



Structure of the network of the World Trade Organization: Challenges and opportunities for Mexico

Estructura de la red de la Organización Mundial de Comercio: desafíos y oportunidades para México

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Abstract

The studies on the structure of commercial networks are recurrent in configurations with a central nucleus and a block of countries in the periphery that foment inequitable and unequal exchanges. Consistent with this the objective of this study is to analyze structurally the centrality of the economic network of Mexico in the World Trade Organization and with it identify the opportunities and challenges for the country. The research method involve calculates centrality metrics based on network theory. It is concluded that the network has a stratified structure what challenges Mexico to replant its strategies of commercial insertion in Latin America and Asia Pacific for the development and the modernization of its economy.

JEL code: F02, F10, F15.

Keywords: structural Analysis of Networks; World Trade Organization; Trade Challenges of Mexico.

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Resumen

Los estudios en cuanto a la estructura de redes comerciales son recurrentes en configuraciones con un núcleo central y un bloque de países en la periferia, que fomentan inequitativos y desiguales intercambios. Consecuente con esto, el objetivo de este estudio es analizar estructuralmente la centralidad de la red económica de México en el marco de la Organización Mundial de Comercio y con ello identificar los desafíos y oportunidades para el país. El método de investigación implicó calcular métricas de centralidad fundamentadas en la teoría de redes. Se concluye que la red tiene una estructura estratificada, lo que desafía a México para replantear sus estrategias de inserción comercial internacional en América Latina y Asia Pacífico para el desarrollo y modernización de su economía.

Código JEL: F02, F10, F15.

Palabras clave: Análisis estructural de redes; Organización Mundial de Comercio; desafíos comerciales de México.

Introduction

The creation of a structure, comprised of a core and a periphery, is a paradigm in the study of the world system. An example of this is the stratified model of the core, semi-periphery and periphery by Wallerstein (1979), in which the international hierarchy and the trade exchange within and among the strata of the system have been examined; and although there is no consensus on its general validity, the studies reiterate the existence of strata despite differing in its number. It is in the cohesive core with high interrelation density where the developed countries reside and it is in the peripheries, that are weakly connected between each other, where the least developed reside (Borgatti and Everett, 1999; Wallerstein, 1979). This configuration encourages regional asymmetries that benefit the core of the perimeter more (Prebisch, 1964;1950), with high technological export patterns and processed products that circulate within the core and towards inferior strata, while the export of agricultural and raw material of the periphery circulate towards the superior blocks, including the core (Smith and White, 1992). Nevertheless, peripheral countries trade more with the basic core on which they have depended than with other countries from the periphery that are geographically closer (Wallerstein, 1979; Smith and White, 1992). Consistent with this, centrality metrics have been applied from the theoretical perspective of networks to confirm the existence of this structural configuration (Nordlund, 2013; Smith and White, 1992). It is due to this that the objective of this study was to analyze the structural centrality of the economic network of exports and imports of merchandise from Mexico in the framework of the World Trade Organization, in order to identify the challenges and opportunities for the country. For this, we utilized a quantitative research method that involved studying the economic exchange of the country under three structural attributes of the centrality metrics: closeness, degree of betweenness (Cherven, 2013; Jackson, 2008; Newman, 2003; Freeman, 1977, 1979), and the clustering coefficient (Watts and Strogatz, 1998). The results support a stratified configuration of the network, which warns governmental decision makers of an urgent need to review and reconsider the strategies for the international trade integration of Mexico in Latin American and the Asia-Pacific region as priorities for the development and modernization of its economy.

Mexico in the World Trade Organization

The growth of world trade has significantly deaccelerated since 2012. The volume of goods and services has increased a little more than 3% per year, less than half of the average rate of expansion in the last three decades (International Monetary Fund, 2016). The reasons for the deacceleration of trade are yet to be clearly understood; however, some of them have been the decrease in the rhythm of trade liberalization and the recent increase in protection measures (Evenett and Fritz 2015), despite the strong consensus among economists stating that a greater trade integration would contribute to the increase of productivity and the development of the economies, increasing the general well-being of the same (International Monetary Fund, 2016). For this reason, in order to favor the trade flow with as much freedom as possible, the World Trade Organization (WTO) has promoted it through world standards in its 164 member countries (World Trade Organization, 2016a) that represent more than 90% of the countries in the world, including the biggest economies regarding the size of their Gross Domestic Product (GDP). China, the United States and Germany are the leading nations for exports and imports in terms of the value of the international trade of goods in the WTO. Meanwhile, Mexico ranks 15 as exporter and 14 as importer (World Trade Organization, 2016b), it ranks 15 in terms of the size of its economy (The World Bank, 2016), and it takes sixth place as a receptor of Foreign Direct Investment among the developing and transition economies (United Nations Conference on Trade and Development, 2016). For the energy sector, Mexico ranks tenth as producer of crude oil and twelfth in natural gas worldwide (Pemex, 2014), while it ranks 12 in mining (Bancomext, no year). In its ease of doing business, Mexico ranks 38 among 189 countries (World Bank, 2016) and in the competitiveness ranking it is number 57 among 140 nations (World Economic Forum, 2016), which reveal the potential for the country to achieve a better position in the structure of foreign trade. However, they are insufficient for an eventual transition from the periphery to the core, which is also supported by its merchandise trade balance by having imported 411,581 million dollars and exporting only 397,506 million dollars with a negative balance (World Trade Organization, 2015a), or by its recurring growth average in the last ten years being low in imports, with a 6% with respect to 6.5% of country exports (Ministry of Economy, 2015). Although all of this can be explained to a large extent by Mexico's high trade dependency with the United States, as it concentrates 78.9% of the total of its exported merchandise, followed, although from a distance, by 5.2% to the European Union (World Trade Organization, 2015a). Among the main products that Mexico exports is crude oil at 11%, and passenger motor vehicles with 9% of its total exports (Organization for Economic Cooperation and Development, and World Trade Organization, 2015). Similarly, for the case of merchandise imported by the country, most of it comes from the United States (49.3%), 16.1% comes from China, and 11.3% from the European Union (World Trade Organization, 2015a). The import of parts and telecommunications equipment and oil products stand out with 7% of the total of imported products (Organization for Economic Cooperation and Development and World Trade Organization, 2015). Because of this, it is evident that the dependent relation with the main world power has caused trade with other countries or regions to decrease (Table 1). Furthermore, it has prevented Mexico from exploring other markets, despite the fact that Mexico is the second country with the greatest number of free trade agreements in the world, with 234 bilateral and 122 multilateral (Secretariat of Foreign Affairs, 2016), and has a strong potential to combine the diversification of its export destinations that would eventually allow

