Mexico: Economic performance of local economies. 2003-2013.

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ABSTRACT.

Siegel et al.s' method (1995) was used to analyze the effects of changes in the final demand structure of the Mexican local economies (32 states and 7 regions) on its economic performance. This method combines input output production model with portfolio theory to measure the economic performance in terms of expected growth in the gross production value and the stability of it (measured by its variance or standard deviation). The study comprehends a period of time from 2003 to 2013. The paper uses three national input-output tables, developed by the Mexican agency of statistic upon the SNA-A methodology for 2003 and 2008, and 2012 IOT made by RAS actualization of 2008 table. The regionalization of IOT's was done using the FLQ method and the series of state gross domestic product produced by INEGI. We worked with 31 economic activities.

Key words: Input-output models; regional input-output models; regional economic performance.

JEL Classification: A11. Regional economic activity; R15. Econometric and input output models; R58. Regional development policies.

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1. Introduction.

Development strategy promoted by the Mexican Government during the postwar period was based on the substitution of imports and trade protectionism which collapsed in November 1982. Three years later, Mexico undertook quick trade openness. In 1986 Mexico joined the GATT (General Agreement on Tariffs and Trade, forerunner institution to the World Trade Organization) and inaugurated an era of intense trade negotiations, bilateral and multilateral, aimed at the holding of multiple trade liberalization agreements. Among those trade agreements, because of its strategic importance, the North American Free Trade Agreement (NAFTA)[3] was the most important one.

Years ago, in 1965, the Federal Government had established the Border Industrialization Program (BIP), which provided imports of inputs free of tariffs for the production of goods which would be exported from the Mexican northern border. BIP program lead to the maquiladora export industry (MEI) creation. As time passed by, this program became the main antecedent to the transition of Mexico's trade policy from protectionism to liberalization of its foreign trade.

Krugman and Livas (1992) explored the relationship between changes in trade policy and its impact on patterns of localization of the productive factors in developing countries. For that reason they built a theoretical model of economic geography. In line with the basic predictions, the trade liberalization of the Mexican economy prompted a process of relative decentralization of its industrial sector, from the city of Mexico, to other metropolitan areas of North-Center and North of the country.

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[3] This agreement entered into operation on January 1st, 1994.

The new geographical distribution of the Mexican industry not only privileged to a relatively limited number of cities, but also focused on a small group of economic sectors, including: metalworking and automotive industries, textile, as well as the electronic (Hanson 1997)[4].

The purpose of the movement of these sectors to metropolitan areas located in the vicinity of the market of the United States of America is to optimize the transportation costs of inputs, final goods and services traded between the two countries.

In parallel with the advantages of economies of transport, the productive establishments try to benefit from economies of agglomeration, in particular, scale and location economies[5], as well as the Marshall type externalities[6].

This would be the explanation provided by the economic theory to the fact that the approach of the industry towards the northern border of Mexico is focused in few cities and a relatively limited number of sectors; this guidance of the economic growth

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[4] Several studies have documented changes in the patterns of localization of the Mexico manufacturing sector during the eighties and nineties, between them the following can be found: (Gutierrez 1994), (Guillermo and Graizbord 1995), (Hiernaux-Nicolas 1995), (Hanson 1997), (Graizbord and Ruiz 1999), (Mendoza and Martinez 1999), (Davila 2000, 2004, 2005), (Chamboux-Leroux 2001), Mendoza (2002), (OECD 2003) and (Felix 2005).

[5] Ohlin (1933) encompasses the factors by which economic activity tends to concentrates in space, under the concept of *agglomeration economies*. These can be of three types: *1)* scale , which directly benefit the companies that generate them; *2)* location , forged by the spatial concentration of establishments in the same industry, and *3)* urbanization , derived from the dimension of the local economy (Keilbach 2000).

[6] When the production function or the utility of an economic agent is affected, positively or negatively, by the action of external economic agents, economic theory speaks of the existence of an externality. Externalities are classified in technological (when they are not necessarily transmitted through market mechanisms) and pecuniary (those propagated by the track of the price system). The dissemination of the knowledge space (*spatial spillovers of knowledge*) is recognized as the main mechanism of transmission of the externalities. We identified two classes of externalities: 1) the type Marshall (1920), which are linked with the productive specialization of a city in an industry in the particular, and 2) the type Jacobs (1969), which result from the variety of existing products and technologies in a locality. How do you relate the externalities, with the economies of location and urbanization? The targeted by Marshall are external to the signature but internal to the industry, which links them to the economies of location. However, the economies of urbanization may occur in a local economy highly specialized or highly diversified. As noted Keilbach (2000), while both the economies of agglomeration externalities as relate to the phenomenon of the spatial concentration of factors, it is of different concepts.

suggests parallel changes in the final demand structures of their state and regional economies. If this is so: What effects has had those changes (changes in the structure of the final demand) on the performance of the abovementioned local economies?[7]

In this general framework, the objectives of the article are the following:

1) To verify the existence of final demand structure modifications of state and regional economies of Mexico;

2) To evaluate the impact of these changes on its economic performance during the period from 2003 to 2013;

3) To suggest some strategies that may serve as a support in shaping public policies aimed at enhancing the regional performance.

2. Diversity, economic diversification and performance

Through a combination of the method developed by Markowitz (1959) for the analysis of investment portfolio optimization and the input-output model[8], Siegel et al. (1995) propose a tool for assessing the impact of the final demand structure transformations over the economic system performance.

Its starting point is a review of the definitions and measurement criteria of the concepts of diversity and economic diversification, as well as how to perform the hypotheses testing about the relationship between these variables and the economic performance[9]. The general conclusion of this exercise is that the previous studies on the

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[7] As noted above, the performance is measured by the expected rates of growth in production, as well as by changes in their levels of economic stability, the latter quantified by the evolution of the observed variance of the gross value of production. Siegel *et al (* 1995) also develop an application of their model with the employment as variable analysis.

[8] The first formulation is done by Leontief (1941).

[9] In the end, it presents an annex with a synoptic table which summarizes the most important aspects of the literature review conducted by the authors.

subject do not provide a coherent analytical framework for assessing the relationships between the structure of an economy and its performance. The authors share with Malizia point of view that, most of the definitions of diversity and economic diversification employed in the literature, are measures of diversity and not diversification, “which should be considered as the process that changes the diversity level" (Malizia 1990, 34).

Intending to clarify the meaning of these concepts, the authors take and delimit the definitions of them: "The noun diversity and the adjective diverse, relate to a static and positive concept (state of; difference, variety, inequality). The verb diversify and the substantive diversification, refer: 1) to the process that makes things more different or varied (positive and dynamic concept) and; 2) a selection of assets (sectors) in order to minimize the risk (instability in production or employment) (dynamic and normative concept)" (Siegel et al. 1995, 261-262).

Changes in the final demand weighted variance of different economic are transmitted to the gross production value or to the employment, through intersectoral linkages, as well as through international and interregional trade flows.

The diversity level attained by an economy is measured by calculating the variance of gross production value and/or regional employment. Using matrix notation, the way to obtain the production variance is the following:

$$1)\ V[Q] = WRCOV[F]R^{T}W^{T}$$

Where:

V[Q] = variance in the gross production value; W = row vector of dimension *1xn* $(0 \le W_i \le 1, \sum W_i = 1)$, with the participation of each sector in final demand; *R* = Leontief

Inverse matrix, dimension *nxn* ; *COV[F]* = variance covariance matrix of the *n* sectors final demands, dimension *nxn*; R^T = transposed matrix *R*; W^T = vector *W transposed*.

In its positive connotation, diversification would be given by a process of reduction in the production variance, oblivious to the explicit adoption of public policies for the achievement of that result. In its normative connotation, it would be the process of volatility levels reduction, resulting from the implementation of public policies for this specific purpose.

