**Does Circular Economy Affect Financial Performance? The Mediating Role of Sustainable Supply Chain Management in the Automotive Industry**

**Abstract**

The implementation of stricter sustainable policies and the tightening of environmental laws are forcing manufacturing companies, particularly those that make up the automotive industry, to make changes and improvements involving Circular Economy (CE) practices. However, CE practices do not always lead to an improvement in firm performance. This study analyzes the effects of the implementation of CE practices on the financial performance (FIP) of manufacturing companies in the automotive industry of Mexico, considering the mediating effect exerted by sustainable supply chain management (SSCM). The proposed model is validated through PLS-SEM using a sample of 460 companies. The results show that the FIP is strengthened through the implementation of the CE and that this effect is mediated by the commitment of the company to promote a better SSCM. This study contributes to the CE and SSCM theories by providing evidence about the positive effect that the implementation of these activities has on the performance of the automotive industry and how a SSCM equally exerts a direct and indirect effect on this. In the same way, managers can use this study and its results to make their operations more efficient and to demonstrate the effects of sustainability on the financial performance of the company.

**Keywords:** Circular economy, financial performance, sustainable supply chain management, resource-based theory, natural resource-based view, automotive industry.

1. **Introduction**

In order to achieve some of the 17 sustainable development goals, previous literature contemplates CE as an essential element (Geissdoerfer *et al*., 2017). CE is considered one of the best alternatives to reduce negative impacts on the environment and enhance sustainable development (Stahel, 2016). Ellen MacArthur Foundation (2013:34) defines CE as “*an industrial system that is reconstituted or regenerated by intention and design*” while the European Action Plan (2015:10) affirms that the CE “*is an economy where an attempt is made to preserve the value of products, materials, and resources for as long as possible, with a minimum generation of waste*”. Although there is a significant number of CE definitions, most of them incorporate a value retention process through various mechanisms, such as reuse, repair, remodeling, remanufacturing, redistribution, and recycling (Nasr *et al*., 2018).

Grounded on the resource-based theory and the natural resource-based view, companies 1) identify resources, capabilities and locate competitive strengths and weaknesses; 2) assess the potential to generate returns; and 3) select the strategy that best takes advantage of their strengths. Therefore, companies will be able to improve their innovation (Green *et al*., 2015), strategic management (Burgelman, 2015), and absorptive capacity (Gebauer & Worch, 2015). CE can be a key element for companies to gain a competitive advantage by providing green product value to customers (Prieto-Sandoval *et al*., 2018; Mishra and Yadav, 2021).

CE minimizes the use of resources in the automotive industry, decreasing waste, pollutants, and energy needed in production. More environmentally friendly products which reduce negative impacts on the environment and CO2 emissions involve an increase in growth and economic prosperity of society in general (Bakker *et al*., 2014). Thus, the vision of the CE to increase awareness and willingness to act, both from government authorities and manufacturing companies, including the automotive industry, is becoming the main engine for the implementation and achievement of sustainable development goals at a global level (Schroeder *et al*., 2019).

CE practices can also have a positive effect on the sustainable supply chain management of manufacturing companies, given that there is a growing awareness among companies about caring for the environment, conserving energy, and reducing climate change (Manavalan & Jayakrishna, 2019). It is not only the responsibility of a particular manufacturing company to conserve the environment and reduce levels of environmental pollution, but it also involves its business partners (supply chain) in achieving these goals (Manavalan & Jayakrishna, 2019). In fact, the changes that are taking place in the climate, pollution, and consumer expectations are forcing companies to create supply chains that improve environmental sustainability (Govindan & Hasanagic, 2018). SSCM is defined by Seuring and Muller (2008:2) *as “managing the flow of materials, information, and capital as well as cooperation and collaboration among firms within the supply chain while adopting all the sustainable development goals entailed by the economic, environmental, and social aspects ”*.

Global competition is putting more pressure on the government authorities, for the implementation of environmental regulations that stimulate greater sustainability in manufacturing companies through the best practices of supply chains (Manavalan & Jayakrishna, 2019). Therefore, CE is oriented not only toward the efficient use of resources and energy conservation but also toward the efficiency of the prouct distribution through sustainable supply chains (Zhu *et al*., 2010). However, to achieve a comprehensive transformation towards CE, there must be not only external reasons for companies to do it but also internal ones. Consequently, the effects of the CE and the SSCM on the performance must be analyzed. Few studies have analyzed the relationships between CE and SSCM, and their effect on financial performance (FIP) (Homrich *et al*., 2017), showing mixed results. On the one hand, the costs linked to the transformation from a linear economy to CE, negatively affect FIP (Silvestre *et al*., 2014), whreas others show an increase in the competitive advantage of companies when carrying out sustainability strategies in their traditional supply chain (Pagell & Wu, 2009).

