

**Mexican automotive sector's competitive indicators analysis****Análisis de los indicadores competitivos del sector automotriz mexicano**

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**Abstract**

Competitiveness indicators identify the index of degree of export openness of a producer country's exports in the international market, taking into account its local production. The general objective of the presentation describes the competitiveness indicators presented by the Automotive Industry in the international market that will allow us to know how important automotive imports are and how significant they are with respect to exports; and how the trade balance influences local consumption taking into account national production. It is proposed as a hypothesis that the application of the indicators identifies the competitiveness of the Automotive Industry, as well as the country's ability to sustain its domestic demand considering automotive exports to the international market. The methodology is through the measurements that were made to the production, exports and imports of the Automotive Industry in Mexico, in the period 2005-2020.

**Indicators, Competitiveness, Automotive industry, Exports, Imports****Resumen**

Los indicadores de Competitividad identifican el índice de grado de apertura exportadora de las exportaciones de un país productor en el mercado internacional tomando en cuenta su producción local. El objetivo general de la ponencia describe los indicadores de competitividad que presenta la Industria Automotriz en el mercado internacional que permitirá saber qué tan importantes son las importaciones automotrices y que significativas son con respecto a las exportaciones; y cómo influye la balanza comercial en el consumo local tomando en cuenta la producción nacional. Se plantea como hipótesis, que con la aplicación de los indicadores se identifica la competitividad de la Industria Automotriz, así como la capacidad que posee el país de sustentar su demanda interna considerando las exportaciones automotrices al mercado internacional. La metodología es mediante las mediciones que se realizaron a la producción, las exportaciones e importaciones de la Industria Automotriz en México, en el periodo 2005-2020.

**Indicadores, Competitividad, Industria Automotriz, Exportaciones, Importaciones****Citation:** BONALES-VALENCIA, Joel. Mexican automotive sector's competitive indicators analysis. *Journal of Mechanical Engineering*. 2021. 5-16:1-11.

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## Introduction

The Automotive Sector is one of the most important worldwide, in recent years it has had an important relevance due to its high contribution to the economic development of Mexico, it is also one of the main generators of foreign exchange, it is an important generator of direct jobs and it is the main recipient of foreign direct investment. It is observed that Mexico is among the most prominent countries in the production and export of automobiles, therefore it becomes the sixth largest producer and fourth largest exporter of automobiles worldwide.

Mexico, the second largest economy in Latin America, has one of the most important manufacturing industries in the region. The industrial sector is of utmost importance for the country, since it represents more than 17% of its gross domestic product (GDP). Thanks to him, Mexico provides raw materials and industrial inputs to many international markets, from food and beverages to more technologically sophisticated goods such as automobiles. The automotive industry is, in fact, one of the pillars of the Mexican manufacturing sector. So much so that Mexico is the Latin American country that produces the largest number of motor vehicles and also holds the sixth position among the largest automobile producers worldwide (Burgeño, 2020).

That is why Mexico has experienced surprising success in its automotive industry in relation to the advancement of its production, changes in the production organization and its international competitiveness. And, the Automotive Industry plays a very important role, since since the beginning of this industry there has been an increase in the economic growth of Mexico, due to its great potential as a generator of jobs, technology transfer and attraction of investments. Exports have experienced a notable increase during the last decade, so much so that production in foreign markets constitutes the main development path for companies to achieve internationalization.

The automotive industry plays a strategic role in the Mexican economy, has a wide supply and competitive advantages worldwide in qualified and competitive labor, a privileged geographical position and preferential access to the main markets of the world (SE, 2012).

However, given the need to increase competitiveness to be able to face international markets, the technological infrastructure of the sector had to be modernized; A situation that was adapted in parallel to the structural adjustments made by the North American companies. Faced with this situation, North American companies began to increase their investments in the northern part of Mexico (Vicencio, 2007).

In this order, competitive advantage grows fundamentally due to the value that a company is capable of generating. The concept of value represents what buyers are willing to pay, and the growth of this value to a higher level is due to the ability to offer lower prices in relation to competitors for equivalent benefits or provide unique benefits in the market that can compensate for higher prices (Porter, 1985).

Following the outbreak of the new type of coronavirus at the end of 2019, the growth prospects for the Mexican automotive industry are not optimistic. Only in April 2020, the monthly production of vehicles has suffered a fall of more than 98% with respect to the previous year, while the sales of automobiles have decreased almost 65% in the same period (Burgeño, 2020).

