Pyramid visualization applied to export performance

Visualización piramidal aplicada a el desempeño de las exportaciones

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Abstract

The objective is to visualize the performance of Mexican exports of petroleum oils, for the years from 2002 to 2021. Balassa Index is an indicator that is used to measure export performance for a given product compared against the total of exports from one country to another. A four-sided pyramidal model is used; it is built from the results of the Balassa Index (IB), being the height of the pyramid, the overall performance and the base is the BI for each destination. Data of exports of petroleum oils, heading 27.10 to the United States of America, Brazil, Colombia and Guatemala are used. Finally, a dynamic model is proposed by using regression equation. The results show that pyramids allow to

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adequately visualize the performance of the analysed exports, in addition, the described methodology allows its application to any tariff code.

Keywords: pyramids – exports – Balassa Index – Mexico.

Resumen

El objetivo es visualizar el desempeño de las exportaciones mexicanas de petróleo, de los años 2002 al 2021. El Índice Balassa es un indicador que se usa para medir el desempeño exportador para un producto en comparación del total de exportaciones de un país a otro. Un modelo de pirámide de 4 lados es usado; se construye con los resultados de Índice Balassa, siendo la altura de la pirámide el desempeño general y la base es el Índice Balassa para cada destino. Se usan datos de las exportaciones de petróleo en la partida 27.10 a los Estados Unidos de América, Brasil, Colombia y Guatemala. Finalmente, un modelo dinámico es propuesto, usando una ecuación lineal. Los resultados muestran que las pirámides permiten visualizar de manera adecuada el desempeño del análisis de exportación, adicionalmente, se describe la metodología que permite aplicarla a cualquier fracción arancelaria.

Palabras clave: pirámides – exportaciones – Índice Balassa – México.

Introduction

According to The Economic Commission for Latin America and the Caribbean (ECLAC), there are different indicators to measure international trade performance. The indicators of commercial position stand out, among which are the statistical data from official sources, as well as the indicators of commercial concentration by sector. On the other hand, there are indicators for dynamics related to intraregional trade, including the intraregional trade index and the trade intensity index (Durán & Alvarez, 2011).

Other indicators measure comparative advantage; Balassa Index (BI) and Revealed Comparative Advantage Index are within this category (Ortiz-Garcés, Polo-Ospino, & Escobar-Espinoza, 2018). For the purpose of this article, Balassa Index will be applied to measure Mexican petroleum oil exports performance. It is important to consider that Mexico is among the 15 major petroleum products exporters in the world. (International Trade Centre, 2022). Balassa Index will be calculated by using Harmonized System 6-Digit level (subheading) of petroleum oil, using International Trade Centre data of Mexican exports, within the period of time from 2002 until 2021.

The obtained results through indicators provide numerical estimates, however the opportunity is presented to complement them through non- conventional visualization that in this case pyramids are proposed. In addition, through a multiple regression, a dynamic prototype is proposed to visualize the results in different scenarios.

The proposal is to use four- sided pyramids which represents the export performance in the main destinations of shipments from Mexico: United States of America (US), Brazil, Colombia and Guatemala. With the performance impulse towards each destination (faces of the pyramid), the height of the top or acme is affected, interpreted as the general performance of exports (higher height, better performance). It begins with the section that describes the Harmonized Commodity Description and Coding System, a following section addresses the BI through the mention of previous works, then the method and data used for visualization through pyramids are presented; finally, conclusions and references are added.

Harmonized Commodity Description and Coding System

Before the creation of the Harmonized System (HS), international trade was extremely complicated, given goods' identification may vary from country to country; jeopardizing the correct fulfilment of restrictions and regulations. This lack of fulfilment of restrictions and regulations may put at risk people's health and threaten environment. In addition, by not accurately identifying the goods, they could be subjected to incorrect duties which would have negative effects in public revenues of the countries.

Hence, World Customs Organization (WCO) was created in 1952, since the beginning most the world's customs joined it. In 1970 World Customs Organization developed a coding system, 6-Digit, in order to internationally standardized goods classification. Then, the first version of the Harmonized System (HS) was created. World Customs Organization updates the HS every 5-6 years, being the 2022 version the latest. (World Customs Organization, 2022).

