Productive Specialization and Relational Analysis: The Automotive Industry in Guanajuato*

Especialización productiva y análisis relacional: el caso de la industria automotriz en Guanajuato**

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ABSTRACT

The main objective of this paper is to measure, on the basis of the Economic Censuses 2004, 2009 and 2014, as well as 2008 Input-Output Matrix, the productive specialization using the location coefficient and the relational analysis of the automotive industry in Guanajuato. The main findings are an increasing specialization of some economic activities and a permanence of a low level of contribution of locally produced inputs. All of this opens up significant challenges for industrial policy in this region.

Keywords: 1. automotive industry, 2. productive specialization, 3. relational analysis, 4. Guanajuato, 5. Bajío.

RESUMEN

El presente trabajo mide, a través de la utilización de los Censos Económicos 2004, 2009 y 2014 así como de la Matriz Insumo-Producto 2008, la especialización productiva utilizando el coeficiente de localización y el análisis relacional de la industria automotriz de Guanajuato. Los principales hallazgos son una creciente especialización de algunas actividades económicas y la persistencia de una baja participación de insumos producidos estatalmente. Esto, sin duda, abre importantes retos de política industrial en esta región.

Palabras clave: 1. industria automotriz, 2. especialización productiva, 3. análisis relacional, 4. Guanajuato, 5. Bajío.

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INTRODUCTION

In recent years, Mexico's automotive industry (AI) has revealed itself to be very dynamic, both in terms of output and attracting investments (Covarrubias, 2014; Martínez and Carrillo, 2017). In the first semester of 2016, "the presence of FCA, Honda, KIA, Mazda, Nissan, Toyota and Volkswagen … have pushed up the production of vehicles to almost 1.7 million" (Toguna, 2016, p.8). According to data from the Mexican Automotive Industry Association (AMIA, for its initials in Spanish) between 2014 and 2020, the Mexican automotive industry will grow by 60 percent, with 5 000 000 automobiles a year. Mexico is currently the world's fourth-largest exporter and seventh in terms of automobile manufacture. In this framework, the geographical area known as the "Bajío" (consisting of Guanajuato, Querétaro and Aguascalientes) is gaining prominence for its production of automobiles and autoparts, and due to the high levels of foreign investment flowing into the region. In Guanajuato alone there has been almost a 20 percent growth in annual output volumes recorded recently (Flores, 2015).

The automotive industry in Guanajuato can be traced back to 1995 with the entry into operation of the General Motors assembly plant at the Silao complex, and the arrival of its respective suppliers of autoparts and services. This assembly plant, originally located in Mexico City, transferred its manufacturing to the state of Guanajuato in order to reduce logistics costs, given its closer proximity to the United States, to lower its labor costs and increase the flexibility of its manufacturing and management system (García and Lara, 1998; García, 2002; Martínez, García and Murguía, 2009; Micheli, 2016).

Some of the largest investments in Guanajuato have included the arrival of Volkswagen to Silao in 2013, with an investment of 840 million dollars in an engine plant, creating 1 200 jobs. In the fourth quarter of that same year, Mazda set up its plant in Salamanca, with an investment of 770 million dollars, to produce its Mazda 2 and 3 models, as well as its Skyactiv 1.5 diesel engines since 2015. In 2014, Honda established its plant in Celaya with an initial investment of 1.3 billion dollars, creating 3 600 direct jobs in the medium term. Toyota's presence in Apaseo el Alto is no less important: it began construction in November 2016 and production will begin in 2019. In terms of autoparts, Pirelli—considered the fifth-largest tire manufacturer in the world—has invested 400 million pesos in its plant which is expected to become the largest of its kind in Latin America in the medium term.