Therefore, the problem is based on the fact that the Competitiveness indices of the Automotive Industry in Mexico are not identified, and that is why it must be determined through the application of international competitiveness indicators.

The general objective of this research is to describe the competitiveness indices presented by the Automotive Industry in the international market. It will allow you to know how important automotive imports are and how significant they are with respect to exports; and how the trade balance influences local consumption taking into account national production, and what have been the trends to develop at the national level and later enter an international automotive dynamics and to reach the point of how it is currently.

### *The Automotive Industry*

The Automotive Industry and the role it plays as an integral part of the economic development of Mexico, will be analyzed in an international scenario considering variables such as production, imports and exports, identifying who are the main economic countries within this sector. Consecutively, the automotive industry will be analyzed in a national panorama considering indicators and variables of production, imports, exports.

This study refers to the economic activity of the automotive industry, which is made up of the Manufacture of automobiles and trucks, the Manufacture of bodies and trailers, and the Manufacture of parts for motor vehicles, defined based on the Industrial Classification System of North America (SCIAN, acronym in English). The most important activities of the automotive industry are the Manufacture of automobiles and trucks and the Manufacture of parts for motor vehicles, since together they contributed 97.9% to the Gross Domestic Product (GDP) of this industry in 2018.

### *International panorama*

The Automotive Sector is one of the most important worldwide, in recent years it has had an important relevance due to its high contribution to the economic development of Mexico, in addition to being the main generators of foreign currency, it is an important generator of direct jobs, it is the main recipient of foreign direct investment. It is observed that Mexico is among the most prominent countries in the production and export of automobiles, therefore it becomes the seventh largest producer and fourth largest exporter of automobiles worldwide.

The Automotive Industry represents a significant part of the economy of any country. In addition, for Mexico the automotive industry has a great strategic importance in the National economic growth (Sosa, 2005); consequently, the growth in this Industry is reflected in the growth of the country's economy.

The production of vehicles worldwide according to the International Organization of Motor Vehicle Manufacturers (OMVM), in 2018 little more than 97 million units were produced worldwide, of which 70% corresponds to the sum of the main seven producing countries: China (29.01 MDU), United States (11.1 MDU), Japan (9.6 MDU), Germany (5.6 MDU), India (4.7 MDU), South Korea (4.1 MDU) and Mexico (4.06 MDU). In the last year, world vehicle production increased more than two million units, representing 2.3%. Of the seven countries mentioned, China, Mexico, India and Japan were the countries that achieved the highest growth with 3.19%, 13.09%, 6.55% and 5.31%, respectively compared to 2017.

According to INEGI (2019), the Automotive Industry is an example of leadership at the international level since it exported 115 billion dollars (mmdd) and ranked 4th among the exporting countries of Automotive Industry products in 2018 after Germany, Japan and the United States of America, table 1.

Place	Country	Exports	%
1	Germany	244.40	17.8
2	Japan	141.79	9.9
3	E.U.A.	124.53	9.4
4	Mexico	115.51	7.6
5	Canada	64.28	4.6
6	South Korea	62.56	4.6
7	China	60.14	3.9
8	Spain	53.91	3.9
9	United Kingdom	51.31	3.7
10	France	45.38	3.4

**Table 1** Exporting Countries in the Automotive Industry (MMDD)

Source: INEGI, 2019

In 2018, global auto exports reached a total value of \$ 1,349 billion. Mexico ranked fourth with \$ 43 billion in foreign sales, behind Germany, Japan and the United States, which together account for 4% of world exports. For its part, in that same year, the United States was the largest importer with \$ 284.8 billion, followed by Germany, the United Kingdom and China, Table 2. According to Pro México, (2018). Mexico "Due to its extensive supply and global competitive advantages offered by Mexico in qualified labor, geographical position and preferential access to other markets, the Mexican Automotive Industry has consolidated Mexico as one of the main producing and exporting countries of the industry at an international level".

Place	Country	Imports
1	U. S. A.	284.83
2	Germany	111.29
3	United Kingdom	74.17
4	China	71.50
5	Canada	67.49
6	France	59.27
7	Belgium	47.01
8	Italy	43.01
9	Spain	40.92
10	Mexico	43.06

**Table 2** Importing Countries in the Automotive Industry (MMDD)

Source: INEGI, 2019

### National Panorama

The Automotive Industry has an important relevance in the economic development in Mexico, the companies that make up the Automotive Industry, provided direct employment to 730,923 people, which accounted for 14.4% of the labor activity of the Manufacturing Industries, according to the 2018 Economic Censuses. It is worth mentioning that, in addition to generating direct jobs, indirect jobs were also created by the industry, since this sector impacts 84 manufacturing factories (INEGI, 2019).