The Harmonized System codes are 6-digit: first 2 digits are chapters (general categories for goods), the next 2 digits

(4-digit level) are headings (less generic category than chapters); finally, the last 2 digits (6-digit level) are sub-heading, which is the most specific level to classify goods according to WCO international agreement. The correct writing of headings (4-digits) is adding a point after two digits; for sub-heading (6-digits) is adding a point after the 4th digit.

Harmonized Tariff Schedule of Mexico contains 98 chapters. Chapter's order corresponds to the value- added to good (processing level), For example, chapter 01 corresponds to live animals, having not any process (as they exist in nature), chapter 02 corresponds to meet and edible meat offal (animal products with a basic level of process). Other examples are chapter 09 that includes coffee, tea, mate, and spices; chapter 75 nickel and articles thereof.

It is important to consider that despite the HS is a six-digit code, each country has the option to add more digits (always by pairs), for example, in Mexico 4 digits are added. So, 8-digit is known as *fracción arancelaria* (tariff code), and the last 2 digits of 10-digit code, are known as NICO, *número de identificación comercial* (commercial identification number or statistical suffix) (Congreso de la Unión, 2022). The last four digits are statistical subdivisions that provides detailed data about the international trade.

Balassa Index and some previous applications

According to The Economic Commission for Latin America and the Caribbean (ECLAC), there are some indicators for measurement of international trade performance, some of them are presented in a concentrated manner, by country, for instance the balance of trade, which is the balance of value of exportations less then value of importations, country

– country, or country – region, which allows to identify the percentage of change of international trade; and the indicators of commercial concentration that identifies the most traded products between two or more countries (Durán & Alvarez, 2011). In the other hand, there are some indicators that have more specific objectives, at goods level or HS codes level. Within this category, the Balassa Index (BI) is placed; it is used to measure export efficiency for a given product compared against the total of exports from one country to another.

For the propose of this article the BI is applied, considering that it is the starting point of measurement of comparative advantage and considers all trade flows. According to Stellian & Danna-Buitrago (2022): "The Balassa Index has the merit of being compatible with Kunimoto-Vollrath principle", this principle considerers that comparative advantages and disadvantages can be revealed comparing exports with a theoretical value, in this case i´s total exports weighted by the share of k in the total exports of trade zone J. In the other hand, there are weaknesses of the BI that need be considered: 1. The interval of comparative advantages and disadvantages is asymmetric; 2. Small-country bias; 3. No flexible concept of comparative advantage; 4. It dot not include country's GDP and 5. It is no possible to add Two or more RCA indices from different countries.

In addition, the BI has been used by contemporary authors for similar studies; for instance: Depetris, Garcia and Rossini (2016) conducted trade performance assessments in Argentina and Uruguay, using 5 of the main foreign trade indicators, among which was the Balassa Index (BI). After the tests, the BI was considered ideal for comparison of efficiency, concluding that in both countries it shows a perfect consistency, adapting to the application regarding the commercial flow.

Gómez and González (2017) used the BI to identify if Chinese exports to US replaced Mexican exports to US. The research is interesting, considering that China does not have a trade agreement and Mexico has (NAFTA at that time, now USMCA); it showed that despite the China's exports increase, from 2001 to 2003, according to BI, Mexico´s trade disadvantage was diminishing, hoping that this Mexican recovery would permanently remain.

Cerda, et al (2008), considering the increase of Chilean wine production, researched to measure the competitiveness of these exportations, moreover Chile had achieved to rank no. 5th in the world, as wine producer. They found that since 1985 and until 2003 the BI, called by them as Balassa Index of revealed comparative advantage, showed positive results, in a constant way, in wine exportations, despite other factors such the entrance of new wine producers, as Australia, evidenced a decrease in Chilean efficiency from 2002.

Another example of uses of the BI in wine industry, was the research performed by Martinez and Medina (2013) who observed the worldwide increase in production and sales since mid- 1980. The increase in the number of new producers, were the argument to measure the Spanish export performance. The started number for was 2.8 million of metric tons (tm), in 1980, 5 million and for 2010 they reach 9.8 million tm. The obtained results were positive; Spain had a commercial advantage, despite the new competitors in international market, and that comparative advantage was permanent.

