

Mexico and Northeast Mexico Region Economies: Sensitivity to changes in exports. Social Accounting Matrices approach.

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ABSTRACT

1. What will be the economic impacts in Mexican and Northeastern Mexican economies (composed by the states of Coahuila, Nuevo León and Tamaulipas), associated with a contraction in its international exports due to tightening of trade policy in the United States of America?

2. An expanded Leontief model, elaborated with data of national and regional social accounting matrices (NSAM and RSAM), will be used to calculate the total elasticities for final demand and for international exports. Elasticities are estimated using Stone proposal (1985) and the National Input Output Table (NIOT) is regionalized by Flegg and Thomo method (2016).

3. NIOT, accounts by institutional sectors and regional income surveys are used to build a regional input output table (RIOT) and a regional social accounting matrix (RSAM) for Northeastern Mexican Economy. National and Regional SAM's are composed by 31 sectors of economic activity and consumption is broken down into ten groups of households regarding their income levels. Capital, government, rest of world and rest of country will be exogenous variables.

4. This is an applied National and Regional Economics research. The main interest lies in addressing a relevant issue in current economic situation.

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1. Introduction.

As a key part of Mexico's trade liberalization strategy developed since the mid-1980s, NAFTA (NAFTA) has contributed significantly to changes structures of aggregate supply and demand of the Mexican economy. With the participation of Canada, the United States of America (USA) and Mexico, this agreement began to operate on January 1, 1994.

As a result of these transformations, the gross domestic product (GDP) of the Mexican economy doubled its real value in a period of 30 years (between 1985 and 2015), while in the same period, the coefficients of exports and imports with respect to GDP went from 15.3 to 35.2 percent and from 7.5 to 33.8, respectively. In this way, the degree of openness of the Mexican economy took off from 22.8 to 69 percent, becoming in a few years one of the most open economies in the world (Dávila and Valdés, 2016).

Meanwhile, oil exports decreased their relative importance (from 68.2 to 6.2 per cent), while non-oil exports reached 93.8 per cent of total sales in 2015. In the latter group, manufacturing exports stood out, concentrating 95.1 percent. Over these three decades, the real value of manufacturing exports multiplied by 31, that is, at an average annual rate of expansion of 12.1 percent, five times higher than that recorded by national GDP in those same years (2.3) (Dávila and Valdés, 2016).

Manufacturing exports are heavily concentrated in a target market (about 80 percent go to the US) and a handful of products. Thus, 60.5 per cent of international manufacturing sales in 2015 corresponded to three of the 97 chapters of the Harmonized Commodity Description and Coding System: 87, Land vehicles and their parts (23.7 per cent of the total); 85, Electrical machinery and equipment (21.3) and; 84, Mechanical appliances, boilers and their parts (15.5). At tariff fractions level, 11 of the 599 Harmonized System accounted for 50.6% of goods exports that year: Tourism-type cars (8.6); Parts and accessories of vehicles (6.6); Vehicles for the transport of goods (6.6); Crude oil (4.9); Machines for data processing (4.8); Televisions (4.4); Electrical telephony or telegraphy apparatus (4.2); Other machines and electrical equipment (3.1); Conductors insulated for electricity (3); Other mechanical appliances and parts (2.9) and; Tractors (2.3) (Dávila and Valdés, 2016).

At the regional level, the economies of northeastern Mexico (Coahuila, Nuevo Leon and Tamaulipas) have played a significant role in these processes. Their border with the US and their industrial vocation, have allowed them to benefit from access to the North American market. Thus, with 9.3 percent of the population settled in its territory, the northeast concentrates 23.8 percent of imports of international inputs, while its foreign sales amounted to 21.5 percent of its gross output. The national content per dollar exported (11.7 percent), is only surpassed by that of the south-southeast region (14.4), which concentrates the bulk of the country's oil exports. The Northeast is the region of Mexico with the highest national exported per capita (US \$ 228.6 in 2003, 94 percent higher than the national per habitant value for the same year) (Dávila, 2015).

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Given these trends, any qualitative change in the normative framework of foreign trade with Canada and, especially, with the US, is of strategic importance for both the Mexican and Northeastern Region economies. In this perspective, it is highly probable that, at the initiative of the US government, renegotiations of the NAFTA will soon begin, which may lead to either a modified treaty or eventual withdrawal by the United States.

In this context, the objectives of paper are as follows:

1. To determine the sensitivity of the economies of Mexico and its Northeastern Region to variations in the value of their international exports. For this purpose, the total elasticity of gross production, employment, value added and wages, should be calculated, considering unitary changes in the value of their exports by sector of economic activity.