Mexico to take part in the global economic structure with other countries with high income levels (Foxley, 2012).

Table 1. Exports and imports of Mexico by regions

Regions	Exports (millions of dollars)	Percentage of Exports	Imports (millions of dollars)	Percentage
North America	319 333.6	86.26	196 750.0	54.29
European Union	18 440.0	4.98	43 722.4	12.06
Asia	12 278.30	3.31	110 201.40	30.40
South America	15 084.3	4.07	9 601.2	2.64
Central America	5 037.1	1.36	2 118.7	0.584
Total:	370 173.30	100%	362 393.70	100%

Source: Own elaboration based on the Ministry of Economy (2015) and the World Trade Organization (2015a).

Theoretical basis: core-periphery structure

The alternative explanation under the theoretical precepts of dependency, in order to understand the dynamics of global development and the relationships between developed and developing countries, has received considerable attention from economists around the globe; with them sharing the presumption of a global system with a stratified structure (Steiber, 1979) with a core, periphery and semi-periphery (Wallerstein, 1979), with increasingly more interdependent and complex relations (Kali and Reyes, 2010). To their understanding, the traditional study of bilateral trade flows is being replaced by new analyses based on the network theory. Three classic networks stand out in international literature: random (Erdős and Rényi, 1960), scale-free (Reka and Barbási, 2002), and small-world (Watts and Strogatz, 1998). These analyze several aspects of their structural and topological properties in their non-directed, directed, binary or pondered forms. There are studies that analyze international trade relations under this perspective of networks (Wlather, 2015; De Benedictis and Tajoli, 2011; Serrano, Boguñá and Vespignani, 2007). Some of these utilize network metrics to describe their structure and complexity (Rombach, Porter, Fowler and Mucha, 2014; Barigozzi, Fagiolo and Mangioni, 2011; Bhattacharya, Mukherjee, Sar'amaki, Kaski and Manna 2008; Mahutga, 2006; Garlaschelli and Loffredo, 2005; Serrano and Boguñá, 2003) and, by doing this, they attempt to measure the extent to which global economy has become integrated and/or evolved in time (Reyes, Schiavo and Fagiolo, 2008; Kim and Shin, 2002; Fujita, Krugman and Venables, 1999), or well, only in certain regions and/or specific sectors (Lámbarry, 2016; Amador and Cabral, 2016; Cerina, Zhu, Chessa and Riccabon, 2015; Ferrarini, 2013). Other studies consider how individual countries are conditioned by their position within the network and/or their level of centrality (Prell, Sun, Feng and Myroniuk, 2015; Mahutga, 2006), differentiating between the countries that are situated at the core and those in the periphery. The nations that are economically diversified, wealthy, powerful, and relatively independent from external control are at the core (Chirot, 1977). On the other end, peripheral nations that are the result of historic exploitation and their high dependency of core nations, are underdeveloped and in constant poverty (Richardson, 1986; Beckford, 1973).

It is in the innovative and cohesive core with high density of interrelations where the countries that generate and promote technical progress and that are leaders of world productive specialization reside; while in the subordinated peripheries in terms of technological dependency and international productive positioning, and with weak connections to one another, that the least developed nations are located (Borgatti and Everett, 1999; Friedman, 1973; Prebisch, 1950). A country is considered a core country in the global economy if it has a dominant role in international trade and if the movement of capital is usually from that country to other countries. Conversely, a country is considered to be in the periphery if it has a secondary or passive role in global trade, which makes it highly dependent of the core (Cárdenas, 2014; Meier and Baldwin, 1957). It is these countries outside the core that carry out more trades with the core, of which they have been historically dependent, than with other countries of the periphery, even when they are geographically closer (Wallerstein, 1979; Smith and White, 1992), thus drawing an unequal exchange pattern with asymmetrical flows of less processed products from the periphery to a change of costly products that are finished in the core (Rosales, 2015). This benefits the core more, regardless of where they are produced (Prebisch, 1950). Because of this, through the calculation of the core-periphery structure of a network, the aim is to determine which nodes are part of a densely connected core and which are part of a poorly connected periphery. One of the most popular methodologies to research the core-periphery structure is the one proposed by Borgatti and Everett (1999); although in recent years, it is possible to identify it with the network analysis software and thus, with respect to the trade structure, to validate the role of the economic, industrial, and export policies of the countries. This could in turn lead to changes and alter the structural position of a country in the economic international scope (Smith and White, 1992), or to know whether the world scenario is creating new asymmetrical relations in which the cores will be able to consolidate their hegemony and increase the economic distances with the periphery regions (Di Filippo, 1988; 1997).

