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# Vertical and Horizontal Patterns of Intra-Industry Trade between Mexico and China

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***ABSTRACT:*** *The primary concern of this research is to analyze the pattern of vertical and horizontal intra-industry trade in the context of the trade relationship between Mexico and China in seven sectors over a five-year period, from 2012 to 2016, using disaggregated trade data at the SITC three digit level. This paper also aims to disentangle trade into: inter-industry trade, horizontal intra-industry trade, low quality vertical ITT (low ITTV) and high quality vertical ITT (high-ITTV).*

***KEYWORDS*** *—China, G-L Index, Intra-Industry Trade, Mexico, and Vertical Intra-Industry Trade.*

## I. INTRODUCTION

Intra-industry trade (IIT) can be defined as the simultaneous import and export of commodities of the same industry group. According to Ekanayake (2001), "Intra-industry trade describes trade in similar, but slightly differentiated products based on imperfect competition, or trade in close substitutes demanded by consumers in different countries who may have distinct tastes or preferences" [1]. In the case of Mexico in particular, intra-industry trade has increased rapidly over the years and as a result has become ever more important. In this context, Mexico has significantly increased cooperation and trade with China; in fact, China is currently Mexico's second largest trading partner. Thus, it is of particular interest the analysis of IIT in order to clarify to what extent these two economies are complementary or competitive, since China has not only become one of the most important trading partners to Mexico.

## II. CHARACTERISTICS OF MEXICO'S INTRA-INDUSTRY TRADE WITH CHINA

There is a very prominent shortage of literature concentrating on the IIT relationship betweenMexico and China. Nevertheless, there still seems to be a general consensus, that there is an overall low level of bilateral intra-industry trade between these two nations. Furthermore, most of the bilateral intra-industry trade involves low quality exports, and some studies have even shown that there is a negative growth of high quality exports from China. As stated by Lopez (2014), "China's trade with Mexico seems to be of an inter-industry nature, as only 11 chapters have a GL index exceeding 0.5" [2].

It is also important to mention that Mexican intra-industry trade has been known to be positively related to the following set of variables: per capita income, average country size, trade intensity, trade orientation, existence of a common border, common language, and the participation in a regional integration scheme. Additionally, in a study done by Ekanayake (2001), it was found that Mexican two-way trade was negatively associated with: income differences, differences in country size, distance, and trade imbalance. On the other hand, China's intra-industry trade has been shown to vary greatly across industries and trading partners. Taking into account the existing literature on China's IIT, we can conclude a few things. First of all, China's two-way trade is an importantelement in its manufacturing sector. Secondly, vertical IIT takes predominance in the Chinesetwo-way trade. This indicates that China's IIT is mostly differentiated by quality as opposed to similar products.

## III. MEASUREMENT OF INTRA-INDUSTRY TRADE

The purpose of this study was to calculate and analyze the pattern of intra-industry trade, of Mexico and China, in seven sectors over a five-year period. To accomplish this task, the methodology that was used in this study was carried out over 3 distinct stages: the measurement of IIT, the classification of IIT into vertical

and horizontal IIT, and lastly the distinction of low quality vertical ITT (low ITTV) and high quality vertical ITT (high-ITTV). There have been various measures of IIT that have been proposed over the years, but the G-L index that Grubel and Lloyd presented in1975, has long been contemplated as the most appropriate method for determining the extent of intra-industry trade in a single period of time. The G-L index measures the share of intra-industry trade of industry [i] for a given country [j] as:

$$GL = \frac{(X_i+M_i)-|X_i-M_i|}{(X_i+M_i)} = 1 - \frac{|X_i-M_i|}{(X_i+M_i)} \quad (1)$$