2. For the calculation of the elasticities, the procedure proposed by Stone (1985) is applied, which uses as inputs the multipliers of these same variables. In turn, in this case the multipliers are obtained from expanded production models of Leontief, built with SAM matrices.

3. Therefore, the third purpose of work is the construction of SAM's for Mexican and its Northeast Region economies.

The following two sections list sources of information and computation procedures for those SAM's, and then we discuss methods of calculating multipliers and total elasticities. The next section is devoted to the presentation and analysis of results and then we close this essay with the relevant conclusions.

2. National Social Accounting Matrix (NSAM) for Mexican Economy.

The main sources of information were the homogeneous national matrix of input output, commodity by commodity format; The accounts by institutional sectors, the household expenditure income survey and the GDP of the Mexican states. In all cases we work with figures corresponding to the year 2008 (INEGI, 2008). The SAM are disaggregated into 31 sectors of economic activity and four institutional sectors (Enterprises, Households, Government and Rest of the World)². In turn, households are broken down into ten groups, made up by their family income ranges.

In order to synthetically formulate the SAM and its applications, some of the conventions of matrix algebra are used. Specifically, letters are highlighted using bold, the capital letters correspond to matrices of dimension " $n \times n$ ", while the lower case indicates vectors of dimension " $n \times 1$ ". The apostrophe is used to signal the transposition of a vector, while the circumflex accent (^) means that the elements of the corresponding vector are ordered in a diagonal matrix. Finally, the letter "i", placed to the right of an array, specifies the sum of the values of its rows, while "i", located to the left of the matrix, denotes the aggregation of the elements of columns. When the bar is used on a vector or a matrix, this indicates that it is a matrix or partitioned vector.

For the formal presentation of SAM, its solution and the analysis of its multipliers, we will use the notation proposed by Holland and Wyeth (1993) and later taken up in Miller and Blair (2009, pp. 514-555).

In this way, the economic transactions carried out in the Mexican economy during 2008, valued in millions of pesos of that year, are presented in the SAM ($\bar{\mathbf{G}}$)³. In the present

² SAM for Northeast Region, include a fifth institutional sector: Rest of the Country.

³ For space constraints, SAM's, as well as multipliers, are not presented here. Those can be delivered by request.

case, it is a matrix of dimension 51x51. As indicated in equation (1), it is made up of four sub-matrices: The first one ($\bar{\mathbf{Z}}$), whose detailed description will be provided later, contains the information of the variables that will be handled as endogenous and, in the present application, has a dimension of 47x47; \mathbf{F} of a size of 47x4, contains a last column with the statistical discrepancies and three previous ones in which the amounts of the exogenous final demand are registered (the purchase of goods and services of domestic origin destined to the gross fixed investment, Government consumption and exports), as well as the net balance of cross-border payments linked to labor; \mathbf{W} (from 4x47), is a matrix that accounts for the exogenous income corresponding to the domestic private capital account (made by two of the four institutional sectors contemplated in the SAM, Enterprises and Households), taxes collected by the general government (With the sole exception of indirect taxes linked to the consumption of goods and services for gross fixed investment), the "rest of the world" income derived from imports of intermediate goods and final consumption by the companies and Households, as well as an additional item in which statistical discrepancies are computed; \mathbf{B} (4x4), which registers the exogenous revenues related to the exogenous final demand costs⁴.

$$\bar{\mathbf{G}} = \begin{matrix} \bar{\mathbf{Z}} & \mathbf{F} \\ \mathbf{W} & \mathbf{B} \end{matrix} \quad (1)$$

For its part, composition of $\bar{\mathbf{Z}}$ matrix is detailed in equation (2). \mathbf{Z} (31x31) includes intermediate transactions of domestic inputs among the 31 sectors of economic included at the SAM; $\bar{\mathbf{C}}$ (31x13) records the endogenous final demand of the model; $\bar{\mathbf{V}}$ (3x31) contains the value added by the productive factors employed (Labor and Capital) by the economic establishments of the 31 productive sectors, as well as the net of indirect taxes less subsidies charged for the sale of goods and services produced; $\bar{\mathbf{Y}}$ (13x3) accounts for the allocation of primary income by payments to productive factors (Labor and Capital) in terms of wages, profits paid to households, and mixed gross income generated by quasi-corporations and surplus accounted for by households and the gross operating surplus of enterprises⁵, as well as tax payments to the general government for the value added in the production of goods and services made by the productive establishments; $\bar{\mathbf{H}}$ (13x13) details the gross disposable income by households (the "households" sector is opened in 10 groups determined by their income levels), once the allocation of primary income and secondary

