFTA with the USA.

4. Regional patterns of the automotive industry

The group of the most important countries in automobile production is different from the one corresponding to the electronics industry. In particular the Nordic countries are not the most important, the selected European countries are important in this industry, as well as some Eastern European countries; the Asian nations that continue to be important, as well as the NAFTA region plus Brazil.

As for the European countries, there is a strong integration between the country and the intra-region as shown in Table 4.1,

Table 4.1 Major inputs of the European countries in automotive industry, 2014.

COUNTRY	AUT	BEL	DEU	ESP	FRA	GBR	ITA	PRT	ROW	RUS	SWE	USA
AUT	23.36%	0.53%	1.76%	0.71%	0.42%	0.42%	0.47%	0.43%	0.09%	0.17%	0.46%	0.16%
BEL	1.11%	15.63%	0.70%	0.56%	1.83%	1.00%	0.40%	0.73%	0.18%	0.26%	1.24%	0.06%
CHN	0.57%	1.84%	0.88%	1.39%	1.66%	1.72%	1.06%	0.70%	3.40%	2.21%	1.11%	2.13%
DEU	23.34%	14.21%	44.38%	8.80%	7.84%	6.41%	4.88%	12.47%	1.25%	5.64%	8.41%	1.34%
ESP	0.64%	2.14%	0.82%	38.25%	2.69%	1.51%	0.77%	14.36%	0.36%	0.27%	0.60%	0.11%
FRA	2.24%	6.70%	1.81%	9.59%	44.76%	2.55%	2.00%	5.21%	0.53%	1.49%	1.79%	0.19%
GBR	0.94%	3.23%	0.83%	0.96%	1.23%	46.87%	0.62%	0.72%	0.47%	0.47%	1.82%	0.28%
ITA	3.86%	2.21%	1.86%	3.63%	4.60%	1.52%	58.85%	2.20%	0.40%	0.59%	1.09%	0.33%
PRT	0.23%	0.32%	0.15%	2.05%	0.51%	0.21%	0.08%	27.35%	0.11%	0.01%	0.19%	0.01%
ROW	1.84%	3.31%	1.34%	4.13%	2.51%	1.76%	1.46%	2.08%	63.94%	2.86%	0.77%	1.67%
RUS	0.13%	0.18%	0.35%	0.06%	0.11%	0.41%	0.16%	0.03%	0.78%	52.33%	0.11%	0.08%
SWE	0.87%	7.04%	0.35%	0.42%	0.95%	0.53%	0.19%	0.40%	0.19%	0.49%	43.79%	0.08%
USA	0.64%	1.91%	0.65%	0.40%	1.31%	1.36%	0.52%	0.16%	1.61%	0.57%	1.00%	59.60%
SUBTOTAL	68.58%	75.28%	65.16%	78.44%	76.64%	72.90%	75.11%	72.19%	78.13%	77.13%	68.00%	75.12%

The integration is very important both intra as well as inter region, depending little on the Asian nations.

The Grafo associated with the Asian automotive industry is:

Figure 4.2: Graph associated with the Asian countries nin automotive industry. 2014

