# 22nd IIOA Conference in LISBON, 2014.

## Sectoral linkages in the knowledge economy, a comparative analysis of Mexico with OECD countries by the database: STAN-IO

Category: World input-output modeling and databases

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## ABSTRACT

In the late twentieth century the world economy falls squarely on the knowledge economy, which has been made possible by the development of Electronics and Information and Communications Technology (E&ICT). The push to E&ICT sector has been a task that the countries have followed differently, as it is one of the essential elements to encourage development and economic growth. In this work we can find a comparative analysis of the importance of the sectors: Office, accounting and computing machinery, Post and telecommunications and Computer and related activities among the OECD countries. The methodology used is based on the calculation of sectoral linkages, backward linkages (BL) and forward linkages (FL), and the classification of key industries from Leontief´s Input-Output model. Data were drawn from OECD STAN IO Matrix Inverse mid 2000s. A first approach shows that the electronic sector in Mexico is relatively disconnected for the domestic economy (BL & FL below average), but this industry becomes key when considering the total economy (domestic and imported inputs), with values well above to OECD countries, above Germany, Finland and Canada. This shows the success of the strategy based of maquiladora exports industry. The telecommunications sector in Mexico is a key industry, with high levels of BL & FL (in domestic and total economy), these linkages are similar to countries like USA, Germany, Finland, Denmark, Chile, Portugal and Spain . This is related to the development of the network of the dominant company Telmex/Telcel in the fixed and mobile telephony.The computer industry in Mexico is driving (high FL) well above of OECD countries, but lower BL, well below of countries concerned. The computer industry in Mexico is in a similar situation to USA, Germany and Denmark, in Canada and Korea is a driven industry.

Key words: Input Output Analisys, World Input-Output Modeling, Electronic, Telecommunications and Computing Sectors (E&ITC).

The authors acknowledge the support of UNAM-DGAPPA-PAPIIT program: IN302413.**1.**

## 1. INTRODUCTION

The knowledge economy (KE) is a new phase of development of the world economy which has been developed since the late twentieth century; the

knowledge is used as a key element to generate value and wealth through its transformation into information. The KE covers sectors such as Electronics, High Technology, Computing and Telecommunications. The KE generates adds value in the products and services whose process of creation or transformation involved. The profitability of knowledge is possible only when it has been codified, becoming codified knowledge.

The material base of KE is formed by the electronic-digital computer, wich has reconfigured the production, distribution and exchange social relations in the world. The KE structures a new industrial development pattern where emerge new industries (software, computing and telecommunications) and traditional industries rejuvenate by the productive application of new technologies.

The globalization has been made possible by these technological achievements of electronics, telecommunications and computing sectors (E&ICT), which has enabled a new labor division based on global chains between producers, distributors and buyers.

At present, the development of the sectors driving the KE is critical in the dynamics of economic growth. The objective of this work is to study comparatively the sectoral linkages corresponding to three of the basic industries of the KE, highlighting Mexico in a group of 45 countries reporting their input-output tables in the Structural Analysis Database (STAN-IO) in OECD web site, these sectors are: 1) Office, accounting and computing machinery, 2) Post and telecommunications, and 3) Computer and related activities (E&ICT).

Our analysis is based on the calculation of sectoral backward and forward linkages in a traditional input-output approach through the use of the Leontief inverse matrix.

First, we present an overview of the country groups that make up the information universe from the point of view of their contribution to wealth (Average Value) and according the place of the three mentioned sectors in the wealth of each country.

Secondly, we present a set of graphs which shows the supply and demand visions in order to characterize the place of Mexico in each of the three mentioned industries with respect to other countries considered.

Finally conclusions are presented.

