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Effects of Sustainable Culture on CSR and Financial Performance in Manufacturing Industry

Efectos de la cultura sustentable en la Responsabilidad Social Empresarial y el desempeño financiero en la industria manufacturera

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Abstract: The relationship between culture and firm sustainability practices is widely recognized in the literature, but little is known about a sustainable culture, particularly in a context of corporate social responsibility, since sustainability in manufacturing firms involves managing physical aspects of production and transforming the organization's culture into a sustainable culture. However, the existing research in the literature has been mainly oriented towards the analysis of a culture that focuses on improving firm financial performance. The present study aims to fill this existing gap, and generate new knowledge of the relationship between these three constructs, distribute a questionnaire to a sample of 300 manufacturing firms in Mexico, and analyze the data through partial least squares structural equation modelling. The results showed that the sustainable culture has positive effects on social responsibility and firms financial performance, and corporate social responsibility has positive effects on financial performance of manufacturing firms. Thus, the results obtained allow us to conclude that manufacturing firms that have adopted a sustainable culture have not only improved their social responsibility, but also their financial performance. However, when corporate social responsibility acts as a mediating variable, it further improves firm financial performance.

Keywords: culture, sustainable culture, corporate social responsibility, financial performance, manufacturing industry.

Resumen: La relación entre la cultura y las prácticas de sustentabilidad empresarial es ampliamente reconocida en la literatura, pero se sabe poco acerca de una cultura sustentable, particularmente en un contexto de la responsabilidad social empresarial, ya que la sustentabilidad en las empresas manufactureras implica gestionar los aspectos físicos de la producción y transformar la cultura de la organización en una cultura sustentable. Sin embargo, la investigación existente en la literatura se ha orientado principalmente en el análisis de una cultura que se enfoca en mejorar el rendimiento financiero de las empresas. El presente estudio tiene como objetivo llenar este vacío existente, y generar nuevo conocimiento de la relación entre estos tres constructos, distribuyendo un cuestionario a una muestra de 300 empresas manufactureras de México, y analizando los datos mediante los modelos de ecuaciones estructurales basados en mínimos cuadrados parciales. Los resultados obtenidos sugieren que la cultura sustentable tiene efectos positivos en la responsabilidad social y en el rendimiento financiero de las empresas, y la responsabilidad social empresarial tiene efectos positivos en el rendimiento financiero de las empresas manufactureras. Así, los resultados obtenidos permiten concluir que las empresas manufactureras que han adoptado una cultura sustentable no solamente han mejorado su responsabilidad social, sino también su rendimiento financiero. Sin embargo, cuando la responsabilidad social empresarial actúa como una variable mediadora, mejora aún más el rendimiento financiero de las empresas.

Palabras clave: cultura, cultura sustentable, responsabilidad social empresarial, rendimiento financiero, industria manufacturera.

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Introduction

Sustainable culture (SC) is considered as an essential element for developing nations, society and the economy (Abbas and Dogan, 2022). However, the productive activities of manufacturing companies generate significant damage to the environment and sustainability, especially in the deterioration of natural resources and increased pollution (Ayayi and Wijesiri, 2022). In this regard, the United Nations (2020) urged companies to generate more sustainable productive operations, as this can improve their reputation and financial performance (FP) (Liu and Lin, 2020). In this sense, SC and Corporate Social Responsibility (CSR) are considered essential sustainable practices applied by manufacturing industry to be more environmentally friendly and socially responsible (Ayayi and Wijesiri, 2022; Pan *et al.*, 2022).

Although the scientific and academic community mentions the essence of SC to improve business sustainability, and SC is one of the most important intangible assets and drivers of competitiveness for manufacturing companies (Streimikiene *et al.*, 2021), the effects of SC on CSR (Isensee *et al.*, 2022), and the effects of SC on the FP of companies are not well known (Srisathan *et al.*, 2020), for which more empirical evidence on the effects of SC on CSR is needed and in the FP (Pan *et al.*, 2022). For this reason, Schönborn *et al.* (2019) recommend conducting studies on the effects of SC on CSR and FP in manufacturing companies.