⁴ At SAM's presented here, the capital account registers the public savings and the balance in the current account. The General Government account contains the net income from the payment of indirect taxes on the purchase of goods and services for gross fixed investment. In the rest of the world account is taken of imports of goods and services for gross fixed investment, government consumption and cross-border transactions. The last column and row contain the statistical discrepancy reported by INEGI in the NIOT (commodity by commodity format) and in the accounts by institutional sectors of 2008.

⁵ Under the heading "enterprises", the institutional accounts made by financial corporations, non-financial corporations and non-profit institutions serving households are included.

distribution of income is fixed⁶. Finally, the $\bar{\mathbf{Z}}$ matrix is filled with blocks of zeros in the ranges of cells: 35,1 a 47,31; 1,32 a 34,34 y 32,35 a 34,47.⁷

$$\bar{\mathbf{Z}} = \begin{matrix} \mathbf{Z} & \mathbf{0} & \bar{\mathbf{C}} \\ \bar{\mathbf{V}} & \mathbf{0} & \mathbf{0} \\ \mathbf{0} & \bar{\mathbf{Y}} & \bar{\mathbf{H}} \end{matrix} \quad (2)$$

It is also necessary to define the vectors $\bar{\mathbf{x}}$ and $\bar{\mathbf{f}}$. The first one consists of three partitions, being: \mathbf{x} the vector of the gross production of the “n” (31) productive activities of SAM; \mathbf{v} the value added; and \mathbf{y} that of total household income for each of the ten levels. For its part, the second also includes three elements: \mathbf{f} is a vector of exogenous final demands; \mathbf{w} a vector of value added exogenous to the model, and; \mathbf{h} those of the income categories of exogenously specified households.

$$\bar{\mathbf{x}} = \begin{matrix} \mathbf{x} \\ \mathbf{v} \\ \mathbf{y} \end{matrix} \quad \mathbf{y} \quad \bar{\mathbf{f}} = \begin{matrix} \mathbf{f} \\ \mathbf{w} \\ \mathbf{h} \end{matrix}$$

The next step is the definition of the coefficient matrix of $\bar{\mathbf{Z}}$, which is called $\bar{\mathbf{S}}$:

$$\bar{\mathbf{S}} = \bar{\mathbf{Z}}\hat{\mathbf{x}}^{-1} - \quad (3)$$

Assuming that the partitions of matrices $\bar{\mathbf{Z}}$ and $\bar{\mathbf{S}}$ are equivalents:

$$\mathbf{S} = \begin{matrix} \mathbf{A} & \mathbf{0} & \mathbf{C} \\ \mathbf{V} & \mathbf{0} & \mathbf{0} \\ \mathbf{0} & \mathbf{Y} & \mathbf{H} \end{matrix} \quad (4)$$

The basic formulation of the SAM production model can be expressed as follows:

$$\bar{\mathbf{x}} = \mathbf{S}\bar{\mathbf{x}} + \bar{\mathbf{f}} \quad (5)$$

And its solution:

$$\bar{\mathbf{x}} = (\mathbf{I} - \mathbf{S})^{-1}\bar{\mathbf{f}} \quad (6)$$

3. Regional Social Accounting Matrix (RSAM) for the economy of Northeast Mexico.

The size of RSAM matrix in the Northeast region is very similar to that of the national economy. The only difference is that in the first one is added an account for an

⁶ Adjusted gross disposable income is obtained after computing transfers in goods and money. Those that perform the general government are discounted from the vector of government consumption (which appears in the exogenous part of the final demand) and are added to the endogenous consumption of households.

⁷ To locate the cells in an matrix or a vector, two subindex are used, the first one corresponds to the row number, while the second identifies the column position.

additional exogenous sector, denominated rest of the country (ROC). So, we modify the dimension of three of the four sub-matrices of $\bar{\mathbf{G}}$ (see equation 1): \mathbf{W} increases a row, \mathbf{F} a column and \mathbf{B} , a column and a row.

The regionalization of the NIOT was done by applying the procedure developed by Flegg *et al.* (1996), using simple localization over main diagonal of national domestic coefficients table and cross-industry coefficients in the rest of those matrix. The calculations were made with GDP statistics for the federative entities provided by INEGI. The sector opening is 31 productive activities.

