**Distribution of the Gross Fixed Investment and the
Employment in Mexico**

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**Abstract.** The aim of this paper is to analyse the impact of the gross fixed investment on the level of employment in Mexico, particularly, we intend to identify those sectors of the Mexican economy that, via gross fixed investment, contribute the most to the level of employment. For these purposes, from the Input-Output analysis, tools like the subsystem analysis, the employment multipliers and the indices of Rasmussen were utilized and applied to the Mexican I-O tables of 2008 (INEGI) and 2009 (WIOD). The findings were weighed and it was concluded that sectors such as basic metals and fabricated metal, and transport equipment production are the sectors that contribute significantly to the level of employment in Mexico because they are labour importing sectors, they register the greatest employment multipliers and they show to be strongly connected to the rest of the system.

**Keywords:** Gross fixed investment, employment, Mexico, I-O tables, subsystem analysis, employment multipliers, indices of Rasmussen.

**JEL Codes:** C67, E22, J23

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1. **Introduction**

One of the most approved hypotheses of economic growth has to do with the process of capital accumulation. It has been argued that it is through the process of capital accumulation that an economy can reach higher levels of growth. Moreover, the process of capital accumulation is related to the concept of expansion of the productive capacity, which, at the time is associated to the expansion in the level of output. Since the different processes of production require not only capital but also labour, then an increase in the level of capital investment (which measures the accumulation of capital) necessarily has impacts on the level of employment, the possible outcomes can be positive or negative depending on the period of time considered. In the short run, for example, the flow of investment can increase but the stock of capital cannot. Therefore, in the short run, increases in the level of investment demand will generate a higher production in the capital-goods’ industries which leads to a higher demand of employees in the capital industries and perhaps in other industries.

In this paper, we try to measure how capital investment demand impacts the level of employment in the short run in the Mexican economy. The Input- Output analysis and some of its tools such as the subsystem analysis, the employment multipliers and the indices of Rasmussen are utilized in order to answer to the following questions:

* What is the impact of the gross fixed investment in the employment in Mexico?
* Which are the sectors that via gross fixed investment significantly contribute to the level of employment in Mexico?

By means of the subsystem analysis we will identify if in order to satisfy investment demand, a sector is labour importer or exporter, that is, if it requires more labour than what it delivers or *vice versa*, this with the aim of analysing the inter-sectorial transactions in terms of labour embodied in the goods that are being traded. Through the employment multipliers we will find the effects that an increase in (investment) demand has on the level of employment. And finally, via the indices of Rasmussen we will verify that the sectors that significantly contribute to the level of employment, are inter-connected to the majority of industries, and that the positive effect that they may have upon the system is evenly distributed among the system. This paper is organized as follows. The methodology is discussed in the next section. Section three presents the empirical answers to the above-formulated questions for the Mexican economy in 2008 and 2009. Two different sets of data were utilized, one from the World Input-Output Database (WIOD) and another from the National Institute of Geography and Statistics (INEGI). The main conclusions are contained in section four.

1. **Methodology**

This section is devoted to a discussion of the methods od the Input-Output analysis that will be utilized for the objectives of this work. The Input-Output model enables to identify how every single economic entity is linked to the rest of the system, and thus it also allows knowing which of the entities has greater power upon the system and through which external shocks can be transmitted to the entire system. First we will focus on the subsystem analysis. Next the employment multipliers and the indices of Rasmussen will be discussed.

1. The subsystem analysis

The subsystem analysis allows identifying the allocation of other inputs, for example labour, to the production processes of the different goods. This approach is based on the partition of the economic system into as many subsystems as commodities. This method was developed by Sraffa (1960) in *The Production of Commodities by Means of Commodities* and then by Pasinetti (1980, 1986) in several of his works.

Sraffa defined a subsystem as follows:

“A system can be subdivided into as may parts as there are commodities in its net product, in such a way that each part forms a smaller self-replacing system, the net product of which consists of only one kind of commodity” (1960: 89).

That is, for example, if the complete systems’ net product consists of 35 commodities, then it can be split up in 35 subsystems. Of course the principle behind this idea has a strong economic meaning; it means that the 35 sectors take the intermediate process for granted and bring into relief the final goods and the labour requirements. In other words, this is what Pasinetti (1980, 1986) calls the *vertically integrated sectors* which as he states, can be represented simply by one physical unit of final good $i$, one physical unit of vertically integrated productive capacity for final good $i$ and one physical quantity of labour for final good $i$. Pasinetti defines a subsystem as:

“(…) an analytical construct that represents a self-contained economic system which produces physical quantity $Y\_{i}$ as net product, and absorbs $L\_{i}$ of labour as net input, while at the same time reproducing all the means of production necessary for this purpose through a self-replacing circular process” (1980: 10).

Technically speaking, this analysis is the result of a change in the allocation of the production system, and is based on the utilization of a synthetic final demand vector $y$(see Schnabl 2000). The vector $y$ contains only zeros except for one element; this one different element in spot $j$ will be equal to the final demand of $j$, this vector will now be multiplied by the Leontief inverse matrix so that we get $c\_{ij}=\left(I-A\right)^{-1} y\_{j}$.

Each element of the resulting vector $c\_{ij}$indicates how much sector $i$ as a whole must produce to contribute creating a unit of final product $j$. As we would like to make this observation for all $n$ final sales simultaneously, we would need to use the appropriate multiplication to apply it for $n$ sectors:

$x\_{sub}=(I-A)^{-1} <y> $(1)

Where $<y >$is the synthetic diagonalized vector of final demand.

By including the $n$ columns as in equation (1) we can define the square matrix $x\_{sub}$ for each $j$-th subsystem of the production system, that is, the matrix consists of “hanged side by side” subsystems and it shows the production efforts of a single row sector $i$ distributed over the production of all final demand goods. This is of course also a form of imputation that has a special feature because the effect of final demand is distributed, in the context of production, exclusively to the production sectors involved. But as these values are absolute values of the contributions of production of sector $i$ to the rest of industries, we will use equation (2) to obtain the sectorial share values of the contributions of production of sector $i$ to the rest of the system.

$S= <x>^{-1}(I-A)^{-1} <y>$(2)

Where $<x>^{-1}$is the inverse of the diagonalized vector of production value, or in other words, the diagonalized matrix that registers the $1/x\_{i}$elements. The $<x>^{-1}$matrix allows a division of each element by the sectorial production value $x\_{i}$ and therefore allows a “standardization” of the row so that the addition of the elements $s\_{ij}$along row $j$ results 1. If we pre-multiply the $S$ operator given by (2) with a diagonal matrix of size $n$ of, for example, the labour force $<e>$, then we obtain the distribution of the labour force in the $n$ subsystems, those that describe the labour inputs needed for the production of the n sectors final demand.

$x\_{e}= <e> <x>^{-1}(I-A)^{-1} <y>$(3)

The matrix $x\_{e}$resulting from (3) registers the direct and indirect labour requirements to satisfy final demand. The individual column elements of $x\_{e}$ show how much the relevant subsystem directly and indirectly needs of labour force for the production of each required quantity of the final demand of the concerned good $j$ in order to create the total final demand of the column sector in question. Therefore if we add column-wise the elements of $x\_{e}$ we will obtain the number of employees *needed* to produce the product(s) of the sector or category $j$. If we add them row-wise we obtain the number of employees embodied in the production of good $i$ that sector $i$ *delivered* to the rest of the system.

For the purpose of this study, the subsystem analysis is a very valuable instrument to identify the impact of a given level of final demand on the level of employment, moreover, if instead of considering the whole final demand we just take the part that corresponds to capital investment, we can directly identify the amount of labour needed to satisfy capital investment demand. By utilizing this analysis we will be able to determine three main things, first we will recognize the net direct and indirect labour requirements of each sector in order to satisfy investment demand, second we will be able to identify those sectors, that in terms of labour, are more connected or depend the most to the rest of the system, and third the degree of connectedness will allow us to identify those sectors that contribute the most to the general level of employment. That is, this analysis helps us identifying the main channels through which the general level of employment can be increased.

1. Employment multipliers

By means of the employment multipliers we can recognize the sectors in which an increase in final demand and, specifically, an increase in capital investment, has the greatest effect on the level of employment. A multiplier measures the difference between the initial and the total effect of an exogenous change, the total effects can be defined either as direct and indirect effects (open Input-Output model) or as direct, indirect and induced effects (closed Input-Output model). The most common kinds of multipliers are those that estimate the effects of exogenous changes on: *a)* outputs of the different sectors, *b)* income earned by households in each sector because of new outputs, *c)* employment that is expected to be generated in each sector because of new outputs and *d)* the value added that is created by each sector because of new outputs (see Miller and Blair 2009 Chap. 6 and Dietzenbacher and Los 2002). However, in this chapter we will focus on the simple employment multipliers, those that account only for the direct and indirect effects, or in other words those that result from the open Input-Output model.

