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Article

Causes of the salary levels in the Mexican automotive industry three years after the USMCA

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Abstract: The United States, Mexico, and Canada (USMCA) seek to promote fair wages and adequate working conditions, especially in Mexico, by strengthening labor rights and freedom of association. The objective of this research is to determine the factors that influence salary levels in the Mexican Automotive Industry (MAI), through a causality analysis in the Granger sense, to generate a panorama that allows a decision-making process in the Mexican salary policy. With data from the National Institute of Statistics and Geography, the Bank of Mexico and Statista, autoregressive vector models were estimated to determine causalities in the Granger sense. It was proven that minimum wage, employed personnel, production, total sales, and exports are some causes of remuneration in the sector, with the minimum wage being the most significant. The above suggests that the salary increase involves several actors, such as the government (minimum wage), the organization (production, sales and exports) and the market (employed personnel), therefore, the design of appropriate labor policies will contribute to the dignification of salaries inside the MAI.

Keywords: dignity; productivity; labor policy; organization; negotiation

1. Introduction

The Agreement between the United States, Mexico, and Canada (USMCA), entered into force on July 1st, 2020, and is the update of the North American Free Trade Agreement (NAFTA). Said update includes a series of provisions related to wages and working conditions, which aim to promote fair wages and adequate working conditions in the three participant countries. In the renegotiation of the treaty, the US government said that they would sign the USMCA only if the Mexican Congress proposed, discussed, and approved a labor reform (Linares, 2019), that would serve to raise the salary levels**;** The USMCA is a broad treaty and covers many aspects of trade, and although it includes provisions related to wages and working conditions, the determination of wages is not directly stipulated.

Chapter 23 of the USMCA establishes a series of provisions related to work and wages, one of the highlighted aspects is Mexico's commitment to strengthen labor rights and freedom of association (Ortiz et al., 2019). In addition, provisions are established so that workers have the right to join a union, bargain collectively and have free and democratic election processes; These measures seek to promote wage equity among workers in USMCA countries and are designed to ensure that workers receive fair wages and that there is no unfair competition based on low wages.

Salary disparity generates social dumping that constitutes a competitive advantage in the absence of systematic bases of competitiveness (Covarrubias, 2019), that is, spurious advantages, which are not significant in the long term. The USMCA seeks to promote fair wages and adequate working conditions, and considering the previous information, we can see that Mexico faces a contradictory situation. On one hand, the USMCA (2020) states in its Mexican Automobile Industry (MAI) section, chapter four, article seven, that any labor cost in assembly plants must be at least 16 US dollars per hour; on the other hand, as evidenced by CEPAL (2017), the relative salary of the MAI with respect to the US industry has decreased by an average 5% annually; which impacts the congestion and competitiveness of the industry in Mexico according to Mendoza-Velazquez et al. (2018).

So, what are the determining factors of salary levels in the MAI? The objective of this research is to determine the factors that influence salary levels in the MAI, through a causality analysis in the Granger sense, to generate an overview that allows a decision-making process in the Mexican salary policy.

The Sustainable Development Goals (SDGs) are a set of global objectives to eradicate poverty, protect the planet and ensure prosperity for all (UN, 2022a). Objective number eight refers to decent work and economic growth and therefore, finding a balance between the industry, workers, and government contributes to the fulfillment of this objective. Article 123 of the Mexican Constitution establishes that everyone has the right to decent work (Political Constitution of the United Mexican States, 2023), constitutionalizing the development and well-being of MAI workers.

Decent work is related to the level of the living wage; said wage must allow the remuneration received to provide a decent standard of living to the worker and his or her dependents (UN, 2022b); The salary issue has been a topic of great debate both in the Mexican work environment and in the world. In Chapter 23 of the USMCA, wage increases were proposed to achieve a decent life. Contradictorily, it has been observed that trade openness causes less competitive companies to lay off workers and reduce salaries (Simpere, 2022), which translates into downward pressure on a country's salaries.