## 2. ADDED VALUE OF ELECTRONICS, TELECOMMUNICATIONS AND COMPUTING SECTORS IN SELECTED COUNTRIES

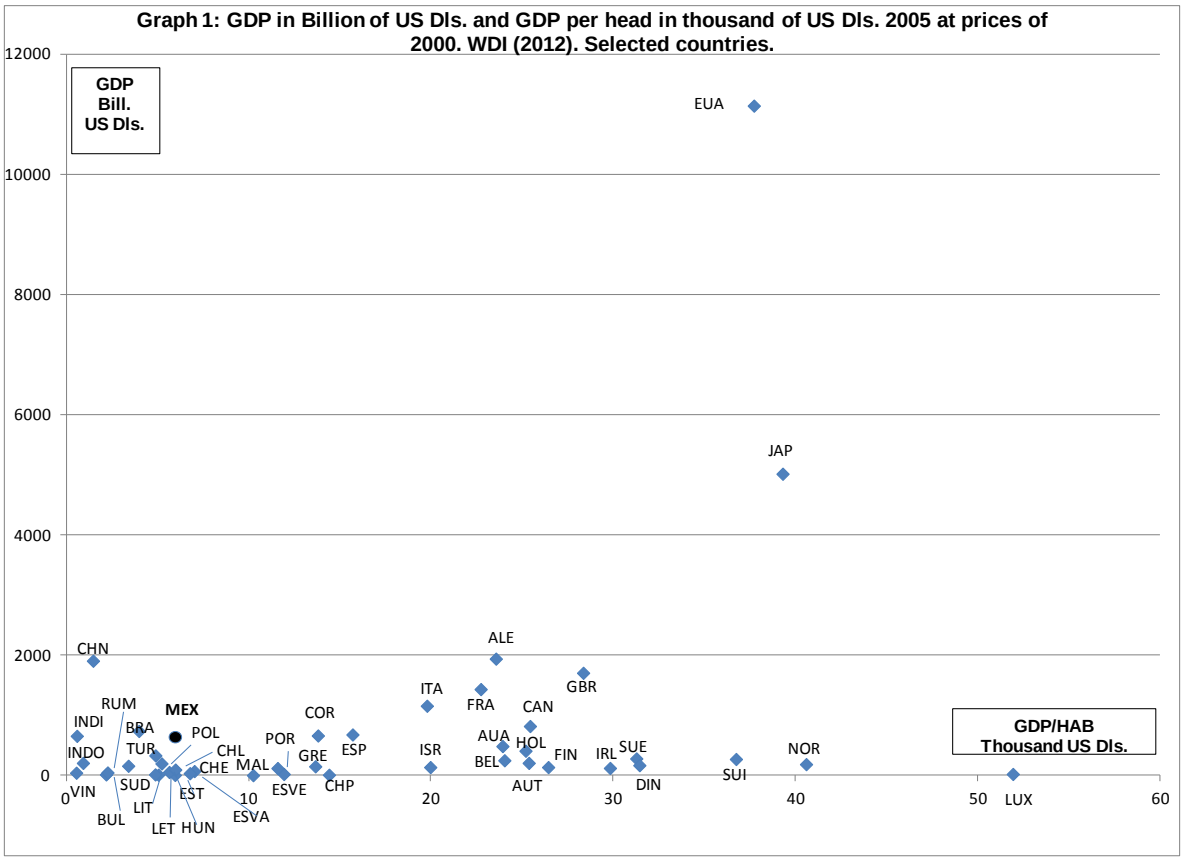
Table 1 presents 45 countries for which there are input-output tables in the STAN-IO corresponding to the domestic, imported and total (imported and domestic) inputs. There are 32 countries belonging to the OECD and 13 outside to the OECD, of which 27 belong to the European Unit (EU), three are Europeans who do not belong to the EU, five are from America, eight from Asia, one from Oceania and another one from Africa.

**Table 1: Countries including in the database STAN -IO.**

| NUMBER | OECD | SIGLA | EUROPEAN UNION | OTHER | NUMBER | OECD | SIGLA | EUROPEAN UNION | OTHER |
|---|---|---|---|---|---|---|---|---|---|
| 1 | AUSTRALIA | AUA | NO | OCEANIA | 24 | POLAND | POL | YES | |
| 2 | AUSTRIA | AUT | YES | | 25 | PORTUGAL | POR | YES | |
| 3 | BELGIUM | BEL | YES | | 26 | SLOVAK REPUBLIC | ESVA | YES | |
| 4 | CANADA | CAN | NO | AMERICA | 27 | SLOVENIA | ESVE | YES | |
| 5 | CHILE | CHL | NO | AMERICA | 28 | SPAIN | ESP | YES | |
| 6 | CZECH REPUBLIC | CHE | YES | | 29 | SWEDEN | SUE | YES | |
| 7 | DENMARK | DIN | YES | | 30 | SWITZERLAND | SUI | NO | EUROPA |
| 8 | ESTONIA | EST | YES | | 31 | TURKEY | TUR | NO | EUROPA |
| 9 | FINLAND | FIN | YES | | 32 | U.S. | EUA | NO | AMERICA |
| 10 | FRANCE | FRA | YES | | | NON OECD | | | |
| 11 | GERMANY | ALE | YES | | 33 | BRAZIL | BRA | NO | AMERICA |
| 12 | GREAT BRITAIN | GBR | YES | | 34 | BULGARIA | BUL | YES | |
| 13 | GREECE | GRE | YES | | 35 | CHINA | CHN | NO | ASIA |
| 14 | HOLLAND | HOL | YES | | 36 | CYPRUS | CHP | YES | |
| 15 | HUNGARY | HUN | YES | | 37 | INDIA | INDI | NO | ASIA |
| 16 | IRELAND | IRL | YES | | 38 | INDONESIA | INDO | NO | ASIA |
| 17 | ISRAEL | ISR | NO | ASIA | 39 | LATVIA | LET | YES | |
| 18 | ITALY | ITA | YES | | 40 | LITHUANIA | LIT | YES | |
| 19 | JAPAN | JAP | NO | ASIA | 41 | MALTA | MAL | YES | |
| 20 | KOREA | COR | NO | ASIA | 42 | ROMANIA | RUM | YES | |
| 21 | LUXEMBOURG | LUX | YES | | 43 | SOUTH AFRICA | SUD | NO | AFRICA |
| 22 | MEXICO | MEX | NO | AMERICA | 44 | TAIWAN | TAI | NO | ASIA |
| 23 | NORWAY | NOR | NO | EUROPA | 45 | VIETNAM | VIN | NO | ASIA |