Therefore, it is important to conduct more studies that contribute with theoretical and empirical evidence to explain the effects that CE has on the SSCM (Wu & Pagell, 2011), and on FIP (Haupt & Hellweg, 2019), as this area is considered inconclusive (Geissdoerfer *et al*., 2018). To fill this gap, an empirical study has been carried out on 460 Mexican companies in the automotive sector. This sector is interesting since it not only contributes to more than 50% of the Mexican economy's GDP and employs more than 30% of the workers, but it is also the backbone of the Mexican economy by positioning this country as the fourth largest exporter of vehicles in the world (INEGI, 2019).

This work contributes to the previous literature in two essential aspects. First, it provides empirical evidence of the mediating effect of SSCM in the relationship between CE and FIP of manufacturing companies in a strategic sector like the automotive industry. Second, the paper contributes through the analysis and discussion of the relationship between these three constructs in a country with an emerging economy, such as that of Mexico, as suggested by Chen *et al*. (2021).

**2. Literature Review**

**2.1 Circular Economy and Financial Performance**

CE literature shows its multidisciplinary nature, in which methods from various disciplines such as engineering, economics, and ecology have contributed to its development (Pizzi *et al*., 2020). This is so because CE needs innovations that can provide environmentally friendly products and services in a context characterized by high complexity and dynamism (Hopkinson *et al*., 2018). The resource-based theory is applied to define resources that a firm can control to innovate in order to gain a competitive advantage (Barney, 1991). In this sense, CE could be a key element for the company to achieve a competitive advantage by providing value for its customers with green products (Prieto-Sandoval *et al*., 2019).

Due to its relevance in the use of materials and energy, generation of by-products, contribution to employment, and GDP, CE strategies play a fundamental role in the performance of manufacturing companies (Lieder & Rashid, 2016). At the heart of the CE is the recovery of value from tangible products through reuse and restoration, which can improve the economic and environmental performance of recycling and energy recovery (Ashby, 2018). In CE, the concept of waste reduction can be achieved by redesigning products, manufacturing processes, and supply chains to maintain the continuous flow of resources in a closed loop (Jia *et al*., 2020). CE achieves this by reducing the consumption of finite resources and creating value using a variety of strategies aimed at increasing efficiency, productivity, and resilience, so that products, components, and materials last longer (EMF, 2015).

CE can affect FIP in two broad areas: resource effectiveness and resource efficiency (Braungart *et al.,* 2007). Resource effectiveness describes the degree to which waste can be exploited in the value of the product. The value of the product is present in two ways: the material value, which describes the value associated with the raw materials integrated into a product and, the functional value, which is the value of the design that performs the functionality of the products (Kumar *et al*., 2007). Resource efficiency is oriented to the best use of available resources, which makes it possible to minimize production costs for manufacturing companies. Resource effectiveness is focused on achieving incremental improvements in the processes of the production lines, which allows for improving the level of FIP of companies (Zhao *et al.,* 2021).

However, Mao & Wang (2018) suggest that the cost CE involves is so high that only companies with certain finances can afford it. Companies must improve the technology at all levels and improve or create product handling processes at the end of their usefulness, including inspection, disposal, recycling, remanufacturing, repair, or reuse (Menon & Ravi, 2021). The processing fee in these cases can be more than producing new products, this fact generally negates all economic benefits (Mao & Wang, 2018). Furthermore, the product resulting from the poor implementation of these practices has a decreasing quality (Bhattacharya *et al*. 2018). Marucci *et al*., (2021) highlight the cost of training personnel for the efficient use of technology linked to CE, as well as the effective application of the necessary processes when migrating from a linear economy to CE. In this sense, commitment is necessary at all management levels, and keep in mind the legislation of each sector to take advantage of it (Menon & Ravi, 2021). Thus, considering the information presented above, we propose the following research hypothesis.