To Galvan and Santos (2019), the BI and revealed comparative advantage, were the ideal methods in order to evaluate the Mexican citrus's export performance, specifically lemon, Persian lime and conventional lime. The obtained results in both indexes allow to conclude that exports have an advantage describe as "extremely favourable", permanent, mainly for exportations to the Unites States. In addition, they manifest that BI is a good option to estimate trends and commercial scenarios for a sector or a specific product.

Ortiz, Polo and Escobar (2018) considered appropriate the BI and revealed comparative advantage to assess the performance of international trade of food, between some Pacific Alliance members, having special interest for Colombia. The results indicated that in farming sector, in 26 cases, Colombia has a comparative advantage against Peru; other 23 cases Colombia showed a comparative advantage against Mexico and finally, other 26 against Chile.

As observed, the BI is a regular indicator to measure export performance, however, the opportunity is to use a visualization that combines the results not only of one country but three or more countries, so, the proposal is to use 4-side pyramids, whose height will express the export performance in a specific product or sector.

Method for visualization export performance

Within this section, the method to measure export performance is described, arising the next research question:

Is it possible to visualize in an appropriate way export performance by using geometric shapes known as 4-side pyramids or polyhedrons?

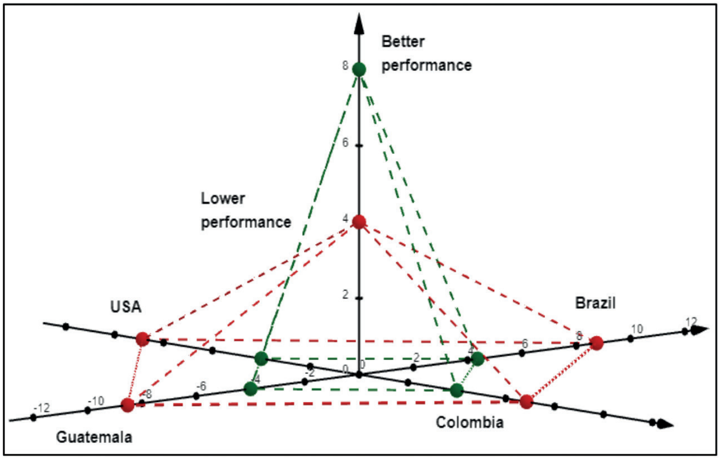
The pyramids or polyhedrons provide a possibility to represent several phenomena ranging from atomic representation (Banadaki & Patala, 2017), visualization of gravity gradient tensors (Ren, Zhong, & Chen, 2018) even in economics applications, such as the consumption of renewable energies by regions or countries (Lagunas, Oropeza, & Boggio, 2020). For this article, the pyramids or polyhedrons will be applied in order to visualize Mexican export performance (Balassa Index), regarding the goods classified in HS heading 27.10 that is describe as petroleum oils and oils obtained from bituminous minerals, other than crude and preparations not elsewhere specified or included, containing by weight 70% or more of petroleum oil or oils obtained from bituminous minerals, these oils being the basics constituents of the preparations, containing biodiesel, other than waste oils.

The International Trade Centre (ITC) is used as data source of Mexican exports HS heading 27.10. In order to build the 4-side pyramid, the four main destinations of Mexican petroleum oil were selected; in 2021 the top four destinations were: US, Panama, Brazil and Colombia. However, considering that Mexican petroleum oil exports in 2020 were $0, this destination was omitted from this article and instead it was used the next destination: Guatemala.

Being a 3-D figure, the prototype is built with a base 4-point polygon, in coordinates (x,y,z).

Figure 1 shows that each of the points in the pyramid base correspond to the value of exports to each of destination countries. By moving through the points in the pyramid base, other, that represents the top or apex, is in different height, pointing the change in the export performance.

Figure 1. Base polygon as per Mexican export performance.



Source: Own elaboration by using GeoGebra.

The points in the pyramid corresponds to the export value during a specific time period. Moreover, a dynamic display is desired, in order to provide mobility to the points through x,y-axis, a regression equation is created, where general export performance is the independent variable (BI arithmetic mean to each destination), influenced by the export value.

