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RESEARCH

Low and declining wages in the automotive industry in Mexico. An analysis by state and branch of activity, 2003-2018

Salarios bajos y a la baja en la industria automotriz en México. Un análisis por entidad federativa y ramas de actividad, 2003-2018

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Abstract

The performance of real wages in the manufacturing of transportation equipment and at the branch levels of activities 3361, 3362, and 3363, which make up the automotive industry, is analyzed, focusing primarily on 17 federal entities where it is located. Real wages were determined using the wages of production, sales, and service personnel, as well as the hours worked by these groups. The results for the 2003-2018 period indicate that, in most federal entities, wages in the automotive industry have stagnated or decreased. The manufacturing of bodies, trailers, and auto parts shows the greatest lag. This trend of low and declining wages depends on the location of the plants and the years they have been established in the country and is influenced by factors such as labor productivity and the labor market structure of the sector.

Key words: Real wages, automotive Industry, Mexico, branch of activity, fixed effects.

JEL Codes: C33, J3, L2, L62

Resumen

Se analiza el desempeño de los salarios reales de la fabricación de equipo de transporte y a nivel ramas de actividad 3361, 3362 y 3363 que conforman la industria automotriz, principalmente en 17 entidades federativas donde se localiza. Con los salarios al personal de producción, ventas y servicios, y las horas trabajadas por personal de producción, ventas y servicios se determinaron los salarios reales. Los resultados para el periodo 2003-2018 señalan que, en la mayoría de las entidades federativas, los salarios de la industria automotriz están estancados o han disminuido; la fabricación de carrocerías y remolques, y de autopartes, son las que presentan el mayor rezago. Esta tendencia de los salarios, bajos y a la baja, dependen de la localización de las plantas, de los años en que se han instalado en el país, y de factores como la productividad laboral y la estructura del mercado de trabajo del sector.

Palabras clave: salarios reales, industria automotriz, México, ramas de actividad, efectos fijos.

Códigos JEL: C33, J3, L2, L62

Introduction

The automotive industry has been a key pillar of the Mexican economy in recent decades. Mexico accounts for 3.9% of global vehicle production, ranking seventh worldwide and first in Latin America. In terms of exports, the country ranks fourth in the export of light vehicles and auto parts and is the leading supplier of auto parts to the United States (Organisation Internationale des Constructeurs d'Automobiles [OICA], 2024; AMIA,2024).

This industry contributes 3.6% to the national gross domestic product (GDP) and 18.0% to the manufacturing GDP. It employs more than 979,000 workers, representing 22.0% of total manufacturing employment, 102,538 of whom work in the terminal industry, while 876,697 are employed in the auto parts, bodywork, and trailer sectors. Additionally, the automotive industry is the country's primary source of foreign currency generation through foreign direct investment (FDI), attracting about 20.0% annually (AMIA, 2024). These figures highlight the significant role of the automotive industry in Mexico's economic activity. However, despite being considered a mature industry, it continues to face several challenges, one of the most notable being the persistent stagnation in wage growth for its workers.

The wage stagnation in Mexico's automotive industry has been analyzed from various perspectives and fields. On a global scale, and within the context of the NAFTA/USMCA region, studies by Linares (2018: 377) and Rodríguez and Sánchez (2017: 1) highlight a significant wage disparity between the countries that were part of NAFTA, as well as among 13 other countries. Their findings indicate that Mexico ranks last in this comparison, with an average of $8.1 per hour (Linares, 2018: 377). Similarly, Tapia and Chiatchoua (2020: 85) compare wages across different positions in the automotive industry and consistently find that Mexico offers the lowest wages among the examined countries.

Through interviews with automotive workers, the studies by Covarrubias (2019: 92) and García-Jiménez, Carrillo, and Bensusán (2021) provide significant insights. The latter includes an estimation of a living wage within the automotive industry across various manufacturing plants in Mexico. In addition, a review of collective labor agreements in final assembly and first-tier companies highlights the contributions of Covarrubias (2014: 26), Covarrubias and Bouzas (2016: 7), García (2023: 199), García-Jiménez, Carrillo, and Bensusán (2022), and Sánchez-González (2023: 220). Notably, García-Jiménez et al. (2022), apply the methodology of Anker and Anker (2017) to calculate the living wage for automotive companies located in different regions of Mexico and the wage gaps. Their findings indicate an increase in labor precarization between 2017 and 2019, due to a widening gap between the living wage and the wages paid in the analyzed companies. To mitigate this issue, they recommend that wage increases should be adjusted based on region, company, and seniority. They argue that wages should correspond to the cost of living in each metropolitan area where assembly companies are located. Furthermore, depending on the companies and their seniority, wage increases should be more significant in greenfield regions (San Luis Potosí, Hermosillo, and Aguascalientes) than in brownfield areas (Toluca and Puebla).

Sánchez-González (2023), using the Kruskal-Wallis and Dunn-Bonferroni tests, examines wage disparities among unionized workers in 20 automotive assembly companies in Mexico. His findings suggest that the establishment phase of a company, along with its geographical location, influences whether annual integrated wages are relatively high or low. He observes that wages tend to decline after the third stage of establishment. Additionally, he finds that wages are generally higher in the central and northern regions, while lower wages are observed in the western and central-northern regions. European companies had high wages, while those of Asian origin had low wages. Moreover, he identifies that companies with unions affiliated with the Federation of Trade Unions of Goods and Services Companies (Fesebs) pay better wages, while those affiliated with the National Federation of Independent Unions (FNSI) pay lower wages.

One of the key contributions to this study is the level of disaggregation by industry and federal entity, as well as the analysis based on a panel data model which aims to analyze the wage growth in the subsector of transportation equipment manufacturing, the branches of vehicle and truck manufacturing, bodywork and trailers, and auto parts manufacturing, at the national level and across the 17 federal entities where the automotive industry is primarily located. Additionally, it compares wages in the Mexican automotive sector with those in the United States and estimates a wage function with fixed effects. The variables used for the wage calculation are the total wages for production, sales, and service personnel along with the total hours

worked by production, sales, and service personnel, using census data from 2003, 2008, 2013, and 2018.

The paper is structured into four sections, in addition to the introduction and conclusions. The first section provides a literature review on the topic. The second outlines the methodology and variables used in the analysis. The third presents the main findings of the exploratory analysis, followed by an estimation of a real wage function using a fixed-effects panel data model.