In the analytical framework proposed, two basic strategies can be used to stimulate the increased diversification of an economic system: 1) induce changes in the level and structure of the final demand, that allow to reduce the variance of the gross production value and; 2) through policies that have an impact on the regional supply of intermediate inputs, so the same effect is propitiated (increased diversity, i.e. a decrease in the variance of the target variables -employment and/or gross production value-).

In this way, it might be modeled the performance of an economy under different economic policy scenarios. Either through changes in the level and structure of the final demand, or by changes in the intermediate consumption quotients. The performance is determined by the expected production growth and/or employment, as well as the evolution of its volatility (quantified through its variance or standard deviation).[10]

3. Input-output models of the state and regional economies of Mexico.

In Mexico there are not input-output tables (IOT) for the federal entities constructed through the application of specific surveys for this purpose, for this reason, in this study

[10] As it is clarified in the corresponding section of the test, the strategies and policy instruments mobilized to achieve these purposes, have undergone major changes over the past few years.

the regional IOT are estimated indirectly using the national IOT[11]. Therefore Flegg's *et al* (1995 and 1997) method is used, which consists in finding an estimator (t_{ij}) of the percentage of the supply domestic quotients (a_{ij})[12] offered on its region. Once t_{ij} value is obtained, regional sectoral trade quotients (r_{ij}) are calculated.

$$3) \quad r_{ij} = t_{ij} a_{ij} \qquad i,j=1,2\ ,\ \ldots n$$

The formula developed by Flegg *et al* (Op. cit.) for the calculation of t_{ij} is the following:

$$4) \quad FLQ_{ij} = \left(CILQ_{ij}\right)\left(\lambda_r{}^{\delta}\right)\left(a_{ij}\right) \qquad i,j=1,2\ ,\ \ldots n$$

Where:

FLQ_{ij} = Flegg *et al* quotient; $CILQ_{ij}$ = Cross industry location quotients; λr^{δ} = weighting factor for the region relative size (r).

At the same time:

$$5) \quad CILQ_{ij} = LQ_i \Big/ LQ_j \qquad i,j=1,2\ ,\ \ldots n$$

$$6) \quad LQ_i = \frac{Y_{ir} \Big/ Y_r}{Y_i \Big/ Y} \qquad i,r=1,2\ ,\ \ldots n$$

$$7) \quad \lambda_r{}^{\delta} = \log_2\left[1 + \left(Y_r \Big/ Y\right)\right] \qquad R=1,2\ ,\ \ldots n$$

Where:

LQ_i, ; LQ_j = simple location quotients; Y= gross domestic product; $\log_2$= Logarithm base 2.

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[11] As already indicated, the INEGI national gender arrays by direct methods for the years 2003 and 2008, and an update to the 2012 of the latter, through the application of the flush method.

[12] These coefficients are obtained by dividing the value of the inter-sector transactions (x) supplied with national inputs by sector of origin (i) to destination (j), by the destination sector gross production value (Q_j): $a_{ij} = x_{ij} \Big/ Q_j$ $i, j = 1, 2, \ldots n$

Location quotients are calculated with gross domestic product information. These statistics, which are produced by the INEGI[13], refer to annual series covering the period 2003-2013, and which are disaggregated into 31 economic activities.

4. Changes in the level and structure of the final demands.

With the regional input output matrices, and the series of the gross domestic product for each of the mesoregions and federal entities of Mexico, it is estimated the gross production value and the final demand[14].

The criteria for the formation of the mesoregions were: "geographical contiguity; exclusivity; distance respect to the northern border; and relevant geographical conditions, specifically the relative location of the entities with respect to the main mountain and coastlines areas" (Davila *et al.*. By 2015, p. 276).

Table 1 lists the states that conforms each region, as well as their respective participation in the national population, gross production and territorial surface.

4.1. Evolution of the levels of the final demands.

During the period of study, at national level, final demand grew at an average real annual rate of 2.5 per cent. At regional level, the Northeast and the Central-North Plateau registered the largest dynamism (3.5 and 3.3 percent, respectively), while in the Southeast-Gulf region , this single variable reached a rate of 0.9 percent.

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[13] The data is supplied at basic prices, so exclude the costs of transportation, commerce and the net amount of indirect taxes less subsidies. These series consider payments by imputed banking services.

[14] In the first case, the estimate is based on the GDP data available (equivalent to the value-added, both at basic prices) and in the proportion (obtained from the national input-output table) of the value added with respect to the gross production value. Knowing the gross production value of each sector (*Qi*), its final demand (Fi) is obtained by subtracting to gross production value, the value of production for the intermediate demand.

Table 1
REGIONS OF MEXICO: Participation (%) on the surface, population and national gross production, 2003.

REGION	STATE	Participation (%) on		
		Surface	Population	Gross production
1. Northwest.	Baja California; Chihuahua; Sonora; Baja California Sur; Sinaloa;	32.1%	11.1%	13.1%
2. Northeast.	Coahuila; Nuevo León; Tamaulipas.	15.1%	9.3%	15.6%
3. Center north Altiplano .	Aguascalientes; Durango; Guanajuato; San Luis Potosí; Zacatecas.	15.1%	10.9%	9.2%
4. West.	Colima; Jalisco; Michoacán; Nayarit.	8.7%	11.9%	10.2%
5. Centre.	Distrito Federal; Hidalgo; México; Morelos; Puebla; Querétaro; Tlaxcala.	5.1%	33.7%	34.8%
6. South.	Chiapas; Guerrero; Oaxaca.	11.8%	10.6%	4.7%
7. Southeast Gulf.	Campeche; Quintana Roo; Tabasco; Veracruz; Yucatán.	12.1%	12.4%	13.0%
TOTAL	**MEXICO**	**100.0%**	**100.0%**	**100.0%**

Source: (Davila *et al.* 2015, p. 276).

In regards to states, and because of the abatement of the oilfields, Campeche was the only state that had negative growth annual rates (-3.2 percent). At the other extreme, seven states reached real final demand annual growth rate above four per cent during those years (2003-2013): Aguascalientes (5.2), Baja California Sur (5.1), Zacatecas (4.9), Sonora and Querétaro (4.7), Quintana Roo (4.5) and Nuevo Leon (4.3).

1.1. Changes in the structures of the final demands.

Table 2 presents a summary of the major changes in the final demand structures during the period 2003-2013. The first two columns contain the concentration indices of the eight and four most important sectors in final demand for the year 2013. In the first three rows are the average for regions, states, and the nationwide. In the following two, are the maximum and minimum values registered by the regions, and in the last two rows, the values registered by the states. Columns three and four compute percentage

changes observed in the levels of concentration between the initial (2003) and the final year (2013). The last column calculates the participation of the four sectors with the most relevant change in concentration levels.

Map 1
MESOREGIONS OF MEXICO.

Source: (Davila *et al.* 2015, p. 277).

At the national level, eight of the 31 economic activities have improved in terms of final demand level between 2003 and 2013. On the whole, they increased their participation in this variable in 9.7 points, from 34.2 percent of the final demand in 2003 to 43.9 in 2013. Four of these activities concentrated the 86.2 percent of the relative increase in final demand: Machinery and equipment (333 to 336 subsectors according to NAICS classification - North American Industrial Classification System); financial

services and insurance; Trade and ; Information in mass media. This select group of economic activities doubled its relative weight in the final demand during the period (from 8.4 to 16.8 percent).

Table 2
MEXICO, MESOREGIONS AND STATES OF MEXICO: Indices of sectoral concentration of the final demand in 2003 (%) and changes in concentration levels during the periods 2003-2013, 2003-2013, 2003-2013 (%).

	Final demand concentration indices		Change on final deman concentration indices. 2003-2013		Total change contribution
	8 sectors	4 sectors	8 sectors	4 sectors	4/8 sectors
Average					
Regions	43.0%	29.0%	9.2%	7.6%	83.1%
States	44.5%	30.6%	10.7%	8.9%	82.9%
National	43.9%	32.1%	9.7%	8.4%	86.2%
Extreme values on regions					
Maximum	50.8%	37.7%	10.2%	9.4%	91.5%
Minimum	38.0%	23.4%	7.8%	6.7%	na
Extreme values on states					
Maximum	67.2%	59.8%	18.9%	18.5%	97.7%
Minimum	18.5%	6.6%	4.8%	4.0%	82.4%

a Northeast region in the four cases
b Sout, West, Central-norh Plateau, respectively
c Tabasco, Tabasco, Sonora and Sonora, respectively
d Campeche, Puebla, Guanajuato and Guanajuato, respectively.