*H1: Circular Economy has a significant positive influence on the financial performance of companies.*

**2.2 Circular Economy and Sustainable Supply Chain Management**

The adoption of sustainability in the supply chain is a greater concern for manufacturing organizations (Boken *et al*., 2014). The changing market has been insisting that these organizations review their supply chain to effectively implement sustainability through various practices such as Lean, Green, and Industry 4.0 (Yadav *et al*., 2020). To overcome barriers and achieve better sustainability in the supply chain, not only do manufacturing companies need to adopt CE practices but also the companies that participate in the supply chain must integrate these activities (Kumar *et al*., 2021).

The natural resource‐based view is an extension of the resource‐based view theory but focuses on more sustainability‐oriented resources. This view describes how a firm’s competitive advantage evolves depending on the role of environmental concerns in organizational relationships like its supply chain strategies (Mishra and Yadav, 2021). In this sense, CE helps companies in the SSCM grow thanks to environmental awareness, energy conservation, and an atmosphere of global competition (Manavalan & Jayakrishna, 2019). Therefore, sustainability is not only the responsibility of a single organization but also of all actors in this chain since climate change, pollution, and customer expectations, force organizations towards sustainable activities (Govidan & Hasanagic, 2018).

The SSCM seeks to integrate issues related to supplier selection and technology to meet customer expectations through binary and supply network relationships (Zeng *et al*., 2017). For example, selecting suppliers with the highest sustainability standards is more likely to play a key role in making the entire supply chain sustainable (Zhu & Geng, 2001), while the extensive experience and collaborative practices of suppliers aim to improve environmental performance, energy savings and global competitive climate (Chen *et al*., 2017). Yadav *et al*. (2020) suggest that as the external sustainability of supply chains becomes more difficult, CE concepts need to be integrated into supply chain management to achieve an optimal balance of economic, social, and environmental benefits.

However, some problems emerge when introducing CE practices in these systems, some of which are: 1) Multiple supply chain systems must be coordinated to maximize the potential for reuse and recycling, and capture added value by integrating all activities of the supply chain. This industrial symbiosis must bring companies together in innovative collaborations that adhere to systems that involve multiple supply chains; 2) Technological constraints which are barriers to the life cycle of new products or waste that can transform materials or resources into new recycled products and lead to the redesign of product-service systems (Ahmad *et al*., 2018); 3) All product and service systems in the supply chains must be redesigned, to convert these recoveries or waste into raw materials or life cycle resources of the subsequent new product, thus adding value to the resources or materials, which entails a high degree of specialization in business processes.

Thus, considering the information presented above, we propose the following research hypothesis.

*H2: Circular Economy has a significant positive influence on the sustainable supply chain management of companies.*

**2.3 Sustainable Supply Chain Management and Financial Performance**

The globalization of the economy and markets is causing the supply chain of manufacturing companies to have a higher level of sophistication (Mokhtar *et al*., 2019). In this way, green investments can keep companies away from the competition, thus creating a competitive advantage (Wong *et al.,* 2020). The SSCM shows that when companies become sustainable, they operate differently from traditional supply chains and gain more market opportunities (Aisjah & Prabandari, 2021). Traditionally, it is necessary to unify the company's capabilities, competencies, skills, and resources among all partners within the organization and in the supply chain to increase innovation and sustainability to improve the company´s performance (Zhao *et al*., 2008). This is achieved through an exchange of knowledge, cooperation in environmental protection, and joint development. Therefore, when the level of company information sharing increases, it improves the company's green innovation and sustainability capabilities (Wong *et al*., 2020).

The resource-based theory advocates synchronizing internal organizational processes and all supply chain partners with effective green practices (Afum *et al*., 2020). Previous studies have found that senior management must modify supply chain processes, not only to adapt them to market requirements (Ojha *et al*., 2018) but also to improve the sustainability of the supply chain and the level of FIP (Chen *et al*., 2021). Likewise, there is empirical evidence in the current literature that supports that the SSCM can cause a greater financial return for companies if they improve their capacities (Asamoah *et al.,* 2021). For example, Liao & Kuo (2014) and Yu *et al.* (2018) observed that companies that improved their capabilities in terms of a more SSCM, obtained a higher financial return by reducing the transportation fees, the number of suppliers, the size of the warehouses and the time to get the raw materials.