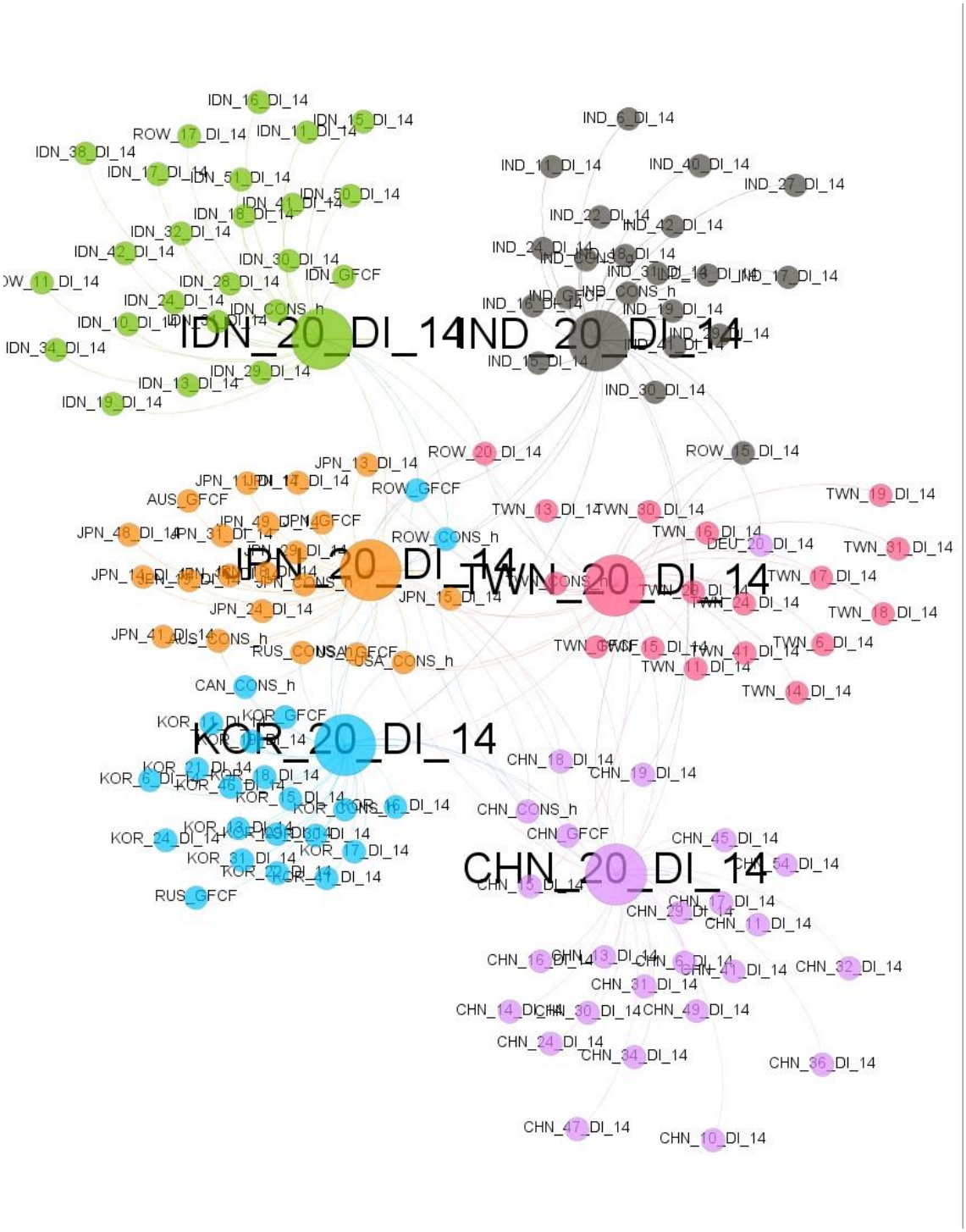
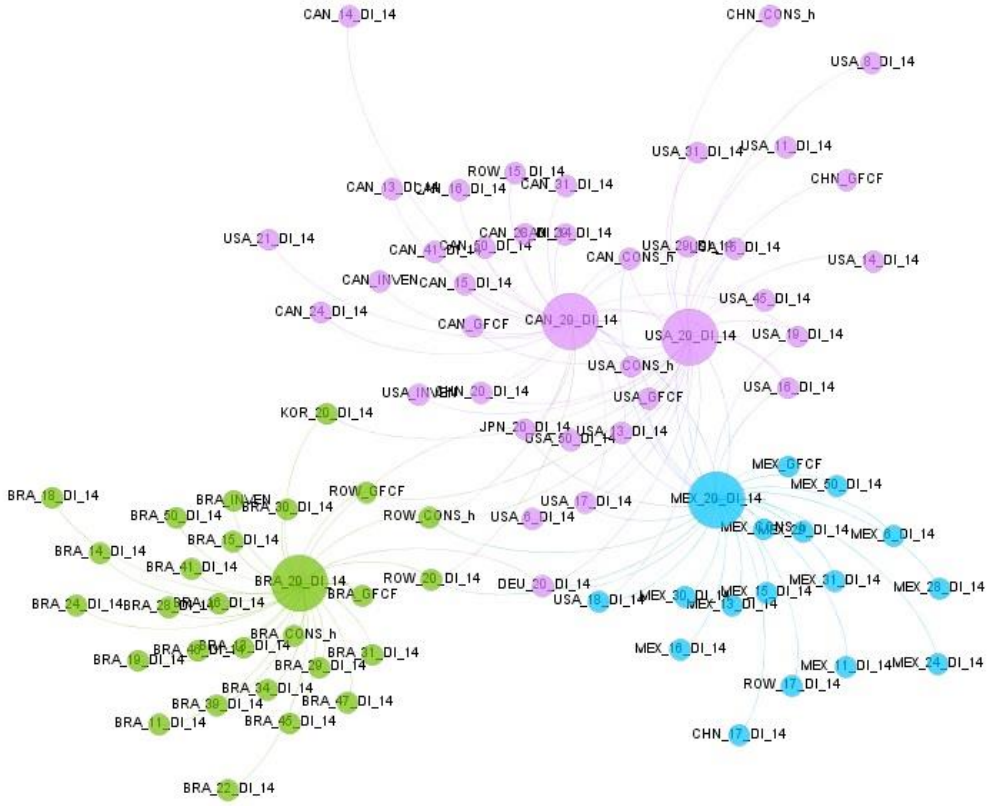