Fuentes et al. (2020) found that an increase in minimum wages in the maquiladora industry generates a positive effect on the salary of the MAI, compared to the same sector they earn 6.8% more, and compared to other sectors they earn 9.7% more. The discussion around the participation of the minimum wage in salary levels is relevant because in the current environment the repeated increases in the prices of the basic basket are very present, which leads to a reduction in the purchasing power. Campos and Rodas (2020, P51), Yuliati et al. (2023) and Bijoya Neog and Barua (2014) state that "the effect of minimum wages on labor income is positive, on average for 2012 and 2015". Based on the above, the following hypothesis is proposed:

H1: There is a high degree of association and causality between the Minimum Wage and salaries in the automotive sector in Mexico.

The equilibrium wage in a competitive labor market is determined at the point where labor supply equals labor demand; furthermore, if markets are perfectly competitive, the wage should be equal throughout the industry (Pindyck and Rubinfeld, 2009); The USMCA aims to unify the salary conditions of the industry.

De la Luz and Pineda (2023) argue that labor low qualifications result in stagnant

wages in the different regions of Mexico. Therefore, a workforce with a higher level of education favors the increase in salary levels, as they point out. It is important to insist on an education based on the use and mastery of technology as pointed out by Lazaroiu and Rogalska (2023) who stated that by using computational processes, immersive reality and digital twin technologies, generative artificial intelligence tools can automate artistic creative production and labor, transforming and redefining employment, tasks, and jobs through the usage of synthetic media and data.

Thus, Alarcón and Domínguez (2014) propose that "the salary of unionized workers is higher than that of non-unionized workers because the former are more frequently linked to large establishments and have a relatively high level of schooling.", Ciaschi et al. (2021) concludes that when the participation in the added value of the most intensive sectors in skilled labor grows, wage gaps by education increase significantly; Therefore, the following hypothesis is proposed:

H2: There is a high degree of association and causality between employed personnel and salaries in the automotive sector in Mexico.

Contradictorily, despite the significant and sustained growth of the industry, a low salary with downward trends is observed. Covarrubias and Bouzas (2016) postulate that due to the negative to modest behavior of the country's economic growth, salaries have remained stable in the industry and that despite the improvement of the sector, the growth of the economy in general is a reason why salaries have not increased, since 1994 when NAFTA came into force, the purchasing power of workers in the three sectors of the Mexican economy have decreased, and in particular the most pronounced loss for the secondary sector was identified in the period 1994–2002 (Figueroa et al., 2022). There is an antagonistic behavior of salaries and the growth of the MAI, as Covarrubias (2021) showed, in two decades of NAFTA, salaries have only increased by less than half a dollar, a situation totally contradictory with the increases that the production and quantity of employees in the industry has had. From the above, it arises the following hypothesis:

H3: There is a high degree of association and causality between vehicle production and salaries in the automotive sector in Mexico.

Trade openness has favored the increase in world trade and the emergence of multinational companies that offer high and competitive salaries (CEPAL, 2015) to win and control markets. Following the idea raised, Van Tulder (2008) points out that the subsidiaries of multinational companies pay, on average, higher salaries than local companies and are more capital intensive. These incentives increase export activities and the flow of global trade. In contrast, Kolk and Van Tulder (2006) refute the idea previously developed and comment that multinational companies generate low-wage jobs, increasing inequality.

This contradiction leads to the following hypothesis.

H4: There is a high degree of association and causality between vehicle exports and salaries in the automotive sector in Mexico.

Bijoya Neog and Barua (2014) in a study whose objective was to evaluate the factors responsible for influencing employees' job satisfaction. The results showed that salary is the most important factor in influencing employees' job satisfaction. This implies that, if the minimum wage is adequate, sales increase and vice versa. Other study developed by Reis and Gomes da Silva (2012) intended to assert in what form

the Japanese approach to business management, concerning the human resources, research, development and organization and methods factors, has effect on the value creation by workers, beyond that expressed indirect salaries. The results demonstrated that the impact on salary productivity is clearly visible in the organization and methods factor. The above shows the fundamental role of wages in productivity levels, in this case the increase in sales in the industry.

Therefore, the following hypothesis is proposed:

H5: There is a high degree of association and causality between vehicle sales and salaries in the automotive sector in Mexico.