The simple employment multipliers are given by the following expression:

$m(e)\_{j}=\sum\_{i=1}^{n}a\_{n+1,j} l\_{ij}$(4)

Where $l\_{ij}$are the elements of the Leontief Matrix, $[\begin{matrix}a\_{n+1,1}&…&a\_{n+1,n}\end{matrix}]$ is the row associated to employment input coefficients that can be measured in terms of monetary or physical units of the number of employees per unit of output, i.e. they result from:

$\left[\begin{matrix}a\_{n+1,1}&…&a\_{n+1,n}\end{matrix}\right]=h´ <x>^{-1}$(5)

Where $h´$is the row vector that measures in physical or monetary terms the labour units required in each sector in the base period. Then the resulting vector of size *n* of simple employment multipliers $m(e)\_{j}$indicates that an additional dollar of final demand for sector *j* would generate the quantity $m(e)\_{j}$ of new jobs when all direct and indirect effects are converted into monetary or physical terms. These multipliers will determine in which sector an increase in final demand generates more employment, if we assume that the increase in final demand is due to an increase in capital investment, then the employment multipliers will tell us the effects that additional capital investment has on the level of employment

1. Indices of Rasmussen

These indices were developed by Rasmussen (1963) in his work *Intersectoral Relations* and are used to highlight and recognize the importance of some sectors that he calls *key sectors*. They help to identify those sectors that in some way are more connected to the rest of the system; for the purpose of this work, they help identifying those sectors in which additional capital investment generates positive effects on the major part of the system so that the largest possible number of industries could benefit from an external shock.

The Rasmussen indices are another method to determine whether a sector is important to an economic system or not. The first pair of indices can be named as the dispersion indices; they show if a sector has a considerable weight in the system and consists on the backward linkage index also known as power of dispersion index and on forward linkage index also known as the sensitivity of dispersion index. These indices describe the relative extension in which an increase in final demand for the products of industry $j$ is dispersed through the other industries (see Drejer, 2002).

We can calculate the dispersion indices as follows (Rasmussen, 1963: 128):

$$U\_{∙j}=\frac{\frac{1}{n}\sum\_{i=1}^{n}l\_{ij}}{\frac{1}{n^{2}}\sum\_{j=1}^{n}\sum\_{i=1}^{n}l\_{ij}}; \left(j=1, 2,…, n\right)$$

 (6)

$$U\_{i ∙}=\frac{\frac{1}{n}\sum\_{j=1}^{n}l\_{ij}}{\frac{1}{n^{2}}\sum\_{i=1}^{n}\sum\_{j=1}^{n}l\_{ij}}; (i=1, 2, …, n)$$

$U\_{∙j}$denotes the backward linkage index and expresses the extent of an expansion caused in the rest of the industries by an expansion in industry $j$, If $U\_{∙j}>1$ means that sector $j$ has a considerable weight upon the economic system compared to the general system of industries. This index describes the relative extension in which an increase in final demand of industry $j$ is dispersed through the economic system. Likewise $U\_{i∙}$ denotes the forward linkage index, if $U\_{i∙}>1$ means that industry $i$ in general will have to increase its production more than other industries to respond to an increase in final demand of other sectors. Then when considering jointly the indices of dispersion that measure the backward and the forward linkages we can classify industries as follows:

1. *Key sector:*  If $U\_{∙j}>1$and $U\_{i∙}>1$
2. *Backward-oriented sector:* If $U\_{∙j}>1$but $U\_{i∙}<1$
3. *Forward-oriented sector:* If $U\_{i∙}>1$but$U\_{∙j}<1$
4. *Non-key sector:* If $U\_{∙j}<1$and $U\_{i∙}<1$

The second index developed also by Rasmussen measures the variance of the dispersion index, this with the intention to know if an expansion in industry $j$ has a uniform effect on the rest of the economic sectors or if it only affects a group of sectors. The variance index measures the variance of the backward linkage index through $V\_{∙j}$ and the variance of the forward linkage index through$V\_{i∙}$, the variance index can be estimated with the following equations (Rasmussen, 1963: 132):

$$V\_{∙j}=\frac{\sqrt{\frac{1}{n-1}\sum\_{i=1}^{n}\left(l\_{ij}-\frac{1}{n}\sum\_{i=1}^{n}l\_{ij}\right)^{2}}}{\frac{1}{n}\sum\_{i=1}^{n}l\_{ij}}, (j=1, 2, …, n)$$

 (7)

$$V\_{i∙}=\frac{\sqrt{\frac{1}{n-1}\sum\_{j=1}^{n}\left(l\_{ij}-\frac{1}{n}\sum\_{j=1}^{n}l\_{ij}\right)^{2}}}{\frac{1}{n}\sum\_{j=1}^{n}l\_{ij}}, (j=1, 2, …, n)$$

$V\_{∙j}$can be interpreted as an index of uniformity of the impact of sector $j$ on the rest of the industries, if the value of $V\_{∙j}$ is low then the expansion affects the majority of the sectors, that is, has an unbiased effect on the economic system, which is a desirable effect. If the value of $V\_{∙j}$ is great, then it means that the expansion on sector $j$ has a unilateral or biased effect, i.e. it only affects a small number of industries. Besides, $V\_{i∙}$ reflects the uniformity of the impact that sector *i* has on the industries to which it delivers its product. If the value of $V\_{i∙}$ is relatively low then the expansion in *i* has an unbiased effect on the economic system. Moreover, a key industry would be identified by reporting $U\_{∙j}$**,** $U\_{i∙}>1$and $V\_{∙j}$**,** $V\_{i∙}$ with the lowest values. This is the case of those industries that are backward and forward linked and which effects on the rest of the system are unbiased and encompass the majority of industries.

1. **Empirical results**

In this section the empirical analysis of the impact of capital accumulation on employment for the case of Mexico is presented. By means of some of the applications of the Input-Output model analysed in the former section we will try to present those sectors of the Mexican economy in which capital accumulation has the greatest impact on employment.

Those sectors will be identified through the subsystem analysis, the multiplier analysis and the indices of Rasmussen; the first one will enable to know the labour units (hours or number of employees) that each sector delivered and required to satisfy a given level of investment demand, that is, we will be able to identify those sectors that in terms of labour are more connected to the rest of the system; the second one will allow us to identify those sectors in which the impact of additional investment demand on employment is higher; and finally, by means of the third one we will make sure that investment in those sectors will actually generate the best possible outcome not only for a small number of industries but for the majority of them.

Two different sets of database were utilized in this work; the first one was obtained from the *World Input-Output Database* (Timmer, 2012); it reports a small quantity of empty cells, which allows a broader image of the relations that occur within the system, this database is from 2009. The Input-Output table is aggregated in 35 sectors and is measured in millions of US dollars, the level of employment obtained from the *WOID Social Accounts* is measured in millions of hours worked.

The second database was obtained from the Mexican Institute of Statistics and Geography (INEGI, 2013). It reports the Input-Output table in the very disaggregated level of 79 industries that allows a better identification of the key industries. This database is from 2008; the Input-Output table is measured in millions of Mexican pesos and the level of employment in number of employees. The industrial classification is different in both databases, the WOID utilizes the International Standard Industrial Classification (*ISIC*) and INEGI database uses the North American Industry Classification System (*NAICS*) (see tables A and B of the appendix).

1. The subsystem analysis

To measure the impact that capital accumulation has on employment in a given period of time we would need to adapt and solve equation (3) of the subsystem analysis, that is, as we are interested in identifying the effect of capital accumulation on employment, we would have to solve equation (3) only for the part of Gross Fixed Capital Formation that corresponds to Machinery and Equipment, that is, from the complete vector of Gross Fixed Capital Formation we will try to identify those sectors in which investment could be associated to the production of machinery and equipment; i.e. $y$will be our vector of *GFCF in Machinery and Equipment*. We should always keep in mind that each set of data registers the level of employment, total output and final demand in different units of measurement.

After solving the subsystem equation (3) for both sets of data we will obtain a square matrix $x\_{e}$of size 35 and another one of size 79, which show how investment (*GFCF in Machinery and Equipment*) was distributed across the different sectors and the level of employment that each sector required in order to satisfy the given level of investment demand, i.e. it shows the level of employment associated with the level of investment in each sector; it associates the distribution of investment with the distribution of employment. In tables 1 and 2 we present the most important results. Tables 1 and 2 report information about employment and information about investment; the employment side registers the information obtained from solving the subsystem $x\_{e}$ and the investment side deals with the information of the *GFCF*.

The first column of the employment side of each table registers the column-wise addition of $x\_{e}$ and it shows how much working force each sector of the subsystem directly and indirectly *required* to satisfy the given investment demand, i.e. it shows the units of employment embodied in the inputs that the (column) sector in question required to satisfy investment demand of machinery and equipment.

The second column registers the row-wise addition of $x\_{e}$ and it shows the units of employment that were *delivered* from the (row) sector to the rest of the system, i.e. it represents the distribution of the (row) sector’s production in terms of labour to the rest of the industries. The third column shows the difference between column 1 and column 2, if the difference is positive, then it means that the sector in question required more employment than the level of employment that it delivered (i.e. the sector *imports* labour). If the difference is negative it means that the sector required less units of labour than what it actually delivered (i.e. the sector *exports* labour).

The fourth column gives an *M* to those sectors that import labour and an *X* to those that export labour, the sectors that become important for our analysis are those that import labour because an increment in the level of investment in machinery and equipment of these sectors will indirectly increase the general level of employment because they demand high amounts of employment from the other industries. As the labour requirements of the labour importer sectors are higher than their deliveries, when the level of investment demand increases, their requirements of labour will increase even more, thus generating an increase in the level of employment.