Research method

This quantitative and transversal research presented the objective of structurally analyzing the centrality of Mexico in the economic network of its imports and exports in the World Trade Organization framework, to know its structure and functioning and to identify the challenges and opportunities for the country.

The study was carried out through the method used by Lámbarry (2016) and supported in the network theory, particularly in the analysis by Freeman (1979) on centrality metrics for nodes in their three structural properties, adapted to the trade context without losing sense of their dimensionality: 1. Closeness, 2. Degree, and 3. Betweenness. Additionally, two global metrics are considered: 1. The Freeman graph centralization measures (1979) and 2. The Watts and Strogatz clustering coefficient (1998), to determine the degree of interconnection of the countries in the trade network.

The study involved two phases of centrality analysis for two trade networks, the first for the World Trade Organization network and focusing on Mexico, and a second phase for the secondary network identified and comprised by the direct partners with which Mexico trades merchandise.

Centrality metrics: nodes and graphs

A graph is defined as a set of points or nodes that are not organized (p_i, p_j) where each one can be reached from the other, if there is a sequence of one or more corners (p_i, p_a), (p_a, p_b), (p_b, p_c)... (p_z, p_j) that start at p_i and which possibly go through intermediate points, $p_a, p_b, p_c \dots p_z$, ending at (Freeman, 1979).

The centrality metrics can be determined both for a point and for a graph by referring to any of its three structural attributes (Freeman, 1979): degree, betweenness, and closeness. It ranges between two values: a value of one when there are few main actors that concentrate the links and the larger number of relations, whereas a zero value means that all the nodes are linked; neither of the actors is more central than the other.

The following was considered for the interpretation of the three node centrality metrics that were used in this study:

The centrality of a node in terms of the *degree* of a point, is simply the number of points that are adjacent to it (Freeman, 1979). This measure is an indicator of the potential communication activity of the point. It is calculated as the degree or number of adjacencies for the point (Nieminen, 1974), (Equation 1).

$$C_D(p_k) = \sum_{i=1}^n a(p_i, p_k) \dots (1).$$

The centrality based on the *betweenness* structural property considers the point as central to the extent of its potential to control communication (Freeman, 1979), (Equation 2).

$$C_B(p_k) = \sum_{i < j}^n b_{ij}(p_k) \dots (2).$$

Regarding the *closeness* of a point, it is considered central to the extent that it can avoid the possible control of others. It is a measure of decentralization or reverse centrality: it grows according to the separation of the points, which in this sense means closeness. The independence of a point is determined by its *closeness* to the rest of the points of the graph (Freeman, 1979). Beauchamp (1965) proposes calculating it with the following equation:

$$3. C'_c(p_k) = \frac{n-1}{\sum_{i=1}^n d(p_i, p_k)} \dots (3)$$

As for the interpretation of the centrality metrics of the graph, the following was considered:

The Freeman centrality index (1977) (Equation 4), which is determined from one of the three different measures of centrality of a point. The graph is compact insofar as the distances between the couple of points that comprise it are small.

$$C_x = \frac{\sum_{i=1}^n [C_x(p^*) - C_x(p_i)]}{\max \sum_{i=1}^n [C_x(p^*) - C_x(p_i)]} \dots (4)$$

The clustering coefficient, grouping or transitivity, by Watts and Strogatz (1998), which quantifies the degree of cluster of the node (or interconnection) with its neighbors (equation 5):

$$C_i = \frac{a_i}{k_i(k_i-1)/2} \dots \quad (5)$$

The values of these coefficients range between a value of zero (no connection) and one (total connection).

Data collection

Information was collected from the Statistical Database and the Trade Profile of the World Trade Organization for the network analysis on the economic trade exchange between the current member countries up to the year 2015 from: <http://stat.wto.org/CountryProfile/WSDBCcountryPFHome.aspx?Language=E>, which involved building a matrix with a structure comprising the country of origin, type of relation (import or export), country of destination, and value of the relation (expressed in percentage of imports and exports according to the main origin or destination countries), which resulted in a matrix with 1,528 records. This matrix is necessary for the calculation of the centrality and cluster coefficients in the software Cytoscape ver. 3.3.0 for the analysis of social networks, (annex Table A1). The treatment of the data did not comprise a process of homologation or depuration for the correct standardization of the database of the WTO.

Analysis and Results

The economic trade network generated by the exchanges of imports and exports of merchandise between the members of the World Trade Organization presents a total of 186 nodes as general parameters, which represent the totality of the countries that maintain a trade relation (annex Figure 1). From those, the European Union comprises the set of countries with the highest potential commercialization activity in the entire network, as they have the highest metrics with 287, followed by China with 221 and the United States with 204, very distant from Japan, which ranks fourth with a value of 80. The clustering coefficient of the network represents the value that indicates the existence of a 52% interconnection between members. In this sense, Honduras, Hungary and Bulgaria have a coefficient of one, followed by Uruguay, Luxembourg and Ireland with 0.9333. However, it stands out that the European Union, China and the United States are the countries with the lowest clustering coefficients, with values below 0.1, while 24 nations present values of zero.