The qualitative analysis allows us to capture in **Figure 1** the six elements linked to the dependent variable, which is the salary levels in the automotive sector; five explanatory variables were analyzed and were assumed to be the causes of the remunerations in the automotive sector. Said variables came as results from the causal regression analyses.

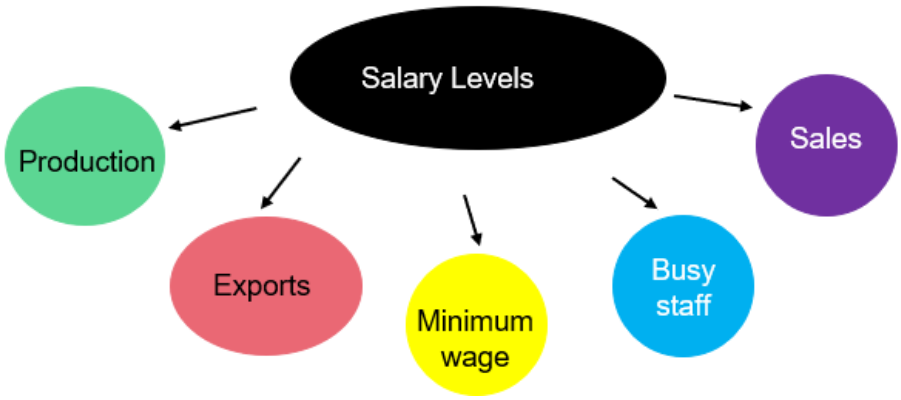

Figure 1. Theoretical model of the determining factors of salary levels in the Automotive Industry of Mexico.
Source: self-made.

2. Materials and methods

2.1. Obtaining the data

The data was obtained through official sources, a total of six variables were considered, five being explanatory variables determined to be the causes of the remunerations in the automotive sector, therefore these remunerations constitute the dependent variables and were found in INEGI (2023). With respect to the explanatory variables, the first one used was the national minimum wage and it was obtained through the Bank of Mexico (2023). The employed personnel of the MAI were the second explanatory variable used and it was obtained through Statista (2023). Another variable used to see if it was considered as a causal of remuneration was the sales of the sector and it was obtained through INEGI (2023), the other two variables considered to see if they were causal of remuneration were production and exports and were obtained from the INEGI source (2023); The period taken into account for the analysis is from 2008 to 2022 because it was possible to obtain consistent and homogeneous information on all variables.

To apply the econometric methods, the STATA software version 14 was used. In

the first instance, a correlation matrix was created that allowed determining the relationship between the independent and dependent variables. In addition, causalities were calculated in the sense of Granger (1969) which made it possible to determine if the independent variables cause variations in the MAI remunerations; In order to determine the causalities, regressions were carried out with the vector autoregressive (VAR) method, and to determine the lag of the variable that provides optimal results, the Akaike Information Criterion (1974) was applied.

2.2. Correlation analysis

Correlational analyses are used to examine the relationship between two or more variables in a data set, seeking to determine if there is a statistical association between the variables and, if so, in what direction and what type of relationship it is. In this analysis, the Pearson coefficient (1985) was used; the correlation coefficient can vary between −1 and 1, where:

$$r = \frac{\sum_{i=1}^{n}(x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\sum_{i=1}^{n}(x_i - \bar{x})^2}\sqrt{\sum_{i=1}^{n}(y_i - \bar{y})^2}}$$

where: $\boldsymbol{x} = (x_1, x_2, \ldots., x_n$, $\boldsymbol{y} = (y_1, y_2, \ldots., y_n)$, two data vectors. Correlational analyses do not necessarily imply a causal relationship between variables (Ruíz et al., 2010), there may be correlations that arise due to external factors or due to more complex relationships not captured by the analysis.

2.3. Akaike criterion

The Akaike information criterion (AIC) is a method used to select the best model amongst a set. It is used in time series analysis. In addition, it is an extension of the maximum likelihood principle, which is conventionally applied to estimate models in a single estimation process with structural and dimensional determination (Cavanaugh and Neath, 2019), and is expressed as follows:

$$AIC_C = AIC + \frac{2k^2 + 2k}{n - k - 1}$$

where 'n' is the number of observations and 'k' is the number of parameters, the AICc is AIC with an additional penalty term for the number of parameters; The AIC is calculated through the STATA software, to subsequently estimate the VAR.