The fifth column registers the share of each element of the main diagonal with respect to its corresponding column sum; it shows the extent to which the sector is responsible for its own labour force, that is to say, the share of its own labour force delivered to itself. The sixth column and first column of the investment side shows how much each sector invested in Machinery and Equipment and the seventh column shows the share of investment of each sector with respect to total investment.

In order to identify those sectors of the system which positively contribute to the level of employment to satisfy a given investment demand, we will need to find those sectors that fulfil the following characteristics:

1. *The sector must be a sector importer of labour:* this will mean that this sector directly and indirectly requires a higher amount of units of labour in order to satisfy its production requirements than what it delivers of labour to the rest of the system. If the sector is a sector importer of labour, then higher investment in Machinery and Equipment in this sector will generate greater imports of units of labour and thus, it may be possible (ceteris paribus) that the rest of the sectors from which it obtains its inputs, will also experience an increase in their level of employment. An importer sector of labour is a sector that is more connected to the rest of the system from the inputs side.

**Table 1.** The Subsystem Analysis: Mexico, 2009 with data from WIOD

|  |  |  |
| --- | --- | --- |
|   | **Employment sidea** | **Investment sideb** |
| *Sector ISIC* | *1) Addition (column-wise)* | *2) Addition (row-wise)* | *3)= 1) - 2)* | *X or M* | *% Main Diagonal with respect to 1)* | *GFCF Ma&Eq* | *% GFCF Ma&Eq with respect to total GFCF Ma&Eq* |
| AtB | 0 | 10.94 | -10.94 | X |   | 0 | 0 |
| C | 0 | 2.31 | -2.31 | X |   | 0 | 0 |
| 15t16 | 18.01 | 8.28 | 9.73 | M | 41.75 | 258 | 2.36 |
| 17t18 | 4.47 | 15.90 | -11.43 | X | 87.07 | 25 | 0.23 |
| 19 | 0.54 | 3.30 | -2.76 | X | 73.22 | 6 | 0.05 |
| 20 | 0.81 | 3.18 | -2.37 | X | 50.40 | 9 | 0.08 |
| 21t22 | 2.15 | 7.53 | -5.37 | X | 70.86 | 34 | 0.31 |
| 23 | 2.94 | 1.05 | 1.88 | M | 19.41 | 181 | 1.66 |
| 24 | 7.43 | 6.99 | 0.44 | M | 46.69 | 240 | 2.19 |
| 25 | 4.83 | 13.74 | -8.91 | X | 71.41 | 63 | 0.58 |
| 26 | 2.26 | 4.09 | -1.83 | X | 69.28 | 43 | 0.39 |
| 27t28 | 27.91 | 24.98 | 2.94 | M | 54.86 | 791 | 7.24 |
| 29 | 108.95 | 84.94 | 24.02 | M | 76.95 | 1,418 | 12.98 |
| 30t33 | 90.62 | 64.14 | 26.48 | M | 66.63 | 2,161 | 19.79 |
| 34t35 | 201.37 | 116.22 | 85.16 | M | 57.20 | 4,349 | 39.83 |
| 36t37 | 106.65 | 82.36 | 24.29 | M | 74.73 | 1,193 | 10.93 |
| E | 5.69 | 6.39 | -0.70 | X | 50.72 | 149 | 1.37 |
| F | 0 | 1.52 | -1.52 | X |   | 0 | 0 |
| 50 | 0 | 8.98 | -8.98 | X |   | 0 | 0 |
| 51 | 0 | 11.99 | -11.99 | X |   | 0 | 0 |
| 52 | 0 | 39.40 | -39.40 | X |   | 0 | 0 |
| H | 0 | 7.43 | -7.43 | X |   | 0 | 0 |
| 60 | 0 | 12.00 | -12.00 | X |   | 0 | 0 |
| 61 | 0 | 0.79 | -0.79 | X |   | 0 | 0 |
| 62 | 0 | 1.03 | -1.03 | X |   | 0 | 0 |
| 63 | 0 | 5.62 | -5.62 | X |   | 0 | 0 |
| 64 | 0 | 0.71 | -0.71 | X |   | 0 | 0 |
| J | 0 | 5.33 | -5.33 | X |   | 0 | 0 |
| 70 | 0 | 0.88 | -0.88 | X |   | 0 | 0 |
| 71t74 | 0 | 31.24 | -31.24 | X |   | 0 | 0 |
| L | 0 | 0.45 | -0.45 | X |   | 0 | 0 |
| M | 0 | 0.39 | -0.39 | X |   | 0 | 0 |
| N | 0 | 0.05 | -0.05 | X |   | 0 | 0 |
| O | 0 | 0.51 | -0.51 | X |   | 0 | 0 |
| P | 0 | 0.00 | 0.00 | .-- |   | 0 | 0 |

Source: Own estimates with data from WOID.

**Notes:** a Employment measured in millions of hours. b Gross Fixed Capital Formation measured in millions of US dollars.

**Table 2.** The Subsystem Analysis: Mexico, 2008 with data from INEGI

|  |  |  |
| --- | --- | --- |
|  | **Employment sidea** | **Investment sideb** |
| *Sector NAICS* | *1) Addition (column-wise)* | *2) Addition (row-wise)* | *3)= 1) - 2)* | *X or M* | *% Main Diagonal with respect to 1)* | *GFCF Ma&Eq* | *% GFCF Ma&Eq with respect to total GFCF Ma&Eq* |
| **111** | 0 | 1,761 | -1,761 | X |   | 0 | 0 |
| **112** | 0 | 297 | -297 | X |   | 0 | 0 |
| **113** | 0 | 2,618 | -2,618 | X |   |   | 0 |
| **114** | 0 | 7 | -7 | X |   |   | 0 |
| **115** | 0 | 116 | -116 | X |   |   | 0 |
| **211** | 0 | 161 | -161 | X |   |   | 0 |
| **212** | 0 | 7,406 | -7,406 | X |   |   | 0 |
| **213** | 0 | 6 | -6 | X |   | 0 | 0 |
| **221** | 0 | 1,866 | -1,866 | X |   |   | 0 |
| **222** | 0 | 757 | -757 | X |   |   | 0 |
| **236** | 0 | 29 | -29 | X |   | 0 | 0 |
| **237** | 0 | 28 | -28 | X |   | 0 | 0 |
| **238** | 0 | 681 | -681 | X |   | 0 | 0 |
| **311** | 0 | 626 | -626 | X |   |   | 0 |
| **312** | 0 | 53 | -53 | X |   |   | 0 |
| **313** | 0 | 1,729 | -1,729 | X |   |   | 0 |
| **314** | 577 | 514 | 64 | M | 63.88 | 179 | 0.06 |
| **315** | 0 | 320 | -320 | X |   |   | 0 |
| **316** | 0 | 1,415 | -1,415 | X |   |   | 0 |
| **321** | 0 | 6,001 | -6,001 | X |   |   | 0 |
| **322** | 0 | 853 | -853 | X |   |   | 0 |
| **323** | 0 | 813 | -813 | X |   |   | 0 |
| **324** | 0 | 183 | -183 | X |   |   | 0 |
| **325** | 0 | 1,781 | -1,781 | X |   |   | 0 |
| **326** | 4,803 | 7,468 | -2,666 | X | 49.94 | 2,208 | 0.76 |
| **327** | 153 | 1,612 | -1,459 | X | 61.74 | 55 | 0.02 |
| **331** | 36,348 | 9,420 | 26,927 | M | 16.16 | 26,517 | 9.14 |
| **332** | 41,166 | 29,863 | 11,303 | M | 59.48 | 15,073 | 5.20 |
| **333** | 57,870 | 27,978 | 29,892 | M | 47.08 | 34,002 | 11.73 |
| **334** | 5,457 | 3,226 | 2,230 | M | 58.37 | 6,741 | 2.32 |
| **335** | 17,408 | 8,889 | 8,519 | M | 49.35 | 10,888 | 3.75 |
| **336** | 249,536 | 94,984 | 154,553 | M | 38.00 | 179,240 | 61.81 |
| **337** | 60,869 | 40,496 | 20,373 | M | 66.19 | 14,547 | 5.02 |
| **339** | 1,137 | 1,053 | 84 | M | 73.76 | 532 | 0.18 |
| **431** | 0 | 118,003 | -118,003 | X |   | 0 | 0 |
| **481** | 0 | 448 | -448 | X |   | 0 | 0 |
| **482** | 0 | 124 | -124 | X |   | 0 | 0 |
| **483** | 0 | 100 | -100 | X |   | 0 | 0 |
| **484** | 0 | 8,693 | -8,693 | X |   | 0 | 0 |
| **485** | 0 | 349 | -349 | X |   | 0 | 0 |

Source: Own estimates with data from INEGI.

**Notes:** **a**Employment measured in number of employees **b** Gross Fixed Capital Formation measured in millions of MX pesos.