The centrality index of 0.743, evidences that the network is compact and in general that there is a strong trade closeness between all the countries in the framework of the World Trade Organization. This high centrality also reveals the existence of at least one member in the economic network that, due to its nuclear position, governs that of the rest (European Union, China, and the United States). One of the big disadvantages of this structure is a poorly effective integration, in which eventually, if the core country decides to withdraw from it, the connection

between the rest of the countries would be destabilized, putting the economy at risk, as well as the multilateral relations of the block. Although at a node level these values are associated with the independence of the country with respect to the others, in this sense, the European Union (with the coefficient with the highest value of 0.814) represents the group of nations with the greatest independence concerning trade exchanges; it is followed by China with a coefficient of 0.793, and the United States with 0.702. Therefore, these are the countries that comprise the core of the network, coinciding with their greater economic weight in terms of the Gross Domestic Product when compared to that of the other trading partners.

In the same trend, once again it is the European Union that shows the highest betweenness metrics with a value of 0.319, followed by China with 0.287, and the United States with 0.163. This represents the significant potential that these countries have to control the exchange of trade activity, which evidences a marked difference from the rest of the WTO members that have values below 0.04.

From this perspective, Mexico has a clustering coefficient of 0.470 within the World Trade Organization (annex Table A2), which is slightly below the average coefficient of the network (0.522) and, therefore, the country has an interconnection of 47% that is below the mean with respect to other countries. This indicates an evident underutilization of its potential to establish trade exchanges with the other members of the WTO, limiting itself to a small number of them (core countries) or to a low level of exports and imports (periphery partners).

The closeness metric of the country has a value of 0.479, which indicates that the country is moderately independent with respect to the other countries, as it is above the mean of 0.450, although it is distant from the highest value of 0.814. Despite these metrics, the betweenness coefficient of Mexico is even lower than the average value of the network, which is at 0.007 while that of Mexico is at 0.001. Therefore, its potential to control trade exchange is inexistent. In short, apart from this last coefficient that is distant from the mean, which is negative in terms of centrality, the other two metrics are close to the averages, but are in turn distant from the core countries. This confirms the peripheral position of the country, which is explained in first instance by its lack of technical generation, but also by a scarce diversification and internal integration of productive and export structures.

That said, when selecting the secondary network that constitutes Mexico, 19 nodes or countries that comprise it (annex) are identified. In a first comparative analysis of the average values of the world centrality metrics with respect to those of the World Trade Organization network, it can be observed that in the secondary network there is a smaller cluster, with a coefficient of 0.507 against 0.522, a greater closeness of 0.523 by 0.45 of the WTO network, and a greater betweenness of 0.043 against 0.007. This indicates that this secondary trade network has a smaller interconnection between countries and, therefore, a lower export and import exchange flow of merchandise, in addition to a greater trade independence between them and the inexistence of a country that controls trade. Although the same structure of the WTO network of the countries with the highest coefficients of closeness is confirmed in this secondary network, the European Union with a value of 0.814, China with a coefficient of 0.793, and the United States with 0.702 (although not significant when compared to the rest of the countries in the block) indicate that despite the fact that there is market integration, these leader countries have a high trade independence. Given the aforementioned, these countries would not be affected in the event that trade relations are interrupted, perhaps with the exception of Honduras, which has the lowest closeness value (0.464) but is not that far from the average

of the network (0.523). This is the case for Mexico, which is slightly below the average value with a closeness coefficient of 0.479.

Concerning the betweenness metric, this stratified trend of the countries that comprise the core of the secondary network is once again replicated, as they are the same countries that lead the closeness metric: the European Union with 0.319, China with 0.287, and the United States with 0.163; even with values far above the rest of the countries that average a 0.043 value. The same happens for the coefficient of degree, while Japan ranks fourth with a value of 80, it is distant from the leading countries, the United States with a coefficient of 204, China with 221 and the European Union with 287, a coefficient that represents the countries with which they carry out merchandise trade exchanges.

On the subject of the clustering coefficient, Honduras shows the highest value every time it results in magnitude one and, in the same manner, this nation also presents the lowest values in closeness and betweenness, followed by El Salvador with a cluster of 0.982, sharing the lowest values in the other two centrality coefficients with Honduras. Although these indicate a good interconnection between these countries with respect to the rest in the block, they also provide evidence of a high dependency and a low potential for the trade control of the secondary network. Conversely, the European Union with a coefficient of 0.071, China with 0.072 and the United States with 0.086, are the countries with the lowest clustering coefficients, even below the average value of 0.507. This reveals the little interest they have in the effective trade interconnection and integration of the network, which is largely attributable to their efforts to maintain their status quo, associated with the core position and to the lack of more equitable policies and trade agreements that stimulate the economic and trade development of the countries.

On the other hand, a correlation analysis determined that the clustering coefficient presented a pronounced negative inverse correlation at -0.728 with the closeness coefficient, and of -0.65 with the betweenness coefficient, while these last two coefficients presented a high correlation of 0.998. This confirms that those countries with the highest values of closeness and intermediation have the lowest clustering coefficients, and those nations with the highest closeness coefficients also have the highest intermediation values.

In short, China, the United States and the European Union are the core countries of the secondary network of Mexico, having the highest structure centrality coefficients except for the clustering coefficients. In the case of Japan, Brazil, the Korean Republic and Canada, these are the economies with greater possibilities of advancing to the core, slightly more distant is Mexico, but this latter has better structure centrality coefficients than the rest of the Central American and South American countries of the periphery (annex).