However, some studies have found a negative connection between the SSCM and the level of FIP (Ataseven & Nair, 2017). This finding is based on a change in demand, or failure of a partner in the extended chain (supplier or a distributor) (Junaid *et al*., 2022), interruption of some links due to natural events (floods, landslides, earthquakes, etc.) or social or/and political events (coups, expropriations, changes in laws, etc.) and the risk in the supply chain due to sudden fluctuations in the price or availability of critical inputs (Menon & Ravi, 2021). These problems can directly affect FIP since companies must make a monetary investment to change their production materials, and their suppliers or reduce their sales volume. These problems are even more important when the relationships in the supply chain are based on sustainable requirements as the choices are significantly reduced.

Therefore, according to the information presented previously, we propose the following research hypothesis.

*H3: Sustainable supply chain management has a significant positive influence on the level of financial performance.*

**2.4 Mediating effect of Sustainable Supply Chain Management on the relationship between the Circular Economy and Financial Performance.**

SSCM is considered a collaboration and cooperation strategy between all the members of the supply chain, which can generate more and better economic benefits for all participating companies (Kamble *et al*., 2020). SSCM can allow companies to improve sustainability through better-coordinated activities between the entire supply chain (Ataseven & Nair, 2017), which can generate greater FIP (Hassan & Abbasi, 2021).

Nandi *et al*. (2021) identified advantages of CE such as the use of sustainable products, components, materials, and resources in the supply chains. As well as shortening, reduction and/or closure, maximizes the resource supply cycle recovery of materials and prevents waste and pollution. This is possible through better supply chain management, which enables consumers to use products longer and easily return them at the end of their lifespan. Following the previous reasoning, we expect that improving the SSCM will have a positive mediating effect on the relationship between CE and FIP. The subjacent nature that may explain the positive effect of CE on FIP has to do with better-coordinated activities in sustainable supply chain management.

*H4: Sustainable supply chain management has a mediating effect on the relationship between the circular economy and financial performance.*

Figure 1 shows the proposed hypotheses.

H1

H2

H4

H3

Indirect effect

Figure 1. Research Model

1. **Research Methodology**

An empirical study was carried out in the Automotive manufacturing sector of Mexico, analyzing the effects of CE on sustainable supply chains and financial performance. Firstly, a Business Panel discussion was carried out with the participation of 3 academics from the area of innovation, 2 officials from government agencies related to business support, and 5 managers from the automotive industry. The results obtained in this phase allowed us to improve the questionnaire to collect information, which was tested in 10 companies in the automotive industry before applying it to the entire sample. Minor adjustments to writing, appearance, and spelling were made based on the panel’s feedback. This method is essential to ensure validity when questionnaires are self-administered (Hair *et al*., 2016). Appendix 1 presents the questionnaire.

**3.1 Sample and Data Collection**

*Asociación Mexicana de la Industria Automotriz* (AMIA) offered the frame of reference because it is the most up-to-date directory of the automotive industry in Mexico, with 909 registered companies (November 2018). By means of a simple random sampling, with a maximum error of ±4% and a reliability level of 95%, 720 companies were contacted. The response rate was 63.88%, getting a database of 460 companies. The fieldwork was carried out from January to March 2019. The questionnaire was distributed through a company dedicated to the collection of information and the application of industrial questionnaires, focusing on the general managers of the companies (not any other criteria).The questionnaire was initially distributed to the general manager of the companies, who then passed it along to the relevant departments for them to complete their corresponding information. The companies surveyed differ in their age, size and family-managed character (see Appendix 2).

A procedure was considered to evade biased answers (Podsakoff et al., 2003). Respondents were informed of the anonymous treatment, that there were no right or wrong answers, and that they should answer the questions honestly. This protocol reduced the chance of responses that were more socially desirable, lenient, acquiescent, and consistent with what is generally accepted. Common method bias was analyzed considering Harman's single factor (Podsakoff and Organ, 1986), revealing that the factorial analysis reports one factor that explains less than 40 percent of the total variance. Therefore, the relationships among the variables were not produced by common method variance.

**3.2 Variables and Analysis**

For the measurement of CE, an adaptation was made from a scale proposed by Ormazabal *et al*. (2018), who considered that CE can be measured through 8 items, which evaluate practices for the care of the environment and its application in the company. This scale was appropriate as it was implemented in the Spanish automotive industry. SSCM was based on an adaptation to the scale developed by Marshall *et al.* (2014), who considered 8 items that evaluate suppliers, employees, and supply chain processes. Finally, for FIP scale,was based on an adaptation from Bansal (2005) and Chan (2005), considering 7 items that take into account economic benefits, sales, and profit. Evidence suggests that CE does not achieve an immediate economic benefit but would provide a return on investment in the long term. However, in this study, FIP was measured in the short term. Vehicle assembly companies, as well as their main suppliers, have been implementing CE practices for several years, even though the Law on Circular Economy was approved in Mexico in 2021. Thus, we considered that it was feasible to measure the results of CE on FIP in the short term. The adaptations made to the original scales consisted of tropicalizing the items to the Mexican context, adjusting them to the common language in the Mexican business environment when translating them into Spanish. A five-point Likert-type scale was chosen to strike a balance between complexity for respondents and accuracy for analysis (Hair *et al*., 2016).