BI for each selected country is calculated by the following formula:

$$BI_c = \frac{\left(x_{ij}/x_j \right)}{\left(x_{it}/x_t \right)} \quad (1)$$

Where:

$x_{ij} = Header\ 27.10\ Mexican\ exports\ to\ country\ j$

$x_j = Header\ 27.10\ worldwide\ Mexican\ exports$

$x_{it} = Total\ (all\ headings)\ Mexican\ exports\ to\ country\ j$

$x_t = Total\ (all\ headings)\ worldwide\ Mexican\ exports$

General criterion is: if *BI*≥1, there is a commercial advantage, on the contrary if *BI*<1, there is a commercial disadvantage.

BI results determine general export performance for the years from 2002 to 2021, which have been previously considered with average values (Griffoli, Meyer, & Natal, 2015), according to the following:

$$\overline{BI}_{2002} = \frac{BI_{US\ 2002} + BI_{Brazil\ 2002} + BI_{Colombia\ 2002} + BI_{Guatemala\ 2002}}{4}$$

$$\vdots \quad \vdots \quad \vdots \qquad (2)$$

$$\overline{BI}_{2021} = \frac{BI_{US\ 2021} + BI_{Brazil\ 2021} + BI_{Colombia\ 2021} + BI_{Guatemala\ 2021}}{4}$$

Table 1 shows the value of Mexican exports of goods classified under heading 27.19 to selected destinations: Brazil, Colombia and Guatemala. Data was obtained from International Trade Centre (ITC), considering the year 2002 to 2021.

The values presented in Table 1 constitute an essential part of the structure for regression model since they are the independent variable, which affects the general export performance.

Table 1. Value of exports of goods classified under heading 27.19 (Thousand dollars)

Year	Total Mexican exports	US	Brazil	Colombia	Guatemala
2002	1,111,193	769,175	86	281	6,277
2003	1,570,487	1,121,669	173	261	4,171
2004	1,930,460	1,731,307	295	647	1,492
2005	2,916,129	2,681,739	364	1,296	2,381
2006	3,539,592	3,242,382	487	1,856	8,019
2007	4,028,797	3,542,880	21,912	3,740	28,979
2008	6,245,144	5,468,564	656	12,739	24,295
2009	4,477,257	3,941,366	14,709	33,922	46,308
2010	4,752,366	4,268,787	1,119	50,402	6,396
2011	5,957,909	5,233,224	1,212	443,871	8,607
2012	4,982,029	3,637,368	143,453	946,348	6,577
2013	5,691,444	5,025,484	46,312	472,411	3,759
2014	5,470,364	4,979,595	90,060	167,651	3,934
2015	3,862,739	2,162,175	276,777	362,105	4,498
2016	2,337,554	1,302,894	43,941	280,060	4,995
2017	2,407,756	1,514,462	76,788	257,555	4,717
2018	2,921,085	1,671,964	18,245	279,545	4,845
2019	1,896,967	1,152,876	2,419	113,267	5,417
2020	1,154,604	1,038,350	2,696	9,626	6,448
2021	3,182,186	2,846,186	18,979	10,989	9,629

Source: Own elaboration with data from the International Trade Centre (2022)

Table 2. Total (all headings) Mexican exports (Thousand dollars)

Year	Total Mexican exports	US	Brazil	Colombia	Guatemala
2002	168,650,541	106,899,862	2,564,593	352,280	116,512
2003	170,545,787	105,723,447	3,267,150	405,510	150,981
2004	196,808,375	111,262,254	4,340,870	635,221	229,919
2005	221,818,980	118,973,102	5,214,246	675,129	221,822
2006	256,085,920	130,809,817	5,557,833	744,225	355,568
2007	281,926,513	139,930,555	5,575,281	764,041	456,700
2008	308,583,120	151,746,430	5,182,663	1,071,547	501,223
2009	234,384,532	112,788,740	3,495,275	619,078	499,469
2010	301,481,734	145,450,398	4,327,470	795,342	488,379
2011	350,842,806	174,878,466	4,561,902	824,512	543,329
2012	370,751,407	185,683,875	4,494,509	877,072	611,731
2013	381,210,149	187,758,444	4,420,606	911,766	528,834
2014	399,984,248	195,856,156	4,470,302	932,637	487,467
2015	395,232,368	187,300,380	4,622,107	922,502	461,200
2016	387,064,500	179,984,302	4,732,838	1,097,876	487,814
2017	420,369,150	194,959,416	5,440,399	1,674,329	527,679
2018	464,276,595	216,254,331	6,510,786	1,771,343	535,762
2019	455,235,784	206,134,038	6,639,145	1,655,511	536,137
2020	382,979,896	168,197,311	5,634,113	963,360	459,934
2021	506,565,459	221,311,736	8,718,415	1,380,666	620,017

Source: Own elaboration with data from the International Trade Centre (2022)

Table 2 depicts the value of Mexican exports of all headings to the entire world and to the selected destinations.