2.4. Autoregressive vectors and Granger causality

Based on the results from the calculation of the AKAIKE criterion, it was established with what number of lags the VAR regression should be executed, so that it is considered a stationary process, and its errors are white noises (Novales, 2011). VARs are used to determine the evolution of multiple variables over time and are modeled based on their previous values, its estimation is necessary in order for the Granger causality to estimate the causality of one variable on the other, so it is fundamental to perform the VAR regression (Casalombo, 2018). The estimation was carried out through the following expression:

$$X \times (t) = \sum_{\tau=1}^{L} A_\tau X(t - \tau) + \varepsilon(t)$$

In the way expressed above, it is identified that $\varepsilon(t)$ is a random white noise

Gaussian vector, and A_τ is a matrix for each τ; The variable on which we want to demonstrate causality is the MAI remunerations and the exogenous variables of the model are the personnel employed in the industry, minimum wage, sales, production, and exports.

3. Analysis of the results

3.1. Results

The correlation matrix is used to analyze and measure the statistical relationship between variables. **Table 1** represents the coefficients between the variables. The matrix provides valuable information about the strength and direction of the associations between the pairs of variables, and in which pairs the relationships of the independent variables with the MAI remunerations can be identified.

Table 1. Correlation matrix.

	Remunerations in the sector	**Minimum wage**	**Employed personnel**	**Sales**	**Production**	**Exports**
Remunerations in the sector	1					
Minimum wage	0.82	1				
Employed personnel	0.78	0.7	1			
Sales	0.39	0.1	0.66	1		
Production	0.57	0.41	0.87	0.83	1	
Exports	0.64	0.51	0.91	0.76	0.98	1

Source: Authors elaboration.

Table 1 shows that all independent variables have a positive correlation with MAI remunerations, so all hypotheses are partially accepted. On one hand the most intense variable is the minimum wage with 0.82, which implies high significance, on the other hand the variable that has the least correlation with remunerations is MAI sales with 0.39, and other variables such as the production and exports have a medium intensity and the one referring to employed personnel is considered high.

The increase in the minimum wage has positive effects on the pockets of employees, favoring an increase in the level of household consumption, while reducing the level of inflation (Fuentes et al., 2020). The salary increase rises wage levels in the MAI and consequently favors the economic growth of the country; The results show that the salary problem involves both the participation of the government and the presence of the unions (Sánchez, 2023), because they have the ability to negotiate, the capacity to draft collective protection contracts, and they can choose the period of establishment or start of operations and the location of the companies.

To determine causality of the independent variables on remuneration, the Granger causality method was proposed; for the adequate implementation of the causality tests, it was necessary to apply the AIC and subsequently VAR regressions. The AIC seeks to select the model that provides the best description of the data with the fewest possible parameters and determines the number of lags in which the VAR regression should be performed. The following **Table 2** shows the results of the application of the AIC.

Table 2. Akaike information criterion.

Variable	Lag 0	Lag 1	Lag 2	Lag 3	Lag 4
Remunerations in the sector	5.45	4.94	5.01	3.91	3.90*
Minimum wage	10.13	5.52	5.25	4.98*	5.05
Employed personnel	26.57	24.26*	24.43	24.54	24.29
Sales	22.65	22.04	21.89*	22.03	22.04
Production	23.68	23.17*	23.25	23.42	23.52
Exports	23.58	22.99*	23.1	23.2	23.3

Source: Authors elaboration.

In the AIC, the lower the final value, the better the model in terms of balance between fit and complexity because models with lower AIC values are preferable since they achieve a good fit to the data with a reasonable number of parameters. The coefficient showed mixed results in the appropriate number of lags for each variable: for remunerations its lowest AIC value was at four lags; the employed personnel, production, and exports variables obtained their lowest values in the first lag; sales at two lags and the minimum wage at three lags. Subsequently, to determine whether the independent variables cause changes in the sector's remuneration, regressions with VAR and causality tests were carried out; the results are illustrated in the following table.