1. Literature Review

Empirical evidence confirms the relationship between productivity and wages (Bino, 2014: 98; González et al., 2022: 29; Galtés, 20215: 108; Katovich and Maia, 2018: 7; Klein, 2012: 20; Korkmaz, 2021: 42; López-Villavicencio and Silva, 2011: 216; Medina, 2018: 78-80). However, research also highlights the weak or nonexistent wage increases despite productivity gains, as well as other factors influencing wage determination. These include public policies aimed at wage containment to control inflation (González et al., 2022: 29; Katovich and Maia, 2018: 7; Klein, 2012: 20; López-Villavicencio and Silva, 2011: 216), inefficient incentive systems (Galtés, 20215: 108), outdated labor legislation, and the absence of human capital training plans within companies (Bino, 2014: 98). Additionally, the inability of industrial sector companies to repay bank loans (Korkmaz, 2021: 42), weak worker bargaining power (Biesebroeck, 2011: 1342-1343; Biesebroeck, 2015: 30-31), and protection contracts that favor employers over workers (Covarrubias, 2019; García-Jiménez, Carrillo and Bensusán, 2021: 12-13; Linares, 2018: 378; Rubio, 2017: 56) further contribute to wage stagnation.

Moreover, low wages have been documented as a key determinant of company location, including within the automotive sector. For instance, Audi and Mercedes Benz established operations in Hungary in 1993 and 2012, respectively, with different wage levels corresponding to their locations in brownfield and greenfield areas (Arendas, 2016: 5). Similarly, some U.S. companies located in China have begun relocating back to the United States due to rising wages (Dolega, 2012: 10). Other companies actively seek regions with inexpensive, labor-intensive workforces for relocation (Bailey and De Propris, 2014: 392; Sánchez-González, 2023); while some aim to weaken trade unions to secure cheaper labor without involvement (Arendas, 2016: 20). In Central and Eastern Europe, deregulated labor market environments have been conducive to achieving quality standards and skilled labor with low wages and precarious employment (Jürgens and Krzywdzinski, 2009: 486).

Mexico has been no exception in this regard; the country remains highly attractive for the establishment of automobile manufacturing plants, largely due to its low production cost associated with comparatively lower wages than those in the United States and Canada, both members of the USMCA. By the end of 2023, hourly wages were approximately $21 in Canada, $28 in the United States, and $4.80 in Mexico[4] (U.S. Bureau of Labor Statistics, 2024; Statistique Canada, 2024; INEGI, 2024).

Empirical evidence not only confirms that wages are significantly lower than in other USMCA countries but also indicates a persistent wage growth lag. Swiecki and Menk (2016: 46) demonstrate that one of the primary advantages of investing in Mexico over the United States is lower labor costs, which declined by 5.0% between 2008 and 2013, compared to a 10.0% increase in the United States during the same period. Additionally, total wages and benefits in Mexico were 25.0% lower than those estimated in the United States, generating cost savings of $600-$700 per vehicle (Covarrubias and Bouzas, 2016; Swiecki and Menk, 2016: 47).

Despite the industry's productivity and employment expansion, wages for automotive workers in Mexico have continued to decline. In 1994, a U.S. worker in the terminal industry earned $35.91 per hour, a Canadian worker earned $34.09, while a Mexican worker earned just $6.65. By 2016, this wage gap persisted, with Mexican automotive workers earning only $3.14 per hour, compared to $28.60 in the United States and $26.34 in Canada (Rodríguez and Sánchez, 2017: 3). In 2015, Mexican automotive wages were the lowest among the following countries: Norway, paid 8.5 times Mexico's wage, Germany 7.8 times, France 6.5 times, the United Kingdom 5.1 times, Spain 4.7 times, Japan 3.9 times, Argentina 2.3 times, Brazil 2.1 times, China 1.3 times, and Taiwan 1.2 times (Linares, 2018: 337).

4 This salary from the Mexican Automotive Industry was recovered from the Economic Information Bank of INEGI (2024).

Although Mexico's automotive industry has significantly contributed to GDP and manufacturing employment, wage growth has not kept pace. Tapia and Chiatchoua (2020: 94-95) show that from 2007 to 2017, wages in vehicle and truck manufacturing increased from 19,175 to 23,842 pesos per month. However, these figures represent total personnel compensation, including managerial salaries, which does not align with the broader literature on wage stagnation. The authors further argue that wage increases during this period merely compensated for inflation, resulting in no real improvements. They also compare salaries for specific positions in the automotive industry across Germany, Brazil, Canada, China, the United States, Japan, the United Kingdom, and Mexico in 2020. In this comparison, Mexico ranked last: a Mexican automotive electrician earned a monthly salary of 710.28 dollars, while their Chinese and Brazilian counterparts earned 2,100.90 and 1,533.42, respectively. Similarly, a Mexican automotive mechanic earned 753.32 dollars per month, significantly less than their Brazilian counterpart, who earned $1,530.51, the second-lowest wage among the countries studied.

A review of the collective bargaining agreements for BMW in San Luis Potosí from 2014, 2016, 2018, and 2020 revealed a gradual increase in wages over time. In 2014, a worker in the lowest category earned 135 pesos per day (equivalent to 7.50 per day, based on an exchange rate of 18.10 pesos per dollar as of July 5, 2024). Given that the company had just begun operations in preparations for mass production, it is likely that all workers received this base wage. By 2016, this amount had increased to 142 pesos (7.8 dollars), and in 2018, when mass production began, it rose to 205 pesos (11.3 dollars). By 2020, the daily wage had reached 292 pesos (16.1 dollars/day) (Secretariat of Labor and Social Welfare [STPS], 2020). Although wages at BMW more than doubled over six years, they remained below the average for the Mexican automotive industry in 2020.

Studies by Covarrubias (2019: 99) and Covarrubias and Bouzas (2016: 8), which analyzed the collective bargaining agreements of 18 companies, indicate that in 2016, a Mexican automotive worker earned an average of 2.30 per hour, while their U.S. counterpart earned 26.5 dollars. When comparing these wages to those paid by BMW in San Luis Potosí in 2018, it becomes evident that a Mexican worker earned in an entire day less than a U.S. worker earned in a single hour. These findings provide strong evidence of the wage advantages that make Mexico attractive for the automotive industry, which has driven the sector's expansion at the expense of workers' well-being.

