International Journal of Development and Sustainability
ISSN: 2186-8662 – www.isdsnet.com/ijds
Volume 13 Number 5 (2024): Pages 384-407
ISDS Article ID: IJDS24020201

The impact of socially responsible businesses and innovation on CO_2 emissions in Mexico

Vicente Germán-Soto *

Facultad de Economía, Universidad Autónoma de Coahuila, Saltillo, México

Abstract

This research investigates whether regions with a greater presence of socially responsible businesses (SRBs) and higher levels of innovation activity produce less CO_2. SRBs create added social value and protect and care for the environment. This study adopts the empirical strategy of first identifying the companies among the 500 largest Mexican firms with an SRB distinction. Next, the SRBs are classified by state and source of capital (foreign or domestic). The sample represents 21 of the 32 Mexican states during the period 2010–2020. To reduce heterogeneity in the database and make the estimates more precise, regression models are based on the principal components method. The results confirm the effectiveness of SRBs at reducing CO_2 emissions, with profitability and innovation estimated to have a greater impact than solvency and business growth. Source of capital did not change these findings, although the source of reductions differed. For domestic firms, most reductions derive from return on equity; for foreign firms, the reductions are most associated with innovation. In Mexico, the search for profitability can be achieved with social responsibility and environmental care, but this requires involving more organizations that prioritize the use of innovative techniques.

Keywords: Environment; Innovation; Profitability; Principal Components

Cite this article as: Germán-Soto, V. (2024), "The impact of socially responsible businesses and innovation on CO_2 emissions in Mexico", *International Journal of Development and Sustainability*, Vol. 13 No. 5, pp. 384-407.

* Corresponding author. *E-mail address:* vicentegerman@uadec.edu.mx

1. Introduction

From a global perspective, the implications of the environmental effects of SRBs are becoming an increasingly important component of economic growth, population well-being, health, and sustainable economic activity, and it is not for less. The role of firms in society is not only to produce, create jobs and generate profits for shareholders but also to consider environmental impacts in the spaces and regions where they operate. In other words, business activity on the creation of new products and services and innovation efforts are interconnected with environmental sustainability (Travassos and Figueiredo, 2024). Acting with social responsibility means recognizing that the business production process inevitably generates pollution of the air, soil, and water, demanding that businesses commit to combatting environmental deterioration. According to several studies (Piacentini et al., 2000; Cajiga, 2010), social responsibility must be voluntary and transcend the boundaries of the legal obligations of firms. In this way, firms must create not only added value in the traditional sense but also social value in the sense of protecting and caring for the environment.

This research associates business performance with regional CO_2 emissions. Specifically, it tests the hypothesis that regions with a greater presence of socially responsible businesses (SRBs) and higher levels of innovation activity should generate less CO_2. In doing so, the study investigates several questions of interest: do SRBs have a quantitatively greater impact than non-SRBs on CO_2 emissions? How does this differ between domestic and foreign firms? Which definitions of corporate financial performance have more impact on the reduction of CO_2 emissions? Does regional innovation negatively impact pollutant emissions?

To explore these issues, this proposal reviews empirical data for Mexican companies for the period 2010–2020. The consensus among Mexico's business organizations is that, effectively, new ways of working involve managing operations to focus on environmental, social, and economic sustainability. This means helping to conserve the environment to the greatest extent possible. By adopting social and environmental commitments, firms achieve greater community penetration, broadening their reach and amplifying publicity. In this way, they become more popular and expand the market for their products. This suggests that large firms should be willing to sacrifice some (short-term) profitability and growth to invest in social and environmental actions if, beyond the positive impact on the environment, socially responsible action allows them to extend the market potential of their products. In this way, caring for and respecting the environment stimulates economic competition. Firms use not only prices, quality, processes, and advertising but also the concept of social responsibility as an instrument of competition. Although, in this way, social responsibility can come to represent a competitive advantage for the company (Cajiga, 2010; Andrade and Andrade, 2022; Chang et al. 2022), a shift towards responsibility requires a long-term strategy (Bolton and Park, 2022). This means that the behaviour of SRBs differs from enterprises yet to make any form of social commitment. This suggests that there should be a more prominent connection between the financial performance of SRBs and reductions in environmental degradation in regions with a greater presence of SRBs.

Based on the economic and financial performance of the 500 largest Mexican firms (Expansion, 2022), this work investigates the effectiveness of SRBs in reducing CO_2 emissions. This involves estimating the impacts of profitability, innovation, solvency, and business growth on the reduction of pollution in the period 2010–2020 with the region adopted as the unit of analysis. These variables have been adopted because social responsibility is more substantially linked to economic and business motives than altruistic or moral motives, as certain studies have demonstrated (e.g., Fernández-Gago and Martínez-Campillo, 2008; Crespo-Razeg, 2010). For

example, Wang (2011) and Chang et al. (2022) have observed that the implementation of social responsibility improves corporate image, positively impacting stock returns for Taiwanese enterprises. The findings of Pang and Yuan (2019) also show a positive correlation between social responsibility and financial performance. In addition, research on the relationship between corporate social responsibility and economic performance at the regional level is needed and relevant (Chen et al. 2019). Beyond the overall sample, this work also analyses the business performance for the groups of SRBs and non-SRBs by region and according to the source of the firm's capital, whether domestic or foreign.

This study adopts the principal components method to develop a model based on regression equations. This enables the inclusion of factor impacts focused on precise estimates by reducing heterogeneity in the database. Mexico's 500 largest firms have been used as the empirical case, assumed to enable understanding of the impact of SRBs on the environment because they are the corporations with the greatest capacity for generating revenues and reducing costs. In addition, SRBs remain marginal in México, a business model almost exclusively accessible to the largest firms (Saldaña, 2009). This group of firms achieves the highest profits and the highest dividends for partners and shareholders. In addition, the jobs generated by Mexico's 500 largest companies accounted for between 20% and 25% of the jobs formally registered with Mexican Social Security Institute during the study period. Meanwhile, their total sales corresponded to around 82% of Mexico's total GDP.

Some advanced results confirm the effectiveness of the SRB at reducing CO_2 emissions, even if the SRBs perform only as well as the non-SRBs. For SRBs, the factors of profitability and innovation have a greater impact than solvency and business growth. Furthermore, for domestic firms, reduced emissions were associated with return on equity (ROE). For foreign firms, in change, innovation was the biggest contributor. This indicates that social responsibility improves the business models of domestic firms – if not, ROE would not be the main factor contributing to the change in the company's impact on the environment. Meanwhile, because innovation is the most important factor for foreign firms, it is apparent that they rely on social responsibility to make their production processes more efficient. Furthermore, SRBs seek not only to fulfil traditional business objectives but also to provide social and community benefits. This is captured by the greater magnitude of the estimated effects compared to the non-SRBs.

The rest of the paper proceeds as follows. Section 2 reviews the literature on SRBs. Section 3 describes the data, hypothesis, and exploratory analysis. Section 4 presents the methodology, Section 5 details the results, and Section 6 provides some concluding remarks.

2. Literature review

It is increasingly urgent for managers and business owners to recognize the social and environmental responsibility associated with corporate activities. This not only helps to generate jobs and add value to society but also contributes to environmental activities in the communities where they operate. Social responsibility no longer involves substantial sacrifice on the part of companies. Instead, SRB models enable companies to better establish themselves in the market, which can mean increased sales and greater market power. Carroll (1979) introduced the concept of corporate social performance based on a study of the internal and external relationships of companies. Social businesses move beyond economic and legal acts by voluntarily making

decisions on areas such as pollution problems. In short, companies should satisfy three aspects: the nature of the corporate social performance (economic, legal, etc.), social issues (environment, consumerism, etc.), and social responsiveness (from doing nothing to doing a lot, that is, proactive). Later, authors such as Jones and Wicks (1999) insisted on the need to develop a multidisciplinary approach to understanding SRBs. They consider that an adequate concept should combine normative and instrumental elements, same that are fulfilled by the stakeholder theory.