The regional production functions are proportionally equal to the national ones, so that once the regional coefficients have been quantified, by difference we calculate the coefficients of inputs imported from the rest of the world and the rest of the country. The flow matrix is calculated with the GDP values at basic prices for each productive activity and applied to the regional and imported coefficients. The value added is divided into three headings: salaries to employees, gross operating surplus and indirect taxes less subsidies to the activity. This allocation is made in the same proportions for each sector accounted in the national matrix.

With the same procedure, the income of the exogenous accounts GOB (Government), ROC and ROW (Rest of the world) are calculated, in their crossing with each one of the productive activities.

The primary income generation is obtained by summing up the values generated by the three components of value added in the 31 productive sectors and in the intersection cell of wage earners and ROW is calculated the payment to residents of the region for the provision of labor services in ROW. This is done according to the proportion of inhabitants in the region with respect to the national total.

Primary incomes are assigned to owners of productive factors. Payments to labor are computed as income in the salary account, while those corresponding to capital, from the gross operating surplus account, are recorded as profits to owners of capital that does not have constituted companies and the rest to profits retained by the enterprises. The gross operating surplus of government enterprises and the net taxes of subsidies to the activity are registered as income in the GOB account. Salary and profit income for individuals are allocated to the ten groups of households, while the earnings of companies are distributed among households, as a distribution of profits, while another fraction remains in the enterprises, as a provision for investment. Subsequently, income tax payments are collected from companies and households that are transferred to the GOB account and finally we compute transfers, as well as payments for social security. The allocation of these values was based on regional income statistics obtained from ENIGH records.

On the other hand, the household expenditure statistics of ENIGH itself were used to determine the regional participation in the national consumption of each good, as well as for its subsequent distribution in the ten groups of households.

The regional allocation by government expenditure was proportional to the population, while the share of investment (which includes gross fixed capital formation and stock changes), with the participation of this variable in the final national demand by sector of activity. The same proportion is applied to regional final demand values.

The data of the international exports by productive activity and federative entity are provided almost entirely by INEGI. When the regional data was not available for some sector or in the few cases of data inconsistency, exports were calculated using the same procedure described for the gross investment expenditure.

The interregional balance is obtained by the difference between the gross regional production of each sector minus the intermediate consumption, and the final demand. When the balance is positive, the initial estimates are conserved and with the surplus the interregional exports vector is formed. When negative, the differences are adjusted using the structure of the components of the final demand of the initial estimate and with the sum of the negative values the interregional imports are calculated.

Government direct in-kind transfers to households for sectors 26 (Education Services) and 27 (Health and social assistance services) are determined by regional participation in the total population of the country.

The net international income in factor payments is distributed according to the regional participation in a mixed coefficient of population and per capita GDP (each of them account for a half). They are opened per decile with the remittance income structure reported by the ENIGH.

The opening of interregional imports of households is done with the household expenditure structure by income group of the ENIGH. International imports are calculated by weighting the national totals by the mixed population and per capita income coefficients and the opening among the ten groups of households, with the regional expenditure structure reported by the ENIGH. This includes the net balance of cross-border purchases.

The mixed population/per capita income coefficients were also used to estimate regional participation in net import subsidy taxes on the other components of final demand.

Total private savings are estimated with the participation of the region in the national total and its opening by income levels is done with the structure derived from the monetary saving data of the region, both reported by the ENIGH.

The ROC savings is obtained by the difference between income (sum of the line of the ROC account) and the sum of dispositions, excepted savings. The same procedure is used to calculate ROW savings. The final adjustment between household provisions and their income shows the net amount of adjusted disposable income for a group of households.

4. Total elasticities computation.

Elasticities, in the context of Leontief's expanded model, are obtained by calculating the quotient of unit percentage changes in the exogenous final demand and their relative effects on the endogenous variable studied (in our case: gross production, employment, wages and value added).

It is an indicator of great utility, since it allows weighted the effects generated by changes in the final demand, quantified through the multipliers, by the absolute dimension of each productive activities. The weighting factor used for this purpose is the quotient of the exogenous final demand value of a sector (f_j) divided by the total gross output of the economy analyzed ($\mathbf{i}'\mathbf{x}$):

$$f_j / \mathbf{i}'\mathbf{x}$$

Using Miller and Blair (2009) notation, the total elasticity of production of a sector is defined as:

$$oe_j = m(o)_j \left[f_j / \mathbf{i}'\mathbf{x} \right] \quad (7)$$

Where: oe_j = Elasticity of gross output of sector "j" and; $m(o)_j$ = Multiplier of the gross production of sector "j".