It is observed that Mexico is among the most prominent countries in the production and export of automobiles, it is contemplated that the Automotive Industry is an important space for economic growth, in addition, it is of great interest, the different benefits that it brings, as well as Foreign Direct Investment (FDI) in its automation factories, likewise year after year innovations in infrastructure, design and technology are developed for the improvement of automobiles, moreover it is a key part for the growth and modernization of the country, which mainly occupies the second place within the manufacturing industries in the country (Meneses, V., B. 2017).

Mexico has experienced surprising success in its automotive industry in relation to the advancement of its production, changes in the production organization and its international competitiveness. For Mexico's economic growth, the Automotive Industry plays a very important role, due to its great potential as a generator of jobs, technology transfer and investment attraction.

The automotive sector, after the economic crisis that arose in 2009, maintained a favorable recovery due to the increase in production and the volumes of exports of compact cars, achieving historical figures. The year 2014 represents a surplus in the trade balance of about 50 billion dollars, production increased 9.8% in relation to 2013, also driven by the opening of new plants.

More than 80% of the production of automobiles, which are manufactured in Mexico, is destined for export. Approximately 20% of the production of compact cars is distributed to the domestic market, which accounts for almost 50% of the units sold in Mexico, and therefore the remaining 50% is supplied with new imported cars (INEGI 2017).

For Mexico's economic growth, the automotive industry plays a very important role, due to its great potential as a generator of jobs, technology transfer and investment attraction.

Mexico, in the context of emerging economies, has become a qualified and specialized assembly country, recognized globally and with its labor costs that are too low on an international scale. Which shows the high investment in the automotive industry based on its attractive cheap labor and international free trade agreements. It is recognized as the explosive start of the sector, which is creating investments and jobs, but is also generating substantial pollution, economic and social costs (Covarrubias, 2014).

Year	Production (P)	Export (X)	Import (M)
2005	56.10	39.50	24.17
2006	68.13	51.19	43.51
2007	69.79	53.73	42.00
2008	72.21	55.36	36.72
2009	52.00	40.74	25.90
2010	78.02	61.95	26.80
2011	89.30	71.41	28.42
2012	99.98	78.47	31.37
2013	97.32	77.19	33.39
2014	109.45	85.96	35.74
2015	116.77	90.36	37.27
2016	114.47	88.08	37.24
2017	127.20	101.74	41.64
2018	130.89	115.51	43.06
2019	137.26	121.29	42.69
*2020	33.84	29.90	17.46

\* Accumulated January-May, 2020

**Table 3** Production, Exports and Imports of the Automotive Industry in Mexico (MMDD)

Source Own elaboration, based on Banco de México; INEGI; Ministry of Economy (Mexico); SAT Mexico, (2020)

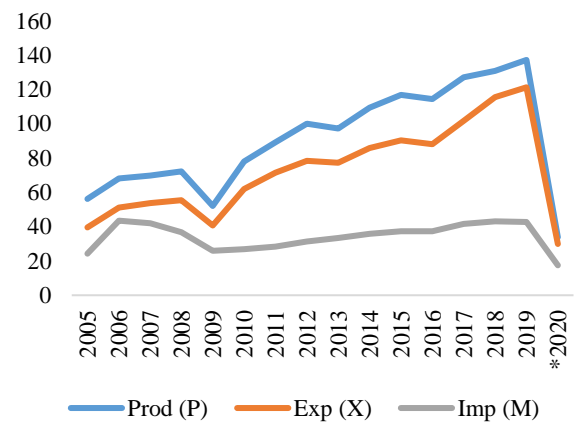
BONALES-VALENCIA, Joel. Mexican automotive sector's competitive indicators analysis. Journal of Mechanical Engineering. 2021

The main destination for Mexican exports of the automotive industry is the United States of America (USA). The economic relationship with the US is particularly important for the automotive sector. According to Mexican production, more than 80% leaves the country in the form of exports and the most important destination is the USA with more than 60% of the total. This implies that the performance of the industry is linked to the behavior of the US economy and, therefore, the crisis and imbalances in this country have also negatively affected Mexican industry. For example, according to the crisis that began in 2007 in the neighboring northern country and the corresponding decrease in demand that it brought with it, which significantly affected Mexican vehicle exports to that country and total manufacturing, which shows that to evaluate the future performance of the industry, it depends to a great extent on the performance of the US economy, which is an important indicator (ECLAC, 2010).