The importance of social responsibility for corporate profits and for the community drives the theoretical currents that seek to understand it. One school of thought considers the ethical and legal issues tied up in the benefits to shareholders. This is known as "shareholder primacy" (Ehrlich, 2005; Fisch, 2006). Elsewhere, according to the "progressive vision", the corporation must aim to benefit society in the long run (Sheehy, 2005; Gabaldon, 2006). A third view is the "operational discretion" model, which holds that the law grants corporate managers discretion to comply with social and moral norms. The theory of stakeholders argues for a positive relationship between corporate social responsibility and business financing. This position advocates for the "capacity to understand [shareholder] expectations as a factor in the development of the organization and to acknowledge their contribution to value creation" (Bonnafous-Boucher and Rendtorff, 2016, p. 9). However, Narbel and Muff (2017) have identified two main limitations to this theory. First, they criticize its mercantilist vision, according to which the main purpose is generating economic value. In this sense, SRBs have adapted to value creation as a goal (Bosch-Badia et al., 2013). Second, social responsibility depends on regulation as a compensatory mechanism for firm-generated externalities. Social responsibility is a constitutive feature of a new form of regulation of global capitalism (Solís, 2008). However, investors view the implementation of social responsibility positively because it improves their corporate image and positively impacts stock returns without necessarily adding to a firm's costs or expenses (Wang, 2011).

The work of Piacentini et al. (2000) focuses on the incentives for food retailers to consider socially responsible actions in response to space maximization, profitability, and customer pressure motives but not philanthropic motives. Elsewhere, in a study of the Spanish electricity sector, Gonzalez (2010) identifies coercive and normative institutional pressures as a main determinant for collaboration in social activities but recognizes that decisions do not obey any form of economic rationality. Graafland and Mazereeuw-Van der Duijn Schouten (2012) indicate divided motives for executives to practise socially responsible conduct: If social aspects prevail, financial motives are more influential; however, if considerations are more predominantly environmental, ethical, and altruistic motives are more influential. That research, based on data representing 473 Dutch employers, suggests that socially responsible actions obligate individuals to move beyond income maximization. Elsewhere, Chambers and Serra (2018) measure the social activity of firms, that is, how much firms carry out social or community actions, and their findings suggest very low levels of social commitment that plummet if CO_2 emissions and worker injuries are considered. Meanwhile, numerous studies show that corporate social performance improves financial performance (Orlitzky et al., 2003; Margolis et al., 2009; Costa and Fonseca, 2022; Chang et al. 2022), although the meta-analysis by Hirsch et al. (2023) finds presence of publication bias around this nexus. Investigations of this type tend to receive the most interest from scholars. For example, Newig et al. (2023) derive similar results in a meta-analysis of 305 case studies. They consider that there is an urgent need to scrutinize and consolidate knowledge regarding stakeholder contributions in the context of socially responsible firms (in particular). In Kang and Ahn (2024), the industries experiencing mergers and acquisitions increase their socially responsible engagement emphasizing the importance of the

spillovers. According to Xing and Lee (2024) the firms owning shares in their rivals present a greater incentive to undertake environmental social responsibility actions.

Xu (2020) shows more interest in firm incentives to innovate, observing that a key motivation is competition with rival firms. Elsewhere, Tripathi and Kaur (2020) compare the financial investments of firms defined as socially responsible and those with conventional investments in emerging BRICS (Brazil, Russia, India, China) countries. Using a Generalized AutoRegressive Conditional Heteroskedasticity (GARCH) model, they conclude that socially responsible investment is aligned with sustainable growth because it stimulates the economic system while mitigating the risks associated with negative externalities. Costa and Fonseca (2022) propose a strategy for combining SRB and innovation where the objective is improving the financial performance of companies while implementing socially responsible actions. Elsewhere, Zhang et al. (2022) analysed 30 provinces in China during the period 2010–2016 and reached conclusions concerning a significant negative correlation between SRB and carbon emissions for different levels of marketization. Nguyen and Ngo (2022) document similar results in their analysis of the relationship between carbon emissions and sustainable economic development in ASEAN countries.

In a world where anthropogenic activities are leading to further environmental degradation, environmental innovation arises as an alternative to mitigate the negative effects of climate change and improve sustainability (Rather and Mahalik, 2024). Ĝater et al. (2023) separate the environmental and social dimensions of sustainability to study a set of firms and demonstrate that environmental and social responsibility activities are not necessarily driven by individual interest. Instead, managers frequently use altruistic actions to seek to improve the corporate image, as in Zain et al. (2023) where corporate governance contributes to facilitating the disclosure of social responsibility, or as in the results by Siems et al. (2023) where supply chain practices are essential for reducing the ecological degradation.

It is now worth properly considering this paper's focus, namely, how Mexican firms participate in SRB. According to Saldaña (2009), in Mexico, SRB diffusion remains marginal and reserved almost exclusively for large firms. This matches more global comments made by Reinhardt et al. (2008) that suggest that larger firms are more likely to participate in voluntary programs due to factors including industry association membership, R&D expenditures, culture, and financial management. In Mexico, large companies demonstrate more social activity and tend to allocate most resources, enabling them to reach a larger market. However, evaluations of their impacts on Mexican society in the medium and long term remain inconclusive (Solís, 2008; Saldaña, 2009; López et al. 2011; Flores and Gaytán, 2018), and studies suggest that such approaches represent part of a business strategy (Bernal and Alpuche, 2023).

3. Data, sample design, and exploratory analysis

3.1. Database and sample design

This study uses three kinds of data: regional CO_2 emissions, data on the financial performance of firms, and variables of regional performance. CO_2 emissions are taken from the Ministry of Environment and Natural Resources via the Register of Emissions and Transfer of Pollutants. These data represent emissions of a total of 200 substances that are generated by the companies. Firm financial data is based on a sample of the 500

largest Mexican firms (Expansión, 2022), including those with the SRB distinction granted by the Mexican Center for Philanthropy (Cemefi). The index of the 500 most important companies in Mexico is a ranking of for-profit companies that offer a good or service and that report income or sales. The objective of the ranking is to provide an overview of the main Mexican companies in the various economic sectors. In an open call, more than 2,500 public and private companies (Mexican and transnational) are invited to present financial data. This enables the establishment of the final list, which was elaborated annually between 2010 and 2020 (Expansión, 2022).

Expansión (2022) provides data on total sales per worker, ROE, solvency, and employment. Innovation is measured by the number of patent applications by region. These data are provided by the Mexican Institute of Industrial Property. Innovation is a key factor for business success because it helps to afront environmental responsibility (Goli et al., 2020). Other variables provided at the regional level to complete the database are education (secondary school enrolment, obtained from the Ministry of Education), financial development based on bank deposits as a ratio of the gross state product (obtained from the Mexican Institute of Statistics (INEGI) in the form of statistical annuaries), GDP of high-growth sectors as a ratio of the total GDP (obtained from the INEGI, System of National Accounts platform), and an index of economic diversification (obtained from the INEGI as the number of sectors in the economy). CO_2 emissions are measured in metric tons per million pesos of GDP, business growth is calculated as the growth rate of the firm's total sales per worker, ROE is calculated as the net income in relation to stockholder equity (%), solvency (the ability to meet the payment obligations) is measured as total assets divided by the total liabilities, total sales (in millions of pesos at constant 2018 prices), and employment is the number of employees in enterprises.

To extract as much information as possible from the data, we organized the panel structure aggregating the information from the Mexican state for the period 2010–2020. However, SRBs exist in only 21 of the country's states, according to the place of production of the companies. As such, the data panel comprises 21 economies over 11 periods. Furthermore, the SRBs are classified both by Mexican state and the source of the company's capital, whether domestic or foreign. A synopsis of the SRBs appears in Figure 1. In selecting variables, we have especially considered dimensions with a significant connection to the commitment of firms to objectives of social and environmental value. However, our study does not substantially represent cultural and ethical elements. ROE enables the measurement of the profitability of firms. Business growth is proxied by total sales, with both related to the commercial dimension. CO_2 emissions cover the ecological dimension, and employment and innovation correspond to the social dimension. The solvency indicator tests the hypothesis regarding commercial sustainability. The synopsis attempts to briefly cover the various hypotheses derived from the theory of social responsibility. As a result, a wide spectrum of the inherent postulates is addressed through these variables.