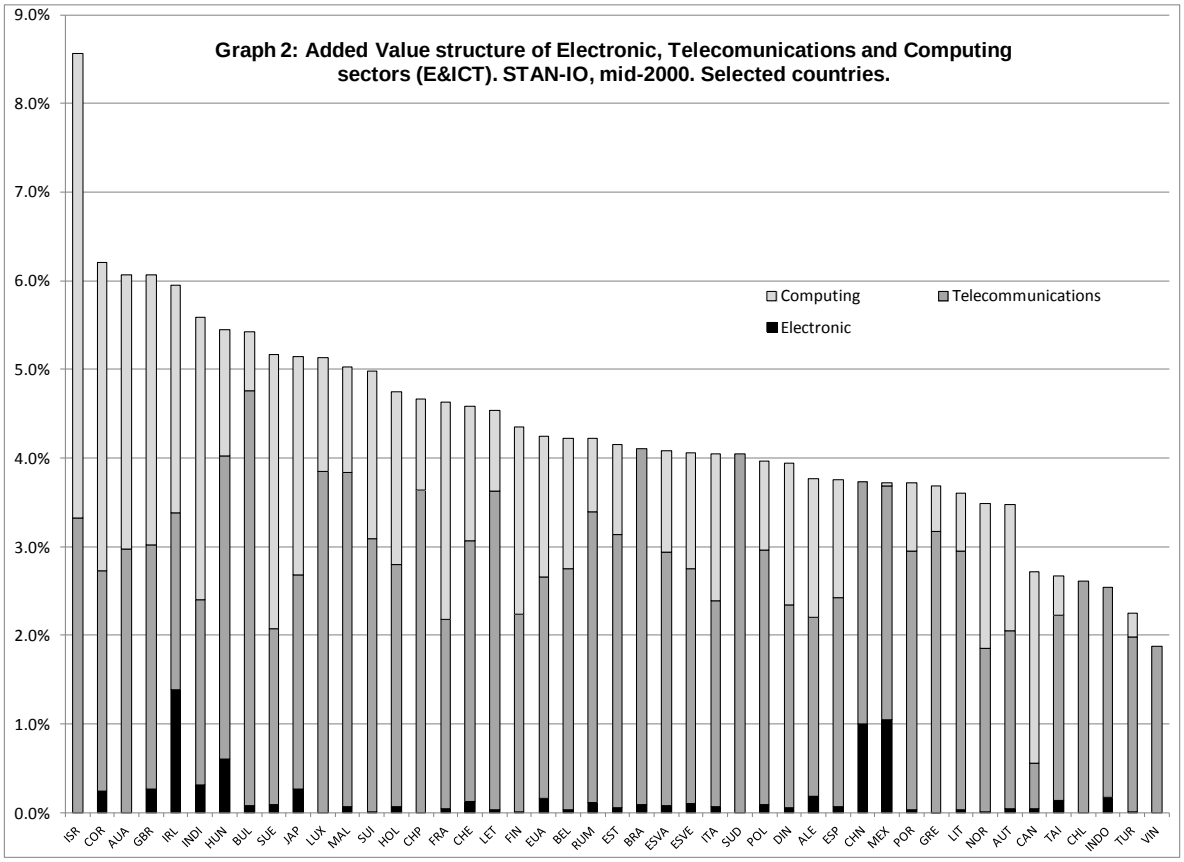
For comparison Table 1 shows the classification of OECD and non-OECD countries distributed by membership of the EU or other continents, in order to generate typologies of nations similar to Mexico.

Figure 1 shows the ranking of selected countries according to the value of GDP in billions of U.S. dollars in combination with levels of GDP per head (in thousands of U.S. dollars per year), this allows us to compare nations by their wealth level simultaneously with their welfare level. Data were obtained from the World Development Indicators database for the year 2005 and are shown in U.S. dollars at constant 2000 prices.




Mexico ranked 13th in wealth level (GDP), however in terms of GDP per head is going to place 29, countries with level of GDP similar to Mexico are divided into two groups, first the countries that observe a higher level of welfare (higher GDP per head), such as Canada, Australia, Spain and Korea, and on the other hand there are nations with similar GDP but with a lower level of welfare given by the GDP per head, among which are Brazil and India.

In Figure 2, the contribution of the added value of each E&ICT sectors in total value added in each country is shown.




The depth of the E&ITC is 3.7% for Mexico below the average of the countries considered which is 4.3%, however in sectorial terms we find that the contribution of the electronic sector is 1% well above average (0.15%) comparable with China and Ireland. Note that the export platform for the electronic industry in Mexico has had greater relevance since the 1990s to the present day.

As the telecommunications sector Mexico is the average (2.7%), but we note above two groups, a first group is well above to Mexico level which highlights countries like South Africa, Brazil, Luxemburg, Hungary, Israel, Romania and Switzerland; and on the other hand there is a group of nations that have a level of depth similar to Mexico, such as: Australia, Czech Republic, Portugal, Poland, Netherland, China, Belgium, Chile, Korea, the United States and Japan. This deep level of telecommunications in Mexico is explained by about 70% for the dominant operator Telmex / telcel in the wired and wireless telephony.