Table 3, Balassa Index Mexican exports classified under heading 27.19

Year	US	Brazil	Colombia	Guatemala	$\overline{BI}$
2002	1.092	0.005	0.121	8.177	2.349
2003	1.152	0.006	0.070	3.000	1.057
2004	1.586	0.007	0.104	0.662	0.590
2005	1.715	0.005	0.146	0.816	0.671
2006	1.793	0.006	0.180	1.632	0.903
2007	1.772	0.275	0.343	4.440	1.707
2008	1.781	0.006	0.587	2.395	1.192
2009	1.829	0.220	2.868	4.854	2.443
2010	1.862	0.016	4.020	0.831	1.682
2011	1.762	0.016	31.701	0.933	8.603
2012	1.458	2.375	80.296	0.800	21.232
2013	1.793	0.702	34.704	0.476	9.419
2014	1.859	1.473	13.144	0.590	4.266
2015	1.181	6.127	40.163	0.998	12.117
2016	1.199	1.537	42.240	1.696	11.668
2017	1.356	2.464	26.856	1.561	8.059
2018	1.229	0.445	25.083	1.437	7.049
2019	1.342	0.087	16.419	2.425	5.068
2020	2.048	0.159	3.314	4.650	2.543
2021	2.047	0.347	1.267	2.472	1.533

Source: Own elaboration with data from the International Trade Centre (2022)

With the values of Table 1 and 2 using equation (1) the results of Balassa Index (BI) were determined for each country.

Table 3 shows the results for BI of each country and year, and average performance, represented by $\overline{BI}_i$ according to formula (2).

Table 4, Natural logarithms (Balassa Index, Table 3) to get regression equation

Year	US	Brazil	Colombia	Guatemala	$\overline{BI}$
			(Natural logarithms)		
2002	13.553	4.454	5.638	8.745	2.349
2003	13.930	5.153	5.565	8.336	1.057
2004	14.364	5.687	6.472	7.308	0.590
2005	14.802	5.897	7.167	7.775	0.671
2006	14.992	6.188	7.526	8.990	0.903
2007	15.080	9.995	8.227	10.274	1.707
2008	15.515	6.486	9.452	10.098	1.192
2009	15.187	9.596	10.432	10.743	2.443
2010	15.267	7.020	10.828	8.763	1.682
2011	15.471	7.100	13.003	9.060	8.603
2012	15.107	11.874	13.760	8.791	21.232
2013	15.430	10.743	13.066	8.232	9.419
2014	15.421	11.408	12.030	8.277	4.266
2015	14.587	12.531	12.800	8.411	12.117
2016	14.080	10.691	12.543	8.516	11.668
2017	14.231	11.249	12.459	8.459	8.059
2018	14.330	9.812	12.541	8.486	7.049
2019	13.958	7.791	11.638	8.597	5.068
2020	13.853	7.900	9.172	8.772	2.543
2021	14.861	9.851	9.305	9.173	1.533

Source: Own elaboration with data from the International Trade Centre (2022)

In order to facilitate the pyramid visualization, avoiding too large numbers, the values of Table 3 (independent variables) and the results of $\overline{BI}_i$ of Table 3 (dependent variable), are transformed to natural logarithms, integrating Table 4.

The information contained in Table 4 will be the basis for the pyramid visualization, where the value towards each destination locates each point of the base of the pyramid, while the height will be located with the value obtained for $\overline{BI}_i$. The axis of abscissas (x-axis) is shared to situate the values of exports made to the US and Colombia; on the ordinate axis (y-axis) the values of exports to Brazil and Guatemala are located (see Figure 1).

The values of export to each destination are separated by height axis (z-axis), any increase or reduction in the values will cause a displacement of the points of the base, affecting the height of the top or apex, which will indicate the change in the export performance (see Figure 1).