Source: Regional input-output models. Developed by the authors based on the methodology described in this document with information from INEGI (Input Output Tables: 2003, 2008 and 2012m and statistics of the Gross Domestic Product of the Federal Entities).

At the national level, eight of the 31 economic activities have improved in terms of final demand level between 2003 and 2013. On the whole, they increased their participation in this variable in 9.7 points, from 34.2 percent of the final demand in 2003 to 43.9 in 2013. Four of these activities concentrated the 86.2 percent of the relative increase in final demand: Machinery and equipment (333 to 336 subsectors according to NAICS classification - North American Industrial Classification System); financial

services and insurance; Trade and ; Information in mass media. This select group of economic activities doubled its relative weight in the final demand during the period (from 8.4 to 16.8 percent).

This expansion greatly influenced the detriment of three industrial activities: Oil mining; Petrochemical, Chemical and Plastic and rubber industries (324 to 326 NAICS subsectors) and; the basic metal and the metal products manufacture (subsectors 331 and 332). This subset of activities lost more than one third (34.2 percent) of its relative weight in aggregated demand, moving from 15.7 percent of the total in 2003 to 10.4 ten years after (5.3 points less).

The state and regional patterns were very similar to the national, with concentration indices and changes slightly more pronounced in the federal entities.

The Northeast region is the one that reaches the maximum values about concentration levels of four (37.7 percent) and eight sectors (50.8), as well as its variations over the years analyzed (9.4 and 10.2 percent, respectively). Three of the four sectors with the highest concentration levels in this region match with those sectors located in this same category at national level . The exception is the food industry in the Northeast region, which appears in this group in replacement of Trade sector.

In the case of states, Tabasco reached the higher concentration indices, as the most significant increases during the period were recorded in the state of Sonora. In Tabasco, Oil mining was the sector with higher specific weight in the final demand, the three remaining activities match the sectors located in the same group at national level (Trade, Financial services and Information services). In the case of Sonora, the Non-oil mining is located among the most important, the remaining three (Machinery and

equipment, Financial services and Information services), are also conforming this subset at national level.

Thus, the data show changes in the final demand structures and a deepening in sectoral specialization levels. How have these trends impacted in the evolution of its economic performance?

2. Performance of the local economies.

In the methodological framework adopted, the performance of an economy is a direct function of the average expectancy of growth in the gross production value, and an inverse function of the levels of volatility of the same variable. Initially we will analyze the evolution of each one of these items separately, and subsequently observe both criteria simultaneously.

2.1. Expected growth in the gross production value.

In line with the behavior of the final demand, the estimated growth of the gross production value in Mexico, reached real annual rates of 2.5 percent between 2003 and 2013[15]. Also regional and state dynamics in the evolution of this variable are very similar to those already described for the case of final demand.

2.2. Performance of variance of the gross production value.

In the approach proposed by Siegel *et al.,* (*op. cit*.), changes in the variance level of the gross production value (or employment), can be explained by: 1) alterations in the level

[15] This value reflects the expected growth in gross production value.

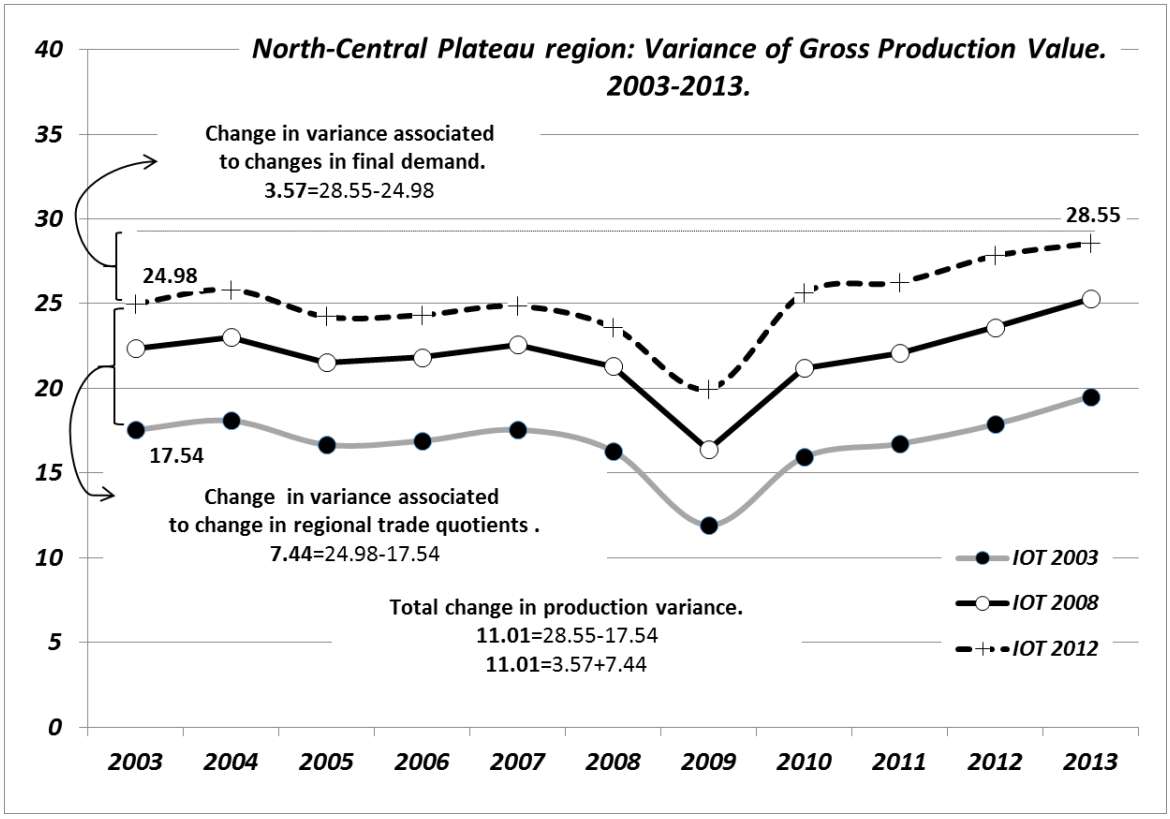
and structure of the final demand, or; 2) changes in regional intersectoral trade quotients. In order to identify the source of fluctuations in the stability, three series were calculated using observed annual variance between 2003 and 2013, with each of the three input-output matrices available, corresponding to the years 2003, 2008 and 2012. All these computations were made for each of the 32 federal entities of the Mexican Republic, for each of the seven mesoregions considered and for the country as a whole. The results are presented in Annex 1 of the work.

To illustrate the procedure, we will analyze at the case of the North-Central Plateau region of Mexico (see Graph 1). The three lines in the graph measure the evolution of the variance in the gross production with each of the three input-output matrices employed. The total change (+11.01) results from subtracting to the level of variance quantified in 2013 with the 2012 matrix (28.55 units), the value of the variance registered in the initial year, 2003, obtained through the matrix of this same year (17.54).

Afterwards, variations associated with each of the two components mentioned above are calculated: The change in the absolute level of variance caused by alterations in the level and structure of the final demand (3.57 units), is obtained by measuring the difference between the values of the variance corresponding to the year 2013 with respect to the year 2003 (3.57 =28.55 -24.98), calculated both with the 2012 matrix.

The impact over the variance of production associated to changes in regional trade quotients; is estimated by the difference between the variance calculated for 2003 with the matrices of the 2012 and 2003. These values were 24.98 and 17.54 , respectively, resulting in a variation of 7.44 units. Combining the two components yields the total change in variance (3.57 +7.44 =11.01).