Table 4.2 confirms the analysis

There are strong intra-country and intra-region linkages.

Now the graph associated with the countries of NAFTA plus Brazil is presented.

Figure 4.2: Graph associated with the NAFTA countries plus Brasil. 2014



This is confirmed with Table 4.3.

Table 4.3: The major inputs in the NAFTA plus Brasil automotive

COUNTRY	BRA	CAN	MEX	USA
BRA	59.1%	0.3%	0.6%	0.2%
CAN	0.0%	32.6%	0.6%	2.2%
CHN	1.0%	1.9%	2.6%	2.1%
DEU	1.0%	0.7%	1.6%	1.3%
JPN	0.6%	2.3%	2.1%	1.7%
KOR	0.8%	0.6%	1.2%	0.9%
MEX	0.4%	2.0%	39.9%	3.3%
ROW	3.3%	2.7%	2.2%	1.7%
TWN	0.1%	0.5%	0.6%	0.5%
USA	0.8%	30.1%	16.5%	59.6%
SUBTOTAL	67.2%	73.7%	67.9%	73.4%

The endogenous capacity to create inputs is important although Mexico shows a lag and a strong dependence on the USA.

5. Conclusions

Mexico needs to implement industrial policies to favor a better progressive integration in global value chains to guarantee a better pattern of productive specialization in the process of global production fragmentation.

Directed anexo

Graphos theory allows a better representation of the opportunities of the countries in the global value chains.

Mexico has been more successful in the progression of value chains in the automotive industry.

Mexico needs to implement industrial policies to favor a better progressive integration in global value chains to guarantee a better pattern of productive specialization in the process of global production fragmentation.

6. Bibliografía:

Bouchain R., y J. A. Ramírez, (2017). Análisis comparativo del desempeño de las TIC's en México en el periodo 1995-2011 en un enfoque de eslabonamientos e industrias clave utilizando las IOTs de la OCDE, VII Jornadas de Análisis Input-Output, SHAIO. Mérida, Yucatán, México, septiembre de 2017.

Bouchain R., Diana, Diana y Rebecca Bouari, (2017) Comparación mundial del contenido de valor agregado en las exportaciones de los sectores electrónico y automovilístico: Cadenas Globales de Valor utilizando las ICIO-OCDE. VII Jornadas de Análisis Input-Output, SHAIO. Mérida, Yucatán, México, septiembre de 2017.

Gereffi, Gary y M. Korzeniewicz,. *Commodity Chains and Global Capitalism,* Wesport, *Praeger*. 1994, p.2.

Timmer, M., E. Dietzenbacher, B. Los, R. Stehrer, and G. De Vries, (2015). An Illustrated User Guide to the World Input-Output Database: the Case of Global Automotive Production. *Review of International Economics*, 23(3), pp.575-605.

Velázquez, Mariana. "La economía del conocimiento: análisis comparativo del sector electrónico entre México y los países de la OCDE". Informe de prácticas profesionales, México, 2014.

Timmer, M., B. Los, R. Stehrer, & G. De Vries. (2016) An anatomy of the global trade slowdon base don the WIOD release. University of Groningen, Groningen Growth and Development Centre.