According to Martínez and Carrillo (2017), from 2006 until the first quarter of 2016, 193 automotive investment projects have been captured, for a total of 11.3 billion dollars. These authors report that the following municipalities have benefitted most: Silao, Irapuato, Celaya, Apaseo el Grande and Salamanca; in this region, 91 percent of the investment has been concentrated, 76.15 percent of projects attracted and 75.53 percent of jobs created. This regional concentration of the industry is also reflected in the work of Unger and Chico (2004): "The automotive industry is concentrated in hubs of nearby municipalities, grouped around different sectoral specializations" (p.911). In fact, these same authors indicate that since the first decade of the twenty-first century the tendency of regional specializations moving toward new industrial regions, as in the case of Guanajuato, has become more pronounced. Given the above, this article seeks to measure the productive specialization by using the location coefficient as well as by carrying out a relational analysis of the automotive industry (AI) in Guanajuato. The study is essentially empirical and based on the results of the Economic Censuses of 2004, 2009 and 2014, as well as Guanajuato's 2008 Input-Output Matrix (IOM) (Dávila, 2008).

The first part of this article provides a brief overview of the AI in Guanajuato, followed by a note on the methodology used to determine the productive specialization using the location coefficient. In the third section we examine the changes in the patterns of AI specialization in Guanajuato and make a relational analysis. Finally, we present our conclusions.

THE AUTOMOTIVE INDUSTRY IN GUANAJUATO: A BRIEF OVERVIEW

The state is located in the geographical center of Mexico and is divided into 46 municipal districts, with a total area of 30 608.44 square kilometers representing 1.6 percent of the country's total land area; its capital is Guanajuato. It borders on the north with the states of Zacatecas and San Luís Potosí, to the east with Querétaro, to the south with Michoacán and to the west with Jalisco. Guanajuato is part of the region known as the Bajío, considered an industrial and manufacturing powerhouse. According to the definitive results of the Inegi's (National Institute of Statistics and Geography) 2010 Population and Housing Census, Guanajuato is Mexico's sixth most populous state, concentrating 4.88 percent of the country's entire population, representing 5 486 372 people.[1]

[1] According to Inegi (2010), Mexico's total population is 112 336 538.

In 2013, Guanajuato was in seventh place with a GDP at 2008 prices of 52.3 billion pesos, 3.99 percent of the national GDP (Inegi, 2015). According to the Foro Consultivo, Científico y Tecnológico, A. C. (2014), Guanajuato has the following specialization indexes: primary sector, 1.13; industrial sector, 1.23; and services, 0.89. The industrial sector is of particular importance and is mainly focused on the output of electrical devices, automobiles, autoparts, footwear, agroindustrial and petrochemical products, textiles, and clothing.

In terms of economic activities in state's automotive industry (AI), four represent 81 percent of the total value added, namely: automobile and light truck manufacturing (59 %), manufacturing of seat and interior accessories for automotive vehicles (9 %), manufacturing of electrical and electronic equipment and associated parts for automotive vehicles (7 %), and manufacturing parts for automotive transmission systems (6 %) (Inegi, 2014).

In terms of economic activities making the highest contribution to employment creation, the following are listed in order of their importance: manufacturing of electrical and electronic equipment and associated parts for automotive vehicles (25 %), car and light truck manufacturing (19 %), manufacturing parts for automotive transmission systems (16 %), manufacturing of seat and interior accessories for vehicles (10 %), and the manufacturing of die-cast metal parts for automotive vehicles (6 %), representing 76 percent of jobs created in the AI (Inegi, 2014).

AI in Guanajuato is regionally clustered around the municipal districts in the industrial region 45, an area comprising Celaya, Salamanca, Irapuato, and León. According to the 2014 Economic Census (Table 1), Silao is the municipality where a total of 27 economic units are concentrated and makes an 80 percent contribution in terms of the state's value added (VA), positioning it as the main generator of VA in the state. However, during 2014 other municipal districts began to gain importance in the generation of VA. These are listed in order of the importance of their contribution: Celaya (7.8 %), San José Iturbide (3.2 %), Apaseo el Grande (2.6 %), Irapuato (2.2 %), Villagrán (0.9 %) and Guanajuato (0.9 %). Once Toyota's plant at Apaseo el Grande enters into operation in 2019, this district is expected to become more important.

