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ENVIRONMENTAL REGULATIONS IN ECO-INNOVATION AND SUSTAINABLE PERFORMANCE IN MEXICAN AUTOMOTIVE INDUSTRY

EFECTOS DE LA REGULACIONES MEDIOAMBIENTALES EN LA ECO-INNOVACIÓN Y EL RENDIMIENTO SUSTENTABLE EN LA INDUSTRIA AUTOMOTRIZ MEXICANA

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Abstract

In the literature, evidence has been provided that establishes that compliance with environmental regulations promotes the adoption and implementation of eco-innovation activities in manufacturing firms, since through this type of activities not only are the costs associated with the discharges of pollutants, but also increases the level of sustainable performance of companies. However, little is known about the relationship between environmental regulations, eco-innovation, and sustainable performance, since there are few studies published in the literature that have focused on their analysis, so this study aims to fill this existing gap, and generate new knowledge of the relationship between these three constructs through an extensive review of the literature. Likewise, a questionnaire was distributed to a sample of 460 manufacturing firms in Mexico, analyzing the data through confirmatory factor analysis and structural equation models based on covariance. The results obtained suggest that environmental regulations have positive effects on eco-innovation, and eco-innovation has positive effects on sustainable performance of manufacturing firms in the automotive industry. In this context, the results obtained allowed us to conclude that compliance with environmental regulations established by the public administration, by manufacturing firms in the automotive industry, improve both eco-innovation activities and sustainable performance of organizations.

Keywords: Environmental, regulation, environmental regulation, innovation, sustainable performance, eco-innovation, manufacturing firms, automotive industry.

Resumen

En la literatura se ha aportado evidencia que establece que el cumplimiento de las regulaciones medioambientales propicia la adopción e implementación de actividades de eco-innovación en las empresas manufactureras, ya que a través de este tipo de actividades no sólo se reducen los costos asociados a las descargas de contaminantes, sino también se incrementa el nivel del rendimiento sustentable de las empresas. Sin embargo, poco se sabe de la relación existente entre las regulaciones medioambientales, la eco-innovación y el rendimiento sustentable, ya que son pocos los estudios publicados en la literatura que se han orientado en su análisis, por lo cual este estudio tiene como objetivo llenar este vacío existente, y generar nuevo conocimiento de la relación entre estos tres constructos a través de una extensa revisión de la literatura. Asimismo, se distribuyó un cuestionario a una muestra de 460 empresas manufactureras de México, analizando los datos mediante el análisis factorial confirmatorio y los modelos de ecuaciones estructurales basados en la covarianza. Los resultados obtenidos sugieren que las regulaciones medioambientales tienen efectos positivos en la eco-innovación, y la eco-innovación tiene efectos positivos en el rendimiento sustentable de las empresas manufactureras de la industria automotriz. Bajo este contexto, los resultados obtenidos permitieron concluir que el cumplimiento de las regulaciones medioambientales establecidas por la administración pública, por parte de las empresas manufactureras de la industria automotriz, mejoran tanto las actividades de eco-innovación como el rendimiento sustentable de las organizaciones.

Palabras clave: Medioambiente, regulación, regulación medioambiental, innovación, eco-innovación, rendimiento sustentable, empresas manufactureras, industria automotriz.

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1 Introduction

In the last decade, environmental problems have become a topic of global interest and public debate in the literature (Geng and He, 2021), particularly because the development of society does not have to depend on natural resources depletion (Almeida and Wasim, 2023). In this regards, Emina (2021) considered that the economic development of countries should not only be subject to meeting the needs of the present, but also to guaranteeing the needs of future generations. Guo et al. (2020) supports this point of view, recommending the adoption of a combination of environmental and innovation policies, which allow long-term economic and business growth. Eco-innovation (EI) is emerging in the literature as one of the alternatives that firms have to improve and mitigate the negative effects that they generate on the environment (Cai and Li, 2018), and can help firms to improve sustainable performance (SP) (García-Parra et al., 2022; Almeida and Wasim, 2023).