In this sense, the aim of this study is to analyze and discuss the effects of SC on both CSR and FP, and how SC acts as a mediating variable between CSR and FP. To achieve this objective, an empirical study was conducted in manufacturing companies in Mexico, using a sample of 300 observations and estimating the research model using Structural Equation Modeling of Partial Least Squares (PLS-SEM), with the support of SmartPLS 4.0 software (Ringle *et al.*, 2022). The manufacturing industry in Mexico is essential for two reasons, firstly, because it is the most incompatible industry regarding the care of the environment and sustainability (Scur *et al.*, 2019) and, secondly, it is the industry that generates the largest contribution to the national GDP (INEGI, 2020).

Following the recommendations of Ketprapakorn and Kantabutra (2022), Chen (2022), Pan *et al.* (2022) and Assoratgoon and Kantabutra (2023) to carry out studies on the analysis of CSR impacts and company performance, the main contribution of this study is to provide cutting-edge knowledge of SC with an impact on CSR, and to integrate it into a coherent CSR framework in manufacturing companies. Therefore, the effects of SC on CSR and FP can be considered inconclusive and open to debate, so that, to complement and expand the limited knowledge existing in the literature this study has as a research question: What are the effects of SC on CSR and FP in manufacturing companies?

Materials and methods

There are several theories in the literature that have been used to analyze strong culture (Pan *et al.*, 2022), one of the most frequently used theories to analyze the individual behavior of people is Skinner´s Operant Conditioning Theory (OCT) (Skinner, 1948), since Skinner considered that the best way to study human behavior is by analyzing their reasoning, because this is the cause and consequences of their actions (Skinner, 1948). In addition, Skinner (1948) considered that OCT can be used to analyze complex behaviors. Thus, manufacturing companies generally reward compliant staff and promote a sustainable and environmentally friendly culture from a social responsibility perspective (Pan *et al.*, 2022). This type of behavior of manufacturing firms' personnel is part of their personality, and commonly tends to strengthen SC and generates more CSR (Manzoor *et al.*, 2021).

Sustainable culture and corporate social responsibility

There are several definitions of SC in the literature, but one of the most recent and used is Yaselitas *et al.* (2022, p. 2), who consider that SC can be defined as "a set of values widely accepted by the staff of a company that involve beliefs, standards, practices and perspectives that guide all staff to behave ecologically", and commonly

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acts as an environmentally friendly culture oriented towards sustainability, and is based on the implementation of SC in an ecological framework to achieve environmental balance (Lee *et al.*, 2022). Thus, SC is reflected in how the personnel of a manufacturing company perform and behave within the company, and how their actions affect the functioning of the company (Satyendra, 2020; Yesiltas *et al*., 2022), particularly the interaction between the behavior of business personnel and CSR (Lakshmi and Shree, 2020).

Although there is empirical evidence showing that SC significantly improves CSR (Miska *et al.*, 2018), there are also other studies showing a negative relationship (e.g. Ioannou and Serafeim, 2012; Szöcs *et al*., 2016), so the relationship between SC and CSR can be considered inconclusive and open to debate (Miska *et al.*, 2018). Also, the differences in the results obtained can be explained by the different conceptualizations of CSR, since various studies have considered only one of the three factors that make up CSR, such as only social, economic or environmental aspects (Weerts *et al.*, 2018), for which it is important to consider the three factors of CSR (Schönborn *et al.*, 2019).

Khan *et al.* (2022) found that SC can serve as a productive means to regulate the attitude of employees, through the development of activities considered essential to achieve greater success and CSR. Beksultanova *et al.* (2022) considered that SC motivates the company's staff to act in an environmentally friendly way, as well as to follow ideas of social responsibility and ecological practices. Aggarwal and Agarwala (2022) found that SC helps companies improve their CSR, through actions such as minimizing printing, turning off lights in workspaces when not in use, and using recyclable items. Thus, considering the information presented above, it is possible to propose the following research hypothesis:

H1 The higher the level of sustainable culture, the higher the level of corporate social responsibility.

Sustainable culture and financial development

SC commonly sets out how the personnel of a company behave and perform within the company, and how their actions affect the functioning of the company (Satyendra, 2020; Yesiltas *et al.*, 2022), especially the individual behavior that can generate better results in business (Cherian *et al.*, 2021), including an increase in the FP (Schönborn *et al.*, 2019). In addition, the bibliography states that SC should be developed in all areas, so that manufacturing companies have more chances to achieve better results (Kosiciarova *et al.*, 2021), including a higher FP (Pinzone *et al.*, 2018), since SC is considered by the scientific and academic community as one of the main factors to achieve organizational change (Frost *et al.*, 2020).