TABLE 1. Contribution of the municipal districts in creating added value and jobs, 2004, 2009, and 2014

	2004		*2009*		*2014*	
	Employment (%)	*VA (%)*	*Employment (%)*	*VA (%)*	*Employment (%)*	*VA (%)*
Acámbaro	-	-	-	-	1.42	0.39
San Miguel de Allende	-	-	-	-	0.05	0.01
Apaseo el Alto	0.92	0.03	0.02	0	0.23	0.05
Apaseo el Grande	8.39	0.81	5.99	1.33	6.60	2.58
Celaya	30.30	5.65	27.21	15.61	13.23	7.75
Manuel Doblado	-	-	-	-	0.01	0
Comonfort	-	-	-	-	2.66	0.57
Dolores Hidalgo	0.30	0.01	0.16	0.01	0.26	0.03
Guanajuato	-	-	-	-	0.75	0.88
Irapuato	0.22	0.01	3.03	0.35	4.24	2.16
León	1.66	0.06	2.16	0.52	2.54	0.61
Ocampo	-	-	-	-	1.57	0.21
Pénjamo	-	-	0.23	0.03	0.11	0.04
Purísima del Rincón	-	-	-	-	0.07	0.01
Salamanca	0.17	0.01	0.41	0.06	9.34	0.21
San Felipe	-	-	0.74	1	0.14	0.17
San Francisco del Rincón	-	-	0.06	0	0.01	0
San José Iturbide	0.53	0.04	3.51	2.08	4.52	3.19
Santa Cruz de Juventino Rosas	-	-	0.39	-0.03	0.87	0.13
Silao de la Victoria	57.52	93.39	54.27	78.54	50.51	80.11
Villagrán	0	0	1.32	0.41	0.87	0.90
Total	*100*	*100*	*100*	*100*	*100*	*100*

Source: Compiled by authors using information from Inegi (2004; 2009; 2014).

According to data from the governor of the state, Miguel Márquez Márquez, the importance of the automotive sector is generally associated with the high levels of investment and jobs created, as well as the large volume of vehicle and autopart manufacturing output:

> Guanajuato has 231 investments totaling over 12.4 billion dollars and 88 300 jobs … Business opportunities in Guanajuato with the automotive and autopart industry have a strong future in Guanajuato, where today 763 000 vehicles are produced with 1 408 000 projected in the years ahead, one of every four; today 932 000 engines are produced, and this is set to rise to 1 810 000; 1 118 000 transmissions is expected to rise to 2 320 000 and the current tire production of 2 million is projected to increase to 5.5 million" (Comunicación Social de Gobierno, 2016).

The following factors have contributed to the arrival of new automotive plants in Guanajuato:

1) The existence of many industrial parks that offer a wide variety of services and the infrastructure needed by international suppliers, as required by the large automotive assembly and autopart companies. In 1999 there were only 16 industrial parks in Guanajuato, but today that number has doubled, with 48 percent of them located in León; 15 percent in Celaya; 13 percent in Irapuato; 10 percent in Silao, and the remainder in other municipalities. These industrial parks undoubtedly promote geographical proximity as well as the sharing of information and knowledge, lower logistics costs, the presence of a local workforce and the integration of norms and regulations that penalize and guide companies' activities (García, 2017).

2) The development of a medium- and long-term industrial policy oriented toward promoting foreign direct investment in Guanajuato's automotive sector. This policy has attracted public investment in infrastructure (highways, railways, lighting, etc.); providing grants for specialist training (design and simulation, hydraulics, robotics, pneumatics), through the *Bécate* grant program run by the Ministry of Labor and Welfare (STPS, for its initials in Spanish) and the Federal Training Institute; government funding in the form of specialist infrastructure, depending on the number of jobs and investment amount involved, the government offers 90 percent of the salary in situations where companies decide to hire new workers, for periods ranging from three to five months; exemption from local taxation for a specific period; facilities are provided to help with bureaucratic processes and complying with government regulations; air fares in order to bring in foreign trainers who offer courses in automotive plants installed in Guanajuato and financial incentives for industrial plant expansion projects (Martínez and Carrillo, 2017).