Finally Mexico is far behind (in last place) in the depth of the electronic sector, well above are Israel, Korea, India, Australia, with no data reported for South Africa, Brazil, Chile, China, Indonesia and Vietnam. Mexico should make efforts to reverse this situation which there is a considerable delay particularly in regards to broadband.

## 3. BACKWARD AND FORWARD LINKAGES OF THE E&ICT SECTORS

The input-output model allows us to quantify the coefficients that define the interrelationships between different sectors of an interdependent production system. On the supply side (columns) we have the value of intermediate inputs (domestic and imported) and the value of factor inputs that are required in the production; and the demand side (rows) we have the products that are destined to be used as inputs by other sectors (intermediate demand) and products that are destined for final demand (household and government consumption, fixed capital formation, change in inventories and exports).

The classic model of Leontief is given by demand in terms of quantity, It is expressed by a system of linear equations:

( 1) $x = Z^N \iota + f^N$

Where: $x$ = vector of sectorial gross production; $Z^N$ = domestic inputs matrix; $f^N$ = vector of final demand and; $\iota$=unit vector.

Assuming there are supply functions with fixed coefficients of inputs per unit of production and is obtained a matrix of fixed coefficients or direct production requirements: $A^N = Z^N \hat{x}^{-1}$. So domestic inputs are proportional to the vector of gross production $Z^N = A^N x$, we have the solution of the demand model:

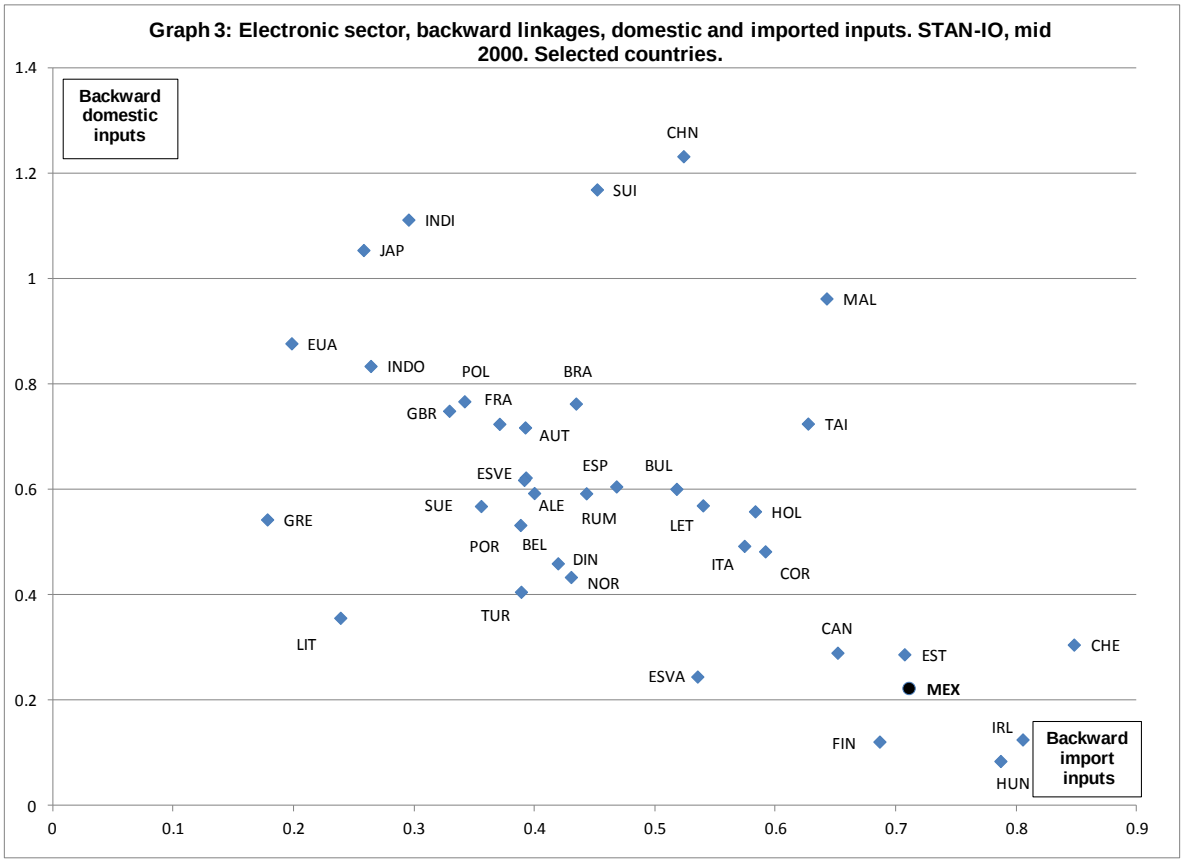
( 1) $x = A^N x + f^N = (I - A^N)^{-1} f^N = L^N f^N$

Where $L^N$ is the Leontief inverse matrix for domestic inputs and the columns represent the direct and indirect production requirements of all sectors per unit of final demand for each of the sectors.

In turn, the sum of each column of Leontief inverse matrix shows the backward linkages of each of the sectors, which are just multipliers.

The sum of the rows of the Leontief inverse matrix gives us a measure of forward linkages given by the Leontief demand model, that is to say, led by the technical coefficients .