**CONT. Table 2.** The Subsystem Analysis: Mexico, 2008 with data from INEGI

|  |  |  |
| --- | --- | --- |
|  | **Employment sidea** | **Investment sideb** |
| *Sector NAICS* | *1) Addition (column-wise)* | *2) Addition (row-wise)* | *3)= 1) - 2)* | *X or M* | *% Main Diagonal with respect to 1)* | *GFCF Ma&Eq* | *% GFCF with respect to total GFCF* |
| **486** | 0 | 60 | -60 | X |   | 0 | 0 |
| **487** | 0 | 6 | -6 | X |   | 0 | 0 |
| **488** | 0 | 835 | -835 | X |   | 0 | 0 |
| **491** | 0 | 31 | -31 | X |   |   | 0 |
| **492** | 0 | 159 | -159 | X |   |   | 0 |
| **493** | 0 | 1,228 | -1,228 | X |   |   | 0 |
| **511** | 10,913 | 6,063 | 4,850 | M | 52.70 | 3,781 | 1.30 |
| **512** | 0 | 99 | -99 | X |   | 0 | 0 |
| **515** | 0 | 1 | -1 | X |   |   | 0 |
| **517** | 0 | 396 | -396 | X |   |   | 0 |
| **518** | 0 | 259 | -259 | X |   |   | 0 |
| **519** | 0 | 21 | -21 | X |   |   | 0 |
| **521** | 0 | 9 | -9 | X |   |   | 0 |
| **522** | 0 | 923 | -923 | X |   |   | 0 |
| **523** | 0 | 161 | -161 | X |   |   | 0 |
| **524** | 0 | 282 | -282 | X |   |   | 0 |
| **531** | 0 | 796 | -796 | X |   |   | 0 |
| **532** | 0 | 1,015 | -1,015 | X |   |   | 0 |
| **533** | 0 | 5 | -5 | X |   | 0 | 0 |
| **541** | 0 | 8,119 | -8,119 | X |   | 0 | 0 |
| **551** | 0 | 294 | -294 | X |   |   | 0 |
| **561** | 0 | 69,732 | -69,732 | X |   |   | 0 |
| **562** | 0 | 38 | -38 | X |   |   | 0 |
| **611** | 0 | 122 | -122 | X |   |   | 0 |
| **621** | 0 | 10 | -10 | X |   |   | 0 |
| **622** | 0 | 29 | -29 | X |   |   | 0 |
| **623** | 0 | 0 | 0 | X |   |   | 0 |
| **624** | 0 | 0 | 0 | X |   |   | 0 |
| **711** | 0 | 60 | -60 | X |   |   | 0 |
| **712** | 0 | 6 | -6 | X |   |   | 0 |
| **713** | 0 | 19 | -19 | X |   |   | 0 |
| **721** | 0 | 685 | -685 | X |   |   | 0 |
| **722** | 0 | 5,849 | -5,849 | X |   |   | 0 |
| **811** | 0 | 5,634 | -5,634 | X |   |   | 0 |
| **812** | 0 | 52 | -52 | X |   |   | 0 |
| **813** | 0 | 501 | -501 | X |   |   | 0 |
| **814** | 0 | 0 | 0 |   |   |   | 0 |
| **931** | 0 | 11 | -11 | X |   |   | 0 |
| **932** | 0 | 0 | 0 |   |   |   | 0 |

Source: Own estimates with data from INEGI.

**Notes:** a Employment measured in number of employees b Gross Fixed Capital Formation measured in millions of MX pesos.

1. *The share of its own labour force delivered to itself must be at most 50%:* The percentage value of the elements of the main diagonal with respect to the column-wise addition should be at most 50%, this would mean that the reason why its labour requirements are higher than its deliveries, is because of the high labour units embodied on the inputs that it required for its production and not because the labour units required in the production of its own good were high. Therefore if the percentage value is smaller than 50% this suggests that in terms of labour, the sector is more connected and depends more on the rest of the system; then higher investment in this sector will generate an increase in employment not only in its own sector but also in the others.

The results from table 1 show that the sectors that import labour represent only 24% of the total number of sectors i.e. out of 35 sectors only 8 sectors result labour importers (those highlighted in blue). More specifically, from table 1 we can see that for example sector (34t35) *Transport Equipment Production* in order to satisfy the highest level of investment demand, reports the highest labour imports, that is, it is the sector that requires more labour units (85.16 millions of hours) from the sectors from which it obtains its inputs, but we also see that 57% of the labour that it required for its production was delivered from itself. Even if the 57% surpasses our 50% criterion, it is difficult to deny the potential positive impact that additional investment in this sector may have on the level of employment.

Also from table 1 there are other special cases that deserve to be mentioned, sectors such as (15t16) *Food, Beverages and Tobacco*, (27t28) *Basic Metals and Fabricated Metal,* (23) *Coke, Refined Petroleum and Nuclear Fuel* and (24) *Chemicals and Chemical Products*, report small labour imports, but a great portion of them are obtained from the rest of the system, that is, less than 50% of the labour imports of each sector are delivered by themselves. In terms of labour they are more connected to the rest of the system because the inputs required in their production embody large units of labour, this suggests that an additional increase in the level of capital investment of these sectors may cause a positive effect not only on the level of employment of themselves but also on the other sectors with whom they are connected, it is very likely that through these sectors, other sectors would also benefit.

Sectors (30t33) *Electrical and Optical Equipment,* (36t37) *Manufacturing, Furniture, Nec; Recycling* and (29) *Machinery* are in the opposite situation, even though it seems that they import labour from the rest of the system to satisfy the given investment demand, between 65% and 75% of their labour imports come from within themselves. Therefore, an additional increase in the level of investment of these sectors may not generate an important impact on the general level of employment.

If we now interpret the results obtained from the same exercise but with the database from INEGI shown in table 2, we will see that in fact the findings bear out the results obtained with the WIOD database. First of all, because in order to satisfy the investment demand on machinery and equipment, the sectors that report the highest labour imports coincide with those obtained with the WOID database, those sectors (highlighted in blue) are (336) *Transport Equipment Production*, (333) *Machinery and Equipment*, (331) *Basic Metals*, (337) *Furniture, Mattress*, *Shutter Production*, (332) Fabricated Metal, (335) *Electrical and Electronic Accessories* and (334) *Electrical and Electronic Equipment* (see table 2).

But this time, from the very disaggregated table 2, it can be seen that in fact, sectors such as (336) *Transport Equipment Production*, (333) *Machinery and Equipment*, (331) *Basic Metals* and (335) *Electrical and Electronic Accessories* represent those sectors that besides of importing labour from the rest of the system, their labour imports are explained to a large extent by the labour units (number of employees in this case) embodied in the inputs that each sector required for its own production, i.e. at least 50% of their labour imports come from other sectors; these sectors represent those that are more connected to the system since they demand in terms of labour, higher amounts of other goods. These sectors depend in a higher degree on other industries. The rest of the sectors highlighted in blue that were not mentioned in this paragraph constitute those sectors that were only labour importers but that their degree of connectedness with the rest of industries was not very strong.

Of course the final decision of whether investing in any of these sectors depends on the social needs and wants of the Mexican economy. Moreover, we would need to make sure that the goods produced in these sectors, are goods that can be sold and that are economically needed and wanted, otherwise to generate a higher level of employment we would be producing goods and services that nobody wants and that cannot be sold.

1. The multiplier analysis

After identifying those sectors that from the subsystem analysis are labour-importer sectors, by means of the employment multipliers we investigate and verify if an increase in capital investment in these industries has a positive effect on the level of employment. After applying equation (4) to both sets of data, we obtained the employment multipliers of the sectors identified with the subsystem analysis (see table 3). The left side of table 3 displays the employment multipliers obtained using the WIOD database, in the right side multipliers obtained from INEGI.

From the left side of table 3 we can see that an additional unit (millions of US dollars) of final demand, and thus of capital investment, has the greatest impact on the level of employment of the following sectors (highlighted in green): (17t18) *Textiles and Textile Products*, (61) *Water Transport*, (H) *Hotels and Restaurants*, (AtB) *Agriculture, Hunting, Forestry and Fishing*, (P) *Private Households with Employed Persons* and (M) *Education*. It is clear that as these sectors are labour-intensive, additional capital investment in these sectors will generate the greatest increases in the level of employment. For example, sectors as (AtB) *Agriculture, Hunting, Forestry and Fishing* and (P) *Private Households with Employed Persons* are sectors that, in their majority, only require labour to produce agricultural products and domestic activities.

The case of sector (17t18) *Textiles and Textile Products* as the sector with the highest employment multiplier was also expected; Mexico is an economy with one of the largest “maquiladora” industries and they are located in the sector of textiles. Consequently, besides from the Education sector, we should be cautious in considering increasing the level of investment in these sectors because many of these activities generate low value added and because the labour needed in the realization of many of these activities does not require a high level of qualification.