Graph 1
North-Central Plateau region of Mexico. Variance of the gross production value. Period 2003-2013.



*Source :*Regional input-output Models. Developed by the authors based on the methodology described in this document with information from INEGI (Input-Output Matrices: 2003, 2008 and 2012 and statistics of the Gross Domestic Product of the Federative Entities).

Using the same scale to facilitate comparison, Graph 2 shows the behavior of the variance of the gross production in the country and in each of its seven mesoregions. As indicated above, the results for the federal entities can be found in Annex 1. For the Mexican economy as a whole, even when the volatility associated with the structure of the final demand grew by 3.3 units (from 27.7 in 2003 to 31 in 2013), these changes were more than offset by the reduction associated with the regional trade quotients (-3.6). The net result was a slight decrease in the volatility indicator.

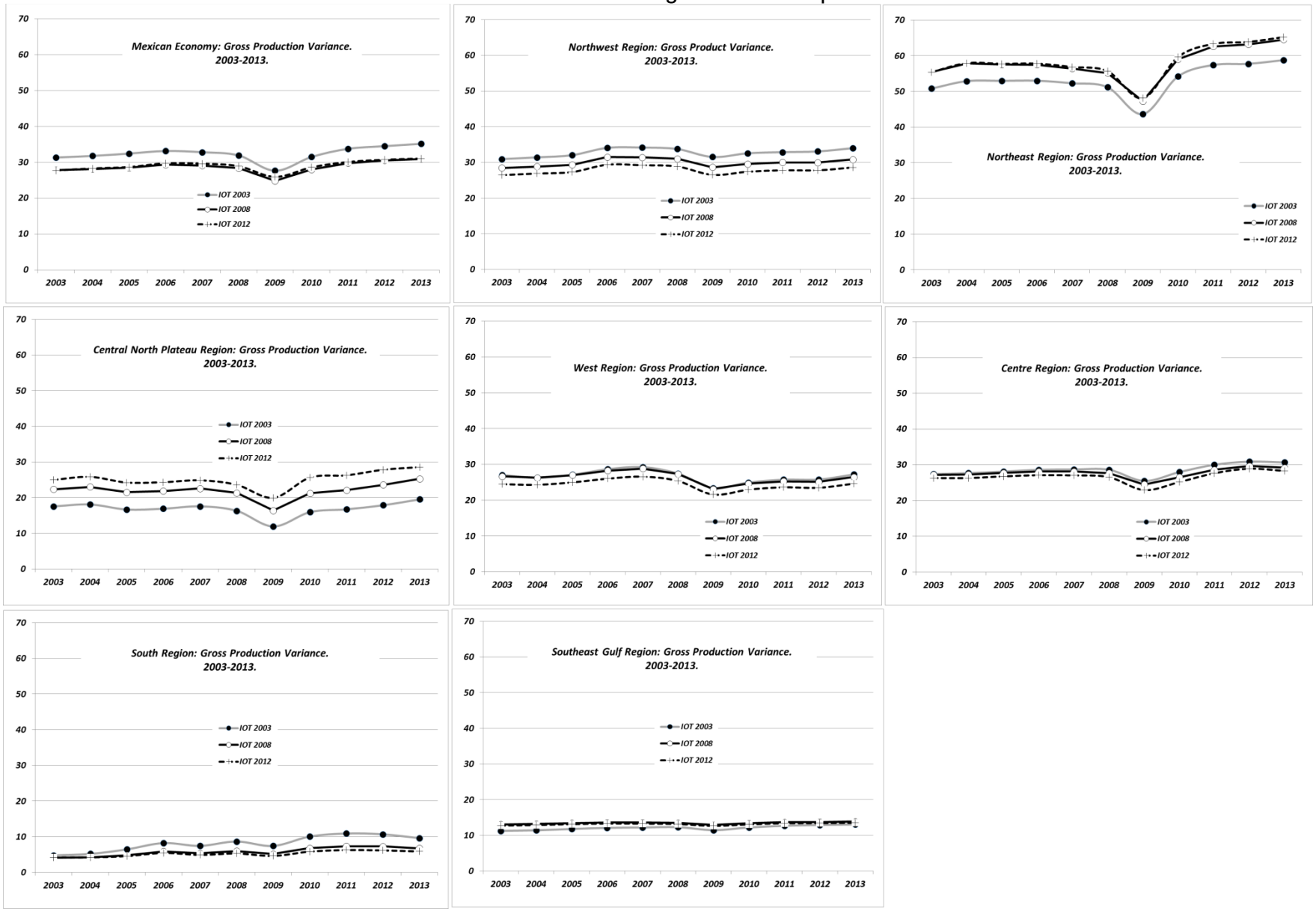
In the meso-regional level, the Northeast region reached the highest levels of volatility, while the regions Northwest, North-Central Plateau, West and Center, recorded similar amounts to those of the country as a whole. The lowest levels of instability were observed in the regions South and Gulf-Southeast.

The percentage changes of the variance of the gross production for the country as a whole, as well as for each of its seven mesoregions and its 32 federal entities were also computed. This information is detailed in Annex 2. The results at national and meso-regional level are presented in Graph 3.

Changes in regional trade quotients helped to temper the volatility of the gross production in Mexico, as well as in the regions Northeast, South, Occident and Center. This same factor led to its greater instability in the regions Central-north Plateau, North-Center, Southeast-Gulf and Northeast. For its part, transformations in the structure of the final demand led greater volatility in the production level of the country and all the regions. The greater instability linked to this component was particularly important in the South, Central-north Plateau and Northeast regions. Combining both factors, the largest percentage increases in the levels of volatility were observed in the North-Central Plateau, Northeast and South regions.