Wages and rules of origin have been central topics in both NAFTA and its renegotiation under the USMCA. The latter includes a chapter aimed at improving labor security by reducing the wage gap within the industry across the three countries. In this context, Gómez Tovar and Ruiz Nápoles (2021) argue that the USMCA's wage provisions benefit Mexico, as they shift the focus from merely exploiting cheap labor to achieving wage parity within the industry.

However, Covarrubias (2021) contends that the new trade agreement sought to curb job losses and prevent capital flight due to Mexico's low wages by introducing monitoring mechanisms unprecedented in U.S trade agreements. The expectation was that these measures would lead to higher net profits in the U.S. automotive industry. Nonetheless, he points out that the labor provisions alone are insufficient to alter industrial location trends, given the significant wage gap that still exists between Mexico and the United States-Canada.

On another note, González Andrade (2024) highlights nearshoring as a strategic opportunity for Mexico's automotive sector. However, he emphasizes that for Mexico to fully capitalize on this trend, the government must implement a comprehensive strategy that includes investments in productive infrastructure — such as roads, ports, airports, and railways — along with trade facilitation measures, including customs modernization and logistics centers. Additionally, ensuring the availability of critical resources like water and electricity will be essential.

García Moreno et al. (2023) cautions that wage prospects in the sector remain uncertain, as the highest wages are concentrated in activities that generate the most added value. Therefore, an industrial policy is needed to prioritize research, development, and design activities, while also promoting a gradual recovery of wages.

2. Methodology

To analyze wage performance in the automotive industry, real average hourly wage indices for workers and production technicians from the 21

subsectors of national manufacturing, as published by INEGI, were first examined. A simple average was calculated for the 12 months of the years 2008, 2013, and 2018, both for the indices and growth rates. For the analysis of the wage trends in transportation equipment[5] manufacturing subsector, specifically in motor vehicle and truck manufacturing (3361), body and trailer manufacturing (3362), and parts manufacturing for motor vehicles (3363) — which together constitute the automotive industry — wages for production, sales, and service personnel were considered. These wages were deflated using the corresponding GDP[6] deflator for the census years 2003, 2008, 2013, and 2018 to obtain real wages based on 2018 values. The wages were then divided by the total hours worked by production, sales, and service personnel to calculate wages in pesos per hour worked.

Seventeen federal entities with the highest concentration of automotive industry activity were included in the study: Aguascalientes, Baja California, Chihuahua, Coahuila, Estado de México, Guanajuato, Hidalgo, Jalisco, Morelos, Nuevo León, Puebla, Querétaro, San Luis Potosí, Sonora, Tamaulipas, Tlaxcala, and Veracruz.

The average growth rates presented in the body of the document correspond to 2018 in relation to 2003, with wages provided for the four census years. In the analysis of body and trailer manufacturing, Morelos and Sonora were excluded due to a lack of data on the variables necessary to calculate wages in pesos per hour. For parts manufacturing, data for Hidalgo was unavailable for 2013, and Morelos lacked data for 2008; however, they were included in the study, as their growth rate remained unaffected. Since INEGI does not publish wage data at the federal entity level for vehicle and truck manufacturing, the analysis for this branch was conducted through a review of collective labor contracts. The most recent contracts, signed in 2020 and published by STPS (2020), were examined. To compare the branches with those in the U.S. automotive industry, an exchange rate of 18.09 pesos per dollar, based on the rate from July 5, 2024, was used (Official Gazette [DOF], 2024).

Finally, a wage function (expressed in pesos per hour) for the Transportation Equipment Manufacturing subsector was estimated using panel data with fixed effects to serve as an indicator of wage behavior in the automotive sector. The detailed specification of this model is presented in Section 4.

3. Wages in Manufacturing and Transportation equipment manufacturing

Within Mexico's manufacturing sector, the automotive industry is one of the most significant due to its substantial contribution to manufacturing output, its generation of gross census value-added, the significant amounts of foreign direct investment it attracts annually, and the direct and indirect jobs it generates. However, despite its economic importance, wages in the sector remain significantly lower compared to other manufacturing subsectors that have a smaller impact on these key indicators.

Nationally, the highest-paying manufacturing subsector is petroleum and coal products, with a total of 189 pesos or 10.4 dollars per hour. In contrast, the transportation equipment manufacturing subsector ranks sixth, with an average of 54 pesos (3.0 dollars) per hour. Despite this, in four states—Hidalgo, Guanajuato, Tamaulipas, and Nuevo León—the automotive industry offers the highest wages within the manufacturing sector, ranging from 46 to 59 pesos per hour (2.5 to 3.3 dollars per hour) (see Table 1).

The states with the highest hourly wages in the automotive industry are Morelos, at 126 pesos (7.0 dollars); Puebla, at 95 pesos (5.2 dollars); Aguascalientes, at 82 pesos (4.5 dollars); and Estado de Mexico, where wages average 69 pesos (3.8 dollars) per hour (see Table 1).

Entities such as Coahuila, Sonora, San Luis Potosí, and Chihuahua stand out for the significant role the automotive industry plays within their economic activity. However, the wages it offers are lower than those in other subsectors. For instance, in Coahuila, transportation equipment manufacturing ranks eighth in terms of wages, paying workers 48 pesos or 2.7 dollars per hour, while basic metal industries, which rank first, pay 88 pesos or 4.9 dollars per hour. In Sonora, the

5 In addition to the mentioned sectors, the manufacturing of transportation equipment also includes the production of maritime, aerospace, and railway equipment, according to the SCIAN classification.

6 Recovered from the World Bank's World Development Indicators (2024).

automotive industry pays 46 pesos or 2.6 dollars per hour, whereas the plastics and rubber industry pay 65 pesos or 3.6 dollars per hour.

The case of Guanajuato and Jalisco is noteworthy as both have recently experienced significant growth in the automotive industry. However, these states also have some of the lowest wages in the automotive sector nationwide (see Table 1).

Additionally, the indices of real average wages per hour worked by production workers and technicians in the national manufacturing subsectors for 2008, 2013, and 2018 show that, despite the global financial crisis of 2008-2009, real wages grew in two-thirds of the subsectors, including transportation equipment manufacturing, which saw a 2.6% increase in 2008. By 2013, wages increased in 10 subsectors and decreased in 11, with transportation equipment manufacturing experiencing a significant decline, showing a negative growth rate of -21.3%. By 2018, however, this subsector rebounded with a 3.7% growth (see Figure 1).