In Mexico the Automotive Industry is one of the most important worldwide and of great importance and relevance. This is in a transformation due to social and economic changes, but mainly in technological changes, which are leading towards the manufacture of increasingly electrified, more connected and more autonomous cars. Mexico by becoming the seventh largest producer and fourth largest exporter, has managed to position itself in the world as one of the main vehicle manufacturers, Table 3.

Graph 1 shows the total production of automobiles manufactured in Mexico, from the year 2005 to 2020, where a decline in production can be observed in 2009 as a result of the financial crisis in the United States, which is why had a worldwide impact.

The Bank of Mexico in its article presented in February 2018, Mexico in 2015, had been suffering from a weak economic activity given worldwide, but thanks to its perseverance to continue working with positive dynamism, it was able to evolve within 2016, where the result of the beginning of this stage was the impact of automotive exports to the US and other parts of the world such as Europe, Asia, Latin America, Canada, mainly, graph 1.



\*Accumulated January-May, 2020

**Graphic 1** Production, Exports, and Imports of the Automotive Industry in Mexico (MMDD)

Source Own elaboration, based on Banco de México; INEGI; Ministry of Economy (Mexico); SAT Mexico, (2020)

## Materials and Methods

The Organization for Economic Development Cooperation (OECD) defines competitiveness as “the degree to which a country, under free and fair market conditions, can produce goods and services that pass the test of international markets, increasing in a sustained way the real income of its population” (OECD, 2010).

The Institute for Management Development (IMD) defines competitiveness as “the ability of a country or a company to proportionally generate more wealth than its competitors in international markets” (IIMD, 2009).

The Inter-American Development Bank (IDB) links the competitiveness of an economy to the creation of the necessary conditions for business development and the sustainable increase in productivity and per capita income (IDB, 2004). In the IDB's view, a country's export performance and its level of competitiveness are different but interrelated concepts, insofar as export success tends to be a consequence of high levels of competitiveness (Pat, et al, 2016).

Competitiveness is measured through indicators that evaluate different aspects of the life of a country. These types of measures are used for different purposes. On the one hand, they are a reference for making investment decisions (establishing a company, business expansions, change of headquarters, etc.) because they offer a diagnosis of many elements that are vital for the operation of companies (educational level of the population, health conditions, available infrastructure, etc.), so that a more competitive country or region translates into a better option for investment and, therefore, for job creation (Competitive Mexico, 2017).

The evolution of trade can reveal how efficient competitors are in terms of exports and imports. To determine the competitiveness of the established products, it is established as an assumption that this branch of automotive production is more competitive when, in addition to satisfying domestic demand without the need to resort to imports, a high proportion of it is destined to the exports. To calculate these, volumes produced and marketed in billions of dollars (mmdd) were used in the period 2005-2020, using the methodology set out in (Schwartz, et al, 2007).

#### *Export Opening Degree (GAE)*

This indicator serves to demonstrate how good exporters are based on their domestic consumption, that is, excluding apparent consumption. With an index close to 0, it is less competitive, since a large part of its production is oriented to the domestic market. It is expressed as follows:

$$GAE = \frac{X}{P+(M-X)} \quad (1)$$

P Prod, X Exp e M Imp

Sets the share of the world market or a specific market. It not only examines exports, but also establishes the country's export vocation and its ability to build permanent advantages, which is evidenced by the product's trade balance (Pat, et al., 2016).

#### *Degree of Import Penetration (GPI)*

It shows the relationship between a country's imports, with respect to its apparent consumption. As the index is higher, it will represent a greater purchasing power, and therefore it is said that that country is less competitive, since it is not capable of producing enough to supply its domestic market. It is expressed by the arithmetic form:

$$GPI = \frac{M}{P+(M-X)} \quad (2)$$

The objective of the article was to characterize the behavior of exports and imports and the competitiveness indicators of the Automotive Industry in Mexico. As this indicator is higher, the competitiveness of the production chain is lower. If the indicator has a range between 0 and 1, it means that as the indicator approaches zero, the competitiveness of the sector or productive chain is greater, and that imports can become zero, even managing to dedicate part of the national production for export (Idem).