Equivalently, the total employment elasticities (t), wages (w), and value added (va) are calculated.

In turn, the production multipliers of each productive activity are obtained by adding the elements of the Leontief inverse columns linked to the sub-matrix \mathbf{A} (dimension 31 x 31) of the matrix \mathbf{S} described in equation 4.

If:

$$\mathbf{L} = (\mathbf{I} - \mathbf{S})^{-1} \quad (8)$$

Then:

$$m(o)_i = \mathbf{i}'\mathbf{L} \quad i = 1, \dots, 31 \quad (9)$$

In order to calculate the multipliers of the remaining variables (employment, wages and value added), the Leontief inverse is premultiplied by diagonal matrices with corresponding coefficients and zeros in the rest of the positions.

Yes, for example, \mathbf{t} is a column vector with the employment coefficients by sector, then:

$$m(t)_i = \hat{\mathbf{t}}\mathbf{L} \quad i = 1, \dots, 31 \quad (10)$$

As the expanded Leontief model incorporates household income and expenditure as endogenous variables, these are truncated total multipliers and, in the case of all variables except gross production, type II multipliers. This means that are weighted by the value of their respective coefficients in order to get normalized variations.

5. Empirical Results.

In the standard version of the production model constructed with a SAM, the income and consumption of households are integrated to the endogenous variables of the model. Therefore, the components of the exogenous final demand are limited to the consumption of government, investment and exports, excluding spending on private consumption goods, which is usually the most important in the final demand.

Notwithstanding the foregoing, as already indicated in the introduction, the rapid opening of the Mexican economy allowed for an accelerated expansion of exports. Thus, even excluding private consumption, the share of exogenous final demand in the total gross product generated by the Mexican economy was slightly less than one-third of the total (31.3 percent). As a consequence of the trends described at the beginning of the document, this same coefficient reached practically half of the total gross product in the Northeast Region of Mexico (49.4). Exports alone accounted for 50.6 percent of the exogenous final demand of the Mexican economy in 2008 and 52.6 percent in the Northeast Region.

Considering these characteristics, it was decided to perform the analysis of the total elasticities in two modalities: The first one, considering unitary changes all components of exogenous final demand by sector and; The second, simulating the effect of a unitary percentage change only on the export component. The results appear sequentially in Tables 1 and 2.

Table 1.

MEXICO AND NORTHEAST MEXICO REGION ECONOMIES: Total elasticity of gross output, employment, salary and value added by unit increases (%) in the exogenous demand for each productive activity. 2008. (%).