3.1. Wages in Transportation Equipment Manufacturing, 2003-2018

The real wages per hour worked in this subsector across the 17 federal entities where the automotive industry is mainly located are generally lower than the national averages (see Figure 2). For instance, in Morelos, wages were 151 pesos per hour in 2003 and rose to 168 pesos by 2018, marking the highest wage during the entire study period with an increase of 11.7%. In Puebla, wages declined by almost -9.0%; however, it still had the second-highest wage in 2018. Other states where wages increased from 2003 to 2018 include Coahuila (18.8%), Guanajuato (11.9%), Hidalgo (5.7%), Nuevo León (20.4%), San Luis Potosí (22.3%), Sonora (31.5%), Tamaulipas

Table 1. Real Average Wages of the National Manufacturing Subsectors and by Federal Entity, 2003, 2008, 2013, and 2018.

STATE	First Place	Salary		Location and Transportation Equipment	Salary	
		Pesos/ hr	Dollars/hr		Pesos/hr	Dollars/hr
Hidalgo	Petroleum and coal products	189	10.4	4	59	3.3
Guanajuato	Petroleum and coal products	179	9.9	4	47	2.6
Tamaulipas	Petroleum and coal products	178	9.8	8	46	2.5
National	Petroleum and coal products	160	8.8	6	54	3.0
Nuevo León	Petroleum and coal products	152	8.4	7	52	2.9
Veracruz	Chemical industry	151	8.3	4	53	2.9
CDMX	Petroleum and coal products	148	8.2	5	52	2.9
Morelos	**Transportation equipment**	**126**	**7.0**	**1**	**-**	**-**
Baja California	Petroleum and coal products	104	5.7	2	61	3.4
Puebla	**Transportation equipment**	**95**	**5.2**	**1**	**-**	**-**
Querétaro	Petroleum and coal products	91	5.0	3	60	3.3
Coahuila	Basic metals	88	4.9	8	48	2.7
Chihuahua	Chemical industry	84	4.6	5	52	2.9
Aguascalientes	**Transportation equipment**	**82**	**4.5**	**1**	**-**	**-**
Jalisco	Petroleum and coal products	76	4.2	7	47	2.6
Edomex	**Transportation equipment**	**69**	**3.8**	**1**	**-**	**-**
Sonora	Plastics and rubber	65	3.6	8	46	2.5
San Luis Potosí	Machinery and equipment	61	3.4	6	44	2.4

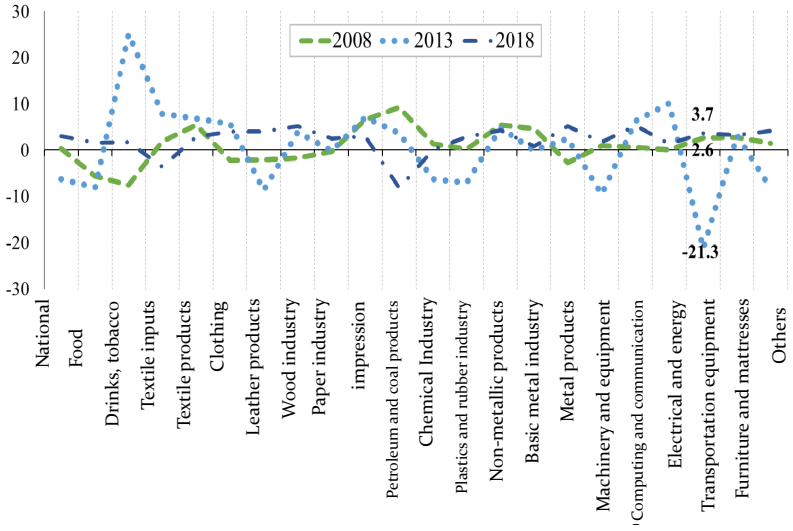
Note: The exchange rate as of July 5, 2024, was 18.09 pesos per dollar.

Source: Information from the Economic Censuses of INEGI (2024).

(4.0%), Tlaxcala (9.2%), and Veracruz (97.5%). On the other hand, states where wages decreased from 2003 to 2018 include Aguascalientes (-11.5%), Baja California (-4.4%), Chihuahua (-12.7%), Estado de Mexico (-16.6%), Jalisco (-18.5%), and Querétaro (-2.1%). Nationally, the transportation equipment subsector saw a decrease in wages from 54 to 52 pesos per hour worked, representing a -2.7% decline from 2003 to 2018.

In the study by García-Jiménez, Carrillo, and Bensusán (2021: 230), Aguascalientes is classified as having high wage precariousness. However, this does not align with the findings of this article, as Aguascalientes paid the highest real wages during the study period. The study agrees with the assertion that Puebla exhibits no wage precariousness, as it ranks second in terms of wages during the study period, surpassing even Estado de Mexico, which

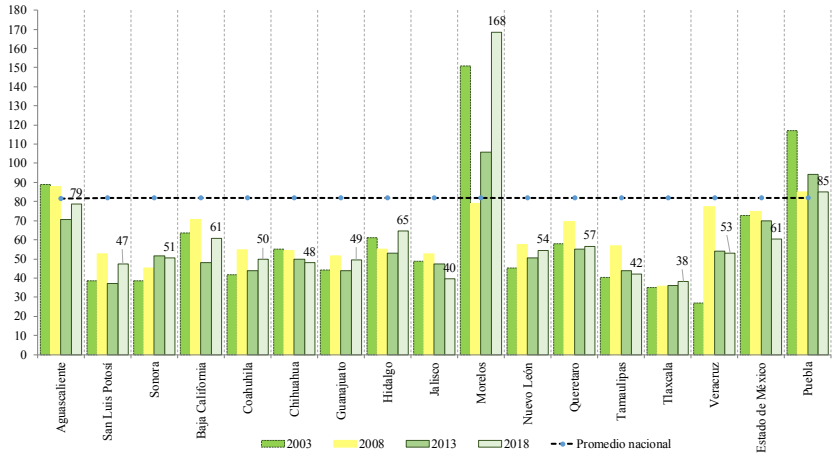
Figure 1. Mexico: Index of Real Average Wages per hour worked by Production Workers and Technicians by National Manufacturing Subsector, 2008, 2013, and 2018 (2018 base).