#### *Relative Trade Balance (BCR)*

If BCR approaches the value 1, the greater will be the importance of exports in relation to imports. An indicator close to -1 allows the identification of potential markets; and, countries with BCR close to 1, in principle, can be ruled out as potential buyers because they satisfy their domestic market and also export. It is expressed as follows:

$$BCR = \frac{X-M}{X+M} \quad (3)$$

This indicator measures the relationship between the trade balance of a product and its total trade for a country on the world market. It consists of giving an idea of the condition of the chain in the market. It is assumed that an export chain is more competitive than one that is not or that it has to fundamentally import its raw materials or intermediate goods (Idem).

#### *Transaction Index (Tij)*

If the IT value is close to -1, they can be important recipients of the products, since they are countries totally dependent on the imports of the goods that are evaluated.

Countries with IT close to 0 indicate capacity close to self-sufficiency. And positive values indicate that they are exporters. It is expressed by the arithmetic form:

$$Tij = \frac{X-M}{P+(M-X)} \quad (4)$$

When the indicator is greater than zero, the sector is considered an exporter, since there is an excess supply, that is, it is a competitive sector within the country. When the indicator is less than zero, the sector is a substitute for imports, since there is an excess demand. (Idem).

## Results

This part deals with the analysis of the variables related to automotive trade, exports and imports in billions of dollars (MMDD), from which the competitiveness indices with which the characteristics of Mexico are determined were constructed. as an international automotive marketer.

### Export Opening Degree

This index allows us to appreciate the importance of exports from a producing country in the international market taking into account local production, which would relate exports to the domestic market. In other words, it takes into account whether in the first instance the national demand of the domestic market is met.

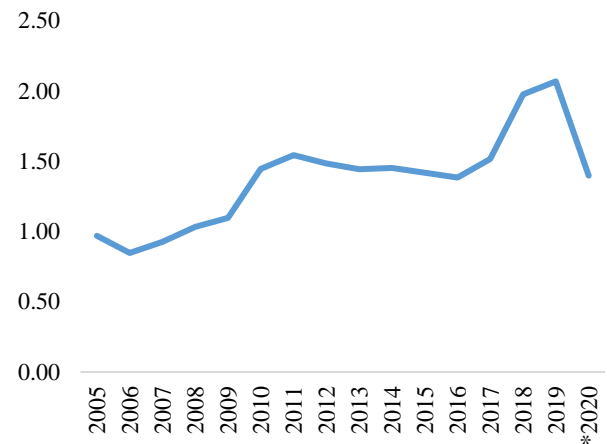
Year	M-X	P+(M-X)	$\frac{X}{P+(M-X)}$
2005	-15.33	40.77	<b>0.97</b>
2006	-7.69	60.44	<b>0.85</b>
2007	-11.72	58.07	<b>0.93</b>
2008	-18.64	53.57	<b>1.03</b>
2009	-14.84	37.16	<b>1.10</b>
2010	-35.15	42.87	<b>1.45</b>
2011	-42.99	46.31	<b>1.54</b>
2012	-47.11	52.88	<b>1.48</b>
2013	-43.80	53.52	<b>1.44</b>
2014	-50.22	59.23	<b>1.45</b>
2015	-53.09	63.68	<b>1.42</b>
2016	-50.84	63.63	<b>1.38</b>
2017	-60.10	67.10	<b>1.52</b>
2018	-72.45	58.44	<b>1.98</b>
2019	-78.60	58.66	<b>2.07</b>
*2020	-12.44	21.40	<b>1.40</b>

\* Accumulated January-May, 2020

**Table 4** Index of Degree of Automotive Export Opening in Mexico

Source Own elaboration, based on Banco de México; INEGI; Ministry of Economy (Mexico); SAT Mexico, (2020)

As can be seen in Table 4, the index is greater than 0, and represents that the automotive sector is competitive, since the sector covers the domestic market and a large part of its production is export-oriented. Starting with the global crisis of 2019, an increase greater than unity is observed.



\* Accumulated January-May 2020

**Graphic 2** Index of Degree of Automotive Export Opening in Mexico

Source Own elaboration, based on Banco de México; INEGI; Ministry of Economy (Mexico); SAT Mexico, (2020)

Through Graphic 2, it is possible to appreciate the trend of the index in the period from 2005 to 2020, which is positive and sustained over time. Given the findings found throughout the series, the statement that Mexico has relative advantages in automotive production; That is why it should be taken as a strategic product in the industrial sector and promote its production and export, in addition to promoting its direct foreign investment.