Conclusions

A first conclusion of this study derived from the centrality metrics of the economic network of exports and imports of the World Trade Organization, is the existence of stratified hierarchical structures, consistent with the statements made by de Smith and Wallerstein (1979), Smith and White (1992) and Nordlund (2013) in their studies of the global system. The network shows a nuclear configuration that is governed by China, the European Union and the United States, which are the countries with the coefficients of closeness, degree, and betweenness with the highest value, which is presumably correlated with the size of their economies, and confirm

based on these metrics the concept of core-periphery, being the generators and promoters of technical progress and leaders of the world productive specialization.

This same stratified configuration is replicated in the secondary network of Mexico and its direct trading partners, which indicates an ineffective centralized structure that favors the economies located at the core, with a high dependency of the periphery countries on the core countries. This is a configuration in which eventually, should the core country decide to withdraw from it, the trade exchange between the rest of the countries would be destabilized, putting their economies at risk. Therefore, these nations govern the trade exchange due to their core position, as suggested by Friedmann (1966) and Uzzi and Spiro (2005). Furthermore, these core countries have low clustering coefficients that contrast with those of the rest of the countries, revealing the little interest they have in the effective trade interconnection and integration of the network, which is attributable, among other factors, to their efforts to maintain their status quo associated with their core position in the network.

Although from the perspective of the periphery (due to the proximity of the values of the centrality and clustering coefficients of these countries) it is concluded that there is an equal and homogeneous periphery; the low coefficients of the countries, which are below the average value, result in an inefficient trade structure with a small reach regarding their insertion in the global economy.

The results of this study confirm the status of Mexico as a country located in the periphery of the WTO network. For this reason, it is suggested that the competitiveness and economic development of Mexico should be encouraged. One of the options to achieve this is to strengthen its trade relations with Central and South America, specifically with those countries which, due to their structural position, comprise the periphery of the secondary network of Mexico. This should be done first with Colombia, Nicaragua and Belize, which are countries that possess similar metric values of centrality and which would represent a supply chain for Mexican producers in the export of final products to the Asia-Pacific region. It is necessary to consolidate a regional trade integration for the future dynamics of Mexican economy, be it through a regional block that is exclusively Asian, one for the Asia-Pacific region, or one that focuses on China.

An additional conclusion that supports the above is to consolidate the Asian market, which has displaced the Latin American market (annex), confirmed from the perspective of the high centrality coefficients of China, Japan and the Korean Republic. These countries represent a potential market for a wide variety of consumer goods that the Mexican economy could offer under competitive conditions. However, the growing threat of Chinese manufacture that causes Mexico to lose ground in global markets, the possibility of a long period of slow growth in the European Union, and the high vulnerability of Mexico due to its high trade dependency on the United States, makes it a priority to come up with a strategy that is focused on the diversification of destination and export structures. Due to the above, we present the urgent need to revise and reconsider the strategies for the international insertion of this country in Latin America and the Asia-Pacific region as a priority for the development and modernization of its economy. A recommendation for future works in this subject is to delve into the analysis of structural centrality by type of exported and imported merchandise from the secondary network of Mexico, in order to identify the trade that is based on regional productive and strategic value chains, which should be the focus of these countries for the equal development

of their economies; a task that is not considered to be easy due to the costs implied by the possible structural changes in the economic system.

References

- Amador, J. & Cabral, S. (2017). Networks of Value-added Trade. *The Work Economy*, 40 (7), 1291-1313. <https://doi.org/10.1111/twec.12469>
- Bancomext. (sin año). Macro Coyuntura Minería. Disponible en: http://www.bancomext.com/wp-content/uploads/2015/08/Minero_1er_informe_2015.pdf
- Banco Mundial (2016). Doing Business. Disponible en: <http://espanol.doingbusiness.org/rankings>
- Barigozzi, M., Fagiolo, G., Mangioni, G. (2011). Identifying the community structure of the international-tradmulti-network. *Physica A: Statistical Mechanics and its Applications*. 390(11), 2051–2066. <https://doi.org/10.1016/j.physa.2011.02.004>
- Bhattacharya, K., G. Mukherjee, J. Sar'amaki, K. Kaski & Manna, S. (2008). The International Trade Network: Weighted Network Analysis and Modeling. *Journal of Statistical Mechanics: Theory and Experiment*. A, 2: P02002.
- Beauchamp, M.A. (1965). An improved index of centrality. *Behavioral Science*, 10,161-163. <https://doi.org/10.1002/bs.3830100205>
- Beckford, G. (1973). Review: Persistent Poverty: Underdevelopment in Plantation Economies of the Third World. *The Economic Journal*, 83(332), 1321-1324. DOI: 10.2307/2230878
- Borgatti, S.P. & Everett, M.G. (1999). Models of core-periphery structures. *Social Networks*, 21, 375– 395. DOI: 10.1016/S0378-8733(99)00019-2
- Cárdenas, J. (2014). *El poder económico mundial: Análisis de redes de interlocking directorates y variedades de capitalismo*. Madrid: Centro de Investigaciones Sociológicas.
- Cerina, F., Zhu, Z., Chessa, A., & Riccaboni, M. (2015). World Input-Output Network. *PLOS ONE*, 10(7), e0134025. <https://doi.org/10.1371/journal.pone.0134025>
- Cherven, K. (2013). *Network Graph Analysis and Visualization with Gephi*. United Kindom: Packt Publishing.
- Chirot, D. (1979). Review: Social Change in the Twentieth Century. *American Journal of Sociology*, 84(5), 1275-1278 <http://www.jstor.org/stable/2778234>
- De Benedictis, L. & Tajoli, L. (2011). TheWorld Trade Network. *The World Economy*, 8(34), 1417–1454. doi: 10.1111/j.1467-9701.2011.01360.x
- Di Filippo, A. (1997). *Multilateralismo y Regionalismo en la Integración de América Latina*. Documentos de trabajo, No. 46, Santiago de Chile: Comisión Económica para América Latina y el Caribe. Disponible en: http://repositorio.cepal.org/bitstream/handle/11362/7367/S9700500_es.pdf?sequence=1&isAllowed=y
- Di Filippo, A. (1988). La visión centro-periferia hoy. *Revista de la CEPAL*. No. Extraordinario, 175-185. Disponible en: <http://www.cepal.org/publicaciones/xml/1/19381/difil.htm>
- Evenett, J. S, & Fritz, J. (2015). *The Tide Turns? Trade Protectionism and Slowing Global Growth*, Global Trade Alert, Centre for Economic Policy Research Press. Disponible en: http://voxeu.org/sites/default/files/file/GTA18_final.pdf
- Ferrarini, B. (2013). Vertical trade maps. *Asian Economic Journal*, 27(2), 105–123. doi: 10.1111/asej.12005
- Foxley, A. (2012). *La trampa del ingreso medio. El desafío de esta década para América Latina*. Chile: CIEPLAN. Disponible en: http://www.cieplan.org/media/publicaciones/archivos/308/Libro_Digital_La_trampa_del_ingreso_medio.pdf
- Friedmann, J. (1973). *Urbanization, planning and national development*. Beverly Hills: Sage.
- Freeman, L. (1979). Centrality in Social Networks Conceptual Clarification. *Social Networks*, 1, 215-239. [https://doi.org/10.1016/0378-8733\(78\)90021-7](https://doi.org/10.1016/0378-8733(78)90021-7)
- Freeman, L. (1977). A Set of Measures of Centrality Based on Betweenness. *Sociometry*, 40(1), 35-41. DOI: 10.2307/3033543