In the Graph 3 we presented, for the electronic industry, backward linkages contrasting domestic linkages (y's axis) with imported linkages (x's axis).




We can see that the electronic industry in Mexico is highly integrated to imported inputs (71%), with low linkages of domestic inputs (0.22%), this is characteristic of a maquiladora export industry. Thus backward linkages of domestic inputs in Mexico are well below China, Switzerland, India, Japan, Brazil, Poland, Spain and Korea, who have managed to climb in value chains in their production processes with respect to the provision of domestic inputs.

In Figure 4, the coefficients of sales to intermediate demand and exports as a component of final demand are shown.

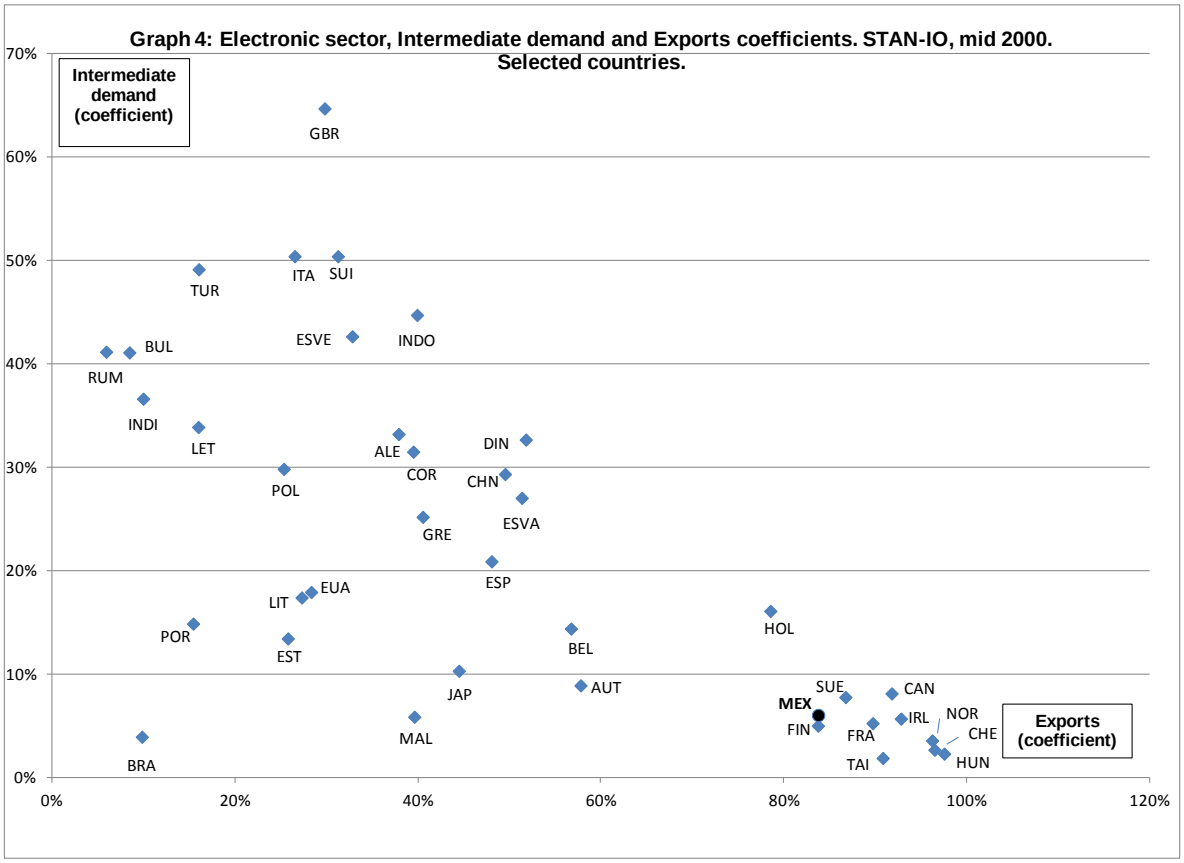
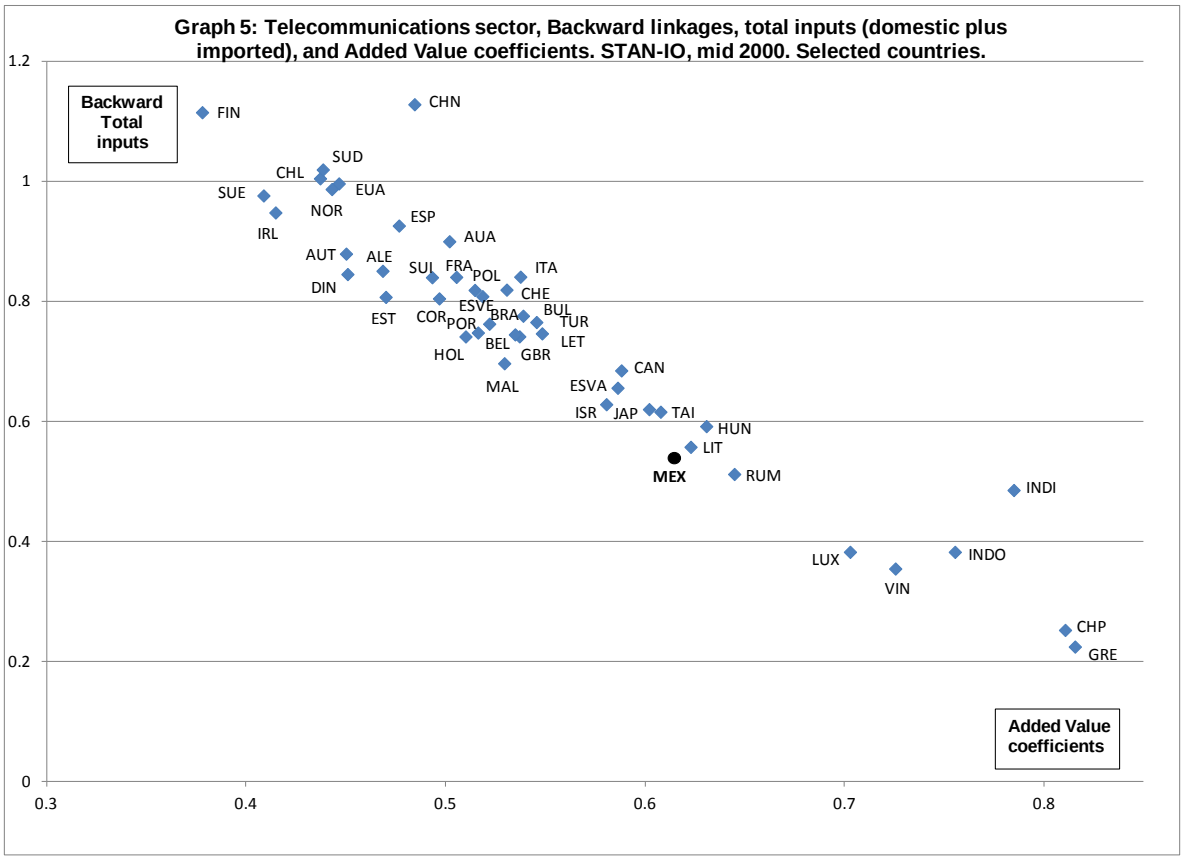