3) An extensive offer of academic courses provide links to specialist higher-education research centers and universities: the Technological Institute of Celaya, the University of Guanajuato at its different campuses, the University of Celaya, the Regional Center of Equipment Optimization and Development of Celaya, and the Technological Institute of Roque, among others.

The dynamic performance of the AI in the state in recent years is also reflected in the following economic indicators for 2014: *1)* 40 343 jobs created, representing 12 percent of the total jobs created by Guanajuato's manufacturing sector and 4 percent of the total employment in the state; *2)* in terms of output, it represented 22 percent of Guanajuato's manufacturing output value and 11 percent of the value added, generated by the state economy as a whole (Table 2).

TABLE 2. Output and employment in Guanajuato's automotive industry, 2004, 2009, and 2014

	2004		*2009*		*2014*	
	Output (thousands of pesos)*	*Jobs*	*Output* (thousands of pesos)*	*Jobs*	*Production* (thousands of pesos)*	*Jobs*
Total automotive Guanajuato	20 552 338	14 406	13 512 304	19 610	22 615 219	40 343
% of national automotive	13	3	6.1	4	6	5
% automotive industry in the manufacturing industry	37	6	18	7	22	12
% State VA	19	2	8	2	11	4

VA= Census Gross Value Added
* Output considering the census gross added value, at current prices.
Source: Compiled by authors using information from the 2004, 2009, and 2014 economic censuses. Definitive results from the Automated Census Information System (Inegi).

According to information from the Mexican Automotive Industry Association (Ruiz, 2015), Guanajuato is expected to double its output in the next five years,

increasing from 560 000 to 1 000 000 units, making it one of the main automotive manufacturing poles in Mexico.

In terms of the external sector, it is the most important export industry in Guanajuato according to data provided by the Foreign Trade Promotion Office (Cofoce, 2013), representing 69 percent of total exports only in 2013, totaling 11.5 billion dollars. However, if we were to add the contribution of the metal-mechanical exports (9 %), a closely related sector, this contribution would rise to 78%. This is far higher than other sectors such as agrifood, which has just 5.84 percent total contribution of exports, while chemical products account for 4.98 percent and footwear and leather goods supplying the footwear and leather goods and components sector only have a 2.99 percent contribution. In that same year, automotive industry imports represented 23 percent of the state total, but if we add the contribution of the metal-mechanical sector (24.6 %), they reached a combined contribution of 47 percent (Table 3).

TABLE 3. Exports and imports of the subsectors in Guanajuato, 2013

Sector	*Exports (millions of dollars)*	*Share of total (%)*	*Imports (millions of dollars)*	*Share of total (%)*
Autoparts-automotive	11 479	69.21	1 460	23.16
Metal-mechanical	1 444	8.71	1 550	24.58
Processed agrifood	968	5.84	919	14.57
Chemical products	826	4.98	505	8
Plastics and manufactured plastic goods	569	3.43	460	7.3
Footwear	497	2.99	26	0.41
Subtotal	15 783	95.16	4 920	78.02
Other sectors	803	4.84	1 386	21.98
Total	*16 586*	*100*	*6 306*	*100*

Source: Compiled by authors using information from Cofoce (2013).

The data shown so far has been provided to emphasize the importance of the AI in Guanajuato; the following section provides methodological information on determining the economic specialization.

DETERMINING THE PRODUCTIVE SPECIALIZATION THROUGH THE LOCATION COEFFICIENT: A METHODOLOGICAL NOTE

An increasingly important aspect of regional studies is the calculation, analysis and evolution of the specialization of the productive structure in a country or specific geographical area, in order to identify the level of concentration or diversification in which certain activities are found (Diniz and Sequeira, 2009; Diniz and Upadhyay, 2010).