### Degree of Penetration of Imports

It is the proportion of apparent consumption that is supplied with imports, as this indicator increases, automotive competitiveness will be lower. As the index is higher, it will represent a greater purchasing power, and therefore it is said that that country is less competitive, since it is not capable of producing enough to supply its domestic market.

This coefficient represents the proportion of apparent consumption that is supplied with automotive imports, for this indicator, like the previous ones, they were analyzed with the time series of sixteen years.



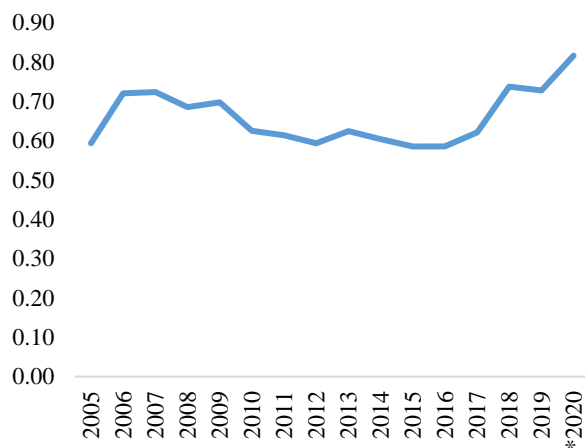
From the calculations carried out, values greater than zero were obtained, which means that the competitiveness of the automotive sector is regular and that imports are 30% with respect to exports. As the indicator approaches zero, the competitiveness of the automotive sector will be higher.

Year	M-X	P+(M-X)	$\frac{M}{P + (M - X)}$
2005	-15.33	40.77	<b>0.59</b>
2006	-7.69	60.44	<b>0.72</b>
2007	-11.72	58.07	<b>0.72</b>
2008	-18.64	53.57	<b>0.69</b>
2009	-14.84	37.16	<b>0.70</b>
2010	-35.15	42.87	<b>0.63</b>
2011	-42.99	46.31	<b>0.61</b>
2012	-47.11	52.88	<b>0.59</b>
2013	-43.80	53.52	<b>0.62</b>
2014	-50.22	59.23	<b>0.60</b>
2015	-53.09	63.68	<b>0.59</b>
2016	-50.84	63.63	<b>0.59</b>
2017	-60.10	67.10	<b>0.62</b>
2018	-72.45	58.44	<b>0.74</b>
2019	-78.60	58.66	<b>0.73</b>
*2020	-12.44	21.40	<b>0.82</b>

\* Accumulated January-May, 2020

**Table 5** Index of Degree of Penetration of Automotive Imports in Mexico

Source Own elaboration, based on Banco de México; INEGI; Ministry of Economy (Mexico); SAT Mexico, (2020)



\* Accumulated January-May, 2020

**Graphic 3** Index of Degree of Penetration of Automotive Imports in Mexico

Source Own elaboration, based on Banco de México; INEGI; Ministry of Economy (Mexico); SAT Mexico, (2020)

The trend that can be seen through Graphic 3 is in a range of .60 to .80, which means that the competitiveness of the automotive sector is regular and the penetration of automotive imports represents a third.

### Relative Trade Balance

The index is used to know the products destined for export, mainly. It can be interpreted as an index of competitive advantage; this indicator indicates the presence of competitive advantage if the result is a positive value. On the contrary, if the result is negative, it indicates that a country is oriented towards imports of the product.

When the index approaches the value 1, the importance of exports is greater in relation to automotive imports. This is the case of Mexico throughout the series analyzed, the country proves to be an automotive exporter. Also noteworthy is the fact that net exports in all years show a positive trade balance in the foreign automotive market for Mexico, which shows that Mexico is a competitor in the international automotive market.