Figure 4 shows a low level of intermediate demand from the electronic industry in Mexico and we confirmed its vocation of export industry. However, Electronics is a strong supplier of intermediate demand in countries such as Indonesia, Korea, China, Greece, Turkey, India and Poland.

Figure 5 shows the total backward linkages (imported and domestic) of telecommunications sector in contrast with the value added coefficients.




As was expected, in Mexico the total backward linkages of the Telecommunications sector are very low; being very low in the case of imported inputs. However, Telecommunications is a generator sector of high value-added.

Figure 6 shows the demand side of the Telecommunications sector, contrasting sale coefficients of intermediate demand with sale coefficients of household consumption.

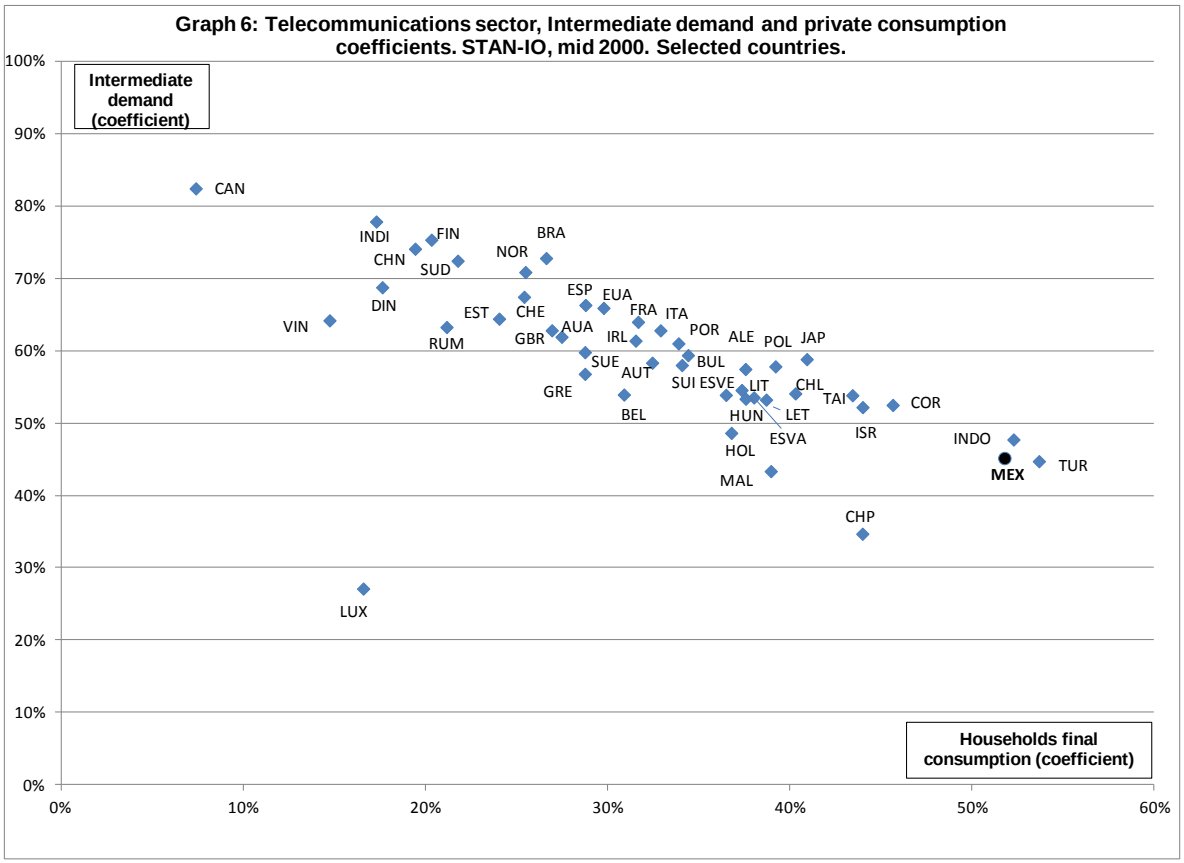
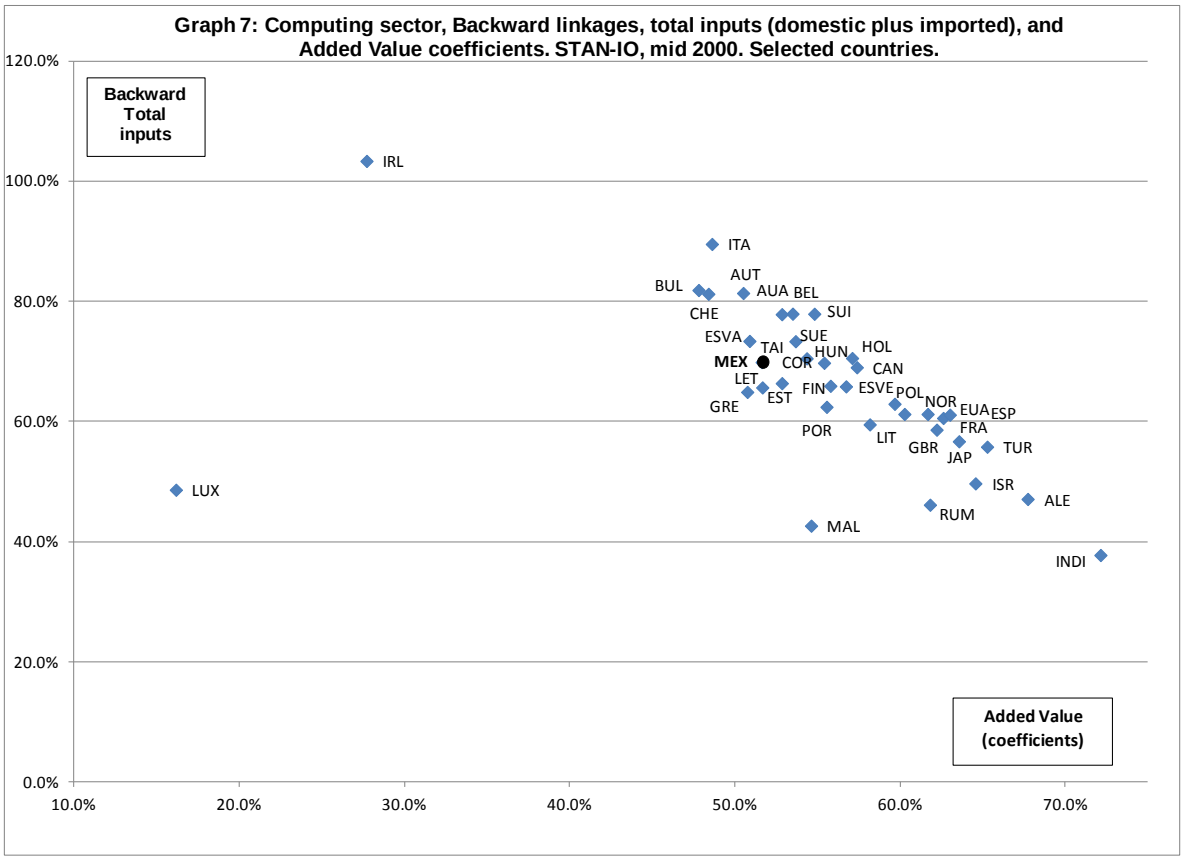
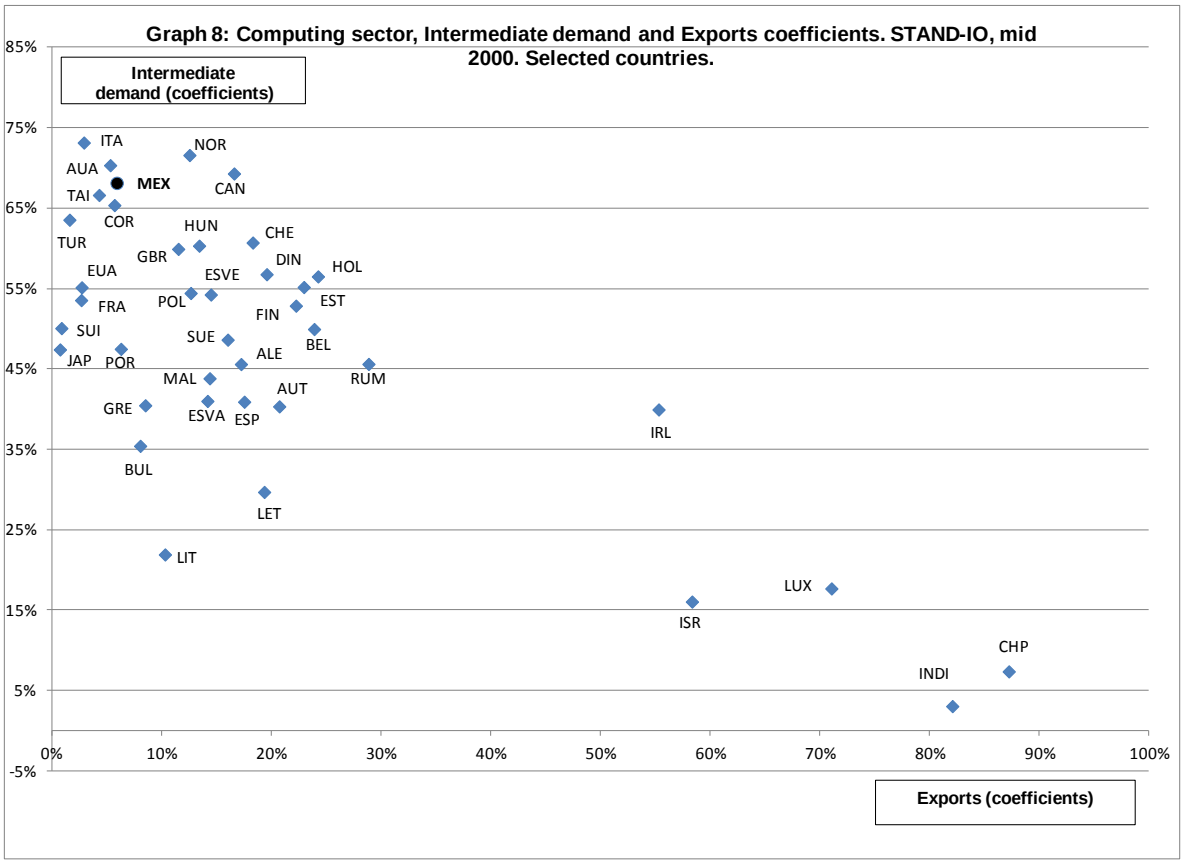