The location index was used to determine the productive specialization of the automotive industry in Guanajuato. This index makes it possible to determine which economic activities that form an industry within a region are specialized (Vidal-Suñé and Pezoa-Fuentes, 2012). This is the outcome between two ratios: the relative weight of a class of a state's product in the overall state economy; and, in the other hand, the relative weight that the product class has on a national level in regard to the country's overall economy. In this way we can ascertain whether the state is specializing in one class of product.

The following formula was used to calculate the location coefficient using the Total Employed Population variable:

Ep. Employment= (EiJ/EJ)/(EIE/EN) *(equation 1)*

Where:
EiJ=Total population employed in the class of activity (i) of the state (J)
EJ= Total population employed in the state J
EIE = Total population employed in the class of activity (I) at a national level (E)
EN= Total population employed at a national level.

Values equal to 1 indicate that the contribution of the total personnel or census gross value added of the class of activity J of the state is exactly the same as the contribution of that class of activity on a national level in the overall national economy. Values greater than 1 indicate a greater contribution of the total personnel or census gross value added of the class of activity J of the state than the contribution of that class of activity on a national level in the overall state economy. This indicates a specialized output of that class of activity.

Values lower than 1 indicate a lower contribution of the total personnel or gross value added census of the class of activity J of the state than the contribution of

that class of activity on a national level in the overall state economy. This indicates an insufficient—and therefore non-specialized—output.

Having made this note, the following section provides information identifying the automotive cluster by state and level of specialization at the level of the branch of activity that form a part of the automotive industry established in Guanajuato.

CHANGES IN THE PATTERNS OF SPECIALIZATION OF THE AUTOMOTIVE INDUSTRY OF GUANAJUATO AND RELATIONAL ANALSYSIS

Patterns of productive specialization

As mentioned above, the location coefficient is a useful method for ascertaining whether any class of economic activity in the automotive sectors is specialized. Calculations as of 2014 indicate that the automotive industry in Guanajuato has seven of the nine classes of specialized activity,[2] three more than the specialized activities in 2009. This indicates that a process of regional automotive specialization is underway in Guanajuato. Unger and Chico (2004) indicate that the Bajío region around the automotive clusters is showing considerable specialization. Similarly, Unger (2011) found in his study on competitiveness and specialization in Guanajuato for the 1993-2013 period that the automotive sector was acquiring economic relevance:

> Among the most important and dynamic branches, the food and auto sectors are notable for their high level of competitiveness. In terms of foods, dairy and bakery products show very positive performance indicators: a growth in the number of companies and jobs, without sacrificing their productivity advantage of 50 percent above the national average. As regards the automotive sector, the General Motors (GM) factory in Silao makes a significant difference by also increasing jobs and maintaining high standards of relative productivity, over three times higher than in the rest of the country, despite increasing pressure from international competition in the sector at the start of the new century (Unger, 2011, p.414).

An analysis of information in Table 4 shows, classes of activity that were not specialized in 2009 but became so in 2014, namely: gasoline engines and their

[2] Without considering the classification "Other parts for automotive vehicles".

parts for automotive vehicles, parts for steering and suspension systems for automotive vehicles, and die-cast metal pieces for automotive vehicles. On the other hand, the classes of activity maintaining their specialization (from 2009 to 2014) are: automobile and truck manufacturing, bodywork and trailers, parts for steering and suspension systems for automotive vehicles, parts for braking systems for automotive vehicles, parts for transmission systems for automotive vehicles, and die-cast metal parts for automotive vehicles. Finally, the classes of activity that have become more specialized are electrical and electronic equipment and parts and seats and interior accessories for vehicles.