It should be noted that the firms panel is composed by only companies that achieved and kept the SRB distinction throughout the analysis period, which implied a matching work, year by year, between the Expansion companies and those listed in Cemefi. A company with the SRB distinction must work to keep it, as Cemefi verifies that the voluntary effort of the companies is part of their corporate culture and business. If a company fails to comply with its social responsibility, it is removed from the list, therefore, the list must be updated every year. In this way, Cemefi ensures that a company with the SRB distinction has a continuous and publicly demonstrable activity with concrete actions in favour of the environment.

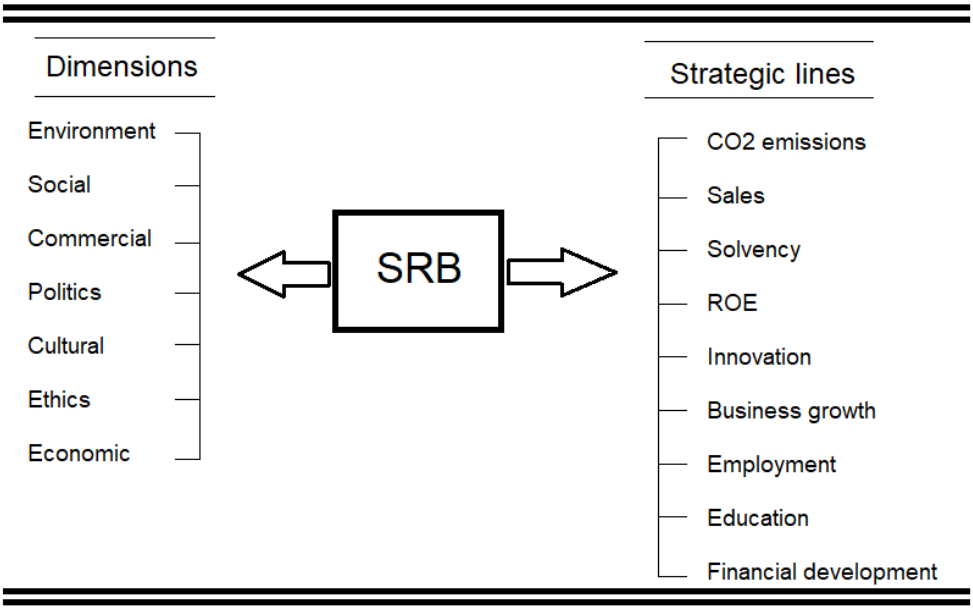

Figure 1. Dimensions and strategic lines of the SRBs considered by this study

To investigate the impact on the environment from each company type, SRBs and non-SRBs, and to know whether the source of capital also concerns this behaviour, our empirical strategy is based on several samples according to the classification of firms and their source of capital, as Figure 2 shows. We conduct analyses for the overall sample and for the SRB and non-SRB samples separately. Each sample estimates the impacts according to the source of the firm's capital. As such, the evidence is based on a total of nine samples.

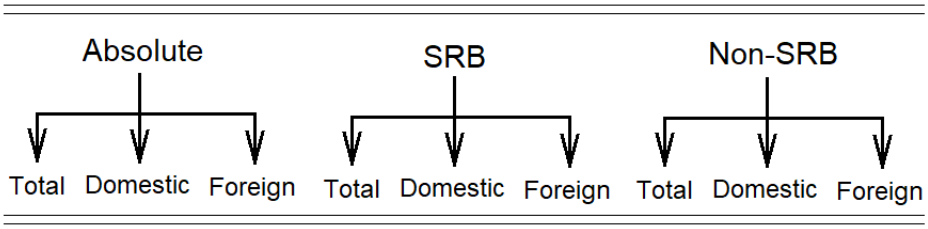

Figure 2. This work's sample design

3.2. Exploratory analysis

3.2.1. Characteristics of the database

The database contains 212 corporations with the SRB distinction granted by Cemefi. This means there are 288 corporations without this recognition. Also, 233 companies have derived their capital from a foreign source, and 267 utilize domestic capital. SRBs are present in very diverse economic sectors: financial and banking, automotive and auto parts, airlines and airports, commercial and department stores, agribusiness, logistics and transportation, construction, telecommunications, restaurants and hotels, metallurgy, mining, food and

beverages, oil, insurance, electrical and electronics, chemicals and pharmaceuticals and real estate companies. Figure 3 presents the sectoral composition of the sample of SRBs.

The sector with the largest number of SRBs is food and beverages (21.7%). It might seem unusual, but this can be explained by the fact that these companies are subject to considerable competition and customer pressure, meaning they have a surplus of motivation to engage in SRB practices. Other large contributors to the diffusion of SRBs are financial and banking services (11.3%), automotive and auto parts (9%), commercial and department stores (8.5%), construction (7.5) and insurance (7.5%).

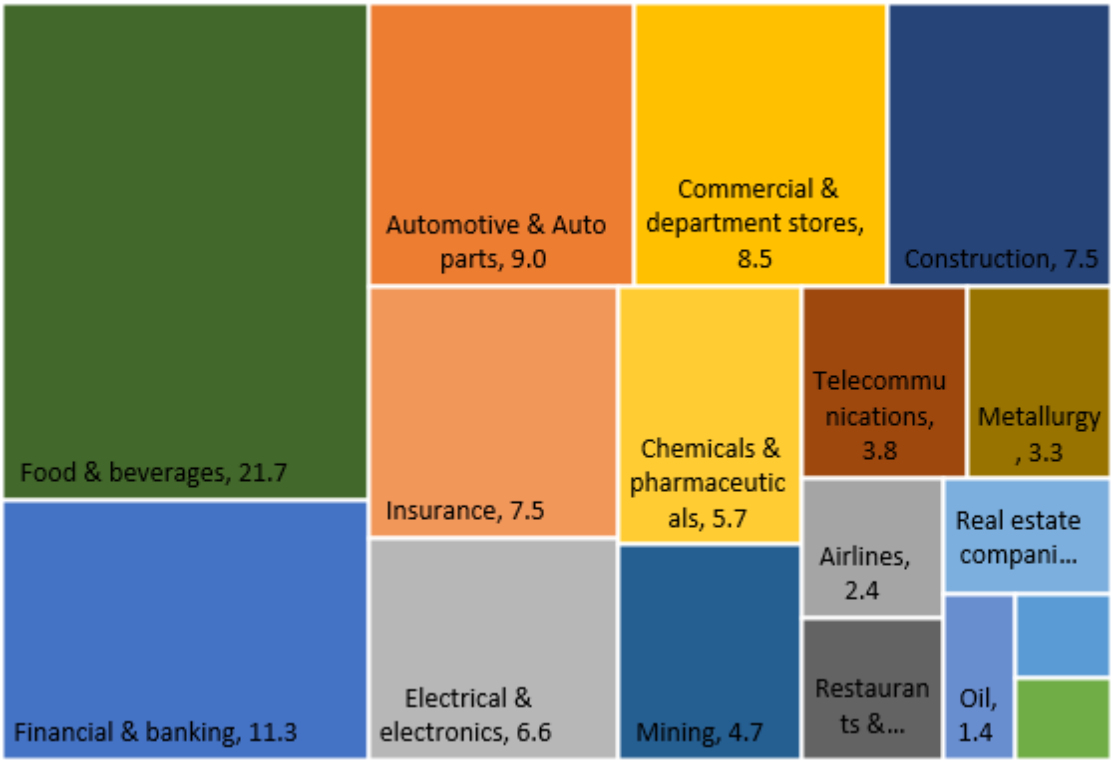

Figure 3. Sectors represented in the sample of SRBs (%) (Source: Developed based on data from Expansión, 2022)

The regional distribution and concentration of companies among the 500 largest Mexican firms appear in Figure 4. Ciudad de México has the largest number of companies (299 in total). This is followed by Nuevo León (61 companies), Jalisco (26 companies) and Estado de Mexico (22 companies). These four are also those with the largest populations and the highest level of total production in the country. In the next category, there is a group of states with between 8 and 20 companies. Next, 13 states have between 1 and 7 companies. Eleven states are not represented among Mexico's 500 largest companies. It is apparent that companies in Mexico tend to be concentrated in the central, western, and northern regions, with the southern and south-eastern regions not featuring in the analysis period.