Also, by using GeoGebra (Hohenwarter, Kovács, & Recio, 2019; de Albornoz Torres, 2010), a prototype is presented in which the height will be a function of the result obtained for regression (4), including sliders (a,b,c,d) each one to vary the value of exports to each destination, the slider "a" corresponds to the value of exports to the US, the slider "b" corresponds to the value of exports to the Brazil, the slider "c" represents the value of exports to Colombia and the "d" represents the value of exports to Guatemala.

The sliders have a value range from the minimum observed exports to the maximum observed exports, according to the data showed in Table 3; the used software is GeoGebra (Mota & Mussato, 2020; Ziatdinov & Valles, 2022).

Finally, a regression model is obtained, (Bissing, Klein, Chinnathambi, Selvaraj, & Ranganathan, 2019; Uyanık & Güler, 2013):

$$BI_{27,10} = b_0 + b_1 x_{US} + b_2 x_{Brazil} + b_3 x_{Colombia} + b_4 x_{Guatemala} \quad (3)$$

Where $x_{country}$ represents the value of exports (expressed as natural logarithms) towards a certain destination, $b_0, b_1, \ldots, b_4$ are the coefficient by which each value is multiplied in logarithms.

The obtained regression model was evaluated though Goodness-of-fit test and precision, using correlation coefficient R and coefficient of determination R^2 (R-squared) from which the following was obtained:

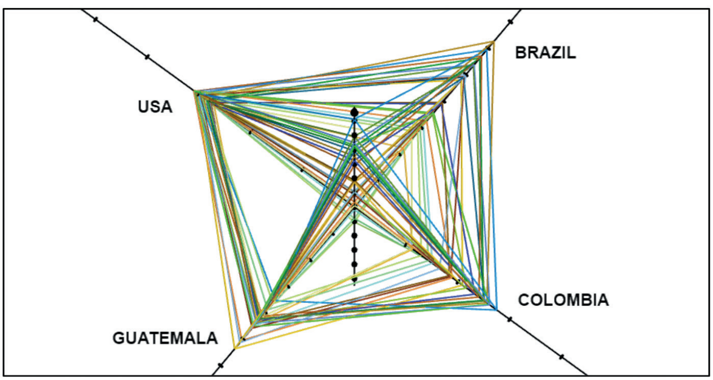
$$BI_{27,10} = 5{,}11 - 0{,}583x_{US} + 0{,}0459x_{Brazil} + 0{,}3624x_{Colombia} + 0{,}059x_{Guatemala} \quad (4)$$

Results for multiple correlation efficient R=0,931 and coefficient of determination R^2=0,867 therefore, it is considered an acceptable adjustment from which to obtain a dynamic prototype by GeoGebra (Borbón, 2012).

Results

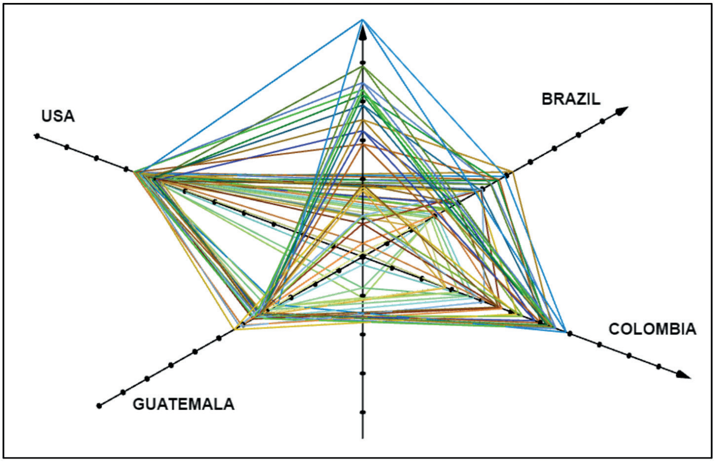
Below are 2 views of export performance for all analysed years (from 2002 to 2021), whose information comes from Table 4.