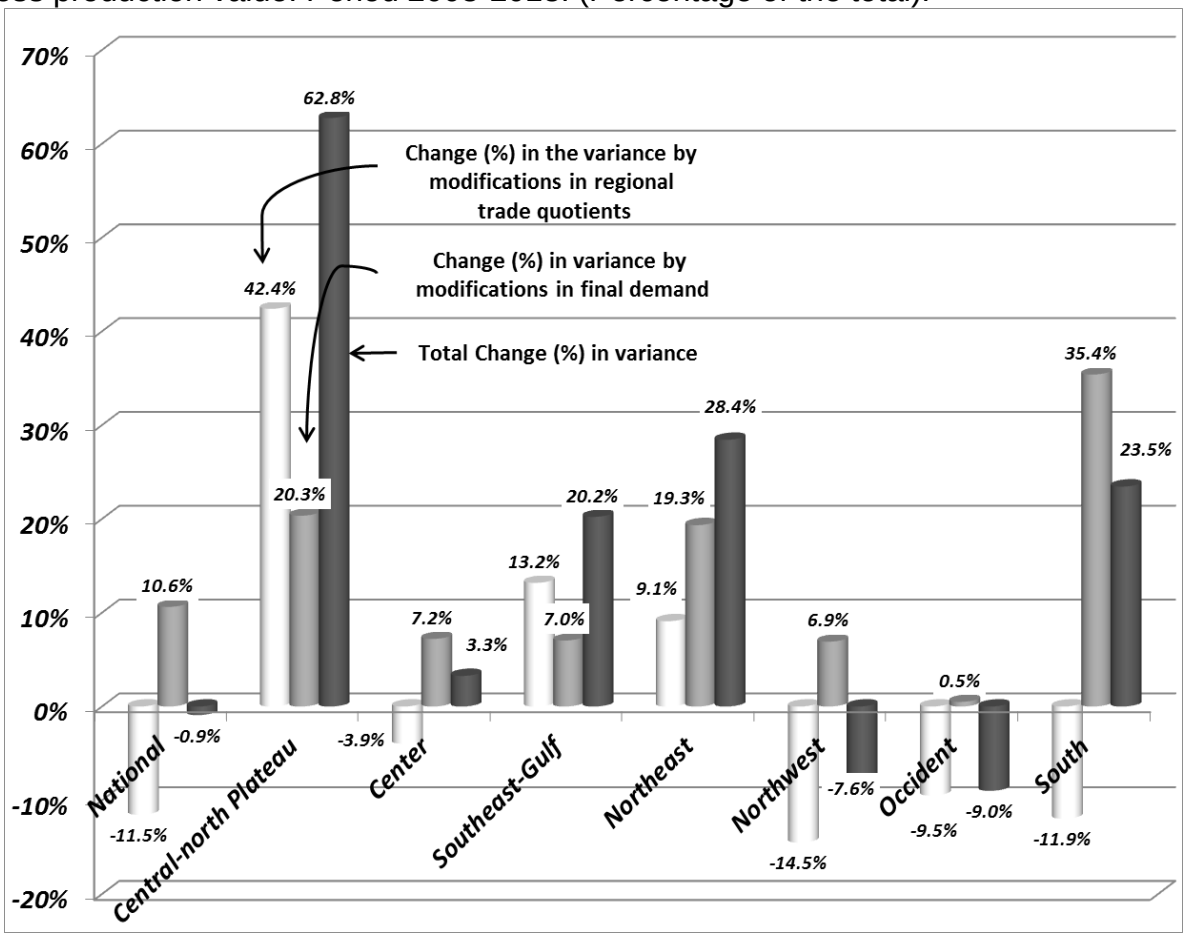
Chart 2

MEXICO AND MESOREGIONS OF MEXICO. Variance of the gross value of production. Period 2003-2013.



Source: Regional input-output Models. Developed by the authors based on the methodology described in this document with information from INEGI (Input Product Matrices 2003, 2008 and 2012 and statistics of the Gross Domestic Product of the Federative Entities).

Graph 3
MEXICO AND MESOREGIONS OF MEXICO. Factors of changes in the variance of the gross production value. Period 2003-2013. (Percentage of the total).



*Source :*Models regional input-output. Developed by the authors based on the methodology described in this document with information from INEGI (arrays of Input Product 2003, 2008 and 2012 and statistics of the Gross Domestic Product of the Federal Entities).

2.3. Evaluation of the economic performance.

Once the volatility is computed, the performance of an economy can be analyzed as a direct function of its expected growth (determined by the average rate of real growth in the gross production value) and as an inverse function of its instability (measured by the standard deviation of the gross production, which is obtained by calculating the square root of the variance).

The results are shown in Graph 4 and 5. The first one contains the information of the regions, while the second one shows the data of the federative entities. Both were evaluated using the input-output matrices of 2012[16] and have the same composition: the indicator of volatility is located in the horizontal axis, *i.e.* the average standard deviation of the gross production during the period 2003-2013; as the vertical axis measures the other performance criteria , the expected gross production growth. Using measures of dispersion of every variable´s mean , ranges of volatility and expected growth are identified, which are delimitated with dotted lines perpendicular to each axle.[17]

The results show a tradeoff between growth and volatility: A greater dynamism of production, less stability or, equivalently, greater volatility. Similarly, a trend line is drawn, which identifies the average levels of correlation between growth and volatility.

During those years, the Northeast was the region with the higher growth rate (3.48 percent per year), being located in the area "very high" in this aspect. Nonetheless, this region was also the one with the highest volatility (on average, the gross production standard deviation was 8.07), being the only mesoregion of the country located in the “very high” area of volatility. For its part, the Central-north Plateau achieved a high level of growth (3.32), but unlike the Northeast, remained in a zone of average volatility (5.34). In the same strip of volatility were located three other regions; Northeast, Central and Occident (with deviations values of 5.35, 5.32 and 4.96 percent,

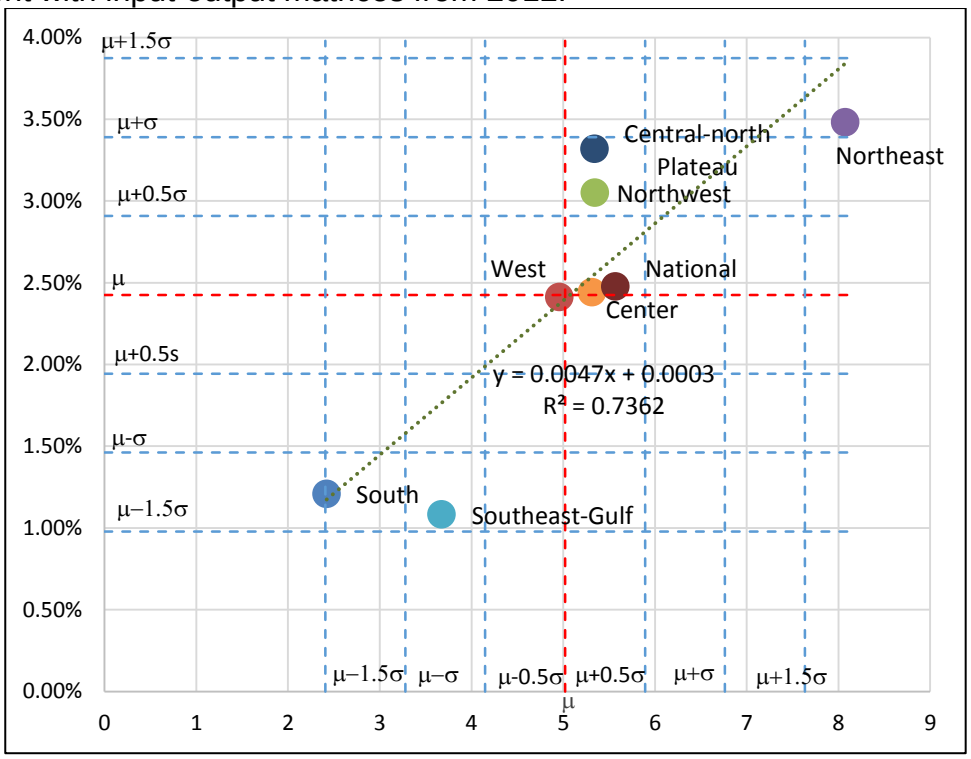
[16] Annex 3 contains the graphs drawn up with the matrices of the 2003 and 2008 years. The three matrices are consistent and show similar results.

[17] Five level ranges were defined in each of the two variables: very low (observations with a value lower than the average minus one and a half standard deviation ; low (level between the mean minus one standard deviation); medium (values between the mean plus / minus half of the standard deviation); high (values located between the mean plus one standard deviation); and very high (values higher than the mean plus one and a half standard deviation).

respectively), but the last two remained in medium growth area, with rates of 2.44 and 2.41 percent, while the Northwest region is ranked in the range of high growth (3.05), but with a slower rate than in the Central-north Plateau. Thus, it can be concluded that the Central-north Plateau region was the one that showed the best combination of growth and volatility, since it achieved an expansion of production slightly lower than in the Northeast, but much more stable. Similarly, with a level of stability similar to the one registered by the regions Northeast, Center and Occident, the region was able to achieve better rates of economic growth.

Graph 4

ECONOMIC PERFORMANCE OF THE REGIONS OF MEXICO: average real growth rate of gross production (%) and average standard deviation (%). 2003-2013. The assessment with input-output matrices from 2012.



Source : Regional input-output Models. Developed by the authors based on the methodology described in this document with information from INEGI (Input Output Matrices: 2003, 2008 and 2012, and statistics of the Gross Domestic Product of the Federal Entities).