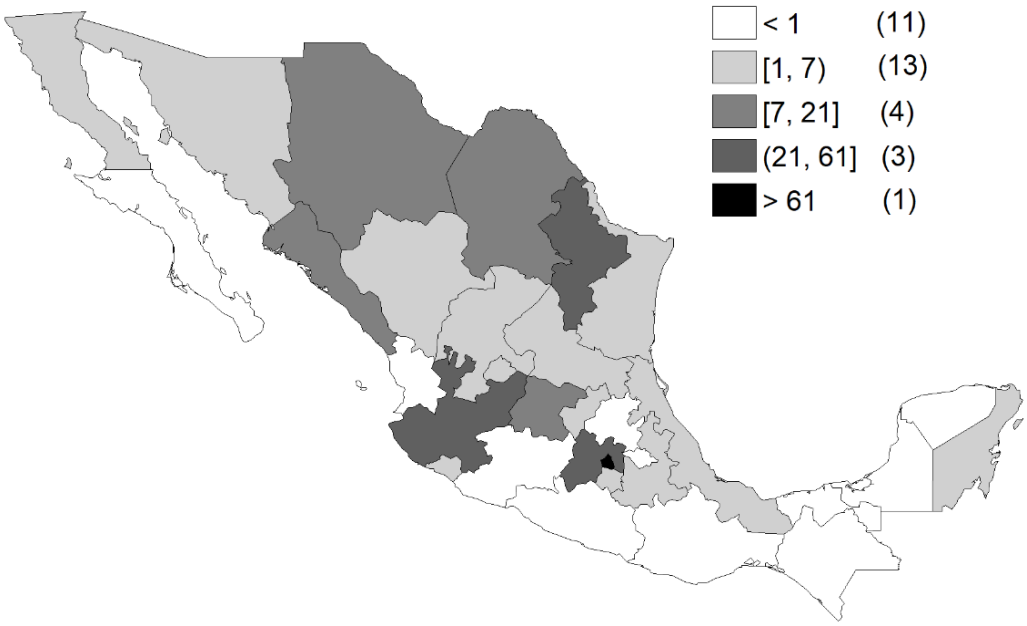

Figure 4. SRB frequency and geographical location (Source: Developed based on data from Expansión, 2022).

3.2.2. Statistical analysis

The analysis of the basic statistics of the set of variables shows that CO_2 emissions closely resemble a normal distribution, while ROE and solvency present distributions further from the normal distribution, indicating greater dispersion and asymmetry across the states that feature in the sample (Table 1). It has been observed that CO_2 averages a kurtosis of 3.00 and a measure of asymmetry very close to zero. These indicators are very different for ROE and solvency. Meanwhile, the rest of the variables, like CO_2, have values close to 3 and 0. These distributions suggest that issues of heterogeneity and large variances in the regression models need to be addressed.

Table 1. Descriptive statistics for the database

	Mean	Maximum	Minimum	Standard deviation	Skewness	Kurtosis
CO_2 emissions	1.985	4.415	-2.623	1.438	-0.678	3.008
ROE (%)	12.039	162.887	-129.128	19.606	0.518	40.983
Solvency (SOL)	0.821	3.846	0.278	0.447	3.204	19.889
Total sales (TS)	11.676	16.332	8.253	1.685	0.855	4.156
Employment (EM)	10.537	14.875	7.003	1.721	0.545	3.540

Table 1. *Cont.*

	Mean	Maximum	Minimum	Standard deviation	Skewness	Kurtosis
Business growth (BG)	11.020	14.875	7.090	1.620	0.671	3.538
Innovation (INN)	3.668	6.056	0.000	1.191	-0.439	3.301
Education (EDU)	12.393	13.727	11.143	0.642	0.152	2.346
Financial development (FD)	5.054	6.648	3.677	0.517	0.213	3.644
High-Growth sectors (HGS)	4.187	4.484	3.757	0.125	-0.737	3.858
Economy diversification (DIV)	6.712	6.856	6.455	0.086	-0.986	3.510

Notes: variables are in logarithms. Observations after adjustments: 156.

The matrix of correlations between CO_2 and the explanatory variables is reported at three levels of analysis, namely, for the total sample (Table 2) and for domestic and foreign companies (Table 3). The strength of the association between SRB and non-SRB companies is estimated separately at each level of analysis. The results align with the theoretical expectation. For example, it is apparent that business growth, innovation, education, financial development, and economic diversification show negative and highly significant associations with CO_2 emissions. However, in absolute terms, financial development shows the greatest strength of association with CO_2. ROE and high-growth sectors present more non-significant cases, with financial solvency only non-significant for the SRB subsample.

The evolution of CO_2 emissions in the 21 states included in this study appears in Figure 5. Although notable individual variation is apparent, the range of global variation in pollutant levels has narrowed during the analysis period, a sign that CO_2 emissions have decreased over time, meaning that a group of economies has converged in terms of pollutants emitted into the atmosphere.

Table 2. CO_2 correlation matrix for the whole sample

	Total	SRB	No-SRB
ROE (%)	-0.158 **	-0.025	-0.135
	(0.048)	(0.771)	(0.138)
Solvency	-0.242 ***	-0.007	-0.362 ***
	(0.002)	(0.936)	(0.000)

Table 2. *Cont.*

	Total	SRB	No-SRB
Total sales	-0.307 ***	-0.065	-0.232 ***
	(0.000)	(0.358)	(0.003)
Employment	-0.302 ***	-0.099	-0.217 ***
	(0.000)	(0.161)	(0.005)
Business growth	-0.400 ***	-0.494 ***	-0.369 ***
	(0.000)	(0.000)	(0.000)
Innovation	-0.331 ***	-0.579 ***	-0.258 ***
	(0.000)	(0.000)	(0.004)
Education	-0.217 ***	-0.408 ***	-0.252 ***
	(0.006)	(0.000)	(0.005)
Financial development	-0.611 ***	-0.715 ***	-0.583 ***
	(0.000)	(0.000)	(0.000)
High-Growth sectors	-0.045	-0.229 ***	0.059
	(0.573)	(0.008)	(0.517)
Economy diversification	-0.172 **	-0.451 ***	-0.164 *
	(0.032)	(0.000)	(0.072)

*Notes: p-values are in parentheses. Superscripts ***, **, and * stand for rejection of the null hypothesis at the 1%, 5%, and 10%, respectively.*

Table 3. CO_2 correlation matrix for domestic and foreign firms

	Domestic firms			Foreign firms		
	Total	SRB	No-SRB	Total	SRB	No-SRB
ROE (%)	-0.158 *	-0.071	-0.101	-0.109	-0.042	-0.219
	(0.077)	(0.455)	(0.321)	(0.286)	(0.748)	(0.110)

Table 3. *Cont.*

	Domestic firms			Foreign firms		
	Total	SRB	No-SRB	Total	SRB	No-SRB
Solvency	-0.395 ***	-0.090	-0.451 ***	0.206 **	0.051	0.233 *
	(0.000)	(0.341)	(0.000)	(0.044)	(0.696)	(0.088)
Total sales	-0.293 ***	-0.272 ***	-0.333 ***	-0.282 ***	-0.329 ***	-0.199 **
	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)	(0.024)
Employment	-0.295 ***	-0.252 ***	-0.285 ***	-0.333 ***	-0.302 ***	-0.229 ***
	(0.000)	(0.002)	(0.001)	(0.000)	(0.000)	(0.009)
Business growth	-0.356 ***	-0.417 ***	-0.342 ***	-0.649 ***	-0.542 ***	-0.721 ***
	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)
Innovation	-0.493 ***	-0.668 ***	-0.418 ***	-0.605 ***	-0.533 ***	-0.682 ***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Education	-0.286 ***	-0.451 ***	-0.325 ***	-0.476 ***	-0.331 ***	-0.573 ***
	(0.001)	(0.000)	(0.001)	(0.000)	(0.009)	(0.000)
Financial development	-0.683 ***	-0.752 ***	-0.639 ***	-0.695 ***	-0.665 ***	-0.778 ***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
High-Growth sectors	-0.106	-0.285 ***	0.023	-0.186 *	-0.046	-0.249 *
	(0.240)	(0.002)	(0.820)	(0.068)	(0.720)	(0.069)
Economy diversification	-0.299 ***	-0.551 ***	-0.266 ***	-0.489 ***	-0.436 ***	-0.678 ***
	(0.001)	(0.000)	(0.007)	(0.000)	(0.000)	(0.000)

*Notes: p-values are in parentheses. Superscripts ***, **, and * stand for rejection of the null hypothesis at the 1%, 5%, and 10%, respectively.*

This exploratory analysis demonstrates that we investigated whether the presence of SRBs and the higher level of innovation implied a lower CO_2 emission. Notably, we also inquired about the impact of the financial performance variables considered, the extent to which improvements in educational attainment, economic diversification and business growth reduced pollutant emissions, and the intensity exerted on the environment between foreign and domestic companies.