Where [X1] and [X2] are home country's exports and imports of industry [i], respectively. The G-Lindex takes values that range between 0 and 1, where 1 indicates that all trade is intra industry, while 0 suggests that all trade is inter-industry. Inversely, if the G-L index takes the value of 0, that would imply that the country in consideration only exports or only imports good [i] and consequently there would be no intra-industry trade. According to Andresen (2013), this index has been heavily criticized from suffering from categorical/subgroup aggregation issues. In order to deal with this aggregation issue, the following adjusted index was used in this research paper:

$$GL' = 1 - \frac{\Sigma_{i=1}^{n}|X_{ij}-M_{ij}|}{(X_j+M_j)} \quad (2)$$

The above G-L index was used to calculate the IIT per sector as well as total IIT between Mexico and China over a five-year period, from 2012 to 2016. The seven sectors were organized as follows:

Table 1: Industry Sector Classification According to the SITC (Rev. 2)

| **Sectors** | **Chemical** | **Electrical** | **Food** | **Machinery** | **Metal** | **Textile** | **Transport** |
|---|---|---|---|---|---|---|---|
| **SITC** | 511-598 | 771-778 | 001-098 | 711-764 | 671-699 | 261-269, 651-659, 831-851 | 781-793 |

Note: SITC stands for Standard International Trade Classification.

In order to break down intra-industry trade into horizontally and vertically differentiated products, this study took inspiration from the steps taken by Fontagné and Freudenberg (1997). Since the prices of goods are unknown, unit values (UV) are used instead in order to evaluate product quality in trade data. According to Ekanayake (2009), "The rationale for using unit value as an indicator of quality is that, assuming perfect information, a variety sold at a higher price must be of higher quality than a variety sold more cheaply" [4]. Therefore, if the difference in unit values is found to be below a certain threshold, in this case (α=0.15), this indicates that the quality of both goods is quite similar, and therefore we can consider them to be horizontally differentiated. That is to say, the difference in unit values of exports ($UV_J^X$) and imports ($UV_J^M$), for a product, j, and using a particular dispersion factor (α=0.15), needs to satisfy the following condition in order to be considered a horizontally differentiated product:

$$1 - \alpha \leq \frac{UV_J^X}{UV_J^M} \geq 1 + \alpha. \quad (3)$$

On the contrary, bilateral trade of a vertical differentiated product occurs when the difference in unit values corresponds with the following criteria:

$$a) \quad \frac{UV_j^x}{UV_j^m} < 1 - \alpha, or \qquad b) \quad \frac{UV_j^x}{UV_j^m} > 1 + \alpha \quad (4)$$

It is important to mention that the threshold was set at 15% (α=0.15), because the assumption is that freight costs do not affect the values of exports and imports by more than 15%.Thus, after using this percentage to categorize both horizontal and vertical IIT, the results were then used to further classify vertical IIT into low quality vertical ITT (low-ITTV) and high quality vertical ITT (high-ITTV).

If the difference in unit values of exports ($UV_J^X$) and imports ($UV_J^M$), was lower than 0.85 (1- $\alpha$=0.85), as shown in incision a, then it was concluded that the quality of the imports was much greater than that of the exports, and therefore it could be regarded as low ITTV. On the other hand, if the results were in accordance with the above incision b, then they were classified as high-ITTV. That is to say, if the difference was found to be greater than 1.15 (1+ $\alpha$=1.15), then the results fell into the category of high-ITTV.

## IV. RESULTS

Table 2 points out the evolution of the traditional G-L index by sectors between Mexico and China, for the years 2012 to 2016. The results demonstrate in which sectors intra-industry was most significant during that time span; as can be seen in the table, the higher the percentage of G-L index symbolizes a higher level of intra-industry trade.

Table 2: Total g-l index by sectors, 2012-2016

TOTAL G-L INDEX FOR ALL SECTORS (2012-2016)

| YEAR | SECTORS | | | | | | |
|---|---|---|---|---|---|---|---|
| | **CHEMICAL** | **ELECTRICAL** | **FOOD** | **MACHINERY** | **METAL** | **TEXTILE** | **TRANSPORT** |
| **2012** | 28.20% | 3.15% | 18.20% | 6.10% | 4.65% | 4.30% | 6.45% |
| **2013** | 26.92% | 2.07% | 17.27% | 5.12% | 5.79% | 2.28% | 15.17% |
| **2014** | 18.05% | 2.15% | 17.89% | 3.46% | 6.52% | 2.11% | 26.02% |
| **2015** | 11.25% | 2.39% | 20.14% | 4.18% | 4.89% | 1.81% | 25.41% |
| **2016** | 17.44% | 2.93% | 17.48% | 6.28% | 4.91% | 1.17% | 36.26% |

Source: prepared by the author, on the basis of data from the United Nations Commodity Trade Statistics Database (COMTRADE).