SECTOR DE ACTIVIDAD ECONÓMICA	MÉXICO				REGIÓN NORESTE			
	Efectos multiplicadores				Efectos multiplicadores			
	Producción	Empleo	Salario	Valor Agregado	Producción	Empleo	Salario	Valor Agregado
	Oj	Ej	Wj	Vaj	Oj	Ej	Wj	Vaj
11-Agricultura, ganadería, aprovechamiento forestal, pesca y caza	0.0213	0.0099	0.0271	0.0207	0.0138	0.0075	0.0169	0.0134
21P-Minería petrolera	0.0886	1.2377	0.2612	0.0707	0.0265	0.2826	0.0701	0.0219
21NP-Minería no petrolera	0.0074	0.0124	0.0109	0.0070	0.0111	0.0158	0.0154	0.0106
22-Electricidad, agua y suministro de gas por ductos al consumidor final	0.0012	0.0039	0.0015	0.0012	0.0164	0.0422	0.0200	0.0169
23-Construcción	0.3122	0.2409	0.2310	0.3360	0.2456	0.1905	0.1945	0.2569
311-Industria alimentaria	0.0140	0.0277	0.0317	0.0205	0.0077	0.0130	0.0157	0.0105
312-Industria de las bebidas y del tabaco	0.0054	0.0131	0.0094	0.0071	0.0034	0.0064	0.0054	0.0042
313-314-Fabricación de insumos textiles y acabado de textiles; Fabricación de productos textiles, excepto prendas de vestir	0.0035	0.0046	0.0044	0.0053	0.0029	0.0034	0.0035	0.0040
315-316-Fabricación de prendas de vestir; Curtido y acabado de cuero y piel, y fabricación de productos de cuero, piel y materiales sucedáneos	0.0089	0.0080	0.0098	0.0114	0.0073	0.0065	0.0080	0.0089
321-Industria de la madera	0.0008	0.0009	0.0008	0.0012	0.0007	0.0007	0.0006	0.0009
322-323-Industrias del papel, impresión e industrias conexas	0.0043	0.0072	0.0064	0.0070	0.0085	0.0119	0.0115	0.0122
324-326-Derivados del petróleo y del carbón; industrias química, del plástico y del hule	0.0334	0.1846	0.0828	0.0784	0.0447	0.1688	0.0901	0.0812
327-Fabricación de productos a base de minerales no metálicos	0.0057	0.0075	0.0082	0.0066	0.0167	0.0194	0.0222	0.0186
331-332-Industrias metálicas	0.0376	0.1011	0.0863	0.0603	0.0922	0.1750	0.1669	0.1255
333-336-Maquinaria y equipo	0.1921	0.5362	0.3472	0.3821	0.2722	0.5235	0.4036	0.4296
337-Fabricación de muebles y productos relacionados	0.0050	0.0047	0.0053	0.0065	0.0035	0.0032	0.0037	0.0043
339-Otras industrias manufactureras	0.0100	0.0135	0.0124	0.0155	0.0090	0.0106	0.0106	0.0124
43-46-Comercio	0.0698	0.0508	0.0782	0.0601	0.0918	0.0683	0.1025	0.0813
48-49-Transportes, correo y almacenamiento	0.0298	0.0347	0.0249	0.0298	0.0214	0.0230	0.0190	0.0213
51-Información en medios masivos	0.0014	0.0046	0.0014	0.0013	0.0027	0.0073	0.0028	0.0026
52-Servicios financieros y de seguros	0.0046	0.0136	0.0043	0.0045	0.0030	0.0073	0.0029	0.0030
53-Servicios inmobiliarios y de alquiler de bienes muebles e intangibles	0.0052	0.0307	0.0381	0.0041	0.0031	0.0142	0.0196	0.0025
54-Servicios profesionales, científicos y técnicos	0.0038	0.0050	0.0033	0.0034	0.0159	0.0189	0.0146	0.0146
55-Dirección de corporativos y empresas	0.0000	0.0000	0.0000	0.0000	0.0037	0.0179	0.0047	0.0033
56-Servicios de apoyo a los negocios y manejo de desechos y servicios de remediación	0.0000	0.0000	0.0000	0.0000	0.0203	0.0119	0.0119	0.0173
61-Servicios educativos	0.0000	0.0000	0.0000	0.0000	0.0002	0.0001	0.0001	0.0002
62-Servicios de salud y de asistencia social	0.0008	0.0007	0.0004	0.0007	0.0003	0.0003	0.0002	0.0003
71-Servicios de esparcimiento, culturales y deportivos y otros servicios recreativos	0.0010	0.0010	0.0010	0.0009	0.0004	0.0004	0.0004	0.0003
72-Servicios de alojamiento temporal y de preparación de alimentos y bebidas	0.0000	0.0000	0.0000	0.0000	0.0015	0.0009	0.0015	0.0014
81-Otros servicios, excepto actividades del gobierno	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
93-Actividades del Gobierno	0.1226	0.0949	0.0527	0.1130	0.0489	0.0372	0.0251	0.0454

Source: SAM's for Mexican and Northeast Region of Mexico economies. Build by the author based on the methodology described in this document with information from (INEGI).

The format of both frames is the same. They are composed of nine columns: In the first one the descriptors of each of the 31 productive activities considered are presented, the four following show the total elasticities of production, employment, wages and value added for the Mexican economy, resulting from a change of one per cent in each exogenous final demand sector (Table 2 shows the total elasticities resulting from a one percent change only in sector "j" exports). The last four columns present the same information and in the same order but for the economy of the Northeastern Mexico. In order to facilitate the reading of the data, the five highest values of each column appear in black background cells and white numbers, the following with dark gray anchored cells and bold highlighted numbers, the next with cells shaded in light Grey. The rest of the values appear in the conventional format.

5.1. Sensitivity to changes in exogenous final demand.

By way of illustration, we will analyze the total elasticities for unitary changes in the exogenous final demand of the Machinery and Equipment sector (sub-sectors 333-336 of the NAICS (North American Industrial Classification System)). The elasticity of gross output for the Mexican economy is 0.192, which means that a unitary change in exogenous final demand for that sector has a general impact on gross national production of 0.19 percent. The same indicator for the Northeast Region is 0.2722, 41.7 percent above the national average. Except for employment, where the total national elasticity is higher than the Northeast, in the three remaining variables (gross production already analyzed, as well as wages and value added), the economy of the Northeast Region is more sensitive to the changes in the exogenous final demand of this industry.