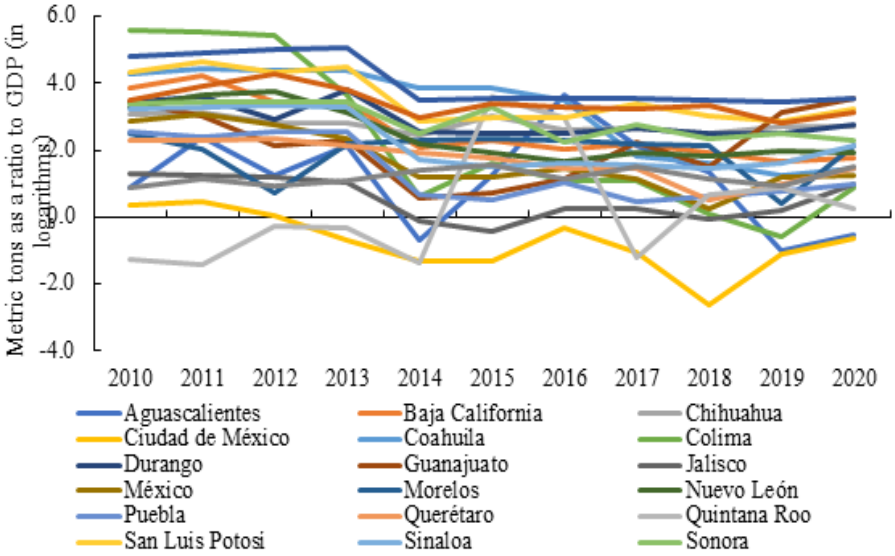

Figure 5. CO_2 emissions by state (Source: Developed based on data from the Ministry of Environment and Natural Resources).

4. The basic method of analysis

The methodological analysis starts from the definition of the standard regression model by ordinary least squares (OLS):

$$y = X\beta + \varepsilon \quad (1)$$

where y is a vector of n observations and X is a matrix of regressors, β is a vector of coefficients and ε is the vector of aleatory terms. For this work, the empirical version of model (1) is as follows:

$$CO_2 = f(ROE,\ SOL,\ TS,\ EM,\ INN,\ EDU,\ FD,\ HGS,\ DIV) \quad (2)$$

with the acronyms defined in Table 1. Then, the empirical regression model in developed notation is specified as:

$$CO2_{i,t} = \beta_0 + \beta_1 ROE_{i,t} + \beta_2 SOL_{i,t} + \beta_3 TS_{i,t} + \beta_4 EM_{i,t} + \beta_5 INN_{i,t} + \\ = \beta_6 EDU_{i,t} + \beta_7 FD_{i,t} + \beta_8 HGS_{i,t} + \beta_9 DIV_{i,t} + \varepsilon_{i,t} \quad (3)$$

Imprecision of the estimators from pool OLS regressions and from fixed effects are of concern due to collinearity between CO_2 determinants. A first approximation from OLS generated very high variance and a very low coefficient of determination (less than 0.06), while the auxiliary regressions estimated with fixed effects showed very high fit coefficients (Table 4), which is usually a clear indication of collinearity (Greene, 2008). Furthermore, the analysis of the OLS residuals concluded that they did not behave randomly or satisfy the normality criterion (Figure 6).

Table 4. Auxiliary regressions (coefficient of determination)

Variable	Overall	SRB	Non-SRB	Domestic	Foreign
ROE	0.13	0.28	0.14	0.21	0.22
Solvency	0.49	0.82	0.58	0.52	0.83
Total sales	0.98	0.99	0.99	0.99	0.99
Employment	0.98	0.99	0.99	0.99	0.99
Business growth	0.97	0.99	0.99	0.99	0.99
Innovation	0.93	0.92	0.91	0.93	0.95
Education	0.99	0.99	0.99	0.99	0.99
Financial development	0.71	0.94	0.91	0.93	0.92
High-Growth sectors	0.93	0.95	0.97	0.96	0.94
Economy diversification	0.98	0.97	0.99	0.98	0.96

As Table 4 shows, almost all the variables strongly correlate with the rest of the explanatory variables, producing coefficients above 0.85. The exceptions are ROE and solvency indicators. Therefore, given the characteristics of the database, collinearity conflicts are an issue. In addition, the finite sample properties of standard methods such as OLS and GMM in highly over-identified cases perform weakly and generate imprecise estimations. The key to improving estimates is to reduce the variability of the database. One way to do this is by considering the eigenvalues/eigenvectors decomposition, i.e., using the principal components method (Doran and Schmidt, 2006).

This demands the application of some strategies in the estimation of the link between CO_2 and its determinants. The first approach involves the definition of business growth as the ratio of total sales to employment. A second strategy is the principal components method as a regression problem (Jolliffe, 2002). This approach involves looking for the linear combination of explanatory variables that provides the best fit of all possible combinations. In Jolliffe (2002) and Jolliffe and Cadima (2016), the central objective of the principal

component analysis is to retain all the possible variations present in the data set, transforming the original variables into uncorrelated variables.

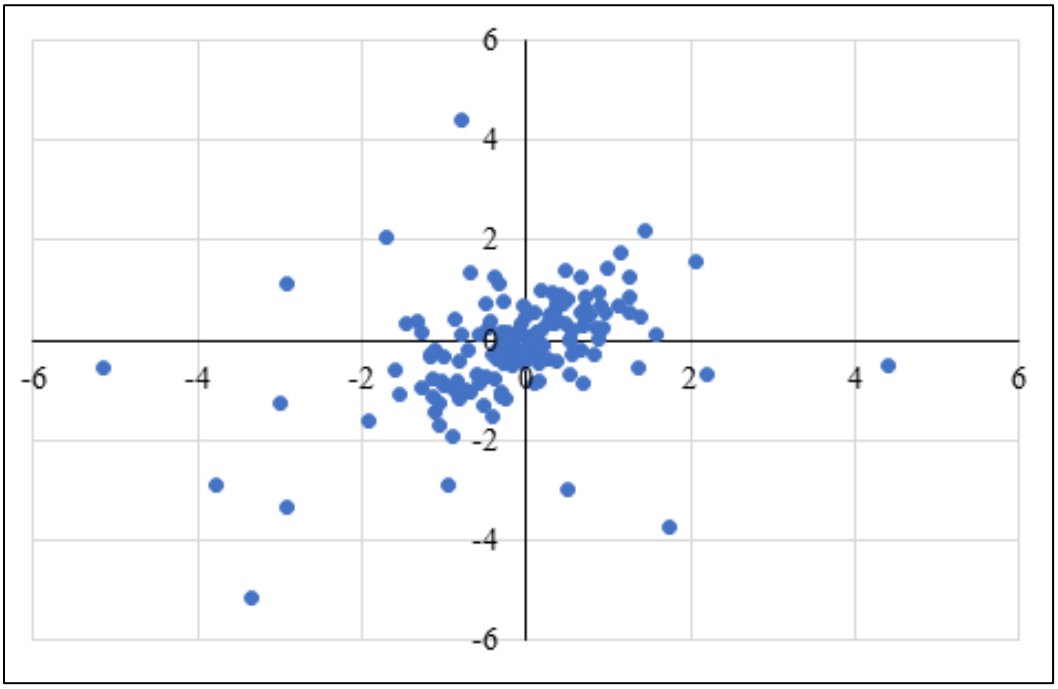

Figure 6. OLS residuals for the whole sample

Principal component regression attempts to represent the original variable X as a system of linear combinations P that best represents the information contained in the original variable X. This is standardized to have a mean equal to zero:

$$X_{it}^{*} = (X_{it} - \bar{X}) \cdot S_X^{-1} \quad (4)$$

where $\bar{X}$ and S_X are the mean and standard deviation of X_{it}. The transformations of principal components are given by:

$$P = X \cdot E \quad (5)$$

where E is a squared matrix kxk of eigenvectors, with elements given by $E = [e_1,\ e_2,\ \ldots,\ e_k]$. Each variable P is uncorrelated because $(P'P)$ is symmetrical, and their eigenvalues are orthogonal (Jolliffe, 2002). At this level, each eigenvector is associated with one eigenvalue, so $\lambda = diag(\lambda_1,\ \lambda_2,\ldots,\ \lambda_k)$ is the diagonal matrix of eigenvalues. As such,

$$cov(P_i P_j) = e_i'(P'P)e_j = \lambda_i e_i' e_j = 0 \quad (6)$$

and the variance of the new P variables is:

$$var(P_i) = E\left[e_i'(P'P)e_j\right] = \left[\lambda_i e_i' e_j\right] = \lambda_i \quad (7)$$