- Fujita, M, Krugman P. & Venables, A. (1999). *The Spatial Economy: Cities, Regions and International Trade*. Cambridge: The MIT Press. Disponible en: http://geografi.ums.ac.id/ebook/The_Spatial_Economy-Fujita_Krugman_Venables.pdf
- Garlaschelli, D., & Loffredo, M. (2005). Structure and evolution of the world trade network. *Physica A, Statistical Mechanics and its Applications*, 355(1), 138-144. <https://doi.org/10.1016/j.physa.2005.02.075>
- International Monetary Fund (2016). *World Economic Outlook (WEO). Subdued Demand: Symptoms and Remedies*. Disponible en: <http://www.imf.org/external/pubs/ft/weo/2016/02/index.htm?cmpid=Obanner#ch2>
- Jackson, M. (2008). *Social and Economic Networks*. Disponible en: <http://web.stanford.edu/~jacksonm/netbook.pdf>
- Kali, R., & Reyes, J. (2010). Financial contagion on the international trade network. *Economic Inquiry*, 48(4), 1072–1101. doi: 10.1111/j.1465-7295.2009.00249.x
- Kim, S., & Shin, EH. (2002). A longitudinal analysis of globalization and regionalization in international trade: a social network approach. *Social Forces*, 81(2), 445–471. Disponible en: <http://www.jstor.org/stable/3086478> <https://doi.org/10.1353/sof.2003.0014>
- Lámbarry, Vilchis, F. (2016). Análisis estructural de la red económica de exportaciones e importaciones de la Alianza del Pacífico y el Mercado Común del Sur. *Estudios Gerenciales*, 32(141), 319-325. <http://dx.doi.org/10.1016/j.estger.2016.10.004>
- Mahutga, M. (2006). The persistence of structural inequality? a network analysis of international trade, 1965–2000. *Social Forces*, 84(4), 1863–1889. <https://doi.org/10.1353/sof.2006.0098>
- Meier, G. M. y Baldwin, R. E. (1957). *Economic Development: Theory, History, Policy*, New York: John Wiley & Sons. DOI: <https://doi.org/10.1017/S0022050700088860>
- Nemeth, R, y Smith, D. A. (1985). International Trade and World-System Structure: A Multiple Network Analysis. *Review Fernand Braudel Center*, 8(4), 517-560.
- Newman, M. (2003). The structure and function of complex networks. *SIAM Review*, 45(2), 167-256.
- Nieminen, J. (1974). On centrality in a graph. *Scandinavian Journal of Psychology*, 15, 332-336. DOI <http://onlinelibrary.wiley.com/doi/10.1111/j.1467-9450.1974.tb00598.x/pdf>
- Nordlund, C. (2013). Seminario departamental. *Core-periphery Structures: Operationalizing patterns of dependence and dominance in binary and valued networks*. Disponible en: <https://www.ceu.edu/event/2013-11-21/core-periphery-structures-operationalizingpatterns-dependence-and-dominance-binary>
- Organisation for Economic Cooperation and Development y World Trade Organization. (2015). *Aid for Trade at a Glance 2015 Reducing Trade Costs for Inclusive, Sustainable Growth*. Disponible en: http://www.keepeek.com/Digital-AssetManagement/oced/development/aid-for-trade-at-a-glance-2015_aid_glance-2015en#.WA_SMtXh-DX4#page3
- Organización Mundial del Comercio. (2016a). *Acerca de la OMC*. Disponible en: https://www.wto.org/spanish/thewto_s/whatis_s/who_we_are_s.htm
- Organización Mundial del Comercio. (2016b). *Trade Profiles*. Disponible en: <http://stat.wto.org/CountryProfile/WSD-BCountryPFHome.aspx?Language=E>
- Pemex. (2014). *Anuario estadístico 2014*. Disponible en: http://www.pemex.com/ri/Publicaciones/Anuario%20Estadistico%20Archivos/2014_ae_00_vc_e.pdf
- Prebisch, R. (1950). *The economic development of Latin America and its principal problems*. New York: Cepal. Disponible en: <http://archivo.cepal.org/pdfs/cdPrebisch/002.pdf>
- Prebisch, R. (1964). *Hacia una dinámica del desarrollo latinoamericano*. México, D.F.: Fondo de Cultura Económica. Disponible en: https://repositorio.cepal.org/bitstream/handle/11362/14230/S33898P922H_es.pdf?sequence=1
- Prell, C., Sun, L., Feng, K., & Myroniuk, TW. (2015). Inequalities in Global Trade: A Cross-Country Comparison of Trade Network Position, Economic Wealth, Pollution and Mortality. *PLoS ONE*, 10(12): e0144453. doi:10.1371/journal.pone.0144453
- Reka, A., & Barabási, A.L. (2002). Statistical mechanics of complex networks. *Review of Modern Physics*, 74(1), 47–97. <https://doi.org/10.1103/RevModPhys.74.47>
- Reyes, J., Schiavo, S., y Fagiolo, G. (2008). Assessing the evolution of international economic integration using random-walk betweenness centrality: The cases of East Asia and Latin America. *Advances in Complex Systems*, 11(5), 685–702. <https://doi.org/10.1142/S0219525908001945>