Additionally, various studies published in the literature have suggested that EI can be considered as an alternative solution to global environmental problems (e.g. Afshari et al. (2020); García-Granero et al. (2020); Han and Chen (2021); Arranz et al. (2021)), particularly because when manufacturing firms adopt environmentally friendly innovations, the negative impacts of environmental pollution are reduced (García-Granero et al., 2020; Arranz et al., 2021). Likewise, Bitencourt et al. (2020) suggested that companies that prioritize environmental care in their policies can obtain greater long-term economic growth, which is why they should pay more attention to environmental and sustainability aspects (Muhammad et al., 2020).

In this context, EI is one of the most effective business strategies to protect the environment and SP (Porter and van der Linde, 1995), and plays a fundamental role in the economic growth of firms and countries (Yang and Yang, 2015). Therefore, there are more government authorities that are generating a series of environmental regulations (ER) to promote environmental firms to adopt EI (Yuan et al., 2017; Yuan and Xiang, 2018). However, the results obtained from studies that relate ER, EI and SP can be considered as inconclusive and open to debate (Dewick et al., 2019), which is why this study contributes to EI literature with the generation of new knowledge, in addition to that it also complements other work published in the literature (You et al., 2019). Therefore, to complement and expand the limited body of knowledge, this paper addresses the following research question: What is the relationship between ER, EI and SP in the automotive industry?

2 Materials and Methods

2.1 Environmental Regulations and Eco-innovation

To reduce negative impacts on the environment and promote sustainable economic development among manufacturing firms, public administration is increasingly intervening through ER, in stimulating companies to adopt measures that improve the environment and sustainability (Xie et al., 2023), especially because ER is one of the better environmental policy instruments (Wang and Zhang, 2022). Furthermore, ER can also stimulate companies to adopt EI, particularly highly polluting manufacturing firms, such as the automotive industry, in emerging economy countries, where the intensity of ER is generally very low (Wang, 2023), and the implementation of ER is required to improve EI capabilities of organizations (Xu et al., 2020).

The relationship between ER and EI has been recently explored in the literature in various studies (e.g. Liao and Tsai (2019); Wang et al. (2020); Frigon et al. (2020); Han and Chen (2021)), particularly from the implication of public administration in restricting regulations imposed on companies and organizations to safeguard ecosystems (Sanni, 2018). Along these lines, Frigon et al. (2020) considered that public administration should tighten environmental policies that would force manufacturing firms to adopt EI to generate pollution-free industries. In a recently published study, Han and Chen (2021) found that ER policies implemented by public administration in Myanmar, had a significant positive impact on the EI of manufacturing companies.

Also, public administration is generating increasingly stringent ER, and is pushing hard for manufacturing firms to comply with the four essential REs: (1) regulation of emissions of pollutants into the environment, (2) tax for discharge of pollutants, (3) use of renewable energy and, (4) investments by plants in new local environmental improvement projects (Xie et al., 2017). In addition, public administration is promoting the adoption and implementation of the different activities involved in EI in all companies in the manufacturing industry, with the purpose of significantly reducing both energy and resource consumption and pollution levels and CO_2 generation (Guo et al., 2017; Liao, 2018). In this line, EI is considered today not only as one of the best strategies that helps manufacturing firms to comply with ER, but also in generating a higher SP (Shu et al., 2016; Wakeford et al., 2017).

Additionally, EI induced by strict compliance with ER is not only limited to innovation or technological advancement of manufacturing firms, but must also include optimization process, product design and production and the implementation of new methods of product management and distribution (Porter and van der Linde, 1995). However, most of the studies published in the literature have focused on the effects that ER have on technological innovation of manufacturing firms (Hojnik and Ruzzier, 2016; Costa-Campi et al., 2017; Wakeford et al., 2017), and relatively few studies have oriented in ER on EI of manufacturing firms (You et al., 2019). ER can promote the EI adoption among manufacturing firms, through the application of three elementary measures: prevention of environmental pollution, management of eco-products and sustainable development (You et al., 2019).

Under this context, ER plays an essential role in stimulating and promoting manufacturing firms, including those that make up automotive industry, to intensify actions in the reuse and recycling of materials in the production of more environmentally friendly products, through EI adoption (Han and Chen, 2021), since this would allow not only to reduce negative impacts on environment, but also to improve its level of competitiveness (Wang et al., 2020). Furthermore, ER imposed on manufacturing firms to protect the environment can generate a substantial increase not only in the demand for eco-products, but also stimulate the development of innovative techniques to improve environmental performance (Fernández et al., 2021). Thus, considering the information presented above, it is possible to propose the following research hypothesis:

H1: Environmental regulations have significant positive effects on eco-innovation.