Moreover, from table 3 we can identify those sectors that in the Subsystem analysis resulted to be those sectors that in terms of labour are more connected to the rest of the system (highlighted in blue), and we can see that according to the employment multipliers, none of them report high employment multipliers, for example, sectors such as (34t35) *Transport Equipment Production,* (15t16) *Food, Beverages and Tobacco*, (27t28) *Basic Metals and Fabricated Metal,* (23) *Coke, Refined Petroleum and Nuclear Fuel* and (24) *Chemicals and Chemical Products* are identified as sectors with low employment multipliers, which means that additional investment demand in these sectors will not generate significant increments in their level of employment. However, this does not mean that the results obtained from the subsystem analysis are not consistent, it means that *directly* these sectors do not generate labour in themselves, or in other words, these sectors are not necessarily labour-intensive sectors. Therefore, additional investment in these sectors will not tend to increase the level of labour in them. In this case, unlike the subsystem analysis, the simple employment multipliers register the *direct effect* of additional investment on the level of employment required in the sectors’ production, while the subsystem analysis registers the net effect[[1]](#footnote-1) of additional investment in machinery and equipment, on employment.

The case of industries (29) *Machinery* and (36t37) *Manufacturing, Furniture, Nec and Recycling* also reaffirm the results obtained from the subsystem analysis. That is, these two sectors were identified as sectors importer of labour but the imports came from within themselves, or in other words, additional investment demand generates a direct increase in their level of employment, i.e. they have high employment multipliers.

In the right side of table 3, we present the employment multipliers obtained with the INEGI database. The highest values of the employment multipliers from this exercise (highlighted in green) are to a large extent the same as those obtained with the WIOD database. We have that sectors (814) *Private Households with Employed Persons*, (111) *Agriculture*, (722) *Restaurants*, (114) *Hunting, Fishing and Animal Capture*, (623) *Residences of Social Assistance and Health Care* and (112) *Breeding and Stocking of Animals* report the six greatest employment multipliers, and as can be seen, all of them except for sector (623) were also the sectors with the greatest employment multipliers from the WIOD database Again the high values in the employment multipliers of these sectors result from the high labour requirements for the realization of these activities, mainly of the domestic, the agricultural and farming activities.

If we now focus on analysing what happened with the sectors, that through the subsystem analysis, we can see that the sectors identified as labour-importer sectors report relatively low employment multipliers, this is the case of sectors (331) *Basic Metals,* (335) *Electrical and Optical Accessories,* (333) *Machinery and Equipment* and (336) *Transport Equipment Production*, again this does not mean that they don’t generate employment, it means that they are not labour-intensive sectors and that additional investment in these sectors will generate increases in the level of employment, but not the greatest increases.

From the right side of table 3 we also find that sectors (314) *Textile Products except clothing* and (337) *Furniture, Mattress and Shutter* that were identified as labour-importer sectors, have high employment multipliers; the case of the textile industry (as mentioned before) was expected, since it requires high units of labour in its production process.

**Table 3.** Employment multipliers, Mexico: WOID 2009 and INEGI 2008

|  |  |
| --- | --- |
| **WIOD, 2009** | **INEGI, 2008** |
| *Sector* *ISIC* | *Employment Multiplier* | *Sector NAICS* | *Employment Multiplier* | *Sector NAICS* | *Employment Multiplier* |
| **AtB** | 0.149 | **111** | 17.27 | **486** | 1.11 |
| **C** | 0.011 | **112** | 8.04 | **487** | 4.97 |
| **15t16** | 0.070 | **113** | 5.12 | **488** | 2.21 |
| **17t18** | 0.177 | **114** | 9.38 | **491** | 5.83 |
| **19** | 0.096 | **115** | 4.03 | **492** | 2.82 |
| **20** | 0.090 | **211** | 0.18 | **493** | 4.59 |
| **21t22** | 0.063 | **212** | 1.96 | **511** | 2.89 |
| **23** | 0.016 | **213** | 1.75 | **512** | 2.91 |
| **24** | 0.031 | **221** | 1.03 | **515** | 3.08 |
| **25** | 0.076 | **222** | 2.67 | **517** | 0.90 |
| **26** | 0.053 | **236** | 4.87 | **518** | 5.66 |
| **27t28** | 0.035 | **237** | 3.95 | **519** | 3.39 |
| **29** | 0.077 | **238** | 5.10 | **521** | 0.27 |
| **30t33** | 0.042 | **311** | 4.95 | **522** | 1.20 |
| **34t35** | 0.046 | **312** | 2.90 | **523** | 2.06 |
| **36t37** | 0.089 | **313** | 3.29 | **524** | 1.87 |
| **E** | 0.038 | **314** | 3.22 | **531** | 0.41 |
| **F** | 0.094 | **315** | 3.61 | **532** | 2.06 |
| **50** | 0.115 | **316** | 5.12 | **533** | 0.12 |
| **51** | 0.031 | **321** | 5.50 | **541** | 2.52 |
| **52** | 0.086 | **322** | 2.18 | **551** | 0.83 |
| **H** | 0.157 | **323** | 3.85 | **561** | 7.74 |
| **60** | 0.061 | **324** | 0.32 | **562** | 4.29 |
| **61** | 0.164 | **325** | 1.28 | **611** | 4.58 |
| **62** | 0.071 | **326** | 2.18 | **621** | 3.60 |
| **63** | 0.098 | **327** | 2.81 | **622** | 3.79 |
| **64** | 0.020 | **331** | 1.37 | **623** | 8.77 |
| **J** | 0.028 | **332** | 2.73 | **624** | 7.50 |
| **70** | 0.010 | **333** | 1.70 | **711** | 2.56 |
| **71t74** | 0.073 | **334** | 0.81 | **712** | 3.38 |
| **L** | 0.102 | **335** | 1.60 | **713** | 3.69 |
| **M** | 0.131 | **336** | 1.39 | **721** | 2.73 |
| **N** | 0.067 | **337** | 4.18 | **722** | 10.07 |
| **O** | 0.084 | **339** | 2.14 | **811** | 7.54 |
| **P** | 0.146 | **431** | 4.77 | **812** | 3.25 |
|  |  | **481** | 1.79 | **813** | 4.40 |
|  |  | **482** | 1.48 | **814** | 34.75 |
|  |  | **483** | 1.40 | **931** | 4.20 |
|  |  | **484** | 2.51 | **932** | 2.40 |
|  |  | **485** | 2.86 |  |  |

Source: Own estimates with data from WIOD and INEGI.

1. Indices of Rasmussen

It is also important to make sure that additional investment in one sector has positive impacts on the greatest possible number of industries, so that the impact does not benefit only one or a narrow number of industries. Therefore, by means of the indices of Rasmussen we will be able to identify those industries in which *a)* the effects of an increase in final demand are dispersed through the economic system and *b)* the effects are uniformly spread among all the industries affected.

Table 4 shows the dispersion and the variance indices obtained after applying equations (6) and (7) to our outstanding sectors from WIOD. On the one side, from table 4 we can recognize the key industries, the backward-linked industries, the forward-linked industries and the non-key industries. On the other side, from table 4 we can obtain those sectors of the economic system that uniformly distribute the impacts of an increase in final demand among all sectors of the economic system, in the following lines we discuss the results obtained.

We should highlight the resemblance of the results of the indices of dispersion with the results obtained from the subsystem analysis. For example, through the subsystem analysis we could identify those sectors that in terms of labour are more connected to the sectors from which they obtain their inputs (sectors importer of labour) and those sectors that are more connected to the sectors to which they sell their output to (sectors exporter of labour); in the case of the dispersion indices of Rasmussen the different sectors are also classified in sectors that are more connected to the sectors from which they obtain their inputs (backward linked sector) and in sectors that are more connected to sectors to which they sell their output to (forward linked sector).

Therefore, if we evaluate the results in terms of the indices of Rasmussen for the sectors that from the subsystem analysis and the employment multipliers were identified as those with the greatest impacts in the level of employment, we see that industries like (23) *Refined Petroleum and Nuclear Fuel*, (24) *Manufacture of Chemicals and Chemical Products* and (27t28) *Basic Metals and Fabricated Metal* are identified as key industries because the values of their backward and forward linkages are greater than one. An increase in the final demand of these industries will generate positive effects in the sectors from which they obtain their inputs and in the sectors to which they sell their products. These are sectors that from the demand-side pull the economic system and that from the supply-side push it.

Some of the backward-linked sectors are sectors like (15t16) *Food, Beverages and Tobacco*, (17t18) *Textiles and Textile Products*, (29) *Machinery*, (34t35) *Manufacture of Transport Equipment* and (36t37) *Manufacture of Furniture,* and they are said to be backward-linked because in order to satisfy a greater final demand in these industries, the total output of the majority of the industries of the system will also have to increase. Therefore additional investment in these sectors will generate positive effects on sectors from which they obtain their inputs.

If we now consider also the results from the variance index showed in the right side of table 4, we can see that the number of industries that generate a uniform or unbiased effect in the economic system by means of an increase in final demand becomes smaller. For the case of the variance index we will try to find those sectors in which either one or both of the variance indices of the backward and the forward linkages is (are) small, it was decided that for the backward linkage the maximum value of variance index should be 4.02, and for the forward linkage 4.03.

The industries that uniformly distribute the effects of an increase in final demand among the rest of the system can be identified in the right side of table 4 as the sectors with the smallest values of the variance indices, they are the following: (23) *Refined Petroleum and Nuclear Fuel*, (24) *Manufacture of Chemicals and Chemical Products* and (27t28) *Basic Metals and Fabricated Metal*.