- Richardson, H.W. (1986). *Economía regional y urbana*. Madrid: Alianza.
- Rombach, P., Porter, M.A., Fowler, J.H., y Mucha P.J. (2014). Core-Periphery Structure in Networks. *SIAM Journal on Applied Mathematics*, 74(1), 167–190. <https://doi.org/10.1137/120881683>
- Rosales, O. (2015). *Globalización, integración y comercio inclusivo en América Latina. Textos seleccionados 2010-2014*. Disponible en: http://repositorio.cepal.org/bitstream/handle/11362/38952/S1500632_es.pdf
- Secretaría de Economía. (2015). Comercio Exterior/Información Estadística y Arancelaria/Importaciones y exportaciones por país 1993–2016/Por socios. Disponible en: <http://www.gob.mx/se/documentos/comercio-exterior-informacionestadistica-y-arancelaria-importaciones-y-exportaciones-por-pais-1993-2016-porsocios>
- Secretaría de Relaciones Exteriores, (2016). Información General de México. Disponible en: consulmex.sre.gob.mx/guangzhou/index.php/zh/economia-y-comercio/mexico.
- Serrano, M.A., y Boguñá, M. (2003). Topology of the World Trade Web. *Physical Review E*, 68 (015101). doi: <https://doi.org/10.1103/PhysRevE.68.015101>
- Serrano, M.A., Boguñá, M., y Vespignani, A.J. (2007). Patterns of dominant flows in the world trade web. *Journal of Economic Interaction and Coordination*, 2(2), 111-124. doi:10.1007/s11403-007-0026-y
- Smith, D.A. y White, D.R. (1992). Structure and dynamics of the global economy: Network analysis of international trade 1965–1980. *Social Forces*, 70(4), 857–893. <https://doi.org/10.2307/2580193>
- Steiber, S. (1979). The World System and World Trade: An Empirical Explanation of Conceptual Conflicts. *The Sociological Quarterly*, 20(1), 23-36. <https://doi.org/10.1111/j.1533-8525.1979.tb02182.x>
- The World Bank (2016). GDP Ranking. Disponible en: <http://data.worldbank.org/datacatalog/gdp-ranking-table>
- United Nations Conference on Trade and Development. (2016). world investment report Investor Nationality: Policy Challenges 2016. Disponible en: http://unctad.org/en/PublicationsLibrary/wir2016_en.pdf
- Uzzi, B., & Spiro, J. (2005). Collaboration and Creativity: The Small World Problem. *American Journal of Sociology*, 111(2), 447–504. <https://doi.org/10.1086/432782>
- Watts, D. J., & Strogatz, S. H. (1998). Collective Dynamics of “Small-World” Networks. *Nature*, 393, 440–442. <https://doi.org/10.1515/9781400841356.301>
- Wallerstein, I. (1979). *The Capitalist World-Economy*. United Kingdom: Cambridge University Press. Disponible en: <http://catdir.loc.gov/catdir/samples/cam034/78002955.pdf>
- Wlather, O.J. (2015). Social Network Analysis and informal trade. SSRN Electronic Journal. doi:10.2139/ssrn.2593021
- World Economic Forum (2016). Competitiveness Rankings. Disponible en: <http://reports.weforum.org/global-competitiveness-report-2015-2016/competitiveness-rankings/>
- World Trade Organisation. (2015a). Trade Profiles. Disponible en: <http://stat.wto.org/CountryProfile/WSDBCountryProfile.aspx?Language=E&Country=MX>
- World Trade Organisation. (2015b). Trade Profiles. Disponible en: <http://stat.wto.org/CountryProfile/WSDBCountryProfile.aspx?Language=E&Country=E28>