2.2 Eco-innovation and Sustainable Performance

The innovation literature established that internal factors such as resources available in firms, structure and essential capacities determine in a high percentage EI implementation, while external pressure exerted by consumers, customers, environmental groups and public administration induces manufacturing firms to be more practical in adopting environmental practices (Cai and Li, 2018). In addition, recent studies have established that EI has significant positive effects on SP of manufacturing firms (e.g. Maldonado-Guzmán and Garza (2020); Almeida and Wasim (2023); Michalski et al. (2023)), since EI is considered as a strategy business that adds value to customers and companies, that contributes to improving both SP and reducing costs and environmental impacts (Tseng et al., 2021).

Likewise, EI can replace existing products in manufacturing firms with eco-products that are more environmentally friendly, which generally reduce negative impacts to the environment (Cai and Li, 2018), and can improve efficiency of resources and raw materials, reduce waste of materials and significantly reduce the costs associated with the generation of pollutants and CO_2 for not complying with ER (Cai and Li, 2018). In addition, EI products can generate additional profits or benefits that will allow manufacturing firms to obtain economic and financial resources necessary to develop EI activities, and establish a corporate image of environmental care responsibility, implement a diversification of its eco-products and increase its market share (Cai and Li, 2018). Also, manufacturing firms that have adopted EI commonly have higher productivity per employee, and economic and SP than those companies that have not yet done so (Hojnik and Ruzzier, 2016).

Additionally, various studies published in the literature have identified different determining factors in EI adoption and application, such as regulation (Han and Chen, 2021; Wasiq et al., 2023), government support (Wang et al., 2020), managerial pressure (Long et al., 2020; Wang et al., 2020), market pressure (Chen and Liu, 2019; Wasiq et al., 2023), technological factors (Andersson et al., 2020; Wasiq et al., 2023), and business performance (Yurdakul and Kazan, 2020; Geng et al., 2021). However, there are relatively few studies published in the literature that have explored the influence of EI on SP (Maldonado-Guzmán and Garza, 2020; Almeida and Wasim, 2023). According to Wang et al. (2020), and Wasiq et al. (2023) government support is essential to encourage competition and promotion of innovative technologies.

In recent years, the analysis and discussion of EI adoption has gained significant attention from academics and researchers (e.g. Mercado-Caruso et al. (2020); Zhang et al. (2020); Fernández et al. (2021); Geng et al. (2021); Wasiq et al. (2023); Almeida and Wasim (2023)). One of the key factors in EI adoption and implementation in manufacturing firms, including the automotive industry, is the growing interest that consumers have in purchasing environmentally friendly products, which is closely linked to the commitment and desire to express identity through the purchase of green products (Fernández et al., 2021; Rana and Solaiman, 2022; Kautish and Khare, 2022), which encourages manufacturing firms to apply EI practices to improve their products, processes and management systems sustainability (Afshari et al., 2020; Chang et al., 2021).

Under this context, EI is generally categorized in the literature as an environmentally related innovation (Wang et al., 2020; Chang et al., 2021), particularly because EI has been shown to generate a positive impact on environmental levels of manufacturing firms, such as profitability (Kraus et al., 2020; Achmad et al., 2023), social performance (Wang et al., 2020), and SP (Singh et al., 2020; Al-Hanakta et al., 2023). Furthermore, recent studies published in the literature (e.g. Han and Chen (2021); Almeida and Wasim (2023)), suggest that ER can encourage manufacturing firms to adopt EI activities, which can generate greater SP level. Thus, considering the information presented above, it is possible to propose the following research hypothesis:

H2: Eco-innovation has significant positive effects on sustainable performance.

To respond to the two established research hypotheses, an empirical study was carried out in manufacturing firms of the Mexican automotive industry, particularly analyzing the relationship between ER, EI and SP. In the first phase of the study, a "Business Panel" was held with three academics from the innovation area and five businessmen from the automotive industry and two representatives of government agencies related to ER.