This research was based on a composite model, the main reason for using structural equations through Partial Least Squares (PLS-SEM) (Sarstedt et al., 2016). In the estimation, the SmartPLS 3 software was used (Ringle et al., 2015). Composite indicators are the operational definition of the emergent construct that mediates all its effects in the model (Hair *et al*., 2021). Constructs measured with composite indicators do not have an error term. Thus, composite indicators work as contributors to a construct instead of truly causing it (Bollen, 2011). These indicators have to share the same consequences (Henseler, 2017), although they may not be unidimensional and might not share a conceptual unit. Thus, composite indicators may represent different aspects relating to the construct. As explained by Sarstedt et al (2016), to estimate the paths, PLS uses Mode A and Mode B. Mode A links to correlation weights derived from bivariate correlations between each indicator and the construct, while Mode B has to do with regression weights. The three constructs considered in this research are Composite Type-A.

Table 1. Measurement Model Assessment

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Circular Economy (CE)  Cronbach’s alpha: 0.949; Dijkstra–Henseler’s rho (ρA): 0.951; CRI (ρc): 0.958; AVE: 0.739; Q2: 0.074 | | Financial Performance (FIP)  Cronbach’s alpha: 0.904; Dijkstra–Henseler’s rho: 0.905; CRI: 0.925; AVE: 0.637; Q2: 0.073 | | | |
|  | Factor loads (p-value) |  | Factor loads (p-value) | Q2 | |
| CE1 | 0,839 (0.000) | FIP1 | 0,804 (0.000) | 0,051 | |
| CE2 | 0,828 (0.000) | FIP2 | 0,773 (0.000) | 0,054 | |
| CE3 | 0,853 (0.000) | FIP3 | 0,829 (0.000) | 0,061 | |
| CE4 | 0,875 (0.000) | FIP4 | 0,773 (0.000) | 0,087 | |
| CE5 | 0,886 (0.000) | FIP5 | 0,825 (0.000) | 0,092 | |
| CE6 | 0,891 (0.000) | FIP6 | 0,862 (0.000) | 0,082 | |
| CE7 | 0,880 (0.000) | FIP7 | 0,714 (0.000) | 0,086 | |
| CE8 | 0,821 (0.000) |  |  |  | |
| Sustainable Supply Chain Management (SSCM)  Cronbach’s alpha: 0.945; Dijkstra–Henseler’s rho (ρA): 0.949; CRI (ρc): 0.954; AVE: 0.721; Q2: 0.201 | | | | | |
|  | Factor loads (p-value) | Q2 |  | Factor loads (p-value) | Q2 |
| SSCM1 | 0,793(0.000) | 0,149 | SSCM5 | 0,853(0.000) | 0,216 |
| SSCM2 | 0,836(0.000) | 0,148 | SSCM6 | 0,879(0.000) | 0,239 |
| SSCM3 | 0,862(0.000) | 0,196 | SSCM7 | 0,875(0.000) | 0,213 |
| SSCM4 | 0,865(0.000) | 0,211 | SSCM8 | 0,827(0.000) | 0,235 |
| Notes: CRI: Composite Reliability Index; AVE: Average Variance Extracted; Q2: Stone-Geisser’s Q² Blindfolding indicator/construct cross-validated redundancy | | | | | |

**4. Results**

**4.1 Reliability and Validity of Measurement Scales Measurement Model**

The reliability and validity of the scales were verified using Cronbach's alpha, Composite Reliability Index (CRI), Dijkstra - Henseler rho, and Average Variance Extracted (AVE) (Table 1) (Hair *et al.,* 2019). While the discriminant validity of the constructs was evaluated by means of three elements: the Fornell and Larcker criterion, and the Heterotrait-Monotrait ratio (HTMT) of correlations (Hair *et al*., 2019; Henseler *et al*., 2015) (Table 2).