Figure 6 shows how the telecommunications sector in Mexico is focused to provide household for more than the intermediate demand, being well below the set of countries, but particularly around Indonesia, Turkey and Korea.




In Figure 7 it can be seen that in Mexico backward linkages of the computing sector are strong (70%), they are above the average (65%), but its ability to generate value added (52%) is by below the middle which is (55%). From the point of view of supply there is a similar pattern to Greece, Korea, Hungary, Netherland and Portugal. There are not data for China, Indonesia, Brazil and Chile.

Figure 8 presents the coefficients of intermediate demand and exports, most of the countries studied show strong export vocation in internet services, while Mexico is far behind in this area (6%). However, the intermediate demand of internet services in Mexico is very high.




Intermediate demand of internet services is very high in Mexico (68%), very close to countries like Italy, Australia, Taiwan, Korea, Turkey, Hungary and Britain, however export coefficients are outside the range of India, Luxembourg, Israel and Ireland and to a lesser extent Romania, Netherland, Belgium and Finland.

## 4. CONCLUSIONS

Mexico is a rich nation that is in 13th place of selected countries below of group of seven countries plus China; It is part of a second group conformed by Brazil, Spain, Korea and India. However, in GDP per head Mexico (site 29) is below Spain and Korea, and above Brazil, Chile, India and China.

The electronic sector shows a level of contribution to wealth above average (1% versus 0.15%), however it has an asymmetric behavior given his low level of linkages of domestic inputs (0.22) and a high level of imports of inputs (71%).

We found on one side that the electronic sector positively contributes to the generation of value added, and on the other hand the filtration of wealth outwards

from imports is very strong. The export strategy based on the maquiladora industry is very expensive in terms of foreign exchange currency. Mexico should adopt a strategy based on the production system scaling in the value chain that drives the substitution of imported inputs for to achieve greater integration of domestic inputs.

The telecommunications sector in Mexico is operating mainly in a monopoly niche given by Telmex/Telcel which has for about 70% of the telecommunications market, certainly the figures 5 and 6 show an asymmetric pattern in the comparison of the group selected countries, on the one hand (the supply side), backward linkages are very small, and the generation of added value is high; while on the side of demand, intermediate demand is at a very low level (45%) and household demand is very high (51%). The current discussion about the reform of the telecommunications sector in Mexico plays an important role in the future operation of the sector.

Finally, the computing sector in Mexico has a long way to go because while its backward linkages are above average (70%), their ability to generate value added (52%) is low compared to the group of countries considered. On the demand side, the internet services sector received a strong push from other sectors demand (68%), by the final demand side its fundamental niche is the households consumption (25%) compared to just with countries such as Lithuania, Poland, Turkey, Taiwan, Bulgaria and Canada; however Graph 8 shows that Mexico is far behind other countries in terms of Internet services exports.

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