The results obtained in this first phase allowed the design of a questionnaire to collect the information, applying a pilot test to ten businessmen of the automotive industry, making minor adjustments in writing, appearance and spelling. Pilot studies are essential to ensure validity when questionnaires are self-administered or contain self-developed scales (Bryman, 2016; Hair et al., 2016).

2.3 Sample Design and Data Collection

The frame of reference used in this study was the directory of the companies of the Mexican automotive industry, which had registered 909 firms as of November 30, 2019, the companies belonging to various local, regional, and national business chambers, Therefore, the empirical study did not focus on a particular group or business association. In addition, the survey for the collection of information was applied to a sample of 460 companies selected by simple random sampling, with a maximum error of $\pm$ 4% and a level of reliability of 95% and applying the survey during the months of January to March 2020. Also, the questionnaire was delivered to the company manager who designated the people responsible for each area to answer the questions that corresponded to them, obtaining information from the experts in each organization area.

2.3.1 Measure Development

ER measurement is an adaptation to the scale established by Xie et al. (2017) and Pan et al. (2017), who considered that ER can be measured through 4 items. EI measurement was made to the scales proposed by Hojnik et al. (2014) and Segarra-Oña et al. (2014), being measured EI product through 4 items, EI processes through 4 items and EI management through 6 items.

Finally, SP measurement is an adaptation to the scale proposed by Gadenne et al. (2012), who measured this construct through 5 items. A five-point

Likert-type scale was chosen to strike a balance between complexity for respondents and accuracy for analysis (Forza, 2016; Hair et al., 2016). Table 1 shows the items of the five scales used in paper.

Table 1. Measurement Model Assessment

Indicators	Constructs
Environmental Regulation (ER)	
ENR1	Regulation of emissions of pollutants into the environment
ENR2	Pollutant discharge tax
ENR3	Use of renewable energies
ENR4	Plant investments in new local environmental improvement projects
Product Eco-innovation (PE)	
PEI1	It constantly improves its product life cycle standards and conducts product life cycle studies
PEI2	It uses or develops new energy sources with a tendency to reduce CO_2 emissions
PEI3	It uses the eco-label system required by each destination country for its products
PEI4	It uses and elaborates eco-innovative components and materials that are made from recycled raw materials
Process Eco-innovation (RE)	
PRE1	Treats wastewater
PRE2	It uses sterilization methods for its components or technological devices
PRE3	Produces or uses fabric components that use fabric sanitization technologies
PRE4	It uses ecological or recyclable paper in its processes
Management Eco-innovation (ME)	
MEI1	Has a management system that reuses obsolete components and equipment
MEI2	Has an ISO 14001 Certification or similar
MEI3	It has constant audits of energy saving and ecology by the state and/or municipal authorities of its location
MEI4	Constantly conducts seminars or training courses for staff related to eco-innovatio
MEI5	It has well-defined policies that encourage and support eco-innovation activities throughout the organization
MEI6	It has a monitoring and control system for wastewated generated by the company
Sustainable Performance (SP)	
SPE1	It has among its objectives the care of the environment
SPE2	Makes great efforts to promote environmental care
SPE3	It has a great commitment to invest in projects that protect the environment
SPE4	Frequently discusses the results of environmental care performance within the organization.
SPE5	It has an excellent performance in protecting the environment compared to other companies in the same industry or sector.

Given that the data were collected by applying a questionnaire to the same informant (company manager), there is the possibility of causing biases that could generate Type I (false positive) or Type II (false negative) errors considered in this study, variance evaluation through the common method (CMV), following Podsakoff et al. (2012) recommendations. Traditionally, the method most used by scientific and academic community to verify the possible effect of CMV is *Harman's one-factor test* (Podsakoff et al., 2003), which indicates that all items on the measured followed an exploratory factor analysis (EFA), forcing extraction to a single factor (Iverson and Maguire, 2000; Aulakh and Gencturk, 2000).