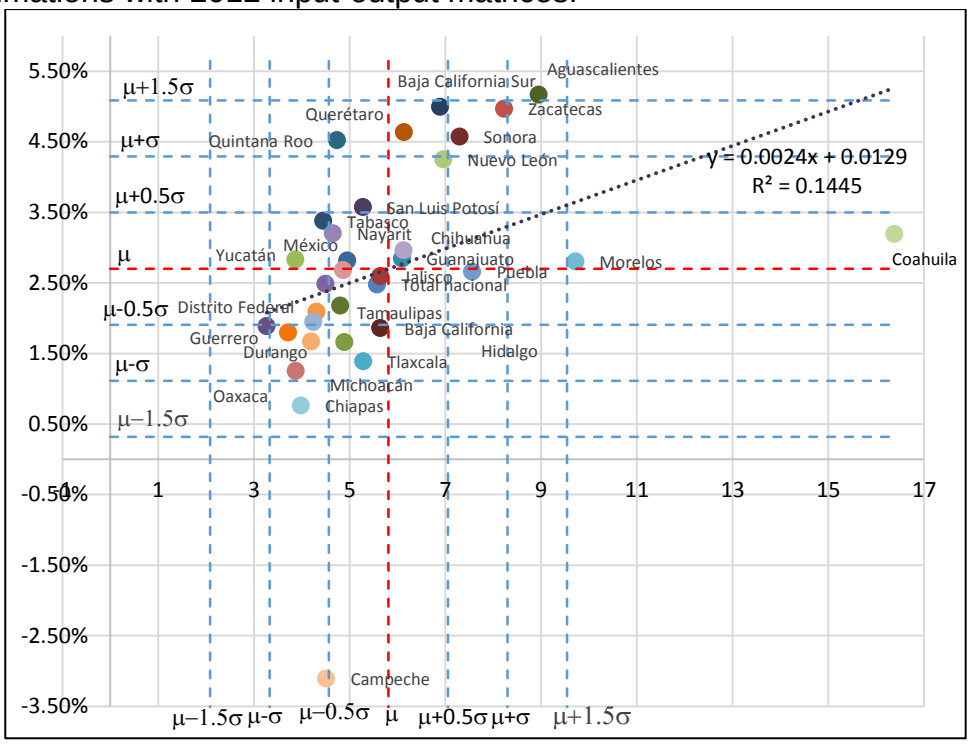
At the other extreme are the two regions with lower growth (Gulf-southeast and South). Clearly the first one was the worst performer, because with higher levels of volatility to those registered in the South region, Gulf-Southeast obtained a lower growth rate (1.08 per cent, against 1.21).

The analysis of the economic performance of the federal entities shows two extreme values: 1) The state of Coahuila, with a volatility value (16.4) almost three times higher than the national average and an economic growth located at the top of the mid-range area (3.19 percent), and; 2) Campeche, the only state of the Mexican Republic with negative growth rates (-3.11 percent) of its gross production over the period 2003-2013.

Six states are located in a very high gross production growth area: Aguascalientes (5.17), Baja California Sur (4.99), Zacatecas (4.97), Queretaro (4.63), Sonora (4.57) and Quintana Roo (4.52). In this group, the lower volatility values were observed in Quintana Roo (4.73, low range), Queretaro and Baja California Sur (placed in a medium instability level, with standard deviations of 6.13 and 6.89, respectively). With the evaluation criteria here employed, these entities attained the best economic performance during the period.

The reverse of the medal was occupied by nine states, located in the “low” (Tlaxcala, Oaxaca, Michoacán, Guerrero, Hidalgo, Durango and Baja California) and “very low” (Campeche and Chiapas) strata of gross production variation. Within this conglomerate, the standard deviations were highest in Baja California (5.64), Tlaxcala (5.28), Hidalgo (4.89) and Campeche (4.51), being the entities with the most precarious levels of economic performance.

Graph 5
ECONOMIC PERFORMANCE OF THE FEDERAL STATES OF MEXICO: average real growth rate of gross production (%) and average standard deviation (%). 2003-2013. Estimations with 2012 input-output matrices.



Source :Models regional input-output. Developed by the authors based on the methodology described in this document with information from INEGI (arrays of Input Product 2003, 2008 and 2012 and statistics of the Gross Domestic Product of the Federal Entities).

3. Strategies to improve economic performance.

These trends can lead two questions: Is it feasible to implement public policies to temper instability without sacrificing growth in a context of increasing competitiveness and international economic integration? What utility can Siegel *et al.* (1995) model in the design, implementation and evaluation of these policies? The final part of this article is devoted to the reflection on these issues.

3.1. Specialization *versus* diversification.

While there is consensus in the specialized literature in terms of recognition of the spatial spillovers of knowledge as the most effective mechanism of externalities transmission, the opinions disagree when laying down the forms of industrial organization that support the process. On the one hand, these externalities are linked with the productive specialization of a city in a particular industry[18], and on the other one, externalities are associated with the greatest diversity of existing products and technologies in a locality.[19]

The different perceptions about the ways by which it is generated the dissemination of the spatial knowledge spillovers, have given rise to a debate in economic geography about the relative importance of the regional specialization and diversification. In the first case, the good performance of a regional economy would be associated with a greater specialization, because this would move faster in the learning curve. In the second, it is argued that the greatest diversity of a region benefits from the creativity and innovation (Porter 2003).

The economic clusters approach provides an alternate way of interpretation. The dissemination of the most relevant knowledge, which drives innovations, and with them the economic efficiency, it is more intense among the companies participating in a cluster. In this way, it would be the regional specialization in *clusters* and not in industries, the path to achieve higher levels of economic efficiency (Porter 2003).

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[18] As is the case with the externalities type Marshall (1920), also called MAR, in recognition of the filiation with the ideas of its three precursors (Marshall, Arrow, made).

[19] As posed by the supporters of the externalities type Jacobs (1969).

Thus, It is feasible to implement a policy of productive diversification that limits the fragility of a region to external shocks without compromising its competitive viability. For this purpose, can be explored strategies of regional diversification of clusters supported on economic activities linked simultaneously with more than one economic cluster. These branches of economic activity, which we call "hinge", can serve as "beach-head" in the momentum of new clusters (Davila 2003a and 2003b).

3.2. The role of clusters in the improvement of the economic competitiveness in territories.

Innovation is defined as the creation, dissemination and application of knowledge in economic processes. The methods for its development have evolved in parallel to the consolidation of economic globalization. In the knowledge economy, innovation is the result of increasingly complex interactions, between various actors (companies, persons, government, and research institutions) located at different spatial level (international, national and local) (OECD, 2001a)

Various studies have demonstrated the growing influence of economic clusters, in the determination of the innovation ability of companies, regions and nations. Likewise, clusters can be viewed as part of national, supranational or regional innovation systems (OECD 2001a).[20]

[20] The framework can be consulted endogenous development territorial policies formulated by the Organization for Economic Cooperation and Development (OECD, 2001b), as well as an application to the case of Mexico (OECD, 2003).

An economic grouping consists of a geographical concentration of companies in an economic activity, specialist suppliers of these companies, suppliers of producer services, companies in related economic branches and associated institutions (local governments, universities, research centers, certifying companies, and trade associations) that compete and cooperate in a specific economic area (Porter 2000).

It is through the concept of value chain, the articulation between the innovation systems and economic clusters is established. The value chain is formed by the intersectoral trade flows, by which companies organize and supply their production processes. Economic clusters are integrated by companies involved in a same value chain.

Technological development and international trade deepening, facilitated major organizational changes in the productive activities. They paved the way for flexible manufacturing systems and their application tools: just in time and total quality control. With them, the subcontracting schemes were expanded and the interdependence between the companies through the creation of more extensive and complex value chains grew.

With increasing frequency, national or regional groupings are articulated with international value chains, reason by these geographical areas can transcend. When several participants of an economic grouping are located in the same locality, the benefit from the economies of agglomeration.

The geographical concentration of related businesses, allows the creation of specialized labor markets, promotes specialization and division of labor among participating companies, opening up the possibility, even to small and medium sized

firms, to have access to economies of scale. Similarly, it facilitates the abatement of unit costs of specialized technical services, paves the various subcontracting activities, as well as the flow of ideas, information and knowledge, which opens the way to productive innovations.

As a result of the combined effect of all these factors, the economic groupings are driving the growth of the companies' productivity, as well as their competitive and innovation capabilities.

In addition, clusters can contribute to accelerate the pace of business creation. This is possible due to lower levels of vertical integration allowed for outsourcing activities. Thanks to this, barriers to entry for new investors are reduced.