Disposing of the eigenvalues in descending order of magnitude:

$$\lambda_i = \lambda_1 \leq \lambda_2 \leq \lambda_3 \leq \ldots \leq \lambda_k \quad (8)$$

Hence, the i_{th} principal component is:

$$C_m = e_m' P \qquad \text{where } m = 1,\ 2,\ 3, \ldots,\ K \quad (9)$$

Equation (9) provides evidence that Cs are the linear combinations of the true data, with their use in regression analysis very useful because there are no multicollinearities between them (Jolliffe, 2002). For example, the analyses based on the principal components improve the predictive power of the economic variables of interest (Ng, 2015). Furthermore, it increases interpretability and lessens the loss of information (Jolliffe and Cadima, 2016).

Despite the principal components having some attractive advantages, such as avoiding redundant information and removing correlated features, the results may be sensitive depending on the number of components considered. Additionally, due to the linear transformation, the estimates may experience a loss of information, weakening the interpretation of the variables in some cases. However, an evaluation of the pros and cons suggests that, overall, economic analyses are enhanced compared to results obtained from regression models using highly correlated variables.

5. Analysis of the results

The empirical exercise comprises nine regressions. These are organized in Tables 5 (whole sample), 6 (domestic firms), and 7 (foreign firms) and enable the analysis of the impact on CO_2 emissions and allow for comparisons between domestic and foreign firms and between SRB and non-SRB firms. In all the regressions, there is a reasonable adjustment according to theoretical expectations about the impacts on CO_2 emissions. Almost all regressions estimated impacts in the predicted direction, only differing in magnitude. Profitability, measured by the ROE, tends to reduce CO_2 emissions, as does education. However, in terms of other factors, the direction of the effects changes according to the sample. Solvency, for example, estimates a negative effect in all samples except for the foreign firms, while innovation has a positive effect except for SRBs.

Table 5 estimates the impacts without distinguishing them by source of capital. The first regression (overall) is the most general because it is not distinguished by SRBs. From this perspective, innovation and high-growth sectors increase emissions, while the other variables reduce them. The greatest reductions are obtained from financial development, with the three variables widely related to business performance (ROE, solvency, and business growth) improving the environment when the analysis is separated individually into SRB and non-SRB samples. The exception is for the business growth of non-SRBs, where the impact is not significant. However, this discussion understands regional innovation as a determinant that causes SRBs to reduce pollutants. By contrast, non-SRBs estimate a positive coefficient. The positive and highly significant effect of financial development is noticeable, while the effects of high-growth sectors and economic diversification are ambiguous.

Table 5. Impacts on CO_2 emissions for the whole sample

Variable	Sample					
	Overall		SRB		No-SRB	
Constant	2.129 ***	(0.058)	2.156 ***	(0.064)	1.939 ***	(0.072)
ROE (%)	-0.343 ***	(0.032)	-0.406 ***	(0.032)	-0.381 ***	(0.048)
Solvency	-0.442 ***	(0.051)	-0.139 ***	(0.048)	-0.418 ***	(0.064)
Business growth	-0.133 **	(0.060)	-0.122 *	(0.063)	0.127	(0.079)
Innovation	0.197 ***	(0.065)	-0.557 ***	(0.068)	0.295 ***	(0.092)
Education	-0.552 ***	(0.067)	-0.543 ***	(0.079)	-0.553 ***	(0.087)
Financial development	-0.787 ***	(0.095)	0.777 ***	(0.097)	0.926 ***	(0.131)
High-Growth sectors	0.211 *	(0.119)	0.135	(0.119)	0.219	(0.154)
Economy diversification	-0.487 **	(0.189)	0.315	(0.229)	0.012	(0.207)
Adjusted R-squared	0.70		0.72		0.69	
F-statistic	45.16 [0.000]		42.88 [0.000]		33.64 [0.000]	
Normality test	1.771 [0.412]		0.604 [0.739]		0.171 [0.917]	
Observations: T/N (unbalanced panel)	11/18		11/16		11/13	

*Notes: standard errors are in parentheses and p-values are in brackets. Superscripts ***, **, and * stand for rejection of the null hypothesis at the 1%, 5%, and 10%, respectively.*

Focusing on domestic firms (Table 6), the indicators of business performance constitute important factors for reducing CO_2 emissions for the overall sample, although financial development and innovation increase it. The impacts of high-growth sectors and economic diversification are again ambiguous. Notable differences prevail among domestic firms, mainly in terms of the impacts of solvency and innovation. However, innovation is not important for SRBs, although it does matter for non-SRBs. Interestingly, solvency estimates opposite effects in each sample. Economic diversification helps to reduce the CO_2 emissions of national firms. As in the case of the whole sample (Table 5), profitability has a greater impact on SRBs than non-SRBs. However, for all other significant variables, SRBs generally record comparatively smaller impacts.

Turning now to foreign firms, Table 7 indicates contrary effects for ROE and solvency. ROE decisively negatively impacts emissions, but the impact from solvency is positive for the three samples. Business growth ambiguously affects CO_2 emissions of foreign SRBs and foreign non-SRBs. Advances in high-growth sectors

only reduce air pollution for non-SRBs, with the effect positive for SRBs. Meanwhile, financial development estimates a consistent negative effect for all three samples, as do the education and ROE indices. Generally speaking, the effectiveness of SRBs at reducing CO_2 emissions is particularly notable for all regressions. Entrepreneurship profitability, innovation and education decisively reduce CO_2 emissions in the case of regressions involving only SRBs. Finally, solvency and business growth exert mixed results on the reductions, with financial development reducing air pollution only in the subsample of foreign firms.

Table 6. Impacts on the CO_2 emissions in domestic firms

Variable	Sample					
	Overall		SRB		No-SRB	
Constant	2.049 ***	(0.067)	2.093 ***	(0.071)	1.857 ***	(0.075)
ROE (%)	-0.357 ***	(0.032)	-0.499 ***	(0.035)	-0.380 ***	(0.046)
Solvency	-0.295 ***	(0.062)	0.142 **	(0.063)	-0.186 **	(0.084)
Business growth	-0.583 ***	(0.071)	-0.243 ***	(0.069)	-0.698 ***	(0.079)
Innovation	0.283 ***	(0.082)	-0.049	(0.081)	-0.264 **	(0.105)
Education	-0.403 ***	(0.089)	-0.390 ***	(0.097)	-0.406 ***	(0.114)
Financial development	0.704 ***	(0.125)	0.982 ***	(0.113)	0.777 ***	(0.135)
High-Growth sectors	0.196	(0.147)	0.101	(0.149)	-0.053	(0.170)
Economy diversification	-0.126	(0.312)	-0.504 *	(0.265)	-0.661 ***	(0.208)
Adjusted R-squared	0.71		0.73		0.78	
F-statistic	38.18 [0.000]		38.46 [0.000]		39.64 [0.000]	
Normality test	1.797 [0.407]		0.608 [0.737]		0.243 [0.885]	
Observations: T/N (unbalanced panel)	11/13		11/11		11/10	

*Notes: standard errors are in parentheses and p-values are in brackets. Superscripts ***, **, and * stand for rejection of the null hypothesis at the 1%, 5%, and 10%, respectively.*

Comparing the impacts of SRBs and non-SRBs enables the conclusion that SRBs demonstrate the greatest reductions in CO_2 emissions due to ROE, innovation, financial development (whole sample and domestic sample) and economic diversification (foreign sample). However, for some factors, the non-SRBs demonstrate better environmental performance. This finding is consistent with the literature, which has not found strong

evidence about the contribution of SRBs (Goldreyer et al., 1999) and has even found mixed evidence in the case of the disaggregated analysis by sector (Piacentini et al., 2000). In addition, the meta-analysis by Margolis et al. (2009) concludes that the difference between corporate social performance and corporate financial performance has a limited impact on profitability. Nonetheless, companies that are profitable are more likely to engage in more socially responsible activities.