To verify the suitability of the data and the possible effect of CMV, an EFA was applied using principal components method and varimax rotation, finding a KMO value = 0.85 and a statistically significant Bartlett test ($X^2_{(1,035)}$ = 6.567,05; p $<$ 0,000). If there was any inconvenience in the data or in the CMV, the common factor extracted should have a value greater than 50 % of the variance extracted (Podsakoff et al., 2003), but the common factor extracted from the application of the EFA is 34.7 %, which is much lower than the recommended value, which indicates the non-existence of CMV, which does not seem to have any effect on the relationships proposed between the variables (Podsakoff et al., 2012).

2.3.2 Reliability and Validity of Measurement Scales

The evaluation of reliability and validity of the three measurement scales required a Confirmatory Factor Analysis (CFA), using the maximum likelihood method with the support of the EQS 6.2 software (Bentler, 2005; Brown, 2006; Byrne, 2006). Therefore, for the measurement of reliability, Cronbach's Alpha and Composite Reliability Index (CRI) (Bagozzi and Yi, 1988) were used, and according to the results obtained in CFA all the values of the three scales are higher than 0.7 for both indices, which provides evidence of the reliability of the scales and justifies their internal reliability (Nunally, 1994; Hair et al., 2014). In addition, as evidence of convergent validity, CFA results indicate that all items of related factors are significant (p <0.001), and the size of all standardized factor loads is greater than 0.60 (Bagozzi and Yi, 1988).

The results of CFA application are presented in Table 2 and suggest that the measurement model provides a good statistical data fit (SBX^2 = 776.804; df = 2202; p = 0.000; NFI = 0.888; NNFI = 0.904; CFI = 0.916; RMSEA = 0.074). In addition, Table 2 shows a high internal consistency of the constructs, in each case *Cronbach's Alpha* exceeds the value of 0.70 recommended by Nunally (1994). CRI represents the variance extracted between the group of observed variables and the fundamental construct (Fornell and Larcker, 1981), so that a CRI greater than 0.60 is considered desirable (Bagozzi and Yi, 1988), in this study this value is widely surpassed. Extracted Variance Index (EVI) was calculated for each of the constructs, resulting in an EVI greater than 0.50 (Fornell and Larcker, 1981), in this work 0.50 is exceeded in all factors.

In addition, the discriminant validity of the theoretical model of ER, EI and SP were measured by means of two tests, which are presented in Table 3. First, confidence interval test is presented. (Anderson and Gerbing, 1988), which states that with a 95 % confidence interval, none of the individual elements of the latent factors of the correlation matrix has the value of 1. Second, *variance extracted test* (Fornell and Larcker, 1981), which states that the variance extracted from each pair of constructs is lower than its corresponding EVI. Therefore, according to the results obtained from the application of both tests, it is possible to conclude that both tests demonstrate sufficient evidence of the existence of discriminant validity.

3 Results and Discussion

To respond to the two hypotheses raised in this empirical study, a structural equation model (SEM) was applied with the support of the EQS 6.2 software (Bentler, 2005; Byrne, 2006; Brown, 2006), analyzing the nomological validity of the theoretical model of ER, EI and SP through the Chi-square test, by means of which the results obtained between the theoretical model and the measurement model were compared, obtaining non-significant results which allows establishing an explanation of the observed relationships between latent constructs (Anderson and Gerbing, 1988; **?**). Table 4 shows the results obtained from the application of the SEM.

Table 4 shows the results obtained from the application of SEM and, with respect to the $\mathbf{H}_1$ hypothesis, the results obtained, β = 0.989 p <0.001, indicate that ER has significant positive effects on EI of manufacturing firms. Regarding the $\mathbf{H}_2$ hypothesis, the results obtained, β = 0.265 p <0.001, indicate that EI has significant positive effects on SP of manufacturing firms. In summary, the existence of a significant positive relationship between ER, EI and SP can be corroborated.