This study resulted in several major findings with regards to the bilateral intra-industry trade between Mexico and China. First of all, the Grubel-Lloyd index calculations demonstrated that thechemical, food, and transport sectors had the highest IIT levels. It also showed that the group ofsectors with the lowest intra-industry trade indices included: electrical, machinery, metal, and textilesectors. Secondly, the results showed that vertical intra-industry trade (both high quality, and lowquality) was predominant over horizontal IIT in all sectors.In summary, the findings suggest that generally there is relatively low bilateral intra-industry tradebetween Mexico and China. Furthermore, the results showed that vertical IIT took predominanceover horizontal IIT in all sectors. When further disentangling vertical IIT, we also found that it washigh-ITTV that prevailed over low-ITTV. This indicated that the majority of Chinese productsbeing exported to Mexico (during 2012-2016) were of relative low quality, in comparison to theMexican exports going to China. The commodities that presented the highest levels of G-L indexare showed in table 3. Pigments, paints, varnishes and related materials had theGrubel-Lloyd index, with an average of 76.78%; although chocolate and other preparationscontaining cocoa came in close second, with 76.48%.

Table 3: Commodities that presented the highest levels of G-L index, 2012-2016

| | **Sector** | **Commodity Code** | **Description** | **Average G-L Index** |
|---|---|---|---|---|
| **1** | Chemical | 533 | Pigments, paints, varnishes and related materials | 76.78% |
| **2** | Food | 73 | Chocolate and other preparations containing cocoa, nes | 76.48% |
| **3** | Food | 36 | Crustaceans and molluscs, fresh, chilled, frozen, salted, etc | 76.07% |
| **4** | Chemical | 572 | Explosives and pyrotechnic products | 75.82% |
| **5** | Textile | 265 | Vegetable textile fibres, excluding cotton, jute, and waste | 74.88% |
| **6** | Food | 11 | Meat and edible meat offal, fresh, chilled or frozen | 73.31% |
| **7** | Food | 61 | Sugar and honey | 68.77% |
| **8** | Chemical | 583 | Polymerization and copolymerization products | 59.94% |
| **9** | Machinery | 714 | Engines and motors, non-electric; parts, nes | 54.66% |
| **10** | Metal | 682 | Copper | 52.56% |

These results reflect the international trend of trading intermediate inputs required by multinationalfirms, which is part of intra-firm trade. According to Mendoza (2016), "it has been argued that thedisintegration of the manufacturing process of production of firms allows increasing trade at theinternational level" [5].

## V. CONCLUSIONS

There is almost no research that has focused primarily on the IIT between Mexico and China,despite the fact that, as was mentioned before, China is one of Mexico's most important tradingpartners. Most importantly, given the rapidly growing Mexican bilateral trade with China, a studyanalyzing these two countries' IIT is warranted. There were several major findings with regards tothe bilateral intra-industry trade between Mexico and China. First of all, it was discovered thatthere is relatively low bilateral intra-industry trade between Mexico and China. Additionally, theresults revealed that vertical IIT took predominance over horizontal IIT in all sectors. These resultsreflect the international trend of trading intermediate inputs required by multinational firms, whichis part of intra-firm trade. When further disentangling vertical IIT, we also found that it washigh-ITTV that prevailed over low-ITTV.

Since this study has focused on measuring the extent of vertical and horizontal intra-industry trade between Mexico and China over a five-year period, it is recommended that further studies use a longer time frame since certain economic phenomenon could be better analyzed in this manner. Lastly, it is highly recommended that future research focus on the special Mexico-China-US intra-industry trade relationship; since the current political atmosphere requires an analysis of this singular trilateral trade relationship.

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