Table 7. Impacts on the CO_2 emissions of foreign firms

Variable	Sample					
	Overall		SRB		No-SRB	
Constant	1.863 ***	(0.069)	1.497 ***	(0.093)	1.516 ***	(0.086)
ROE (%)	-0.448 ***	(0.030)	-0.394 ***	(0.038)	-0.541 ***	(0.041)
Solvency	0.156 ***	(0.049)	0.211 ***	(0.068)	0.117	(0.073)
Business growth	-0.228 ***	(0.062)	0.046	(0.077)	-0.563 ***	(0.089)
Innovation	0.553 ***	(0.067)	-0.242 ***	(0.092)	0.373 ***	(0.102)
Education	-0.208 **	(0.086)	-0.371 ***	(0.096)	-0.395 ***	(0.116)
Financial development	-1.022 ***	(0.099)	-1.275 ***	(0.122)	-0.287 **	(0.118)
High-Growth sectors	0.448 ***	(0.132)	0.611 ***	(0.187)	-1.158 ***	(0.204)
Economy diversification	-0.224	(0.202)	-1.014 ***	(0.314)	-0.013	(0.401)
Adjusted R-squared	0.78		0.75		0.81	
F-statistic	42.79 [0.000]		24.05 [0.000]		29.18 [0.000]	
Normality test	1.640 [0.440]		1.865 [0.393]		1.013 [0.602]	
Observations: T/N (unbalanced panel)	11/14		11/9		11/7	

*Notes: standard errors are in parentheses and p-values are in brackets. Superscripts ***, **, and * stand for rejection of the null hypothesis at the 1%, 5%, and 10%, respectively.*

The negative signs observed in the different samples are consistent with findings from other studies. Villena and Quinteros (2024) conducted a study using a Cournot model with social responsibility and concluded that market regulations through an emission tax led to more effective firm behaviour in enhancing the environment. Similarly, Rather and Mahalik (2024) found that environmental innovation helps reduce environmental

damages. Travassos and Figueiredo (2024) also noted that innovation plays a role in promoting sustainable development.

The findings from this study have some interesting implications for policy-making and corporate strategy within Mexico. As the SRB's strategy brings efficiency and benefits for the community, the firm, and its stakeholders, progress in SRBs translates into economically sustainable growth. This way, while stimulating growth, it supports the transition to a low-carbon economy. Governments should design strategies for companies to develop community activities for economic and environmental regeneration and not only act as entities that create jobs and private profits. An appropriate policy is to support the socially responsible label not only large companies but also small and medium-sized companies in the country since these latter have a greater presence in the country and are more closely related to community activity. For example, fiscal incentives can be created for those companies that undertake actions in favour of the community and the environment, since financially they are at a disadvantage compared to large companies. Another wise policy is to improve ties between institutions of higher education and small businesses in the community through joint collaborations that help the environment.

Finally, it is necessary to recognize that this work's findings require some limitations. First, not all companies classified as SRBs use their profits to benefit either or both social and environmental causes. Second, the nature of their business means some of the industries comprising the data sample have little social or environmental impact. Third, the sample of the 500 largest companies generates only partial evidence concerning real behaviour. This is not only because a multitude of socially committed companies are excluded from the analysis but also because the data are complicated. In any case, the contribution of this research is to understand the extent to which the activities of socially responsible firms contribute to the reduction in CO_2 emissions.

6. Conclusions

The conclusions confirm the effectiveness of SRBs at reducing CO_2 emissions, with profitability and innovation estimated to have greater impacts than solvency and business growth compared to non-SRBs. These findings are maintained across both domestic and foreign samples, even if the source of reductions differs: Among domestic firms, most reductions come from ROE; among foreign firms, reductions are due to innovation.

The empirical results allow us to present conclusions about two characteristics of the 500 largest corporations operating in Mexico. First, corporations not only seek to produce, create jobs and benefit their owners and stakeholders but also to act with social responsibility, at least in terms of contemplating strategies to reduce damage to the environment. This is reflected in emissions reductions. The second characteristic concerns the prioritization of ethical, philanthropic, legal, regulatory, and economic issues, with the latter continuing to carry a greater weight in business decisions. The evidence for this is that although the estimates describe differences between SRBs and non-SRBs, several of the factors see the non-SRBs perform better in terms of environmental outcomes than SRBs. This means that having the SRB distinction does not necessarily guarantee that effective actions are taken to reduce emissions. This means that, in Mexico, it is necessary to strengthen the regulation of SRBs to increase commitment and increase the weight of ethical and philanthropic dimensions, a commitment to which developed countries have made greater progress.

This means that although Mexico sees the search for profitability achieved with social responsibility and environmental care, it is necessary to involve more organizations that prioritize the use of innovative techniques to fulfil the social commitments explored in this paper. Future research directions could explore the role of specific types of innovation or the impact of SRBs in different industries. It would also be a good idea to deal with a more complete concept of environment than CO_2 emissions.

Acknowledgements

This paper pertains to the project CF-2023-I-810, "Electricity Demand, Temperature, and Economic Development in Mexico: A Regional Analysis", which has been developed by V. German-Soto. The author acknowledges financial support from Conahcyt in 2023.

References

Andrade Restrepo, L.M. and Andrade Restrepo, M.A. (2022), "Responsabilidad social empresarial y cómo deben implementarla las empresas para que sean más competitivas", *Actualidad Económica*, Vol. 32, No. 108, pp. 19-26.

Bernal López, J.L. and Alpuche de la Cruz, E. (2023), "La responsabilidad social empresarial como estrategia organizacional: un análisis empírico para la región oriente del Estado de México", *CIENCIA Ergo-sum*, Vol. 30, No. 1, p. e183.

Bolton, B. and Park, J. (2022), "Social impact as corporate strategy: responsibility and opportunity", *Cogent Business & Management*, Vol. 9 No. 1.

Bonnafous-Boucher, M. and Rendtorff, J.D. (2016), *Stakeholder Theory: A Model for Strategic Management*, Springer, Switzerland.

Bosch-Badia, M.T., Montllor-Serrat, J., and Tarrazon, M.A. (2013), "Corporate social responsibility from Friedman to Porter and Kramer", *Theoretical Economics Letters*, Vol. 3, pp. 11-15.

Cajiga, J.F. (2010), "El concepto de responsabilidad social empresarial. Centro Mexicano para la Filantropía (Cemefi)", available at: https://www.cemefi.org/esr/images/stories/pdf/esr/concepto_esr.pdf (accessed 8 February 2024).

Carroll, A. (1979), "A three-dimensional model of corporate performance", *Academy of Management Review*, Vol. 4, pp. 497-505.

Chambers, R.G. and Serra, T. (2018), "The social dimension of firm performance: a data envelopment approach", *Empirical Economics*, Vol. 54, pp. 189-206.

Chang, C.C., Yang, H., and Hsu, K.Z. (2022), "Corporate social responsibility and product market power", *Economies*, Vol. 10 No. 6, p. 151.

Chen, S., Zhang, D. and Hao, M. (2019), "A multidimensional analysis of the relationship between corporate social responsibility and firm's financial performance-based on the data of 78 listed companies in 10 years in Henan Province, China", *Open Journal of Applied Sciences*, Vol. 9, pp. 104-114.

Costa, J. and Fonseca, J.P. (2022), "The impact of corporate social responsibility and innovative strategies on financial performance", *Risks*, Vol. 10 No. 5, p. 103.

Crespo-Razeg, F. (2010), "Entre el concepto y la práctica: responsabilidad social empresarial", *Estudios Gerenciales*, Vol. 26, No. 117, pp. 119-130.