However, if we add the five activities with the highest total value-added elasticities to unitary changes in exogenous final demand for each region, we see a coincidence in three of the five productive activities (Construction-sector 23-, Petrochemicals- subsectors 324 to 326-, and Machinery and Equipment). Divergences occur in oil mining (in which petroleum extraction stands out) and Government Activities, which are part of the group of activities with higher total value added elasticities at the national level, while in the case of the Northeast Region are the Metallic Industries (subsectors 331-332) and Commerce (sector 43).

If in these respective groups we obtain the subtotals of the total elasticities for the four variables and compare them with the accumulated ones of the 31 productive activities, we can observe that the subgroup of national sectors identified above accumulated 63.3 percent of the changes in gross production, 83 in employment, 68.8 in wages and 69.1 in value added.

Except for employment, the concentration percentages are higher for the economy of the Northeast Region, since the accumulated variations of the five activities with the highest total elasticities accounted for 75 percent of the changes in gross production, two thirds of employment, 75.7 of wages and 79.5 of value added.

5.2. Sensitivity to changes in exports.

For the purposes of this study, it is more interesting to calculate the sensitivity of the Mexican and Northeastern economies of Mexico to fluctuations in exports, which are the most important component of the exogenous final demand vector in the Leontief extended model applied to those economies. The results are presented in Table 2, whose format and interpretation is the same as in the previous section.

If we form the group of five sectors with higher total value added elasticities in relation to unitary changes in exports, we find a coincidence in four of the five activities (Petrochemical, Basic Metals, Machinery and Equipment, as well as Commerce). Oil appears in this group at national level, while in the Northeast the fifth activity of this sub set is the Other Manufacturing Industries. These sectors account for 87.7 percent of international exports from the Northeast Region and 88.3 percent for the national economy.

The cumulative sensitivity of these five activities in the national economy absorbs 79.9 per cent of the total changes in gross production related to unitary changes in exports of all sectors (31), 93.4 of employment, 86.3 of wages and 84.3 of value added.

In the case of the Northeastern Region, the accumulated sectors identified are 86.3 percent of gross production, 84.3 of employment, 86.9 of wages and 90.0 of value added.

These are the activities most sensitive to a potential qualitative change in the trade policies of the North American Region.

If we consider the cumulative elasticities of the 31 productive activities of the Mexican economy, a unitary change in the exports of each one of them would be affected by a 0.448 in gross production, 0.884 in employment 0.678 in wages and 0.657 in value added. In the case of the Northeast Region these values would rise to 0.448, 0.884, 0.678 and 0.657, respectively.

Table 2.

MEXICO AND NORTHEAST MEXICO REGION ECONOMIES: Total elasticity of gross output, employment, wages and value added by unit increases (%) in international exports of each productive activity. 2008. (%)