3.3. Strategies and policies to improve the economic performance .

In a study about economic performance of the regions in the United States of America, Porter (2003) reported data and relevant conclusions. Slightly less than one-third of the total employment in the economy (31.8 %), are generated by companies producing tradable goods and services[21]. Notwithstanding the foregoing, their standards of wages, productivity and innovation are higher, so they have great influence on the prosperity of a region, because their competitive success stimulates the demand for local industry.

[21] By the spatial distance range of their markets and by reason of their localization patterns, economic activities are classified into tradable, non-tradable and intensive in the use of natural resources. The first spent the bulk of its goods and services production to external consumers (from other countries or regions). For this reason, its location criteria is strongly determined by competitive conditions existing in the selected locations, which induces its geographic concentration due to the economies of agglomeration. The activities non-tradables are directed to supply the local markets, a circumstance which its spatial distribution is close to population. Finally, the activities focused on natural resources exploitation, are located in the vicinity of the corresponding fields.

In fact, the author demonstrates the existence of a strong association between the average wages in the region and the average wage paid in the export industries (the first amounted to 66 per cent of the seconds) on the basis of which concludes that for a region is more important to develop the conditions that allow higher wages in the export industries, rather than increase the coefficient of regional export.

Non-tradable activities reported lower levels of wages, productivity and innovation. However, in these sectors were offered more than two-thirds of the job opportunities (67.4 %)

Finally, the companies associated with the use of natural resources had marginal participation in employment (0.8 %) and stood at intermediate levels of wages, productivity and innovation.

For the outlined considerations, it is emerged a set of guidelines to be considered in regional development policies:

1. Must be identified the economic activities that conforms existing export clusters in a region and develop their competitive capacity.[22]

2. A strategy for productive diversification can be structured through the promotion of emerging export clusters in the region. In this regard, the role of the "hinge" branches is important.

[22] Feser (2000) proposes a typology that includes three types of groupings: 1) Existing; 2) emerging, and; 3) potential. In the first group are those who have reached a critical mass, both in terms of its absolute dimension, as in terms of its diversity. In the second, to those who, by their dynamism, can reach a critical mass. Finally, in the third case are those in which it is identified opportunities for development, but conditions for its emergence are uncertain.

3. On the export base of a region, the optimization of the value production in non-tradable activities must be sought.

4. Try to link infrastructure, training, temporary employment and poverty policies, with policies that promote competitive strategies of local clusters and diversification of local economies.

4. Conclusions.

Using optimization tools, it is possible to identify the final demand structures that minimize the production variance applying the Siegel *et al. (*1995) model of to project the behavior of volatility under different scenarios. The same technique can also be used to simulate the impact of different public policies (fight against poverty, promotion of small and medium sized industry, imports substitution, strengthening of the regional inter-industry trade quotients, and so on) on the performance of an economy.

The results obtained suggest that the liberalization of foreign trade led to a greater specialization of local economies. This trend is explained by the new balance between the agglomeration and transport economies favored by the radical change in trade policy and the improved access to foreign markets that these policies made it possible.

The effects on economic performance have been contrasting since, although some local economies reached acceptable rates of expansion in its gross output, economic growth has been moderate in most of the federal entities. On the other hand, the deepening of the productive specialization has significantly increased the

levels of instability, particularly in states and regions in which the machinery and equipment industry has a preponderant weight.

Some guidelines in the design, formulation and evaluation of regional development polices, can contribute to temper its volatility without sacrificing their levels of economic growth:

1. Identify the economic activities that make up the existing export clusters in a region and develop their competitive capacity.

2. Shape strategies for productive diversification by promoting the development of the emerging export clusters of the region. In this regard, the role of the "hinge" economic activities is key.

3. On the export base of a region, the optimization of the production of value in the non-tradable activities must be sought.

4. Try to link infrastructure, training, temporary employment and poverty policies, with policies that promote competitive strategies of local clusters and diversification of local economies.

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Annex 1. Production variances for 2003, 2008, 2012 and 2013 years.

	IOT 2003				IOT 2008				IOT 2012			
REGION	**2003**	**2008**	**2012**	**2013**	**2003**	**2008**	**2012**	**2013**	**2003**	**2008**	**2012**	**2013**
National	**31.32**	**31.90**	**34.49**	**35.14**	**27.86**	**28.37**	**30.56**	**30.93**	**27.71**	**28.91**	**30.70**	**31.04**
South	4.75	8.66	10.67	9.60	4.15	6.00	7.29	6.75	8.37	5.29	6.15	5.87
West	27.03	27.41	25.75	27.17	26.65	27.34	25.10	26.45	24.46	25.36	23.46	24.60
Northwest	30.94	33.76	33.08	34.01	28.45	31.04	29.98	30.83	26.45	28.86	27.79	28.59
Northeast	50.80	51.18	57.74	58.78	55.39	55.14	63.18	64.53	55.42	55.69	63.87	65.25
Gulf-Southeast	11.25	12.28	12.90	13.04	13.02	13.49	13.73	13.85	12.73	13.16	13.42	13.52
Center	27.37	28.60	30.87	30.64	73.67	75.06	79.35	82.14	26.29	26.53	28.90	28.26
Plateau	17.54	16.30	17.87	19.52	22.34	21.29	23.59	25.27	42.73	38.87	54.42	50.10
Aguascalientes	40.91	60.21	66.45	76.47	47.02	68.29	75.07	85.46	42.81	63.60	70.09	80.07
Baja California	37.41	38.92	36.19	35.85	35.01	36.36	33.63	33.27	33.53	34.84	32.15	31.78
B.C. Sur	43.03	55.68	53.41	52.98	45.40	56.58	54.99	53.54	37.57	50.27	48.10	47.43
Campeche	24.57	22.58	20.99	21.23	24.41	22.48	20.34	20.71	23.53	21.85	19.99	20.35
Chiapas	20.22	57.43	46.95	32.84	22.01	34.05	28.38	19.60	21.44	21.92	21.04	15.85
Chihuahua	33.61	36.32	36.38	36.96	31.78	34.64	34.44	34.95	32.00	36.23	36.51	37.52
Coahuila	202.88	177.32	240.85	257.49	216.99	192.41	257.08	274.07	209.40	188.02	251.49	268.19
Colima	27.13	31.94	30.00	31.17	23.87	27.74	24.80	24.85	22.41	25.62	23.87	23.66
Distrito Federal	25.35	26.27	24.83	24.32	19.08	20.30	18.91	18.29	18.27	19.64	18.58	18.00
Durango	8.76	10.33	9.91	11.08	9.45	11.11	10.63	12.54	10.56	12.11	11.08	13.80
Guanajuato	37.48	29.59	32.22	33.28	42.16	34.48	36.74	37.81	40.47	33.83	36.17	37.14
Guerrero	13.07	15.70	17.45	17.30	9.70	12.63	12.43	12.30	8.55	11.20	10.79	10.68
Hidalgo	20.49	23.33	21.55	23.08	24.89	25.48	22.67	23.56	25.84	26.09	23.37	23.93
Jalisco	37.37	35.16	34.27	35.74	35.69	34.38	33.53	34.71	32.09	31.54	30.88	31.82
México	23.60	22.37	24.34	23.06	25.30	24.01	26.32	25.05	24.40	23.40	25.69	24.50
Michoacán	15.68	19.86	15.68	17.24	18.90	23.78	15.29	18.01	18.76	23.20	14.89	17.57
Morelos	35.10	39.06	89.63	87.75	38.17	43.26	100.48	98.40	37.30	42.45	95.99	94.42
Nayarit	24.41	55.92	30.85	32.17	17.87	40.53	23.41	24.48	15.52	29.72	20.78	21.61
Nuevo León	37.57	42.13	42.91	42.45	40.68	45.45	47.11	46.96	41.80	46.69	48.44	48.35
Oaxaca	8.29	7.03	12.28	11.63	9.31	7.81	10.60	10.62	9.20	6.91	14.70	15.00
Puebla	54.51	56.25	69.20	59.18	53.57	55.13	66.53	57.36	47.52	49.73	65.70	57.14
Querétaro	32.07	27.04	30.63	30.63	38.67	32.07	37.13	37.11	38.47	32.50	37.71	37.61
Quintana Roo	21.95	24.81	22.82	23.08	21.28	25.34	23.15	23.45	20.41	24.33	22.09	22.42
San Luis Potosí	32.00	30.06	31.15	30.38	41.75	39.60	42.14	41.52	31.70	31.40	27.60	27.84
Sinaloa	22.03	26.58	24.24	24.47	23.03	28.29	24.12	24.12	22.43	27.32	23.12	23.06
Sonora	72.01	83.06	78.31	89.56	35.37	55.83	48.09	60.55	33.89	49.75	43.11	53.30
Tabasco	16.99	16.07	15.78	16.36	26.02	21.82	19.95	21.05	24.46	20.49	18.67	19.77
Tamaulipas	19.81	22.01	20.06	19.03	20.41	22.34	20.15	19.40	19.46	21.40	19.34	18.56
Tlaxcala	34.98	23.76	25.46	24.13	45.16	28.16	31.02	29.03	43.33	27.10	29.60	27.92
Veracruz	15.41	16.51	17.05	16.54	20.48	22.95	23.14	22.57	17.58	20.32	20.85	20.19
Yucatán	13.90	17.33	18.53	18.36	11.89	14.62	15.49	15.36	11.61	14.10	14.97	14.96
Zacatecas	18.83	21.48	22.11	20.96	23.90	23.00	37.77	34.24	31.40	30.17	76.19	67.70