Table 2. Internal consistency and convergent validity of the theoretical model

Variable	Indicator	Factorial Loading	Robust t-Value	Cronbach's Alpha	CRI	EVI
Environmental Regulations	ENR1	0.719***	1 000 [a]	0.913	0.914	0.728
	ENR2	0.852***	18.058			
	ENR3	0.954***	19.953			
	ENR4	0.871***	18.483			
Product Eco-innovation **(F1)**	PEI1	0.668***	1 000 [a]	0.874	0.875	0.639
	PEI2	0.801***	14.877			
	PEI3	0.893***	16.025			
	PEI4	0.819***	15.137			
Process Eco-innovation **(F2)**	PRE1	0.859***	1 000 [a]	0.916	0.917	0.736
	PRE2	0.884***	24.806			
	PRE3	0.877***	24.505			
	PRE4	0.809***	21.391			
Management Eco-innovation **(F3)**	MEI1	0.776***	1 000 [a]	0.926	0.927	0.681
	MEI2	0.758***	17.421			
	MEI3	0.862***	20.463			
	MEI4	0.889***	21.279			
	MEI5	0.886***	21.197			
	MEI6	0.769***	17.730			
Eco-innovation	**F1**	0.815***	5.806	0.821	0.822	0.609
	F2	0.686***	5.169			
	F3	0.831***	6.133			
Sustainable Performance	SPE1	0.751***	1 000 [a]	0.898	0.899	0.642
	SPE2	0.755***	16.237			
	SPE3	0.850***	18.450			
	SPE4	0.858***	18.634			
	SPE5	0.786***	16.959			

S-BX^2 (df = 220) = 776.804; $p < 0.000$; NFI = 0.888; NNFI = 0.904; CFI = 0.916; RMSEA = 0.074
[a] = Constrained parameters to such value in the identification process
*** = $p < 0.01$

The results selected in this empirical study have different implications for both managers and manufacturing firms. A first implication originated from these results is that the data derived from the application of 460 surveys confirmed the realization of a general analysis of the relationship between ER, EI (means through eco-innovation in products, processes, and management), and SP in a particular industry (Mexican automotive industry), so in future studies these three constructs in longitudinal studies or in case studies of success will be relevant. However, from the point of view of the evolution of innovation, the results indicate that full compliance with ER improves EI activities of manufacturing firms (You et al., 2019; Dewick et al., 2019).

A second implication derived from the results is that ER allow manufacturing firms, not only to implement eco-investment and eco-planning activities in EI of products, processes and management, as suggested previously in published studies (e.g., Wakeford et al. (2017); Guo et al. (2017)), but also facilitates compliance with the goals of reducing negative impacts to environment and reduces human and environmental risks (Severo et al., 2018). However, even though the adoption of EI is strongly influenced by ER and financial regulations, it is also true that it is important that government authorities should reform their fiscal system to promote the adoption of EI among manufacturing firms (You et al., 2019).

A third implication of the results obtained is that it has been shown in the literature that ER to be much more effective it has to be rigorous, flexible and enforceable (e.g., Ribeiro and Kruglianskas (2015)), because this would allow a greater implementation of EI in manufacturing firms (Yang and Yang, 2015; Yuan et al., 2017), as ER stimulates the adoption of EI because they essentially reduce the costs for compliance (Dewick et al., 2019), even though the concept of EI is too complex, and requires the application of the three types of knowledge (EI of products, processes and management) to obtain best results (Marzucchi and Montresor, 2017).

A fourth implication derived from the results is that even when empirical evidence has been provided of the positive relationship between ER and EI of products, processes and management (e.g., Cai and Li (2018); You et al. (2019)), there are few studies that analyze and discuss EI from a general point of view, however, the results obtained in this study are consistent and similar to those obtained in the aforementioned studies. Therefore, ER promote, among manufacturing firms, not only the development of the different EI activities of products, processes and management that are more environmentally friendly, but also the significant improvement of SP (Hojnik and Ruzzier, 2016).

A fifth and final implication of the results obtained is that manufacturing firms are increasingly under pressure from different environmental groups, consumers, suppliers, communities and society in general to adopt more effective measures of environmental care sustainable development, so one of the alternatives that are being considered by researchers, academics and industry professionals is EI. However, for manufacturing firms to contribute to reducing the current climate change, they require full compliance with government ER, as this will allow them to significantly reduce the use of energy and raw materials (Fellner et al., 2017), waste (Tisserant et al., 2017), and raw materials (Tisserant et al., 2017).