Figure 2, Visualization of Mexican export of heading 27,10
Years from 2002 to 2021



Source: Own elaboration by using GeoGebra

Figure 3, Visualization of Mexican export of heading 27,10 Years from 2002 to 2021

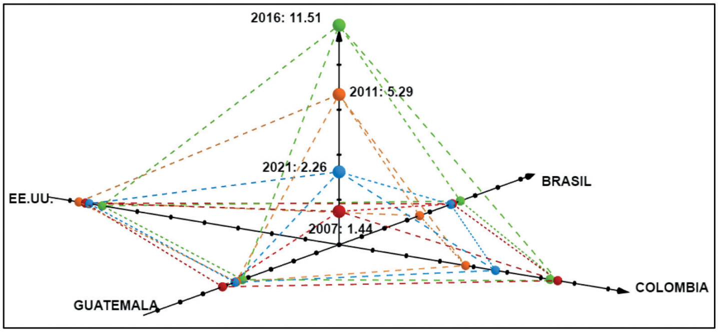


Source: Own elaboration by using GeoGebra

The view offered by Figure 2 let identify that, in general, during the observed 20 years, positive performance was presented in terms of goods classified in heading 27.10 (being the best performance in 2012, turquoise colour pyramid). In the other hand, Figure 3, provides a different perspective, highlighting the export value to US, given it is much greater than the value sent to the other countries.

For a better appreciation, Figure 4 shows the integrated visualization of export performance in years 2007, 2011, 2016 and 2021, For each of those years, the value of exports in thousand dollars, to the US were: 3,542,880; 5,233,224; 1,302,894; 2,846,186, to Brazil: 21,912; 1,212; 43,941; 18,979, Regarding what was exported to Colombia: 3,740; 443,871; 280,060; 10,989, Finally, exports to Guatemala: 28,979; 8,607; 4,995; 9,629.

Figure 4, Visualization of Mexican export of heading 27,10: 2007, 2011, 2016, 2021



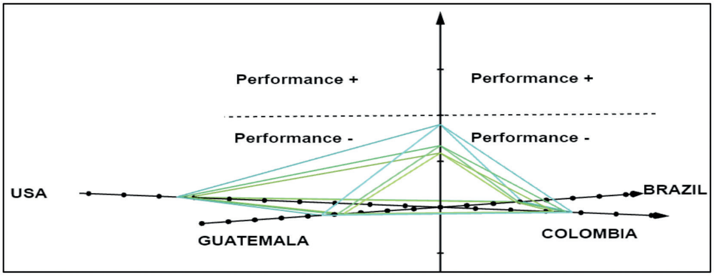
Source: Own elaboration by using GeoGebra.

Figure 4 shows that the points that represent export performance, the higher they are, is due to a better value in BI towards each country, Specifically, for the selected years in this figure, the best result was presented in 2016 while the lowest performance was in 2007.

Furthermore, a first sight all export performance are above 0 value of z-axis or height axis, which could be mistakenly interpreted as a positive performance; however, it must be remembered that when BI is less than 1 there is a commercial disadvantage.

Afterwards, Figure 5 shows the frontier to get positive performances (starting from 1), adding a closer approach to appreciate that in years 2004, 2005 and 2006 there were commercial disadvantages.

Figure 5, Pyramid visualization of the years of commercial disadvantage.

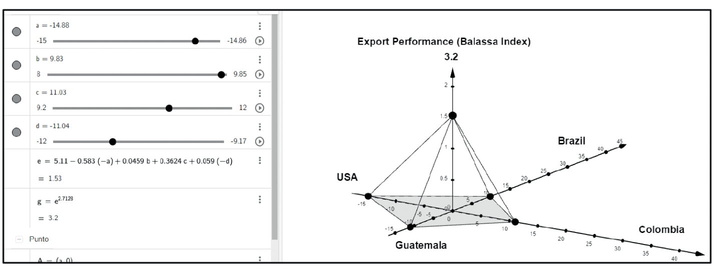


Source: Own elaboration by using GeoGebra.

The structure that was implemented to provide a dynamic model is presented, that is, with random mobility of export values and their effect in the export performance, using the regression equation (4).

Figure 6 displays the model in order to visualized export performance in a dynamic way, it includes four sliders; each one represents the value of Mexican exports to the selected destinations.