TABLE 4. Productive specialization of the classes of economic activity in the automotive sector in Guanajuato, 2009 and 2014

Product classes	*Location index*		*Variation 2009-2014*
	2009	*2014*	
Cars and light trucks	2	2.77	+
Trucks and tractor-trailers	0	0.04	+
Bodywork and trailers	2.42	1.63	-
Gasoline engines and associated parts for automotive vehicles	0.63	1.13	+
Electrical and electronic equipment and associated parts for automotive vehicles	0.52	0.77	+
Parts for steering and suspension systems for automotive vehicles	0.73	1.29	+
Parts for braking systems for automotive vehicles	1.11	1.28	+
Parts for transmission systems for automotive vehicles	5.51	5.24	-
Seats and interior accessories for automotive vehicles	0.5	0.79	+
Die-cast metal parts for automotive vehicles	0.83	1.99	+
Other parts for automotive vehicles	0.14	0.41	+

Source: Compiled by authors using information from Ingei (2004; 2009; 2014).

This shows progress made on the studies by Unger and Chico (2004), who found that in 1998 the Bajío was still at an initial stage, when Guanajuato was only important for assembly work.

Relational analysis

One way of analyzing relationships between suppliers (backward linkages) and buyers (forward linkages) existing in the automotive industry in Guanajuato is through the Input-Output Matrix (IOM) (Dávila, 2008), which provides information about the structure of production in the automotive sector, on locally sourced inputs, regional and international imports, remunerations, output taxes, etc. In order to analyze the relationships between the different actors in the AI, we have used the results of the IOM in Guanajuato in 2008.[3] In order to regionalize the matrix created by Dávila (2008), the location coefficient by Flegg et al. (1995) was used as it was the best-performing indirect method.

The original Input-Output Matrix, proposed by Leontief (1941), consists of dual-entry tables recording inter-sector sales and purchases taking place in an economy. It is a system of financial analysis and forecasting that is used to make a more detailed analysis of the automotive sector in terms of which ones have backward linkages (suppliers) and which ones have forward linkages (buyers). It is also possible to discover the sector's output structure in order to analyze intermediate consumption, the value added composition, regional, and international imports, among other variables. Below we analyze the relationships of companies with suppliers and buyers, the structure of gross output, as well as job multipliers, salaries and value added.

Relationship with suppliers

The automotive industry provides 54 percent of its total inputs itself. This finding is expected, since the automotive industry is structured so that the supply chain is located nearby the assembly plants and generally few inputs are sourced from other industries. The next provider of inputs, with 17.68, is the plastic and rubber industry (5.8 %), basic metal industries (3.1 %), road freight transport (3 %), business support services (2.5 %), metal product manufacturing (2.5 %), which together represent 88 percent of the sector's total inputs.

[3] The 2008 IOM is used since it is the most up to date source available, and the information for that year also helps us to understand the current structure of the automotive industry in Guanajuato.

By contrasting the contribution of the main inputs for Guanajuato's automotive industry in relation to the Central-Western Region (CWR) we find important differences that indicate the possibilities for Guanajuato to increase its contribution in certain segments. One case in point could be the basic metal industries, of which the CWR region uses 13.9 percent and Guanajuato just 3 percent, commercial activities that also represent 23 percent of the inputs for the CWR as a whole, while they represent 17.6 percent for Guanajuato (Table 5).

TABLE 5. Principal inputs for transport equipment output (%)
Guanajuato and the Central Western Region, 2008

Subsectors	*Guanajuato*	*Central-Western Region*
Transport equipment manufacturing	54.6	33.9
Commerce	17.6	23
Plastics and rubber industry	5.8	6.6
Basic metal industries	3.1	13.9
Road freight transport	3	3.2
Business support services	2.5	2.6
Metal product manufacturing	1.7	2.8
Tanning and finishing leather, leather goods manufacturing, leather and substitute materials	1.4	0.90
Electricity generation, transmission and distribution	1.1	1.60
Professional, scientific and technical services	0.60	1
Others	8.6	17.1
Total	*100*	*100*

Source: Compiled by authors using information from Dávila (2008).