Then, if we summarize the results obtained from applying the indices of Rasmussen to the WIOD database, we can see that the sectors that produce goods like *Refined Petroleum, Basic Metals, Electricity and Chemicals* are the sectors that were classified as key sectors and that reported the smallest variance indices of the backward and of the forward linkages.

**Table 4.** Dispersion and Variance Indices: Mexico, 2009 with data from WIOD

|  |  |
| --- | --- |
| ***Dispersion indices*** | ***Variance indices*** |
| *Sector* | *Backward Linkage Index* | *Forward Linkage Index* | Classification | *Backward Linkage Index* | *Forward Linkage Index* | Classification |
| AtB | 1.03 | 1.17 | Key sector | 4.30 | 3.88 | Forward-unbiased effect |
| C | 0.80 | 1.93 | Forward-oriented sector | 5.02 | 2.46 | Forward-unbiased effect |
| 15t16 | 1.19 | 0.96 | Backward-oriented sector | 3.76 | 4.63 | Backward-unbiased effect |
| 17t18 | 1.12 | 0.89 | Backward-oriented sector | 4.18 | 5.31 | Biased effect |
| 19 | 1.19 | 0.82 | Backward-oriented sector | 3.94 | 5.71 | Biased effect |
| 20 | 1.14 | 0.77 | Backward-oriented sector | 3.74 | 5.47 | Backward-unbiased effect |
| 21t22 | 1.07 | 1.05 | Key sector | 4.16 | 4.20 | Biased effect |
| 23 | 1.33 | 1.19 | Key sector | 3.55 | 3.35 | Unbiased effect |
| 24 | 1.19 | 1.33 | Key sector | 3.75 | 3.27 | Unbiased effect |
| 25 | 1.13 | 0.81 | Backward-oriented sector | 3.55 | 4.96 | Backward-unbiased effect |
| 26 | 1.04 | 0.80 | Backward-oriented sector | 3.91 | 5.14 | Biased effect |
| 27t28 | 1.13 | 1.16 | Key sector | 4.15 | 4.03 | Forward-unbiased effect |
| 29 | 1.02 | 0.69 | Backward-oriented sector | 3.87 | 5.77 | Backward-unbiased effect |
| 30t33 | 0.97 | 0.80 | Non-key sector | 4.33 | 5.27 | Biased effect |
| 34t35 | 1.04 | 0.82 | Backward-oriented sector | 4.02 | 5.15 | Backward-unbiased effect |
| 36t37 | 1.06 | 0.75 | Backward-oriented sector | 3.79 | 5.39 | Backward-unbiased effect |
| E | 1.22 | 1.23 | Key sector | 3.79 | 3.73 | Unbiased effect |
| F | 1.06 | 0.76 | Backward-oriented sector | 3.91 | 5.50 | Backward-unbiased effect |
| 50 | 0.88 | 0.83 | Non-key sector | 4.44 | 4.74 | Biased effect |
| 51 | 0.85 | 1.48 | Forward-oriented sector | 4.67 | 2.64 | Forward-unbiased effect |
| 52 | 0.84 | 1.38 | Forward-oriented sector | 4.73 | 2.82 | Forward-unbiased effect |
| H | 0.91 | 0.75 | Non-key sector | 4.33 | 5.24 | Biased effect |
| 60 | 0.96 | 1.12 | Forward-oriented sector | 4.17 | 3.51 | Biased effect |
| 61 | 1.08 | 0.68 | Backward-oriented sector | 3.69 | 5.82 | Backward-unbiased effect |
| 62 | 1.23 | 0.71 | Backward-oriented sector | 3.23 | 5.60 | Biased effect |
| 63 | 0.89 | 0.85 | Non-key sector | 4.46 | 4.66 | Biased effect |
| 64 | 0.97 | 1.01 | Forward-oriented sector | 4.40 | 4.18 | Biased effect |
| J | 0.92 | 1.64 | Forward-oriented sector | 4.71 | 2.57 | Forward-unbiased effect |
| 70 | 0.74 | 1.06 | Forward-oriented sector | 5.36 | 3.69 | Biased effect |
| 71t74 | 0.87 | 2.14 | Forward-oriented sector | 4.82 | 1.91 | Forward-unbiased effect |
| L | 0.92 | 0.69 | Non-key sector | 4.27 | 5.75 | Biased effect |
| M | 0.77 | 0.69 | Non-key sector | 5.13 | 5.76 | Biased effect |
| N | 0.85 | 0.67 | Non-key sector | 4.60 | 5.90 | Biased effect |
| O | 0.90 | 0.71 | Non-key sector | 4.37 | 5.59 | Biased effect |
| P | 0.68 | 0.67 | Non-key sector | 5.83 | 5.92 | Biased effect |

Source: Own estimates with data from WIOD

**Table 5.** Dispersion and Variance Indices: Mexico, 2008 with data from INEGI

|  |  |
| --- | --- |
| ***Dispersion indices*** | ***Variance indices*** |
| *Sector* | *Backward Linkage Index* | *Forward Linkage Index* | Classification | *Backward Linkage Index* | *Forward Linkage Index* | Classification |
| 111 | 0.85 | 0.99 | Forward-oriented sector | 7.15 | 6.21 | Biased effect |
| 112 | 1.15 | 0.85 | Backward-oriented sector | 5.49 | 7.26 | Backward-unbiased effect |
| 113 | 0.83 | 0.92 | Non-key sector | 7.31 | 6.79 | Biased effect |
| 114 | 1.15 | 0.68 | Backward-oriented sector | 5.36 | 8.86 | Backward-unbiased effect |
| 115 | 0.87 | 0.74 | Non-key sector | 6.85 | 8.08 | Biased effect |
| 211 | 0.74 | 2.56 | Forward-oriented sector | 8.16 | 2.68 | Forward-unbiased effect |
| 212 | 0.94 | 1.00 | Forward-oriented sector | 6.51 | 6.20 | Biased effect |
| 213 | 1.03 | 0.67 | Backward-oriented sector | 5.80 | 8.84 | Backward-unbiased effect |
| 221 | 1.12 | 1.93 | Key sector | 5.55 | 3.10 | Unbiased effect |
| 222 | 0.92 | 0.89 | Non-key sector | 6.51 | 6.64 | Biased effect |
| 236 | 1.05 | 0.68 | Backward-oriented sector | 5.72 | 8.79 | Backward-unbiased effect |
| 237 | 1.14 | 0.71 | Backward-oriented sector | 5.46 | 8.78 | Backward-unbiased effect |
| 238 | 0.97 | 0.86 | Non-key sector | 6.12 | 6.90 | Biased effect |
| 311 | 1.19 | 1.21 | Key sector | 5.71 | 5.65 | Backward-unbiased effect |
| 312 | 1.15 | 0.73 | Backward-oriented sector | 5.27 | 8.21 | Backward-unbiased effect |
| 313 | 1.08 | 0.92 | Backward-oriented sector | 5.83 | 6.84 | Backward-unbiased effect |
| 314 | 1.03 | 0.72 | Backward-oriented sector | 5.92 | 8.41 | Backward-unbiased effect |
| 315 | 0.94 | 0.74 | Non-key sector | 6.53 | 8.24 | Biased effect |
| 316 | 1.17 | 0.77 | Backward-oriented sector | 5.72 | 8.66 | Backward-unbiased effect |
| 321 | 1.19 | 0.87 | Backward-oriented sector | 5.69 | 7.52 | Backward-unbiased effect |
| 322 | 1.18 | 1.27 | Key sector | 6.14 | 5.72 | Biased effect |
| 323 | 1.17 | 0.90 | Backward-oriented sector | 5.32 | 6.78 | Backward-unbiased effect |
| 324 | 1.13 | 2.90 | Key sector | 6.04 | 2.33 | Unbiased effect |
| 325 | 1.16 | 2.65 | Key sector | 6.38 | 2.78 | Forward-unbiased effect |
| 326 | 1.06 | 0.94 | Backward-oriented sector | 5.79 | 6.39 | Backward-unbiased effect |
| 327 | 1.11 | 0.91 | Backward-oriented sector | 5.74 | 6.95 | Backward-unbiased effect |
| 331 | 1.19 | 1.49 | Key sector | 6.06 | 4.90 | Backward-unbiased effect |
| 332 | 1.14 | 0.92 | Backward-oriented sector | 5.61 | 6.81 | Backward-unbiased effect |
| 333 | 0.99 | 0.75 | Backward-oriented sector | 6.17 | 8.06 | Biased effect |
| 334 | 0.77 | 0.71 | Non-key sector | 7.72 | 8.38 | Biased effect |
| 335 | 0.97 | 0.75 | Non-key sector | 6.26 | 8.06 | Biased effect |
| 336 | 0.96 | 0.85 | Non-key sector | 6.62 | 7.46 | Biased effect |
| 337 | 1.09 | 0.68 | Backward-oriented sector | 5.52 | 8.73 | Backward-unbiased effect |
| 339 | 0.86 | 0.74 | Non-key sector | 6.89 | 8.08 | Biased effect |
| 431 | 0.85 | 3.41 | Forward-oriented sector | 7.11 | 1.78 | Forward-unbiased effect |
| 481 | 1.48 | 0.81 | Backward-oriented sector | 4.46 | 7.33 | Backward-unbiased effect |
| 482 | 1.09 | 0.69 | Backward-oriented sector | 5.53 | 8.58 | Backward-unbiased effect |
| 483 | 0.89 | 0.70 | Non-key sector | 6.74 | 8.58 | Biased effect |
| 484 | 0.98 | 1.08 | Forward-oriented sector | 6.19 | 5.54 | Biased effect |
| 485 | 1.14 | 0.75 | Backward-oriented sector | 5.44 | 7.93 | Backward-unbiased effect |