Year	X+M	X-M	$\frac{X - M}{X + M}$
2005	63.67	15.33	<b>0.24</b>
2006	94.70	7.69	<b>0.08</b>
2007	95.73	11.72	<b>0.12</b>
2008	92.07	18.64	<b>0.20</b>
2009	66.64	14.84	<b>0.22</b>
2010	88.75	35.15	<b>0.40</b>
2011	99.84	42.99	<b>0.43</b>
2012	109.84	47.11	<b>0.43</b>
2013	110.58	43.80	<b>0.40</b>
2014	121.70	50.22	<b>0.41</b>
2015	127.63	53.09	<b>0.42</b>
2016	125.32	50.84	<b>0.41</b>
2017	143.38	60.10	<b>0.42</b>
2018	158.57	72.45	<b>0.46</b>
2019	163.98	78.60	<b>0.48</b>
*2020	47.36	12.44	<b>0.26</b>

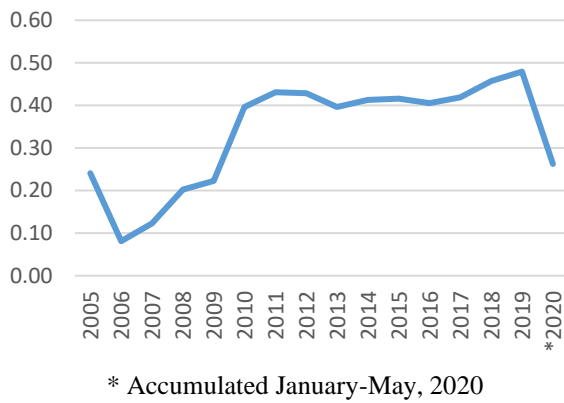
\* Accumulated January-May, 2020

**Table 6** Relative Automotive Trade Balance Index in Mexico

Source Own elaboration, based on Banco de México; INEGI; Ministry of Economy (Mexico); SAT Mexico, (2020)

With a Relative Trade Balance greater than 40%, it indicates Mexico as an automotive exporting country. This is mainly due to the influence exerted by the 2010-2019 period, having a competitive advantage in the world market. According to the results obtained in the application of the proposed methodology, this indicator indicates the presence of a competitive advantage for Mexico in automotive exports because the value is positive, in the analyzed period, the relative trade balance was on average of 0.34 in the period from 2005 to 2020.





**Graphic 4** Relative Automotive Trade Balance Index in Mexico  
Source Own elaboration, based on Banco de México; INEGI; Ministry of Economy (Mexico); SAT Mexico, (2020)

*Transability Index*

It measures the relationship between net exports and apparent consumption (domestic production plus imports minus exports). For foreign trade, it is used to track the gain or loss of the exporting capacity of the country that produces the good (Idem).

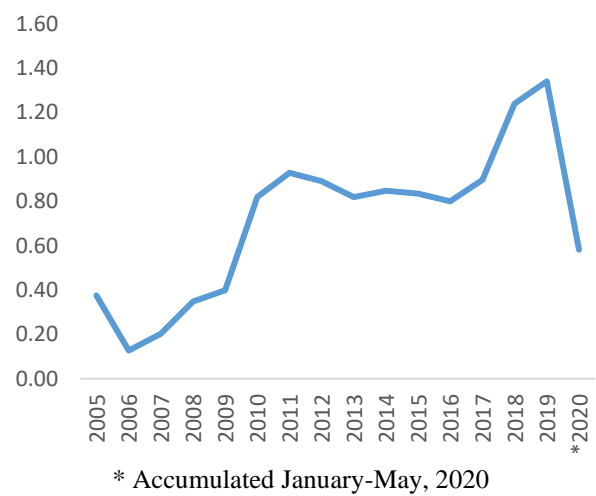
Table 7 shows the evolution of tradability, in the case of the Automotive Sector in Mexico, it has a high Transability Index. In this case, where the indicator is greater than zero, the sector is considered an exporter, since there is an excess supply. Therefore, this indicator indicates that the Automotive Sector in Mexico is competitive in the domestic market.

Year	X-M	M-X	P+(M-X)	$\frac{X - M}{P + (M - X)}$
2005	15.33	-15.33	40.77	<b>0.38</b>
2006	7.69	-7.69	60.44	<b>0.13</b>
2007	11.72	-11.72	58.07	<b>0.20</b>
2008	18.64	-18.64	53.57	<b>0.35</b>
2009	14.84	-14.84	37.16	<b>0.40</b>
2010	35.15	-35.15	42.87	<b>0.82</b>
2011	42.99	-42.99	46.31	<b>0.93</b>
2012	47.11	-47.11	52.88	<b>0.89</b>
2013	43.80	-43.80	53.52	<b>0.82</b>
2014	50.22	-50.22	59.23	<b>0.85</b>
2015	53.09	-53.09	63.68	<b>0.83</b>
2016	50.84	-50.84	63.63	<b>0.80</b>
2017	60.10	-60.10	67.10	<b>0.90</b>
2018	72.45	-72.45	58.44	<b>1.24</b>
2019	78.60	-78.60	58.66	<b>1.34</b>
*2020	12.44	-12.44	21.40	<b>0.58</b>