SECTOR DE ACTIVIDAD ECONÓMICA	MÉXICO				REGIÓN NORESTE			
	Efectos multiplicadores				Efectos multiplicadores			
	Producción	Empleo	Salario	Valor Agregado	Producción	Empleo	Salario	Valor Agregado
	Oj	Ej	Wj	Vaj	Oj	Ej	Wj	Vaj
11-Agricultura, ganadería, aprovechamiento forestal, pesca y caza	0.0117	0.0054	0.0149	0.0114	0.0059	0.0032	0.0072	0.0057
21P-Minería petrolera	0.0692	0.9674	0.2042	0.0553	0.0036	0.0388	0.0096	0.0030
21NP-Minería no petrolera	0.0053	0.0089	0.0078	0.0050	0.0004	0.0005	0.0005	0.0004
22-Electricidad, agua y suministro de gas por ductos al consumidor final	0.0012	0.0039	0.0015	0.0012	0.0014	0.0037	0.0018	0.0015
23-Construcción	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
311-Industria alimentaria	0.0096	0.0190	0.0218	0.0141	0.0060	0.0100	0.0121	0.0081
312-Industria de las bebidas y del tabaco	0.0051	0.0123	0.0088	0.0066	0.0032	0.0061	0.0051	0.0039
313-314-Fabricación de insumos textiles y acabado de textiles; Fabricación de productos textiles, excepto prendas de vestir	0.0032	0.0042	0.0040	0.0049	0.0027	0.0032	0.0033	0.0038
315-316-Fabricación de prendas de vestir; Curtido y acabado de cuero y piel, y fabricación de productos de cuero, piel y materiales sucedáneos	0.0088	0.0080	0.0098	0.0113	0.0073	0.0065	0.0080	0.0089
321-Industria de la madera	0.0007	0.0007	0.0007	0.0009	0.0002	0.0002	0.0002	0.0002
322-323-Industrias del papel, impresión e industrias conexas	0.0032	0.0054	0.0047	0.0052	0.0024	0.0033	0.0032	0.0034
324-326-Derivados del petróleo y del carbón; industrias química, del plástico y del hule	0.0328	0.1816	0.0814	0.0771	0.0367	0.1387	0.0741	0.0668
327-Fabricación de productos a base de minerales no metálicos	0.0051	0.0067	0.0073	0.0059	0.0063	0.0073	0.0084	0.0070
331-332-Industrias metálicas	0.0326	0.0876	0.0748	0.0522	0.0529	0.1004	0.0957	0.0720
333-336-Maquinaria y equipo	0.1783	0.4977	0.3223	0.3547	0.2628	0.5054	0.3896	0.4147
337-Fabricación de muebles y productos relacionados	0.0022	0.0021	0.0024	0.0029	0.0022	0.0019	0.0023	0.0026
339-Otras industrias manufactureras	0.0099	0.0133	0.0123	0.0153	0.0104	0.0122	0.0123	0.0144
43-46-Comercio	0.0365	0.0265	0.0409	0.0314	0.0263	0.0196	0.0293	0.0233
48-49-Transportes, correo y almacenamiento	0.0160	0.0187	0.0134	0.0160	0.0122	0.0131	0.0108	0.0121
51-Información en medios masivos	0.0007	0.0024	0.0008	0.0007	0.0004	0.0012	0.0005	0.0004
52-Servicios financieros y de seguros	0.0042	0.0124	0.0039	0.0041	0.0029	0.0069	0.0028	0.0028
53-Servicios inmobiliarios y de alquiler de bienes muebles e intangibles	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
54-Servicios profesionales, científicos y técnicos	0.0011	0.0014	0.0010	0.0010	0.0018	0.0021	0.0016	0.0016
55-Dirección de corporativos y empresas	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
56-Servicios de apoyo a los negocios y manejo de desechos y servicios de remediación	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
61-Servicios educativos	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
62-Servicios de salud y de asistencia social	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
71-Servicios de esparcimiento, culturales y deportivos y otros servicios recreativos	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
72-Servicios de alojamiento temporal y de preparación de alimentos y bebidas	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
81-Otros servicios, excepto actividades del gobierno	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
93-Actividades del Gobierno	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Source: Idem.

6. Concluding Remarks.

References.

- Dávila Flores, Alejandro y Valdés Ibarra, Miriam. 2016.
Mexico: Economic performance of local economies. 2003-2013. *ECORFAN Journal-Mexico*, ISSN 2414-4959, en edición.
- Dávila Flores, Alejandro (Coordinador). 2015.
Modelos interregionales de insumo producto de la economía mexicana, Editorial Miguel Ángel Porrúa, Universidad Autónoma de Coahuila y Universidad Autónoma de Nuevo León, México, D. F., junio, pp. 1-319.
- Holland, D. and Wyeth, P. (1993). *SAM Multipliers: Their decomposition, interpretation and relationship to input-output multipliers*. Research Bulletin XB1027, Washington State University, College of Agriculture and Home Economics Research Center, USA, pp. 1-42.
- Miller, R. E. and Blair, P. D. (2009). *Input-Output Analysis. Foundations and Extensions*, Second Edition, Cambridge University Press, New York, pp. 1-750.
- Pyatt, G. and Round, J. (1985). "Accounting and Fixed-Price Multipliers in a Social Accounting Matrix Framework," in Pyatt and Round (eds.), *Social Accounting Matrices. A Basis for Planning*, A World Bank Symposium, The World Bank, Washington, D. C., U. S. A., September, pp. 186-206.
- Stone, R. (1985). "The Disaggregation of the Household Sector in the National Accounts," in Pyatt and Round (eds.), *Social Accounting Matrices. A Basis for Planning*, A World Bank Symposium, The World Bank, Washington, D. C., U. S. A., September, pp. 145-185.
- Thorbecke, Erik. (1998). "Social accounting matrices and social accounting analysis." In: Isard, Walter et. Al. 1998. *Methods of interregional and regional analysis*, Ashgate, England, pp. 281-331.