**CONT. Table 5.** Dispersion and Variance Indices: Mexico, 2008 with data from INEGI

|  |  |
| --- | --- |
| ***Dispersion indices*** | ***Variance indices*** |
| *Sector* | *Backward Linkage Index* | *Forward Linkage Index* | Classification | *Backward Linkage Index* | *Forward Linkage Index* | Classification |
| 486 | 0.88 | 0.68 | Non-key sector | 6.78 | 8.76 | Biased effect |
| 487 | 1.10 | 0.67 | Backward-oriented sector | 5.47 | 8.88 | Backward-unbiased effect |
| 488 | 0.91 | 0.93 | Non-key sector | 6.57 | 6.46 | Biased effect |
| 491 | 0.80 | 0.69 | Non-key sector | 7.41 | 8.64 | Biased effect |
| 492 | 1.06 | 0.72 | Backward-oriented sector | 5.65 | 8.25 | Backward-unbiased effect |
| 493 | 1.15 | 0.75 | Backward-oriented sector | 5.26 | 7.92 | Backward-unbiased effect |
| 511 | 1.00 | 0.78 | Backward-oriented sector | 6.08 | 7.73 | Backward-unbiased effect |
| 512 | 1.13 | 0.76 | Backward-oriented sector | 5.76 | 8.41 | Backward-unbiased effect |
| 515 | 1.14 | 0.68 | Backward-oriented sector | 5.36 | 8.77 | Backward-unbiased effect |
| 517 | 0.87 | 1.49 | Forward-oriented sector | 7.16 | 4.31 | Biased effect |
| 518 | 0.98 | 0.69 | Non-key sector | 6.16 | 8.60 | Biased effect |
| 519 | 1.09 | 0.68 | Backward-oriented sector | 5.68 | 8.72 | Backward-unbiased effect |
| 521 | 0.73 | 0.74 | Non-key sector | 8.17 | 8.05 | Biased effect |
| 522 | 0.89 | 1.28 | Forward-oriented sector | 6.72 | 4.73 | Biased effect |
| 523 | 0.97 | 0.70 | Non-key sector | 6.21 | 8.54 | Biased effect |
| 524 | 1.27 | 0.89 | Backward-oriented sector | 5.51 | 7.59 | Backward-unbiased effect |
| 531 | 0.74 | 1.72 | Forward-oriented sector | 8.13 | 3.50 | Forward-unbiased effect |
| 532 | 0.97 | 0.82 | Non-key sector | 6.17 | 7.26 | Biased effect |
| 533 | 0.69 | 0.71 | Non-key sector | 8.56 | 8.37 | Biased effect |
| 541 | 0.89 | 2.68 | Forward-oriented sector | 7.23 | 2.43 | Forward-unbiased effect |
| 551 | 0.86 | 1.19 | Forward-oriented sector | 7.46 | 5.34 | Biased effect |
| 561 | 0.81 | 3.08 | Forward-oriented sector | 7.56 | 2.00 | Forward-unbiased effect |
| 562 | 0.99 | 0.70 | Backward-oriented sector | 6.23 | 8.83 | Biased effect |
| 611 | 0.78 | 0.69 | Non-key sector | 7.66 | 8.68 | Biased effect |
| 621 | 0.88 | 0.67 | Non-key sector | 6.76 | 8.88 | Biased effect |
| 622 | 0.97 | 0.67 | Non-key sector | 6.16 | 8.86 | Biased effect |
| 623 | 1.02 | 0.67 | Backward-oriented sector | 5.87 | 8.89 | Backward-unbiased effect |
| 624 | 1.21 | 0.67 | Backward-oriented sector | 4.93 | 8.89 | Backward-unbiased effect |
| 711 | 0.79 | 0.70 | Non-key sector | 7.55 | 8.58 | Biased effect |
| 712 | 0.93 | 0.67 | Non-key sector | 6.39 | 8.87 | Biased effect |
| 713 | 0.95 | 0.67 | Non-key sector | 6.26 | 8.87 | Biased effect |
| 721 | 0.94 | 0.87 | Non-key sector | 6.37 | 6.86 | Biased effect |
| 722 | 0.99 | 0.83 | Backward-oriented sector | 6.02 | 7.13 | Backward-unbiased effect |
| 811 | 0.96 | 1.00 | Forward-oriented sector | 6.29 | 6.03 | Biased effect |
| 812 | 0.88 | 0.74 | Non-key sector | 6.88 | 8.12 | Biased effect |
| 813 | 0.96 | 0.73 | Non-key sector | 6.22 | 8.12 | Biased effect |
| 814 | 0.67 | 0.67 | Non-key sector | 8.89 | 8.89 | Biased effect |
| 931 | 0.96 | 0.67 | Non-key sector | 6.21 | 8.88 | Biased effect |
| 932 | 1.49 | 0.67 | Backward-oriented sector | 4.09 | 8.89 | Backward-unbiased effect |

Source: Own estimates with data from WIO

These results reveal what to some extent is evident; all these products are needed for the production of all goods but also require of the production of other sectors, and consequently when there is an increase in the level of production of any industry, the production of these sectors will also increase in order to satisfy the increment in their final demand.

What we can also see is that the sectors that are backward linked are those that depend on the production of other sectors, that is, the inputs needed in their production processes are obtained from a high number of industries. Therefore a direct increase in their level of production will lead to a higher input demand generating an increase in the level of production of other industries. This suggests that additional machinery and equipment investment in sectors (15t16), (23), (24), (27t28), (29), (34t35) and (36t37) apart from leading to an increase in the level of employment of the system, it will also lead to an unbiased increase in the level of output of the majority of the system, the effects will be equally distributed among the system.

If we now apply the dispersion and the variance indices to the database from INEGI, we obtain that from those sectors that were identified, with the subsystem analysis and the employment multipliers, as sectors with the ability to generate employment, only the sector (331) *Basic Metals* was classified as key sector[[2]](#footnote-2).

Some of the sectors that are classified as backward-linked sectors are the following: (314) *Textile Products*, (333) *Machinery and Equipment* and (337) *Furniture Production*, an increase in the final demand of any of these sectors will generate an increase in the level of production of all the sectors from which they buy their inputs.

Considering the variance indices, we decided that variance indices for backward linkages greater than 6.10, and for forward linkages greater that 3.50 their effect on the rest of the system is classified as biased. With this in mind, the only sectors that report small values of the variance indices are sectors (221) *Generation and Distribution of Electric Energy* and (324) *Products derived from Oil and Coal* these industries evenly distribute the effects of an increase in final demand among the sectors from which they obtains their inputs and the sectors to which they deliver their product. Additionally, from table 5 we observe that the only backward-linked industries that distributes uniformly its effects to the rest of the sectors is sector (337) *Furniture, Mattress and Shutter*.

From the subsystem analysis, the employment multipliers and the indices of Rasmussen we found that the only sectors in which additional capital and equipment investment generate positive effects in the level of employment and in the level of production of the entire system are sectors (331) *Basic Metals* and (337) *Furniture, Mattress and Shutter*.

1. **Summary and Conclusions**

From the subsystem analysis, the employment multipliers and the indices of Rasmussen we have identified some sectors in which an increase in their capital investment will generate the largest possible effects in terms of labour and output, table 6 summarizes the results from the WIOD and the INEGI databases.

From the WIOD database we identified four sectors in which additional capital investment will generate positive effects in terms of employment and output, these sectors are: (15t16) *Food, Beverages and Tobacco,* (23) *Coke, Refined Petroleum and Nuclear Fuel,* (27t28) *Basic Metals and Fabricated Metal,* and (34t35) *Transport Equipment Production*; these sectors fulfil the characteristics required by every single method, these are sectors that import labour from almost all the other sectors, they report relatively high employment multipliers, they are also very connected to the rest of the system, and additionally, they assure that the positive effects of external positive shocks are distributed in an evenly way among all the system.

From the WIOD database we also have sectors such as (24) *Chemicals and Chemical Products,* (29) *Machinery* and (36t37) *Manufacturing, Furniture, Nec; Recycling* that report significant indices of Ramussen, relatively high employment multipliers, high labour imports but more than 50% of their labour imports come from within themselves This suggests that additional capital investment in these sectors will generate higher employment in themselves, but the impact on the level of employment of other industries may not be significant.