Annex

Table A1 Example of the export-import matrix of the countries of the WTO

Origin	Relation	Destination	Value*
Albania	Exports	European Union (28)	76.7
Albania	Exports	Serbia	7.5
Albania	Exports	China	4.6
Albania	Exports	Turkey	3.7
Albania	Exports	FYR Macedonia	3.7
Albania	Imports	European Union (28)	64.2
Albania	Imports	China	6.8
Albania	Imports	Turkey	6.4
Albania	Imports	Serbia	4.1
Albania	Imports	United States of America	2.4
Antigua and Barbuda	Exports	United States of America	27.1
Antigua and Barbuda	Exports	European Union (28)	25.2
Antigua and Barbuda	Exports	Curaçao	7.3
Antigua and Barbuda	Exports	New Zealand	5.3
Antigua and Barbuda	Exports	Montserrat	3.0
Antigua and Barbuda	Imports	United States of America	52.3
Antigua and Barbuda	Imports	European Union (28)	10.4
Antigua and Barbuda	Imports	China	5.7
Antigua and Barbuda	Imports	Trinidad and Tobago	4.5
Antigua and Barbuda	Imports	Japan	3.0
.....

Source: Own elaboration based on the World Trade Organization. (2016b).

Note: *percentage of exports/imports.

Table A2
 Mexico direct network in the framework of the World Trade Organization

Country	Ranking (GDP)	2014	GDP 2015* Export	Ranking Import	Closeness	Betweenness	Cluster	Degree	
European Union	N/A		16 301 833**	2	2	0.81415929	0.31928949	287	
China	2		10 866 444	1	3	0.79310345	0.28700141	0.07147517	221
United States	1		17 946 996	2	1	0.70229008	0.16333292	0.07272001	204
Japan	3		4 123 258	4	4	0.54599407	0.0289463	0.0862259	80
Brazil	9		1 774 725	25	25	0.49329759	0.00506625	0.15793152	39
Korean Republic	11		1 377 873	4	4	0.49197861	0.0042901	0.28307692	35
Canada	10		1 550 537	11	10	0.49066667	0.0035352	0.26461538	33
Mexico	15		1 144 331	13	12	0.47916667	0.00110394	0.26	26
Colombia	38		292 080	56	47	0.47179487	4.95E-04	0.47058824	18
Nicaragua	123		12 693	107	110	0.46938776	0.00358309	0.52564103	14
Belize	170		1 763	159	172	0.46819338	0.00372924	0.58181818	10
Guatemala	71		63 794	83	78	0.46819338	1.87E-04	0.52777778	16
Cuba	66		77 150	112	83	0.46819338	1.41E-04	0.77777778	10
Cape Verde	171		1 630	185	182	0.46700508	1.00E-04	0.69444444	10
Costa Rica	79		51 107	86	82	0.46700508	8.16E-05	0.77777778	12
Panama	78		52 132	80	75	0.46582278	1.66E-04	0.78571429	15
Argentina	21		548 055	46	46	0.46582278	1.02E-04	0.66666667	19
El Salvador	103		25 850	103	93	0.46582278	4.02E-05	0.75	14
Honduras	107		20 152	92	91	0.46464646	0	0.89285714	12
Average:						0.523818114	0.043220587		57

Source: Elaborated with data from The World Bank (2016) and the World Trade Organization, (2015b).

* Million dollars.

** Data from 2015 from the World Trade Organization (2015b).

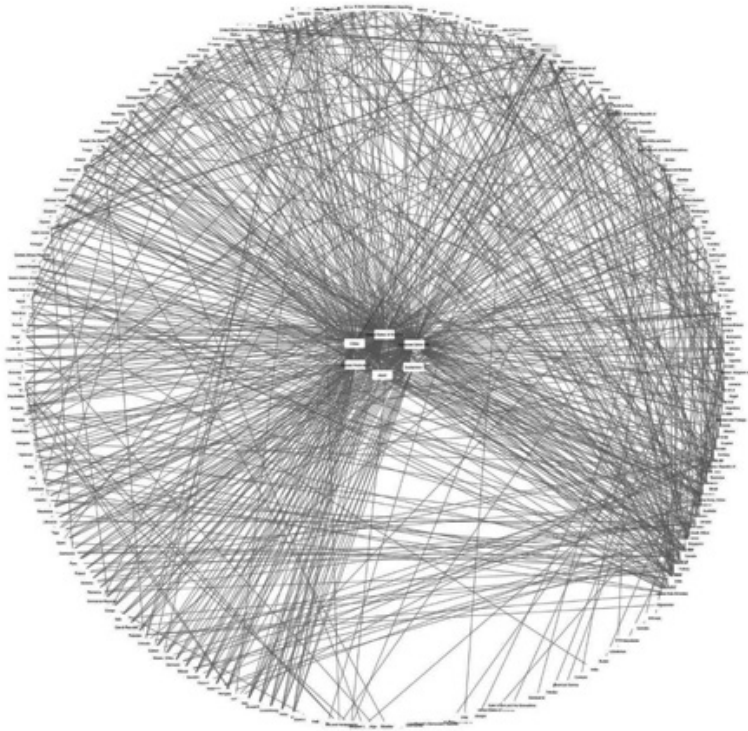


Figure 1. Import-Export network of the WTO: Mexico

Source: Own elaboration with data from the WTO and Cytoscape version 3.3.0.

Note: The countries in the core are the ones that present the greatest centrality coefficients.