Another approach to identify potential areas where import substitution policies might be developed would be through an analysis of the principal subsectors that supply inputs, in order to determine whether they import their products internationally or intra-regionally. For example, the transport equipment manufacturing subsector imports 70 percent of inputs from international markets, while 30 percent comes from regional markets. The commercial sector offers a contrasting

example, as it only imports 15 percent from international markets and 85 percent from intra-regional ones (Table 6).

TABLE 6. Imports of the main suppliers for the automotive sector in Guanajuato, 2008

Principal inputs	*Millions of Pesos*	*%*	*Total imports*	*Intra-regional imports*	*(%)*	*International imports*	*(%)*
Transport equipment manufacturing	4 733.9	54.6	45 652.18	13 611.58	30	32 040.60	70
Commerce	1 529.8	17.6	12 509.53	10 673.78	85	1 835.75	15
Other	795.5	9.2					
Plastics and rubber industry	498.6	5.8	7 243.14	3 226.79	45	4 016.35	55
Basic metal industries	272.4	3.1	2 798.23	1 465.11	52	1 333.12	48
Road freight transport	258.7	3	3 077.36	1 660.14	54	1 417.23	46
Business support services	214.6	2.5	1 298.65	1 101.39	85	197.26	15
Metal product manufacturing	149.2	1.7	3 487.04	1 746.74	50	1 740.30	50
Tanning and finishing leather, leather goods manufacturing, leather and substitute materials	122.2	1.4	16 174.88	11 424.22	71	4 750.66	29
Electricity generation, transmission and distribution	92.6	1.1	3 270.72	1 949.88	60	1 320.85	40

Source: Compiled by authors using information from Dávila (2008).

Relationship with buyers

The intermediate demand, meanwhile, corresponds to forward linkages, in other words to those subsectors with a demand for the economic activity of transport equipment manufacturing. In this sense, the subsector of transport equipment manufacturing has its own demand in the order of 80 percent. Other economic activities with a demand on the sector correspond to: commerce (4.7 %), road freight transport (5.1 %), passenger ground transportation, except for railways (3 %), other telecommunications (2.1 %), and other activities (5.3 %).

Gross production structure

Continuing with Guanajuato's Input-Output Matrix (GTO-IOM), in 2008, the gross value of the output of the transport equipment manufacturing subsector was 74 billion pesos. Of the total gross value, the uses originating in the state participate with 11.7 percent, imports from other regions account for 18.4 percent, international imports 43.3 percent, total remunerations 5.9 percent, gross operating surplus 20.5 percent, and output taxes, 0.2 percent.

The proportion of inputs originating from the state is much lower than that of inputs imported intra-regionally (18.4 %), opening up the possibility for promoting policies to support suppliers. There is also a low contribution of salaries (5.9 %), indicating that they are not decisive in locating new automotive plants, a finding corroborated by Unger and Chico (2004: 911): "salaries are not the determining factor for location, since they are usually higher there where they are located than elsewhere in the country."

Employment, salary, and value added multipliers

The GTO-IOM provides information on employment, salary, and value added multipliers. This is of prime importance for public policy makers, since multipliers help us to answer the question of what would happen to Guanajuato's economy as a whole resulting from the increase by one unit in employment, salary, and added value.

For the subsector of equipment and transport manufacturing, the employment multiplier is 1.42, below the CWR, which was 1.84. This indicates that for every new job created by the automotive industry in Guanajuato, 1.42 jobs would be created in the state's economy as a whole, while for the CWR in general, an increase of employment by the same magnitude would create an increase of 2 new jobs in the region. In terms of salaries, an increase of one peso in the sector in question would increase the salary of Guanajuato as a whole by 1.23 pesos, compared to

1.43 pesos for the CWR. In terms of added value, an increase of 1 peso would have a positive impact of 1.21 pesos on Guanajuato's group of sectors, while an increase of the same magnitude would create an increase of 1.43 in the value added of the CWR in general (Table 7).