Source: Elaborated with information from the Economic Census of INEGI (2024).

also classified as having no wage precariousness. For San Luis Potosí, the result mirrors that presented by the authors, as it is one of the entities with the highest wage precariousness among the 17 studied. According to the study by Sánchez-González (2023: 228-229), companies that were established between 1962 and 1978 and located in the central part of the country (Estado de Mexico, Puebla, Morelos, and Hidalgo) have, on average, the highest wages. This observation aligns with the current study, which shows that Morelos (with an average of 126 pesos per hour) pays the highest wages, followed by Puebla (95 pesos), Aguascalientes (82 pesos), Estado de Mexico (69 pesos per hour), and Hidalgo (59 pesos). The central-northern region, which includes San Luis Potosí and Guanajuato, is found to have the lowest wages, with averages of 44 and 47 pesos per hour from 2003 to 2018, respectively. These wage differences are tied to the first companies established in states with institutional rigidities, known as brownfields (central region), compared to Greenfields in northern states (Chihuahua, Sonora, Coahuila, Baja California, and Nuevo León)

Figure 2. México: Real wages per hour in Transportation Equipment Manufacturing in the Federal Entities where the Automotive Industry is located, 2003, 2008, 2013, and 2018 (Pesos per hour, 2018 base).



Source: Elaborated with information from the Economic Census of INEGI (2024).

and western-central regions (Covarrubias, 2014: 28). Due to this flexibility, wages were lower in the Greenfields, resulting in automotive plants moving to these areas in the northern zone (Arteaga, 2003; Covarrubias, 2000: 53). However, Covarrubias (2014: 27) points out that while companies with better wages tend to be located in brownfields, this is not always the case. For example, General Motors Mexico has significant wage differences across its locations: in San Luis Potosí, the lowest salary category is 164.61 pesos per day; in Ramos Arizpe, Coahuila, it is 226.82, and in Toluca, it reaches 294.51 pesos per day. Stellantis also shows consistent low wages in Coahuila and Estado de Mexico, where the lowest category wages are 309 and 308.30 pesos per day, respectively (according to the collective labor agreements published in 2020) (STPS, 2020).

3.2. Real wages in the automotive industry sectors, 2003-2018

The most significant sector within the automotive industry is the manufacturing of parts for motor vehicles. This sector generates 51.2% of the gross census value added (GCVA) in the industry, employs 88.5% of the total workforce, and accounts for 79.6% of the wages and 74.8% of the salaries to administrative personnel. The manufacturing of automobiles and trucks follows, contributing 47.0% to GCVA but employing only 8.9% of the workforce and paying 18.2% of wages and 22.2% of salaries. Finally, the manufacturing of bodies and trailers accounts for 1.8% of the GCVA generation, 2.7% of the workforce, and 2.2% of wages and 3.1% of salaries (INEGI, 2018).

When examining wage trends in the automotive industry sectors, it is observed that only six states experienced wage increased in the manufacturing of parts for motor vehicles from 2003 to 2018. For example, Coahuila and Guanajuato increased wages from 36 to 46 pesos per hour, equivalent to 30.4%; Nuevo León 9.9%, San Luis Potosí 16.4%, Sonora 30.6%, and Tamaulipas 4.8%. In contrast, the following 10 states experienced wage decreases, Aguascalientes -36.7%, Baja California -18.1%, Chihuahua -11.6%, Jalisco -15.1%, Estado de Mexico -19.6%, Puebla -20.0%, and Veracruz -19.6%. Nationally, wages for auto parts manufacturing decreased by -4.0%, from 48 to 46 pesos per hour worked. It is noteworthy that there is no available data for Hidalgo and Morelos for the years 2018 and 2013, respectively (see Figure 3).

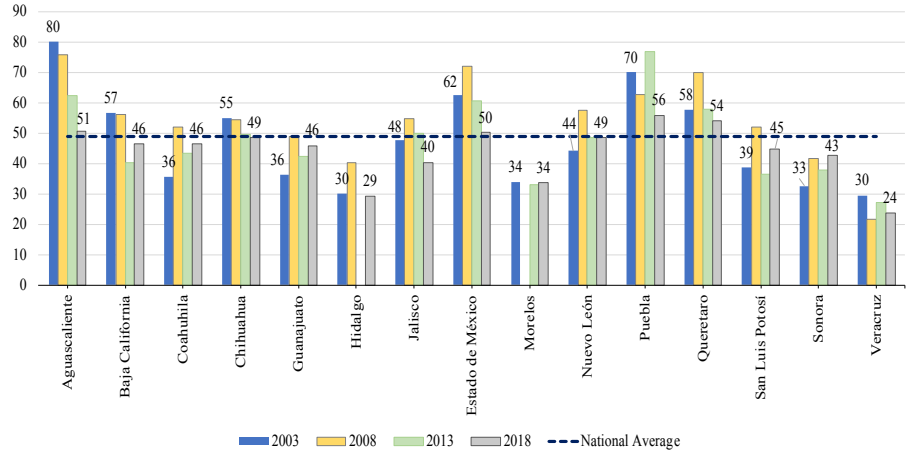
The manufacturing of auto parts has recently become a more significant activity, only in traditionally strong states such as Coahuila, Nuevo León, Chihuahua, and Tamaulipas but also in states that have recently entered the automotive production sector. For instance, Yucatán saw a 117% increase in auto parts production in January 2024 compared to January 2023. Zacatecas and Durango also witnessed growth rates of 31.5% and 18.8%, respectively, during the same period (González, 2024).

Among auto parts, the production of wiring harnesses and seat parts stands out, accounting for 32.0% of total automotive exports to the United States. According to Crossa (2024:74), these activities exhibit low levels of automation and contribute the lowest added value—1.0% of the car's value in the case of wiring harnesses. This could partially explain why the observed low wages in this sector are linked to low productivity. The limited production technology and the capital- and labor-intensive nature of these activities might be contributing factors to this wage discrepancy.

Unlike the auto parts sector, the wage performance in the vehicle and truck manufacturing sector is harder to analyze due to the lack of data from INEGI for the federal entities of interest. However, by reviewing collective labor contracts from some assembly companies, the daily base salary for the lowest and highest categories (new hires or workers with less than one year of seniority, and long-term employees) was identified (see Table 2). General Motors, located in San Luis Potosí, pays the lowest salary to new hires or employees with less than one year of seniority. The company's wages are influenced by the age of its plants—older plants tend to pay higher wages, while newer plants pay less. Similar trends are observed with Ford, Nissan, and Toyota. Unlike other companies, Stellantis (formerly Chrysler) pays a consistent wage, regardless of the location or establishment year. In contrast, Nissan in Morelos offers the highest salary in this category, surpassing other companies.