The results revealed that the factorial loads were significant (between 0.714 and 0.891), above the proposed minimum level of 0.7. Cronbach's alphas were also greater than 0.8, showing good levels (Hair *et al.,* 2019). The CRI and Dijkstra - Henseler rho levels were also higher than the recommended threshold. CRI values were between 0.925 and 0.958 and Dijkstra - Henseler rho varied between 0.905 and 0.951, all above the recommended levels (Hair *et al.,* 2014). AVE values were also above the limits proposed by previous literature (Fornell & Larcker, 1981). Table 1 also reveals the Stone-Geisser’s Q² value (Stone, 1974; Geisser, 1974) as a criterion of predictive relevance. Q² values linked to both indicators and construct were above zero.

Table 2 also shows the discriminant validity analysis. Fornell and Larcker criterion was fulfilled in such a way that the shared variance between pairs of constructs was less than the variance extracted for each construct. HTMT ratio varied between 0.264 and 0.558, showing very satisfactory levels far from the recommended maximum of 0.85 (Henseler *et al*., 2015). Discriminant validity is also verified by the cross-loadings (Appendix 2).

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Table 2. Measurement Model. Discriminant validity | | | | | |
| Fornell-Larcker Criterio | | | | Heterotrait–Monotrait ratio (HTMT) | |
|  | 1 | 2 | 3 | 1 | 2 |
| 1 CE | **0.860** |  |  |  |  |
| 2 FIP | 0.264 | **0.798** |  | 0.281 |  |
| 3 SSCM | 0.534 | 0.251 | **0.849** | 0.558 | 0.264 |
| Notes: CE Circular Economy; SSCM: Sustainable Supply Chain Management; FIP: Financial Performance. Fornell-Larcker Criterion: Diagonal elements (bold) are the square root of the variance shared between the constructs and their measures (AVE). | | | | | |

**4.2 Structural Model**

Table 3 shows the results of the evaluation criteria which satisfied the general criteria. In this sense, the SRMR, the geodetic discrepancy (dG), and the unweighted least squares discrepancy (dULS) were below HI 99%, verifying the significance of the model (Dijkstra & Henseler, 2015). The estimation verified that CE positively impacts both FIP and SSCM. The coefficient linked to the relationship between CE and FIP was 0.160 (p-value:0.000). Similarly, the relationship between CE and SSCM revealed a significant coefficient of 0.534 (p-value: 0.000). These findings showed evidence in favor of H1 and H2, indicating that the adoption of CE promoted both SSCM and FIP.

Results also showed that a SSCM exerted a positive effect on FIP (0.129, p-value:0.009), identifying a significant mediating effect linked to the SSCM as the indirect effect was significant and positive (0.069, p-value:0.009). These findings showed evidence in favor of H3 and H4. Part of the positive effect of the CE on FIP was transmitted through the SSCM, because collaboration in improving the sustainability of the supply chain of companies in the automotive industry, not only substantially improved their FIP, but also reduced industrial waste and the recycling of components of the automotive industry, vehicles that had ended their useful life, using as raw materials to produce new ones could increase their level of FIP. Concerning the control variables, the results revealed a significant coefficient for SMEs (-0.188; p-value:0.000). Therefore, the size of the company positively influences its FIP.

Table 3. Structural model

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Paths** | **Path (*t-value;p-value*)** | **95% confidence interval** | **f2** | **Support** |
| CE→FIP (H1) | 0.160 (2.929;0.002) | [0.071;0.251] | 0.020 | Yes |
| CE→SSCM (H2) | 0.534 (12.084;0.000) | [0.462;0.609] | 0.399 | Yes |
| SSCM→FIP (H3) | 0.129 (2.370;0.009) | [0.043;0.218] | 0.013 | Yes |
| Size→FIP | -0.188 (3.871;0.000) | [-0.267;-0.107] | 0.038 |  |
| Age→FIP | -0.006 (0.131;0.448) | [-0.086;0.071] | 0.000 |  |
| **Indirect effect** |  | 95% confidence interval |  |  |
| CE\_SSCM\_FIP (H4) | 0.069 (2.346;0.009) | [0.023;0.119] |  |  |
|  | Adjusted R2 | Model Fit | Value | HI99 |
| SRMR | 0.033 | 0.034 |
| SSCM | 0.283 | dULS | 0.298 | 0.328 |
| FIP | 0.112 | dG | 0.138 | 0.143 |

Note: CE Circular Economy; SSCM: Sustainable Supply Chain Management; FIP: Financial Performance; Size: dummy variable that takes value 1 for small and medium-sized companies and 0 otherwise; Age: dummy variable that takes value 1 for young companies and 0 otherwise. One-tailed t-values and p-values in parentheses; bootstrapping 95% confidence intervals (based on n= 10000 subsamples) SRMR: standardized root mean squared residual (SRMR); dULS: unweighted least squares discrepancy; dG: geodesic discrepancy; HI99: bootstrap-based 99% percentiles.