TABLE 7. Employment, salary, and value added multipliers for the subsector of transport manufacturing equipment. Guanajuato and Central Western Region

Subsector Transport equipment manufacturing	*Multipliers*		
	Jobs	*Salary*	*Value added*
Guanajuato	1.42	1.23	1.21
Central Western Region	1.84	1.43	1.43

Source: Compiled by authors using information from Dávila (2008).

To answer the question about which subsectors would react to a change in added value, employment, and salary, we would need to begin by identifying the contribution of the total impact on each subsector. In this case, it is found that most of the impact would be concentrated in a few of the subsectors, with transport equipment manufacturing participating most in the total multiplying effect, in terms of added value (88.2 %), employment (75 %), and salary (87.1 %) (Table 8). However, to a lesser degree, other activities such as commerce, business support services, automotive freight transport, plastic and rubber industry, and leatherwork and goods also contribute to adding value, employment, and salary in the total multiplying effect.

TABLE 8. Employment, salary, and value added multipliers for the subsectors with the stronger multiplier effect

Subsector	*Value added multiplier*		*Employment multiplier*		*Salary multiplier*	
	Mult.	*Contribution (%)*	*Mult.*	*Contribution (%)*	*Mult.*	*Contribution (%)*
Transport equipment manufacturing	1.069	88.2	1.069	75.42	1.07	87.1
Commerce	0.069	5.7	0.192	13.53	0.06	4.6
Business support services	0.012	1	0.057	4.01	0.04	2.9
Road freight transport	0.010	0.8	0.016	1.10	0.01	1.1
Plastics and rubber industry	0.008	0.6	0.016	1.13	0.01	0.9
Leather goods, leather tanning, leather goods manufacturing, leather and substitute materials	0.003	0.2	0.013	0.89	0.01	0.4
Other activities	0.041	3.42	0.055	3.92	0.04	2.94
Total multiplier	*1.21*	*100*	*1.42*	*100*	*1.23*	*100*

Source: Compiled by authors using information from Dávila (2008).

CONCLUSIONS

The automotive industry in Guanajuato has raised high expectations for the state's economy as a whole. On the basis of the arguments presented in this article, this industry in the state is well positioned for the manufacture of automobiles and light trucks, and ranks fourth in Mexico, as well as being first in the manufacture of bodywork and trailers, parts for braking systems, transmission systems, seats, and accessories. This refers to a productive specialization in which Guanajuato must consolidate its position.

In terms of the impact that significant growth in the automotive industry could have, we can observe that the employment, salary, and value added multipliers are

all positive and above the unit that indicates this sector's relevance for the state of Guanajuato's economy. However, when reviewing how the multiplier effect is distributed across the various economic subsectors, we can see that these are concentrated in a small handful of economic activities. This has also been found in other research papers (Bracamonte and Contreras, 2008; Galicia-Bretón and Sánchez, 2011; Álvarez, 2002) that show evidence of a weak integration of local actors with supplier networks. However, the analysis of output composition indicates that an area of opportunity exists in order to increase the contribution of higher value added economic activities in the chain, such as professional services and segments of the leather goods and footwear subsector that show a slight integration with the automotive sector. Furthermore, research and development in science and technology do not show sensitivity toward a change in the growth of the automotive sector, proving that they do not have well developed links with this sector, possibly representing an area of opportunity to increase those links. This all points to the need to implement a series of strategies through industrial policies that help strengthen links between different actors in the value chain, knowledge transfer, the integration of local suppliers into the value chain, something that ultimately may lead to the consolidation of an automotive cluster, which today looks as though it has potential and would undoubtedly help build up endogenous innovation abilities.

Finally, future research would be needed to: *1)* define in more detail the level of cooperation between automotive industry actors in Guanajuato, and *2)* measure the medium-and long-term impacts that this will have on the region's automotive industry, in the sense of the proposal by Brenner and Gildner (2006).

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