Ford, located in Hermosillo, Sonora, pays the lowest wage in the highest category, with two groups. The first one has six categories, and the highest wage within this group is 383.31 pesos per day. A worker progresses to the next group after six years, with annual promotions. In contrast, workers

Figure 3. Real Wages per hour in Auto Parts Manufacturing in the Federal Entities where the Automotive Industry is located, 2003, 2008, 2013, and 2018 (Pesos per hour, 2018 base).



Source: Elaborated with information from the Economic Census of INEGI (2024).

in the second group, at the highest category, earn 754.20 pesos per day. In contrast, Stellantis offers the highest wages, with 1,467.90 pesos per day in Coahuila and 1,411.40 pesos per day in Toluca. The difference between the highest and lowest salary in this category is 1,084 pesos, or nearly 60 dollars per day (see Table 2)

These salaries were also converted into dollars, and it can be observed that no company reaches the 144 dollars per day required by the USMCA for products to be considered regional or from the country. This means that a Mexican automotive worker earns in one day what a U.S. worker makes in less than an hour. There are even companies that set salary increases up to three years in advance, such as Audi Puebla, which in 2019 set the salaries for 2020, 2021, and 2022 with an annual increase of 5.4%.

In the case of body and trailer manufacturing, it is observed that real wages increased in 10 states from 2003 to 2018 (see Graph 4). In Aguascalientes, wages rose from 28 to 31 pesos per hour, equivalent to 12.0%; in Baja California, 21.3%; in Hidalgo, 38.4%; in Jalisco, 13.5%; in Nuevo León, 11.3%; in Puebla, 22.1%; in Tlaxcala, 12.0%; and in Veracruz,

Table 2. México. Base Salary of Assembly Companies Located in the Federal Entities of Interest, 2020-2021

Plant	State	Year of starting operations	Lowest category salary (daily)		Highest category salary (daily)	
			Pesos	dollars	PesosD	ollars
Audi	Puebla	2017	279.01	5.48	70.0	48.1
VolkswgenP	uebla1	9643	15.1	17.4	1,024.85	6.6
BMWS	an Luis Potosí	2019	292.01	6.15	70.0	31.5
Ford	Sonora	1986	197.91	0.93	83.3	21.2
	Sonora	1986	282.81	5.67	54.2	41.7
	Edomex	1964	319.41	7.77	13.9	39.5
General Motors	Coahuila	1981	226.81	2.55	73.6	31.7
	San Luis Potosí2	0081	64.6	9.16	62.7	36.6
HondaG	uanajuato2	0142	09.9	11.6	517.82	8.6
Mazda	Guanajuato	2014	207.61	1.54	28.6	23.7
Nissan	Aguascalientes A11	9922	16.9	12.0	639.83	5.4
	Aguascalientes A22	0131	89.2	10.5	566.43	1.3
	Morelos	1966	400.42	2.18	01.4	44.3
Stellantis	Coahuila	1995	309.01	7.11	,467.9	81.1
	Edomex	1964	308.31	7.01	,411.4	78.0
Toyota	Baja California2	0043	20.0	17.7	844.04	6.7
	Guanajuato	2019	261.51	4.55	22.8	28.9

Note: The exchange rate as of July 5, 2024, was 18.09 pesos per dollar.

Source: Elaborated with information from the Economic Censuses of INEGI (2024).

4.6%. On the other hand, the entities that showed negative growth rates were Coahuila (-51.4%), Chihuahua (-10.7%), Guanajuato (-8.4%), San Luis Potosí (-44.8%), and Tamaulipas (-18.5%). For this branch, the entities of Morelos and Sonora were not considered in the analysis due to the lack of information from INEGI. Nationally this branch increased from 44 to 48 pesos per hour, equivalent to a 9.7% increase from 2003 to 2018.

In general, from 2003 to 2018, wages in the automotive industry through its vehicle and truck manufacturing sector increased by 1.9 pesos, body and trailer manufacturing increased by 4.2 pesos, and parts manufacturing experienced a real decrease of 1.9 pesos. Therefore, it can be argued that wages in Mexico's automotive industry have stagnated for at least 15 years.

Furthermore, the wages paid in Mexico's automotive industry are considerably lower compared to those in the United States (when converted to U.S. dollars). For instance, in 2018, the wage in vehicle and truck manufacturing in the United States was 4.7 times higher than in Mexico; while the U.S. paid 29.8 dollars per hour, Mexico paid only 6.4 dollars. In body and trailer manufacturing, the wage difference between the two countries was even greater, with wages in the U.S. being 7.5 times higher than in Mexico. In parts manufacturing, the difference was 8.2 times greater, as the U.S. paid 20.9 dollars per hour, while Mexico paid just 2.6 dollars (see Figure 5).

It is also important to note that real wages have stagnated the analyzed period in both Mexico and the United States, as wage increases have been practically negligible in both countries. In fact, wages in parts manufacturing even saw a decline. In 2003, 2.7 dollars were paid per hour, and in 2018, this figure dropped to 2.6 dollars (see Figure 6).

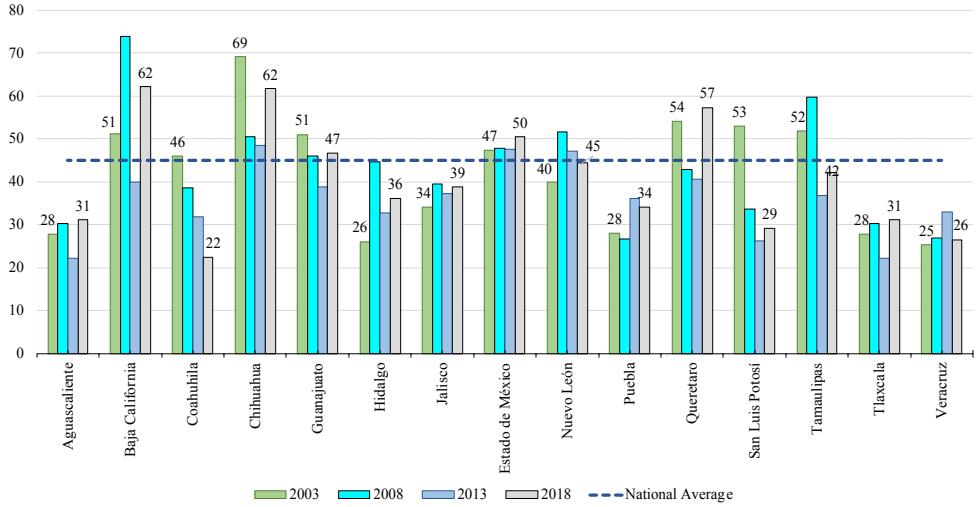
This behavior of low wages with a downward trend can be observed at this level of disaggregation of the national automotive industry and within the federal entities. The results presented in this study align with the statement made by Covarrubias (2019), who notes that "wages are low and declining" (2019: 91). Alternatively, "wages have been stagnant and, in some cases, have decreased... wages are not only not increasing, but are actually decreasing." (Carrillo y García-Jiménez, 2018: 1).