0.160 (2.929;0.002)

0.534 (12.084;0.000)

0.069 (2.346;0.009)

0.129 (2.929;0.009)

Size

Age

-0.188 (3.871;0.000)

-0.006 (0.131;0.448)

Figure 2. Research Model Results

**5. Discussion**

The findings support that CE in the Mexican automotive industry exerts a positive effect on SSCM and FIP. These findings are consistent with the results obtained by Kuo & Chang (2021). The reasons for these positive effects are tax subsidies or preferential treatments from the government, a better competitive advantage, the reuse of waste into new products and more efficient use of raw materials and energy consumption. Therefore, the benefits associated with CE practices in the automotive industry are greater than the involved costs. The positive effect of CE practices on SSCM is in line with Yadav *et al*. (2020), who highlights the need to review the supply chain so that the company can reach appropriate levels of sustainability. The company's competitive advantage does not depend solely on its CE practices, but on the degree to which its relationships in SC are dictated by sustainability principles. As Manavalan and Jayakrishna (2019) point out, the competitive advantage will evolve depending on the role that the environmental concern has in the design of the supply chain strategy.

This paper also supports that SSC exerts a positive effect on FIP, leading to a significant indirect effect of CE on FIP by means of SSCM. This finding is in line with Tseng *et al.* (2020) and Genovese *et al.* (2017). SSCM not only generates a higher level of FIP but also transmits the effect of CE on FIP. Given that the use of strategies to care for the environment has been shown to have a positive effect on sales volume and thus on profit and return on investment, this effect is boosted if all the links in the supply chain carry out similar or complementary sustainable activities. The results of this study support the fact that the benefits of having a SSCM outweigh the negative aspects identified by Ahmad *et al*., (2018). Consequently, SSCM plays a fundamental role because it addresses sustainability issues by reducing negative processes in production, using non-toxic materials, and recycling the used products (Mativenga *et al*., 2017).

Additionally, the implementation of CE practices in the automotive industry facilitates the improvement of the level of FIP through better management of the sustainable supply chain, since it is through SSCM practices that companies reuse and recycle an important part of the materials of the vehicles that have completed their useful life as well as the industrial waste generated by the organizations, incorporating the recycled parts in the production of new vehicles. This does not only reduce the production costs of vehicles but also industrial waste. In addition, an important part of industrial waste is sold in the automotive industry to other recycling companies, thereby generating a substantial increase in their FIP.

This paper confirms that the practices of reduction, reuse, and recycling that integrate the CE, promote the sustainability of the supply chain, and improve the financial growth of companies in the automotive industry. In addition, the incorporation of remanufactured or recycled materials into new vehicles reduces the strong social pressure that companies must improve the environment and sustainability (Hofmann & Jaeger-Erben, 2020).

**6. Implications and limitations**

The implications are relevant for managers and public administration. Given the importance of achieving good financial results (Kharub & Sharma, 2016), the identification of relevant variables that drive this result can help promote strategies aimed at its maximization. Thus, the positive effects of the CE and SSCM policy on this performance indicator advocate business strategies aligned with sustainable policies that are justified not only by their effect on the environment but also by favorable business results in an industry as highly polluting as the automotive industry.

The fact that part of the positive effect of the CE is transferred through the sustainability of the supply chain indicates that the circular economy must go beyond the borders of the company itself, forcing or rewarding and always controlling that the suppliers of the supply chain maintain a philosophy of behavior aligned with the company's commitment to the environment. In this sense, the managers in the automotive industry must promote the adoption of technologies that increase the sustainability of the supply chain (Raut *et al.,* 2019), since this can facilitate a greater increase in the level of FIP. An example of these results is the case of Toyota, in which the company's management supported the improvement of the sustainability of the companies in its supply chain, which allowed them not only to be more innovative in the activities that make up the supply chain but also obtain better business results, including better FIP.