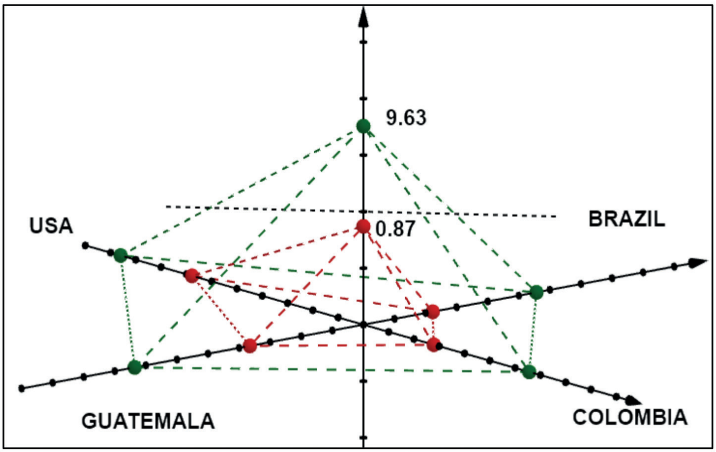
Figure 6, Dynamic model for export performance of heading 27,10



Source: Own elaboration by using GeoGebra.

With the model shown in Figure 6, the following assumptions are made: first, obtain the result and display of export performance considering the minimum exports to each country; second, consider the maximum amounts, for both cases, of the observed information in the last 20 years (see Table 3).

Figure 7.



Source: Own elaboration by using GeoGebra.

Figure 7 shows in red that when considering the minimum export value in the last 20 years, BI result is 0.87, that is a clear commercial disadvantage, on the contrary, when considering the maximum value of exports to each country, BI is 9.63 that means is an excellent commercial advantage.

However, the obtained results in the preceding paragraph are only two possible scenarios, by having a dynamic model (Figure 6) it is possible to simulate the expected results in export performance of any heading.

Discussion

It is important to point out that pyramid visualization, even when is based on observed data, requires the location on a graphic plane of 4 points, whose coordinates are related to the value of exports, and another points whose coordinates are export performance, measured by $\overline{BI}_i$ value.

Regarding the BI, jointly evaluated as part the regression, it adequately adjusted to the correlations and determination coefficients; however, the performance value also could be calculated by weighting commercial criteria, for instance, by assigning higher weight to BI of the country that has a better commercial agreement with respect to others with which there is not commercial agreement.

It is also possible that views are made to more than four destinations, which would require new axes, constituting pyramids with more than four faces. In order for the value of exports to move from a fifth, sixth or more destinations, it is recommended to use logarithm scales for export value, which are usually expressed in thousand dollars, while export performance or the Balassa Index (BI) in most cases will be close to 1.

Regarding the dynamic model, it is important to assign the scroll speed of each slider, a speed that is too fast makes difficult to observe the changes with a better level of detail.

Another important aspect to keep in mind, that it was actually shown in this article, is that converting money value to natural logarithm actually is better for this type of visualization, however, the obtained result should be reversed to ordinary number. Given BI values are small; it can be confusing since results in natural logarithm are also small numbers; there is a risk of interpreting natural logarithm as the direct value of BI.

Finally, it is important to reiterate that results for BI can be less than 1; any BI value less than 1 is a commercial disadvantage.

Conclusions

The pyramids or polyhedrons are geometric shapes that can be used to visualized a variety of results, in this article it is proposed to use 4- face pyramids to visualize export performance It is possible to locate any commercial point with x,y,z coordinates, by using the conversion of monetary units to natural logarithms.

Taking into account the application carried out for this article, by using GeoGebra, it is recommended to first locate the points of commerce of each country and the height later, to form the pyramid figure; before moving on to the location of the coordinates of another period, it is important to decide the format of each line or connector that will shape the pyramid, This recommendation is due the fact that when diagramming several periods, it is very easy to get confused between lines or points of different periods.

The colours in lines and points to differentiate periods are very helpful for a good visualization, Additionally, the use of different formats as the type of lines and connectors is recommended, for instance use continuous or intermittent lines.

At the end of the form of the pyramids for each period, it is important to stop and visualize all their points and lines, in this way it will be much clearer to capture the following commercial periods.

Because official data on exports from Mexico were used, in addition to the visual representation it can be said that there has always been a commercial advantage with respect to the US. However, it is a destination that could be classified as stable because in the 20 observed years there was never an export performance greater than 2.05.

On the other hand, although exports to Colombia in some years reflected disadvantages in Mexican exports, in another 9 years the export performance exceeded 10 points according to the BI.

Finally, it can be said that regarding exportations to Guatemala and Brazil there are years with positive export performance and some years with commercial disadvantage for Mexico.

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