4. Wages in the Automotive Sector: Mexican Empirical Evidence

The discussion regarding the conditions prevailing in wages within the automotive sector, which, as discussed in the previous section, shows a downward trend, necessitates the search for empirical evidence that can contribute to the explanation of this process. In this regard, a wage function is estimated– measured by the wages (pesos per hour) in the transportation equipment manufacturing subsector as an indicator of wage behavior in the automotive sector – as follows:

$$LSALFETR_{i,t} = \beta_0 + \beta_1 PRODFET_{i,t} + \beta_2 ISUB_{i,t} + \beta_3 CH1P_{i,t} + \varepsilon_{i,t}$$

Figure 4. México: Real Wages per hour for Body and Trailer Manufacturing in the Federal Entities where the Automotive Industry is located, 2003, 2008, 2013, and 2018 (pesos per hour, 2018 base).



Source: Elaborated with information from the Economic Census of INEGI (2024).

Where LSALFETR is the logarithm of wages in the transportation equipment manufacturing subsector, PRODFET is the labor productivity of the transportation equipment manufacturing subsector, ISUB is a subcontracting index that relates the number of hours worked by workers supplied by another legal entity to the total number of worker hours in the same subsector (see Murillo, Carbajal, and De Jesús, 2021), and CH1P is the percentage of the population with technical and high school education that seeks to approximate a human capital variable in terms of the available workforce for the automotive sector. For i = 1, …, 16 federal entities in Mexico where the automotive sector is located; t = 2003, 2008, 2013, 2018, data from the economic censuses (INEGI, 2003, 2008, 2013, and 2018).

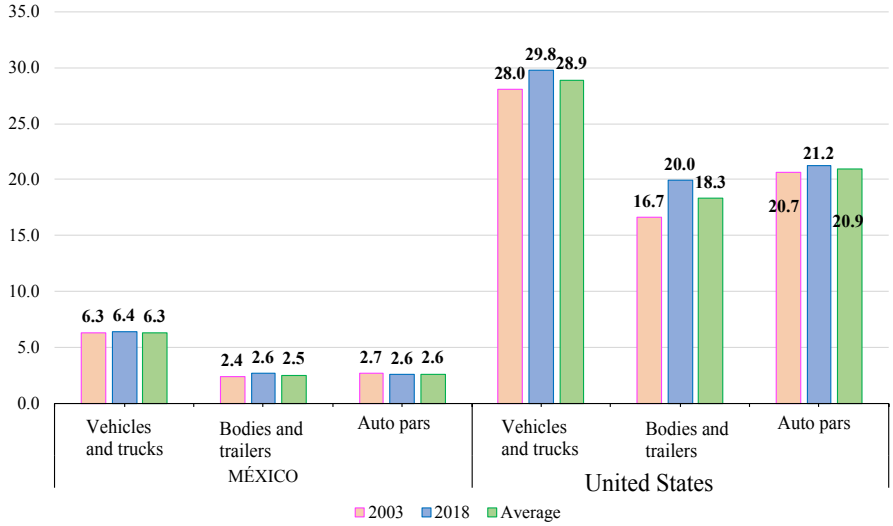
This approach to identifying the factors central to explaining wages in the automotive sector is based on important theoretical arguments and empirical evidence. Among the theoretical literature related to wage determinants, those considering productivity as a central factor are identified, particularly the neo-Keynesian efficiency wage hypothesis (see Akerlof and Yellen, 1990; Mankiw and Romer, 1991). As explained by López and Mendoza (2017: 188), the efficiency wage "can be understood as a wage higher than the average market wage, through which costs derived from the hiring process are minimized and greater productivity for workers is promoted." This argument helps explain the positive relationship between productivity and wages.

In the case of the automotive sector, under the efficiency wage hypothesis, it is assumed that labor productivity will have a positive effect on wages because it is a highly dynamic, innovative sector with relatively high productivity compared to other sectors, being considered a central variable. Furthermore, recent empirical evidence has documented a positive relationship between productivity and wages (see González et al., 2022; Katovich and Maia, 2018; Korkmaz, 2021; Medina, 2018), particularly for the automotive sector (Covarrubias, 2019; García-Jiménez, Carrillo, and Bensusán, 2021; Rodríguez and Sánchez, 2017).

ISUB (subcontracting index) is a variable that attempts to consider the importance of the prevailing labor conditions in the sector, in terms of labor flexibility and outsourcing, elements that have gained importance in recent years. A negative relationship is assumed because it has been considered that the formalization of outsourcing, rather than encouraging productivity and wages, has led to their precarization (see Andrés-Rosales et al., 2023, and Murillo et al., 2021). Furthermore, some experts claim that with the 2012 labor reform, Mexico aimed to reduce labor informality (Loría and Salas, 2019); however, with labor flexibility and outsourcing, many benefits that were the result of union achievements have gradually been eliminated (Andrés-Rosales et al., 2023).

Murillo et al. (2021) state that the fragmentation of the production processes of large companies and the increasing relevance of global value chains have primarily aimed at seeking low labor costs. This is why

Figure 5. Real Hourly Wages in the Automotive Industry in Mexico and the United States, 2003 and 2018, and Average (Dollars per Hour, 2018 base)



Note: At the exchange rate of July 5, 2024, 18.09 pesos.