However, the adoption of the CE is not a constant practice in all the companies that make up the supply chain of the Mexican automotive industry, since managers are generally unaware of the positive effects that these activities have on organizations and coupled with the few government incentives that are offered could help their performance in the long term (Calzolari *et al.,* 2021). But the results obtained in this study clearly indicate that CE practices substantially affect the FIP and SSCM, which in turn, significantly improves the level of the FIP in the automotive industry, as it acts as a mediating variable between CE and FIP.

The fact that there is a multiplier effect since the environmental commitment of a company is transmitted exponentially to the rest of the companies, is relevant for the policy design. Improving the sustainability of the supply chain not only generates a significant increase in the level of FIP of companies in the automotive industry but also facilitates and contributes to the environmental activities of other organizations (Sahebjamnia *et al.,* 2018). These results advocate the closed-loop supply chain network design and the design of public policies aligned with the identification of driving companies that promote the multiplier effect of their environmental actions through CE policies. This identification will make it possible to direct public incentives to those agents that can have a greater effect on society, without forgetting that these agents obtain a financial benefit, being even greater the motivation to adopt CE policies that involve the entire supply chain.

This study provides important features: first, for managers and companies, the reasons why companies adopt these (CE and SSCM) practices are to improve competitiveness, improve reputation in the market, reduce energy costs through the use of renewable energy, execute the vision of top management, and improve quality. Managers must focus on identifying and eliminating activities that do not add value to their operations and processes (Centobelli *et al.,* 2020). The shift towards circular product streams, sustainable supply, and process design will significantly reduce emissions and waste. top management should develop leadership for corporate social responsibility and be more proactive in engaging in these practices.

Second in the academic world theoretical linkage and development—especially within SSCM and CE research is relatively neglected (Alkhuzaim *et al*., 2021). This research is clear evidence of the importance of the SSCM in the automotive industry when companies implement the activities of the CE. Therefore, SSCM plays a fundamental role, since it generally acts as a transmitter of the commitments that the automotive industry has with the care of the environment and sustainability, through the development of CE activities, which positively influences the level of FIP (Yu et al., 2018).

This study has some limitations. The sample only includes Mexican companies, so the results may vary with other countries with different economies, legislation, and business. Second, the data is cross-sectional, so in the proposed model the temporal effects have not been analyzed, hence the need for longitudinal studies. Third, the source of information used is single. Using quantitative data from other sources, or the opinions of employees could reinforce our results (Afshari *et al*., 2020). However, it is necessary to emphasize that the level of formal information in Mexico through statistics is far from adequate. Fourth, it is necessary to comment that although the adjusted R2 of the financial return is significant, its magnitude is not as high as we would like. CE may have a more relevant effect in the long term, that is, they will have a greater effect on the ROI when the implementation of CE reaches a degree of maturity.

**7. Conclusions and Future Research Directions**

This paper studies the direct and indirect effects of the CE on FIP, considering the mediating effect exerted by the SSCM in the context of the Mexican automotive industry. Analysis of a sample of 460 managers concludes that the CE and the SSCM have a direct positive effect on FIP. When the SSCM is considered as a mediating variable between the CE and FIP, a significant and positive indirect effect is obtained. Therefore, part of the effect that the CE has on FIP is transmitted through the SSCM.

This paper opens the doors to future research. First, given the significance of the relationships, the scarcity of studies on them advocates encouraging analysis in different contexts according to geographic scope and activity sector and considering the multiple dimensions of the constructs considered. Future research could be oriented to the analysis of the SSCM and its relationship with various dimensions of financial performance existing in the literature, as well as the consideration of the different measurement scales of the SSCM (ie one-dimensional or multidimensional), or through second-order constructs (ie suppliers, customer integration). Second, external factors related to interinstitutional theory should be investigated, such as coercive pressures, normative pressures, and mimetic pressures. Furthermore, intrinsic aspects of SSCM like localization, agility, and digitalization can help a company's CE flow. However, these can also carry high costs with no return in the short term. Finally, regarding the methodology, a qualitative case study analysis would help academia to get a deep knowledge about the whys and the insights of the previous relationships. Regarding quantitative methods, other approaches apart from PLS-SEM can be useful. For example, panel data analysis methods are able to take into account more information, more variability, and more efficiency than pure time series data or cross-sectional data, although the collection of panel data is obviously much more costly. This data considers both the intertemporal dynamics and the individuality of the entities.

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