\* Accumulated January-May, 2020

**Table 7** Automotive Transaction Index in Mexico  
Source Own elaboration, based on Banco de México; INEGI; Ministry of Economy (Mexico); SAT Mexico, (2020)

Graphic 5 shows the evolution of tradability of the Automotive Sector in Mexico. Therefore, it presents a growing competitiveness. In foreign trade analyzes, the tradability indicator is used to make inference through the analysis of the gain or loss of the export capacity of the country that produces the good. According to the results obtained, Mexico is considered an exporting country because there is an excess supply that it presents throughout the period analyzed, the average indicator in the period was 0.70, reflecting automotive production and trade as a competitive activity in the market.



**Graphic 5** Automotive Transaction Index in Mexico  
Source Own elaboration, based on Banco de México; INEGI; Ministry of Economy (Mexico); SAT Mexico, (2020)

**Conclusions**

Mexico has abundant natural characteristics, which allow it to be an attractive destination for industries that want to establish themselves within and be productive, taking advantage of these resources as part of their production process, contributing to a positive trade balance in the Automotive Industry.

The Automotive Industry was described in an international and national panorama considering variables such as production, imports and exports, identifying who are the main economic countries within this sector.

Information was obtained from the Bank of Mexico, INEGI, the Ministry of Economy and the Mexican SAT on the Production, Export and Import of the Automotive Industry of Mexico from 2005 to 2020, in billions of dollars.

A response was given to the objective of the research carried out on the Automotive Industry, by describing its Competitiveness, through the use of export openness indices, the degree of import penetration, the relative trade balance and the tradability index.

The national production of the Automotive Industry has been increasing significantly, from 1,186 in 2005 to 3,334 thousand units in 2019. The increase in production is due to the creation of 18 production complexes in 11 Federal Entities of the country, the increase of FDI, since in 2019 an investment in the sector for 4,291 million dollars was achieved, technological innovation, the location of the country in relation to the United States of America, the skilled labor of Mexican workers, among others.

Based on the contextual framework, it was identified that Mexico is the 6th global producer of vehicles, the 4th exporter in millions of units, it has around 600 level 1 companies and around 1,200 level 2 and level 3 companies and factories of auto parts with an approximate value of 87 billion dollars that are successfully integrated into global value chains.

Exports had a growing behavior. The amount of imports accounted for a third in relation to exports; In every year the trade balance is favorable for Mexico, exports far exceed imports of cars and trucks. The net trade balance grew almost to the same extent as exports, which reflects the Competitiveness of Mexico's exporting Automotive Industry.

The degree of export openness index allowed us to appreciate the importance of a producer country's exports in the international market, taking into account local production, which would relate exports to the domestic market. In each of the years analyzed, the index is positive for Mexico (from 0.97 to 2.07) and with a very growing trend; This implies that the internal demand of Mexico has been covered in each of the years and that exports are production surpluses and that Mexico has an export vocation when it comes to the Automotive Industry; and that it has permanent advantages in the production and export of cars.

In relation to the indicator of the degree of penetration of imports, it was observed that the calculations made were obtained values greater than zero, which means that the competitiveness of the automotive sector is regular and that imports are 30% compared to exports.

The relative trade balance index throughout the series analyzed, the country proved to be a competitive exporter of the Automotive Industry. Also noteworthy is the fact that net exports in all years show a positive trade balance in the foreign automotive market for Mexico, which shows that Mexico is a competitor in the international automotive market. The values range from 0.24 in 2005 to 0.48 in 2019, therefore, the hypothesis of this research is approved, in relation to the data obtained by applying the referred indices.

The tradability index that measures the relationship between net exports and apparent consumption. In the case of the Automotive Industry in Mexico, it has a positive average index of tradability. In this case, where the indicator is greater than zero, the sector is considered an exporter, since there is an excess supply. According to the results obtained, Mexico is considered an exporting country because there is an excess supply that it presents throughout the period analyzed, the average indicator in the period was 0.70, reflecting automotive production and trade as a competitive activity in the market.

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