Source: Elaborated with information from the INEGI Economic Censuses (2024) and the U.S. Bureau of Labor Statistics (2024).

the way in which work is organized—associated with processes that favor labor flexibility and reduce union participation—must be considered a factor in explaining the evolution of wages. In this regard, the inclusion of ISUB as a variable for labor flexibility is justified. Finally, CH1P, as a human capital variable, seeks to test the hypothesis that the availability of relatively skilled labor may be a factor contributing to higher wages.

Panel data were used due to the availability of statistical information on the automotive sector at the federal entity level and, as suggested by Mayorga and Muñoz (2000), the technique allows for combining the temporal dimension, in the sense of incorporating information over a period of time, and the cross-sectional cut, which represents the analysis of available information for the federal entities. The estimation was performed using R version 3.0.1 from a fixed-effects panel data model with the purpose of identifying the presence of specific factors that prevail in the federal entities in the determination of wages in the automotive sector. The panel data was assembled as a short panel with information from the Economic Censuses of 2003, 2008, 2013, and 2018 for 16 federal entities in Mexico where the automotive industry is significantly present. These entities are: Aguascalientes, Baja California, Coahuila, Chihuahua, Guanajuato, Hidalgo, Jalisco, México, Morelos, Nuevo León, Puebla, Querétaro, San Luis Potosí, Sonora, Tamaulipas, and Tlaxcala.

The results of the estimation are presented in Table 3. A positive impact of labor productivity (PRODFET) on wages in the transportation equipment manufacturing subsector is confirmed (coefficient of 0.145). This indicates that labor efficiency in the sector, in terms of its productivity, is a determining factor for wage levels. The relatively small magnitude of the coefficient suggests that as sector productivity increases, the impact on wage growth will be positive.

Regarding ISUB and CH1P, the results presented in Table 3 indicate negative and statistically significant coefficients (-0.812 and -0.069). These results show that flexibility in hiring, measured by the subcontracting index, has been a factor negatively affecting wage growth in the sector. This can be explained by the arguments of Loría and Salas (2019), who state that Mexico's 2012 labor reform aimed to reduce labor informality by promoting more flexible hiring modalities; especially since the federal government during the 2012-2018 period considered that reducing informality was both a necessary and sufficient means to increase productivity and economic growth. This result is associated with the fact that a significant percentage of the labor force available for the automotive sector, with technical and high school education (CH1P), becomes an element that exerts downward pressure on sector wages.

Finally, the fixed effects resulting from the estimation (see Table 3) can be interpreted as the effect of contextual or entity-specific variables that may either mitigate or exacerbate the wage levels prevailing in the automotive sector.

Conclusions

The results indicate that the estimation shows a positive impact of labor productivity on wages in the transportation equipment manufacturing subsector (coefficient of 0.145), suggesting that the recovery of wages in the sector is linked to increases in labor productivity. Additionally, a negative impact of ISUB and CH1P on wages is reported, providing evidence to analyze the effects that the labor reform has had on sector wages, which, combined with a relatively high labor supply, have created the conditions for the trend of wage reduction.

Undoubtedly, the proximity to the United States, the numerous free trade agreements with many countries worldwide, low taxes, skilled labor, and low wages have been the main competitive advantages that have attracted automotive companies to establish operations in Mexico. In this regard, the automotive industry pays the highest wages in brownfield regions, where unions have greater bargaining power and where U.S., Japanese, and German companies are located. The lowest wages are found in greenfield regions, where almost the same companies are present; this difference is related to wage flexibility, unions with less willingness to negotiate, and the imposition of collective contracts. This has motivated companies established in brownfields to move to Greenfields. Low wages also depend on the timing of companies' establishments (first in Estado de Mexico, Puebla, Morelos, and Aguascalientes, then in Chihuahua, Coahuila, Nuevo León, Sonora, Coahuila, followed by Jalisco, and finally in San Luis Potosí, Guanajuato, and Querétaro, where mainly Korean and Chinese companies are located). This pattern aligns with the high, medium, and low wages.

The information presented also highlights the wage gap between the countries in the USMCA; in the best-case scenario, with sustained increases in Mexican wages, it would take years for them to match those of the United States and Canada,

hoping that automation and artificial intelligence do not eliminate cheap labor. However, the labor content value rules established in the USMCA do not guarantee that wages in the Mexican automotive industry will increase, as this agreement only requires that 40-45 percent of the value added to vehicles must be incorporated in North American regions that pay wages of at least 16 dollars per hour. Therefore, these wage increases will have to be pursued through legitimized collective labor contracts and under the Federal Center for Conciliation and Labor Registration, once workers have elected union representatives through voting who advocate for better working conditions, including fair wages.

Future studies should examine whether this trend continues as automotive companies establish operations in Mexico, as wages are likely to become increasingly lower. It is also necessary to determine the impact on the workforce and wages due to the implementation of automation, robotics, and artificial intelligence. In this regard, policies on training are essential to ensure a skilled workforce that meets the demands of cutting-edge technologies. The update of the minimum wage should consider, in addition to inflation, improvements in labor productivity. It will also be necessary to review whether the legitimization of existing collective contracts is being carried out by workers, as established in the USMCA and the Federal Labor Law, to which the Mexican government has committed.

Table 3. Real Wages in the Automotive Sector (Transportation Equipment Manufacturing Subsector). Fixed-Effects Estimation

PRODFET	**0.145 (0.014)***
ISUB	-0.812 (0.000)***
CH1P	-0.069 (0.000)***
Fixed Effects by Federal Entity	
Aguascalientes	5.655 (0.000)***
Baja California	5.627 (0.000)***
Coahuila	5.407 (0.000)***
Chihuahua	5.326 (0.000)***
Guanajuato	5.057 (0.000)***
Hidalgo	5.612 (0.000)***
Jalisco	5.284 (0.000)***
México	5.896 (0.000)***
Morelos	6.250 (0.000)***
Nuevo León	5.554 (0.000)***
Puebla	5.720 (0.000)***
Querétaro	5.558 (0.000)***
San Luis Potosí	5.211 (0.000)***
Sonora	5.349 (0.000)***
Tamaulipas	5.279 (0.000)***
Tlaxcala	5.448 (0.000)***
R^2	0.77
Adjusted R^2	0.68
F-statistic	52.50 (0.000)
Pooled data test	10.92 (0.000)
Hausman test	536.3 (0.000)

Note: Balanced panel, n=16, T=4, N=64. Probability of the t-statistic in parentheses. Statistical significance at 10% *; ** at 5%; and *** at 1%.
Source: Estimates performed using R version 3.0.1.

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