Table 3. Discriminant validity of the theoretical model

Variables	Environmental Regulation	Eco-innovation	Sustainable Performance
Environmental Regulation	**0.728**	0.045	0.095
Eco-innovation	0.165 - 0.261	**0.609**	0.068
Sustainable Performance	0.244 - 0,372	0.203 - 0.319	**0.642**

The diagonal represents the Extracted Variance Index (EVI), whereas above the diagonal the variance is presented (squared correlation). Below diagonal, the estimated correlation of factors is presented with 95 % confidence interval.

4 Conclusions

The results obtained in this study will generate different conclusions among the most important will be the following. A first conclusion is the theoretical model that is considered to have a high internal consistency, generating a strong correlation between the three constructs analyzed, which determines the acceptance of the two research hypotheses proposed. A second conclusion is the same theoretical model used that has an overview of the main EI activities (product eco-innovation, process eco-innovation and management eco-innovation). A third conclusion is many previously published studies that have analyzed and discussed the relationship between ER, EI and SP are few, compared to studies that have been oriented towards conceptualization (You et al., 2019), which from our point of view lack a specific contribution.

A fourth conclusion is that the analysis of the relationship between these three important cons-

Table 4. Results of the SEM

Hypothesis	Structural Relationship	Standardized Coefficient	Robust t-Value
H$_1$: The higher level of environmental regulations, higher level of eco-innovation.	Environmental R $\rightarrow$ Eco-inn.	0.989***	20.409
H$_2$: The higher level of eco-innovation, higher level of sustainable performance.	Eco-inn. $\rightarrow$ Sustainable P.	0.265***	14.074

S-BX^2 (df = 214) = 685.502; $p < 0.000$; NFI = 0.901; NNFI = 0.916; CFI = 0.929; RMSEA = 0.069
*** = $P < 0{,}01$

tructs is a relatively recent topic in the literature, even though the relationship of these three constructs is increasingly gaining attention of researchers, academics and industry professionals the empirical results are not necessary to establish a total relationship, so it is possible to conclude the relationship between ER, EI and SP is an unfinished issue that is open to discussion (Yuan and Xiang, 2018). A fifth conclusion is that the analysis of the relationship between the three constructs analyzed is this empirical study in emerging economy countries, as is the case in Mexico, has not been explored in the literature, so this study provides empirical evidence and new knowledge of the relationship between the three constructs.

A sixth and final conclusion is that the results of this empirical study affected the generation of knowledge, both from previously published studies that analyzed the effects of ER and EI (e.g. Yuan and Xiang (2018); Dewick et al. (2019); You et al. (2019)), as of those studies that analyze the relationship between EI and SP (e.g. Yuan et al. (2017); **?**); Cai and Li (2018)), by incorporating them into a model that simultaneously analyzes the four types of ER and the three types of EI most cited in the literature, which allows to conclude in general terms that ER do allow a significant increase in EI.

This study has different limitations that are essential to consider before analyzing and interpreting the results obtained. A first limitation of this study is the use of the measurement scales of ER, EI, and SP, since these three important constructs were measured through subjective indicators obtained from the survey. Therefore, in future studies it will be necessary to incorporate some objective data of manufacturing firms (e.g., total certifications in international and national standards, amount of tax payment for emissions of polluting gases, amount of EI performed, percentage of energy use renewable, percentage of treated water use), to verify whether the results obtained differ or not from those obtained in this study.

A second limitation is that ER and EI (EI of products, processes and management), may have better results if they are analyzed and discussed in a disaggregated manner, or if a moderating variable is incorporated into the analysis of the particular characteristics of manufacturing firms (e.g., size, subsector, location), or of managers (e.g. leadership, experience, skills). Therefore, in future studies it will be necessary to use some variables that moderate the effects exerted by ER on EI, and this in their view on SP, to corroborate whether the results obtained are different from the results found in this study.

A third limitation is that this study considered only four types of ER and the three types of EI most cited in the literature, so in future studies it would be necessary to consider other types of EI (e.g., marketing, technology, systems), to corroborate whether the results obtained are similar or not to those obtained in this study. A fourth and final limitation of these results is that the surveys were applied only in the manufacturing firms of the Mexican automotive industry, so in future studies it would be convenient to apply them in other sectors to corroborate whether the results obtained differ or not from the results obtained in this study.

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