Doran, H.E. and Schmidt, P. (2006), "GMM estimators with improved finite sample properties using principal components of the weighting matrix, with an application to the dynamic panel data model", *Journal of Econometrics*, Vol. 133, pp. 387-409.

Ehrlich, C. (2005), "Is business ethics necessary?", *DePaul Business & Commercial Law Journal*, Vol. 4 No. 1.

Expansión (2022), "Las 500 empresas más importantes de México, Grupo Expansión, México", available at: https://expansion.mx/las-500 (accessed 20 August 2023).

Fernández-Gago, R. and Martínez-Campillo, A. (2008), "Naturaleza estratégica de la responsabilidad social empresarial", *Revista de Globalización, Competitividad y Gobernabilidad*, Vol. 2, No. 2, pp. 116-125.

Fisch, J.E. (2006), "Robert Clark's corporate law: Twenty years of change: Measuring efficiency in corporate law: The role of shareholder primacy", *The Iowa Journal of Corporation Law*, Vol. 31, p. 637.

Flores Villanueva, C.A. and Gaytán Ramírez, M.C. (2018), "The level of corporate social responsibility in Mexican franchises", *Revista EAN*, Vol. 85 No. 2, pp. 15-35.

Gabaldon, T.A. (2006), "Like a fish needs a bicycle: Public corporations and their shareholders", *Maryland Law Review*, Vol. 65, p. 538.

Ĝater, T., Ĝater, B., Milić, P., and Žabkar, V. (2023), "Drivers of corporate environmental and social responsibility practices: A comparison of two moderated mediation models", *Journal of Business Research*, Vol. 159, p. 113652.

Goldreyer, E.F., Ahmed, P. and Diltz, J.D. (1999), "The performance of socially responsible mutual funds: Incorporating sociopolitical information in portfolio selection", *Managerial Finance*, Vol. 25, pp. 23-36.

Goli, Y.S., Ye, J., Ye, Y. and Kalgora, B. (2020), "Impact of ecological related innovations enhancing the efficiency of corporate environmental responsibility", *American Journal of Industrial and Business Management*, Vol. 10, pp. 191-217.

González González, J.M. (2010), "Determinants of socially responsible corporate behaviours in the Spanish electricity sector", *Social Responsibility Journal*, Vol. 6 No. 3, pp. 386-403.

Graafland, J. and Mazereeuw-Van der Duijn Schouten, C. (2012), "Motives for corporate social responsibility", *De Economist*, Vol. 160, pp. 377-396.

Greene, W.H. (2008*), Econometric Analysis*, Pearson PrenticeHall, New Jersey, US.

Hirsch, S., Petersen, T., Koppenberg, M. and Hartmann, M. (2023), "CSR and firm profitability: Evidence from a meta-regression analysis", *Journal of Economic Surveys*, Vol. 37, pp. 993-1032.

Jolliffe, I.T. (2002), *Principal Components Analysis*, Springer-Verlag, New York, N.Y.

Jolliffe, I.T. and Cadima, J. (2016), "Principal component analysis: A review and recent developments", *Philosophical Transactions of the Royal Society A*, Vol. 374 No. 2065.

Jones, T. and Wicks, A. (1999), "Convergent stakeholder theory", *Academy of Management Review*, Vol. 24 No. 2, pp. 206-221.

Kang, G.I. and Ahn, H.S. (2024), "CSR spillovers of corporate M&As by U.S. acquirers", *Industry and Innovation*, pp. 1-27.

López Salazar, A., Contreras Soto, R. and Molina Sánchez, R. (2011), "La responsabilidad social empresarial como estrategia de competitividad en el sector alimentario", *Cuadernos de Administración*, Vol. 24, No. 43, pp. 261-683.

Margolis, J., Elfenbein, H. and Walsh, J. (2009), "Does it pay to be good? A meta-analysis and redirection of research on the relationship between corporate social and financial performance", Working paper, Harvard Business School, 1 March, 2009.

Narbel, F. and Muff, K. (2017), "Should the evolution of stakeholder theory be discontinued given its limitations?", *Theoretical Economics Letters*, Vol. 7, pp. 1357-1381.

Newig, J., Jager, N.W., Challies, E. and Kochskämper, E. (2023), "Does stakeholder participation improve environmental governance? Evidence from a meta-analysis of 305 case studies", *Global Environmental Change*, Vol. 82.

Ng, S. (2015), "Constructing common factors from continuous and categorical data", *Econometric Reviews*, Vol. 34 No. 6-10, pp. 1141-1171.

Nguyen, T.D. and Ngo, Q.T. (2022), "The impact of corporate social responsibility, energy consumption, energy import and usages and carbon emission on sustainable economic development: Evidence from ASEAN countries", *Contemporary Economics*, Vol. 16 No. 2, pp. 241-256.

Orlitzky, M., Schmidt, F. and Rynes, S. (2003), "Corporate social and financial performance: A meta-analysis", *Organization Studies*, Vol. 24 No. 3, pp. 403-441.

Pang, S. and Yuan, J. (2019), "Research on the impact of corporate social responsibility reputation on financial performance-based on listed company data", *Open Journal of Social Sciences*, Vol. 7, pp. 160-169.

Piacentini, M., MacFadyen, L. and Eadie, D. (2000), "Corporate social responsibility in food retailing", *Journal of Retail & Distribution Management*, Vol. 28 No. 11, pp. 459-469.

Rather, K.N. and Mahalik, M.K. (2024), "Do world uncertainty and income inequality moderate the efficiency of environmental innovation in driving global renewable energy generation?", *International Journal of Sustainable Development & World Ecology*, pp. 1-14.

Reinhardt, F.L., Stavins, R.N. and Vietor, R.H.K. (2008), "Corporate social responsibility through an economic lens", NBER Working Papers Series No. 13989, May 2008.

Saldaña Rosas, A. (2009), "La empresa socialmente responsable en México: auge, paradojas y perspectivas", *Ciencia Administrativa*, Vol. 2, pp. 1-8.

Sheehy, B. (2005), "Scrooge the reluctant stakeholder: Theoretical problems in the shareholder-stakeholder debate", *University of Miami Business Law Review*, Vol. 14, 193.

Siems, E., Seuring, S., and Schilling, L. (2023), "Stakeholder roles in sustainable supply chain management: A literature review", *Journal of Business Economics*, Vol. 93, pp. 747-775.

Solís González, J.L. (2008), "Responsabilidad social empresarial: un enfoque alternativo", *Análisis Económico*, Vol. 23 No. 53, pp. 227-252.

Travassos Rosário, A. and Figueiredo, J. (2024), "Sustainable entrepreneurship and corporate social responsibility: Analysing the state of research", Sustainable Environment, Vol. 10, No. 1.

Tripathi, V. and Kaur, A. (2020), "Socially responsible investing: Performance evaluation of BRICS nations", *Journal of Advances in Management Research*, Vol. 17 No. 4, pp. 525-547.

Villena, M.G. and Quinteros, M.J. (2024), "Corporate social responsibility, environmental emissions and time-consistent taxation", *Environmental and Resource Economics*, Vol. 87, pp. 219-255.

Wang, Y.G. (2011), "Corporate social responsibility and stock performance-evidence from Taiwan", *Modern Economy*, Vol. 2, pp. 788-799.

Xing, M. and Lee, S.H. (2024), "Cross-ownership and strategic environmental corporate social responsibility under price competition", *Environmental and Development Economics*, Vol. 29 No. 3, pp. 234-256.

Xu, H. (2020), "Corporate social responsibility, product innovation, and product line", *Nankai Business Review International*, Vol. 11, No. 2, pp. 171-190.

Zain, F.A.M., Muda, W.A., Muhamad, S.F., Tajuddin, S.A.F.S. and Abdullah, H. (2023), "Strengthening governance mechanisms and corporate social responsibility disclosure: drivers of performance in Islamic banks", *Journal of Asian Scientific Research*, Vol. 13 No. 4, pp. 149-167.

Zhang, J., Wang, K., Zhao, W., Han, Y. and Miao, X. (2022), "Corporate social responsibility and carbon emission intensity: Is there a marketization threshold effect?", *Emerging Markets Finance and Trade*, Vol. 58 No. 4, pp. 952-964.