All regressions yielded significant results, the probability of each regression is in parentheses, and all are less than 0.05, which implies significance in the coefficient of the explanatory variables. The results show that each of the variables contribute to the growth of MAI remunerations, the one with the largest coefficient is the minimum wage and the variable with the lowest coefficient is the employed personnel, in general the positive contribution of each explanatory variable is the expected one.

The previous results show that employed personnel (skilled or unskilled) have little relationship with remuneration in the MAI. This result is consistent with research since it is not possible to discuss the establishment of salary levels without the presence of the workers who are essential for the organization, so the intervention of a union that represents the latter is of great importance.

Furthermore, it is important to highlight that after the pandemic, employees found it difficult to re-integrate into business activities. About this, Cramarenco et al. (2023) highlighted the difficulties associated with the ongoing requirement for upskilling or reskilling as an adaptive reaction to technological changes. The efforts to counterbalance the skill mismatch impacted employees' well-being in the challenging pandemic times.

An adequate work situation must be guaranteed and must allow one to aspire to a decent wage. Ovando et al. (2018) set the objective of establishing the relationship between part-time work and wage inequality in workers in the manufacturing industry in Mexico by federal entity in a period from 2005 to 2015. The results showed a statistically significant relationship between part-time work and the Gini index by entity, which is consistent with what was found regarding the variable of employed personnel.

Through the econometric analysis, it is shown that the minimum wage is the

variable with the greatest impact on remunerations within the MAI; In this regard, Fuentes et al. (2020) found that "the increase in the minimum wage has a positive impact on the income of workers, since they earn 6.8% more, and on the rest of the sectors, they earn 9.7% more." Furthermore, Campos and Rodas (2020) found that "the effect of minimum wages on labor income is positive for workers in the first five quantiles, on average for 2012 and 2015 of the salary distribution."

Finally, **Table 3** presents the values calculated from the chi-square test and all the dependent variables exceeded the critical value. As mentioned above, the regressions positively influence remunerations and, in addition, the results obtained in the causality tests. They ensure that there is causality in the Granger sense, which is consistent with the significance of the correlations.

Table 3. VAR results and Granger causality.

Variable	Minimum wage	Employed personnel	Sales	Production	Exports
Remunerations in the sector VAR	0.067 (0.018)	0.0000143 (0.001)	0.000087 (0.024)	0.0000515 (0.008)	0.0000535 (0.007)
Remunerations in the sector Causality	19.987 (0.000)	28.383 (0.000)	18.875 (0.000)	22.819 (0.000)	23.078 (0.000)

Source: Authors elaboration.

4. Conclusions

The USMCA includes provisions that aim to promote fair wages and adequate working conditions in the three participant countries. It was shown that the independent variables have a significant correlation with industry remuneration; The AIC determined that the number of lags, when performing the regressions, caused positive and significant coefficients for each independent variable. It was concluded that the minimum wage, employed personnel, production, total sales, and exports were all causals of remunerations of the sector, with the minimum wage being the variable that most influences salary increases and the employed personnel the least determining.

In the salary negotiations of the MAI, the union must be able to participate because it looks after the interests of the workers, also the bargaining power of the workers must be based on qualified labor. For this reason, the role of unions in organizations is fundamental: it is to negotiate, draft collective contracts, determine the period of establishment or start operations and the location of the companies.

The less significant relationship found between variables was the one of employed personnel and the salary levels. This less significant relationship implies that the employed personnel found it difficult to insert themselves back into business activities because the working models and skills changed after the pandemic crisis. In practice, organizations must design training policies with new technologies to develop a competitive advantage. At the same time, employees can secure their jobs and generate high salaries.

In the political sphere, the government, together with organizations and the market, must design labor policies aimed at new job offers such as Content Marketing and Social Networks, Artificial Intelligence, 3D Printing, Virtual Reality, Big Data, Devices through Voice, Robotization, automation and digital transformation of companies, Electronic Commerce and Digital Leisure.

The research presents certain limitations in terms of the selection of the variables that affect salary levels, so it is recommended for future research to consider the region where the company or companies of interest are located, their size also must be considered and the time they have been on the market.

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