Source: Regional input-output models. Developed by the authors based on the methodology described in this document with information from INEGI (Input Output Tables: 2003, 2008 and 2012m and statistics of the Gross Domestic Product of the Federal Entities).

Annex 2. Percentage variance changes (∆% VQ) due to changes on final demand levels (∆% VQ FD) and changes on inter-sectoral trade quotients (∆% VQ IQ). Periods 2003-2008, 2008-2012, 2003-2012.

	∆% VQ			∆% VQ IQ			∆% VQ FD		
REGIÓN	**2003-2008**	**2008-2012**	**2003-2012**	**2003-2008**	**2008-2012**	**2003-2012**	**2003-2008**	**2008-2012**	**2003-2012**
National	-9.20%	9.65%	-2.24%	-11.05%	1.93%	-13.04%	1.85%	7.72%	10.80%
South	69.54%	9.57%	16.72%	-12.65%	-11.87%	43.22%	82.19%	21.43%	-26.49%
West	0.01%	-15.41%	-14.59%	-1.42%	-7.22%	-10.48%	1.42%	-8.19%	-4.11%
Northwest	1.06%	-10.42%	-11.92%	-8.05%	-7.01%	-16.96%	9.11%	-3.42%	5.04%
Northeast	9.79%	15.58%	23.59%	9.04%	1.00%	8.34%	0.76%	14.58%	15.25%
Gulf-Southeast	24.94%	-0.61%	17.10%	15.77%	-2.41%	11.65%	9.16%	1.80%	5.45%
Centre	173.63%	-58.93%	5.81%	169.15%	-64.65%	-4.11%	4.49%	5.73%	9.92%
Plateau	20.27%	93.37%	86.31%	27.35%	82.56%	58.94%	-7.08%	10.81%	27.37%
Aguascalientes	62.09%	3.08%	68.16%	14.92%	-6.86%	4.44%	47.17%	9.94%	63.72%
Baja California	-2.37%	-11.68%	-15.69%	-6.41%	-4.19%	-11.57%	4.04%	-7.49%	-4.12%
B.C. Sur	34.93%	-13.98%	13.51%	5.52%	-11.16%	-14.54%	29.41%	-2.82%	28.05%
Campeche	-8.74%	-12.26%	-19.45%	-0.63%	-2.76%	-4.44%	-8.11%	-9.49%	-15.01%
Chiapas	192.79%	-52.29%	3.80%	8.82%	-35.62%	5.70%	183.97%	-16.67%	-1.89%
Chihuahua	2.61%	3.99%	9.07%	-5.45%	4.57%	-5.02%	8.06%	-0.58%	14.10%
Coahuila	-5.65%	31.32%	23.21%	6.95%	-2.29%	3.11%	-12.60%	33.61%	20.10%
Colima	5.73%	-18.28%	-14.56%	-12.01%	-7.66%	-21.09%	17.74%	-10.62%	6.52%
Distrito Federal	-21.10%	-10.11%	-37.06%	-24.72%	-3.26%	-38.77%	3.62%	-6.86%	1.71%
Durango	25.85%	4.62%	22.00%	7.92%	8.99%	17.01%	17.93%	-4.38%	4.99%
Guanajuato	-8.56%	4.66%	-3.22%	12.49%	-1.89%	7.39%	-21.06%	6.55%	-10.61%
Guerrero	-5.74%	-12.95%	-26.78%	-25.78%	-11.33%	-52.99%	20.04%	-1.61%	26.21%
Hidalgo	35.40%	-8.64%	11.16%	21.52%	2.39%	20.73%	13.88%	-11.02%	-9.57%
Jalisco	-10.40%	-10.73%	-20.21%	-4.50%	-8.26%	-16.43%	-5.90%	-2.48%	-3.78%
México	2.01%	7.08%	8.58%	7.21%	-2.55%	3.28%	-5.20%	9.63%	5.30%
Michoacán	47.22%	-38.15%	-4.21%	20.57%	-2.43%	16.45%	26.65%	-35.72%	-20.66%
Morelos	20.01%	130.42%	163.26%	8.73%	-1.86%	5.89%	11.28%	132.28%	157.37%
Nayarit	102.24%	-68.90%	-23.44%	-26.79%	-26.67%	-57.27%	129.03%	-42.22%	33.83%
Nuevo León	20.42%	6.36%	26.00%	8.27%	2.71%	10.12%	12.15%	3.65%	15.89%
Oaxaca	-2.85%	24.21%	69.66%	12.33%	-11.53%	9.91%	-15.19%	35.74%	59.75%
Puebla	1.46%	10.91%	23.54%	-1.73%	-9.79%	-14.72%	3.19%	20.69%	38.26%
Querétaro	4.91%	17.15%	14.65%	20.58%	1.36%	16.63%	-15.67%	15.79%	-1.98%
Quintana Roo	10.01%	-12.65%	0.69%	-3.04%	-3.99%	-7.57%	13.05%	-8.66%	8.26%
San Luis Potosí	24.45%	-14.30%	-13.86%	30.50%	-20.71%	-0.93%	-6.05%	6.41%	-12.93%
Sinaloa	25.22%	-18.23%	4.88%	4.55%	-3.46%	1.77%	20.67%	-14.77%	3.10%
Sonora	-35.55%	-24.76%	-85.30%	-50.89%	-10.89%	-112.50%	15.34%	-13.87%	27.20%
Tabasco	47.65%	-14.69%	6.85%	53.10%	-6.11%	30.54%	-5.45%	-8.58%	-23.68%
Tamaulipas	14.18%	-14.04%	-2.42%	3.04%	-4.22%	-1.79%	11.14%	-9.82%	-0.63%
Tlaxcala	-2.94%	6.35%	-12.42%	29.13%	-3.79%	19.28%	-32.06%	10.14%	-31.69%
Veracruz	39.93%	-10.60%	30.95%	32.85%	-11.46%	12.33%	7.08%	0.86%	18.62%
Yucatán	10.30%	2.40%	9.23%	-14.41%	-3.55%	-19.70%	24.71%	5.95%	28.93%
Zacatecas	41.01%	95.47%	182.69%	26.94%	31.21%	40.02%	14.07%	64.26%	142.67%

Source: Regional input-output models. Developed by the authors based on the methodology described in this document with information from INEGI (Input Output Tables: 2003, 2008 and 2012m and statistics of the Gross Domestic Product of the Federal Entities).