**Table 6.** Sectors with positive effects on employment and output

|  |  |  |  |
| --- | --- | --- | --- |
| *Sector* | *Importer of labour in Subsystem analysis* | *Relatively high Employment Multiplier* | *Indices of Rasmussen* |
| *Key or backward-linked industry by dispersion index* | *Low variance index of the key or backward-linked industry* |
| **WIOD** |   |   |   |   |
| 15t16 | ✓ | ✗ | ✓ | ✓ |
| 23 | ✓ | ✗ | ✓ | ✓ |
| 24 | ✓ | ✗ | ✓ | ✓ |
| 27t28 | ✓ | ✗ | ✓ | ✓ |
| 29 | ✗ | ✓ | ✓ | ✓ |
| 34t35 | ✓ | ✗ | ✓ | ✓ |
| 36t37 | ✗ | ✓ | ✓ | ✓ |
| **INEGI** |  |  |  |   |
| 314 | ✗ | ✓ | ✓ | ✓ |
| 331 | ✓ | ✗ | ✓ | ✓ |
| 332 | ✗ | ✗ | ✓ | ✓ |
| 333 | ✓ | ✗ | ✓ | ✗ |
| 334 | ✓ | ✗ | ✗ | ✗ |
| 335 | ✓ | ✗ | ✗ | ✗ |
| 336 | ✓ | ✗ | ✗ | ✗ |
| 337 | ✗ | ✓ | ✓ | ✓ |

Source: Own estimates.

In the case of the INEGI database surprisingly we only obtained one sector that fulfils the characteristics required by every method, it is (331) *Basic Metals* in which additional investment in them will generate positive effects in the level of employment. As we can see, the results obtained from both sets of data coincide with respect to the fact that the sector Basic Metals is the sector that possesses the characteristics of a sector that could positively influence the level of employment and production of the system.

We also see that sectors (314) *Textile products except from Clothing* and (337) *Furniture, Mattress and Shutter* show significant indices of Rasmussen, high employment multipliers, are labour importer sectors but the labour imports are ought to the high labour requirements in themselves and not because of the labour units embodied in their inputs. From the results obtained with INEGI database, we can see that with a higher degree of disaggregation, it becomes more difficult to identify a sector that fulfils all the characteristics required.

Even though the database from INEGI does not suggest that sectors like (333) *Machinery Production* and (336) *Transport Equipment Production* are sectors in which higher capital investment will lead to a higher level of employment and production in the system, there are many reasons why we should not ignore these industries, first of all, because these are industries that add value to the productive processes, second, because new methods of production can be developed and adopted in these industries and third because they require qualified labour for their production. Thus the level of employment by these means will be increased not only in quantity but also in quality.

In future work, we intend to study the impact of capital accumulation in the long run, considering the effects that technological progress can have on the level of employment. The effects might be positive or negative but I believe that the net effect may be negative.

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**APPENDIX**

**Table A.** Classification of the Input-Output Table from WIOD

|  |  |  |
| --- | --- | --- |
| ***ISIC*** | *No.* | *Name of the Sector* |
| **AtB** | 1 | Agriculture, Hunting, Forestry and Fishing |
| **C** | 2 | Mining and Quarrying |
| **15t16** | 3 | Food, Beverages and Tobacco |
| **17t18** | 4 | Textiles and Textile Products |
| **19** | 5 | Leather, Leather and Footwear |
| **20** | 6 | Wood and Products of Wood and Cork |
| **21t22** | 7 | Pulp, Paper, Paper , Printing and Publishing |
| **23** | 8 | Coke, Refined Petroleum and Nuclear Fuel |
| **24** | 9 | Chemicals and Chemical Products |
| **25** | 10 | Rubber and Plastics |
| **26** | 11 | Other Non-Metallic Mineral |
| **27t28** | 12 | Basic Metals and Fabricated Metal |
| **29** | 13 | Machinery, Nec |
| **30t33** | 14 | Electrical and Optical Equipment |
| **34t35** | 15 | Transport Equipment |
| **36t37** | 16 | Manufacturing, Furniture, Nec; Recycling |
| **E** | 17 | Electricity, Gas and Water Supply |
| **F** | 18 | Construction |
| **50** | 19 | Sale, Maintenance and Repair of Motor Vehicles and Motorcycles; Retail Sale of Fuel |
| **51** | 20 | Wholesale Trade and Commission Trade, Except of Motor Vehicles and Motorcycles |
| **52** | 21 | Retail Trade, Except of Motor Vehicles and Motorcycles; Repair of Household Goods |
| **H** | 22 | Hotels and Restaurants |
| **60** | 23 | Inland Transport |
| **61** | 24 | Water Transport |
| **62** | 25 | Air Transport |
| **63** | 26 | Other Supporting and Auxiliary Transport Activities; Activities of Travel Agencies |
| **64** | 27 | Post and Telecommunications |
| **J** | 28 | Financial Intermediation |
| **70** | 29 | Real Estate Activities |
| **71t74** | 30 | Renting of M&Eq and Other Business Activities |
| **L** | 31 | Public Admin and Defence; Compulsory Social Security |
| **M** | 32 | Education |
| **N** | 33 | Health and Social Work |
| **O** | 34 | Other Community, Social and Personal Services |
| **P** | 35 | Private Households with Employed Persons |

Source: WIOD. Timmer (2012).

**Table B.** Classification of the Input-Output Table from INEGI

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| ***NAICS*** | *No.* | *Name of the Sector* | ***NAICS*** | *No.* | *Name of the Sector* |
| **111** | 1 | Agriculture | **486** | 41 | Pipeline Transport |
| **112** | 2 | Breeding and Stocking of Animals | **487** | 42 | Touristic Transport |
| **113** | 3 | Forestry activities | **488** | 43 | Services related to Transport |
| **114** | 4 | Hunting, Fishing and Animal Capture | **491** | 44 | Post |
| **115** | 5 | Services related to Farming and Forestry | **492** | 45 | Messaging and Packaging |
| **211** | 6 | Oil and Gas Extraction | **493** | 46 | Storage Services |
| **212** | 7 | Mining and Quarrying except Oil and Gas | **511** | 47 | Newspaper, Magazines, Books, Software and Publishing |
| **213** | 8 | Services related to Mining | **512** | 48 | Film, Video and Sound Industry |
| **221** | 9 | Generation and Distribution of Electric Energy | **515** | 49 | Radio and Television |
| **222** | 10 | Distribution of Gas and Water by pipeline | **517** | 50 | Other Telecommunications |
| **236** | 11 | Construction | **518** | 51 | Processing of Information, Accommodation and others |
| **237** | 12 | Civil engineering works | **519** | 52 | Other Information Services |
| **238** | 13 | Specialized works for construction | **521** | 53 | Central Bank |
| **311** | 14 | Food | **522** | 54 | Financial Intermediation |
| **312** | 15 | Beverages and Tobacco | **523** | 55 | Stock, Exchange and Financial Investment Activities |
| **313** | 16 | Textile inputs | **524** | 56 | Insurance and bonds |
| **314** | 17 | Textile products except from clothing | **531** | 57 | Real Estate Activities |
| **315** | 18 | Clothing production | **532** | 58 | Renting of Machinery and Equipment |
| **316** | 19 | Leather  | **533** | 59 | Renting of Registered Brands, Patents and Franchise. |
| **321** | 20 | Wood | **541** | 60 | Professional, Scientific and Technical services |
| **322** | 21 | Paper | **551** | 61 | Corporates |
| **323** | 22 | Printing | **561** | 62 | Support to businesses |
| **324** | 23 | Products derived from Oil and Coal | **562** | 63 | Waste and Remediation Activities |
| **325** | 24 | Chemical Industry | **611** | 64 | Education |
| **326** | 25 | Rubber and Plastics | **621** | 65 | External Medical assistance |
| **327** | 26 | Other Non-Metallic Mineral | **622** | 66 | Hospitals |
| **331** | 27 | Basic Metals | **623** | 67 | Residences of Social Assistance and Health Care |
| **332** | 28 | Fabricated Metal | **624** | 68 | Other Social Services |
| **333** | 29 | Machinery and Equipment | **711** | 69 | Artistic, Cultural and Sport services |
| **334** | 30 | Electrical and Electronic Equipment | **712** | 70 | Museums, Zoos, Historical places and similar |
| **335** | 31 | Electrical and Electronic Accessories | **713** | 71 | Entertaining |
| **336** | 32 | Transport Equipment Production | **721** | 72 | Hotels |
| **337** | 33 | Furniture, Mattress and Shutter | **722** | 73 | Restaurants |
| **339** | 34 | Other Manufacturing industries | **811** | 74 | Maintenance and Repair services |
| **431** | 35 | Commerce | **812** | 75 | Personal services |
| **481** | 36 | Air Transport | **813** | 76 | Associations and Organizations |
| **482** | 37 | Rail Transport | **814** | 77 | Private Households with Employed Persons |
| **483** | 38 | Water Transport | **931** | 78 | Public Admin and Defence; Compulsory Social Security |
| **484** | 39 | Cargo Transport | **932** | 79 | International and Extraterritorial Organisms |
| **485** | 40 | Passenger Transport |  |  |  |

Source: INEGI (2013).

1. Units of labour embodied in the inputs that the sector required minus units of labour delivered from the sector to the rest of the system. [↑](#footnote-ref-1)
2. The reason why we do not see sectors such as (324) Products derived from oil and coal and (325) Chemical industry is because INEGI does not report Gross Fixed Capital Investment for these sectors. I believe, that if there were available information about this, the results for these sectors would be completely different. [↑](#footnote-ref-2)