In this context, the commitment to change by the staff of manufacturing companies, especially managers, will allow the development of a positive SC that can be extended to the whole company (Chen, 2022), which could generate the opportunity to learn about the implementation of the activities involved in SC (Schönborn *et al.*, 2019), leading not only to a significant development in the human capital of companies, but also to significant positive effects in the FP in terms of productivity, quality and innovation (Pinzone *et al.*, 2018). In addition, manufacturing companies that have adopted a SC are more likely to improve investors' FP (Schaltegger and Burritt, 2018; Schönborn *et al.*, 2019).

Little is known about the integration of SC into sustainable programs and FP (Isensee *et al.*, 2020; Srisathan *et al.*, 2020). Similarly, Miskha *et al.* (2018, p. 263) state that "research in this specific area is fraught with significant challenges, which limits the full theoretical understanding of how cultural features can influence sustainability." Thus, SC can help companies to develop and implement sustainable strategies proactively, thereby improving existing processes and products (Schaltegger and Burritt, 2018). In addition, SC can change the future competitive scenario of manufacturing companies, through the development of socially more sustainable innovation activities in terms of new products or services,

business models and markets (Schaltegger and Burritt, 2018), which could result in an increase in FP (Schönborn *et al.*, 2019). Thus, considering the information presented, it is possible to raise the following research hypothesis:

H2 The higher the sustainable culture level, the higher the financial performance level.

Mediating effects of corporate social responsibility on the relationship between sustainable culture and financial performance

It is common to find in the literature that companies must create an individuality that allows them to distinguish them from their main competitors in the minds of customers and consumers (Kumari *et al.*, 2021a). Several studies, such as Abbas (2020), China (2021) and Viererbl and Koch (2022), mention that CSR allows manufacturing companies to create an individuality, since the main objective of CSR is for companies to devote part of their economic benefits to improving society (Pan *et al.*, 2022). CSR can therefore not only be economically, socially and environmentally beneficial for society (Abbas and Dogan, 2022), but can also have an individual benefit, since CSR affects social operations as well as the DF of manufacturing companies (Herrera and Heras-Rosas, 2020).

In addition, CSR applied by manufacturing companies can be carried out geographically in the communities in which they are located, generally and culturally (China, 2021), which usually include different ethical practices that allow manufacturing companies to obtain more FP (Pan *et al.*, 2022). In addition, CSR helps manufacturing companies to generate some purchasing stability for their products, for those customers who have deep-rooted moral and ethical beliefs (Kim, 2022). In this sense, CSR can help manufacturing companies build a high business reputation, due to increased customer and consumer loyalty (Hwang *et al.*, 2022), which can substantially improve relationships with their customers, suppliers and employees through an increase in FP (Kumari *et al.*, 2021b).

In addition, CSR can not only generate a social advantage for economic value creation, competitive spirit, and creativity (Al-Swidi *et al.*, 2021), but can also help company staff to work together to benefit the company itself and society (China, 2021). Freitas *et al.* (2020) linked CSR to sustainable activities carried out by company staff and found that effective sustainable activities by staff strengthen both CSR and the economic performance of companies, in particular CSR significantly improves not only staff teamwork, but also the FP of manufacturing companies *(Pan et al.*, 2022). Therefore, considering the information presented above, it is possible to propose the following research hypothesis:

H3 The higher the CSR level, the higher the financial performance.

The implementation of CSR is generally considered in the literature as one of the optimal alternatives, both to improve relations with stakeholders and to create competitive advantages that allow increasing FP (Chen, 2022). This means that manufacturing companies have obtained a better FP with CSR, for which they are willing to make the necessary changes in their SC and take full advantage of the opportunities offered by the market (Kim and Kim, 2017). In this sense, manufacturing companies can take advantage of their SC in CSR practices to improve cultural values (Elbaz and Iddik, 2020), transformational leadership (Cicea *et al.*, 2022), mental states, attitudes of employees and leaders (Isensee *et al.*, 2020), and social factors (Cicea *et al.*, 2022); on the other hand, they can provide continuous learning opportunities for managers and employees, and can develop more human capital with positive effects on the FP (Pinzone*et al.*, 222222). (2018).

In addition, SC plays a key role in determining the commitment in CSR implementation (Liu and Lin, 2020), as companies that have implemented CSR generally have a direct and indirect FP, both within and outside the organization (Ahmed *et al.*, 2020). According *to* Latif *et al.* (2022), manufacturing companies that have incorporated CSR prac-

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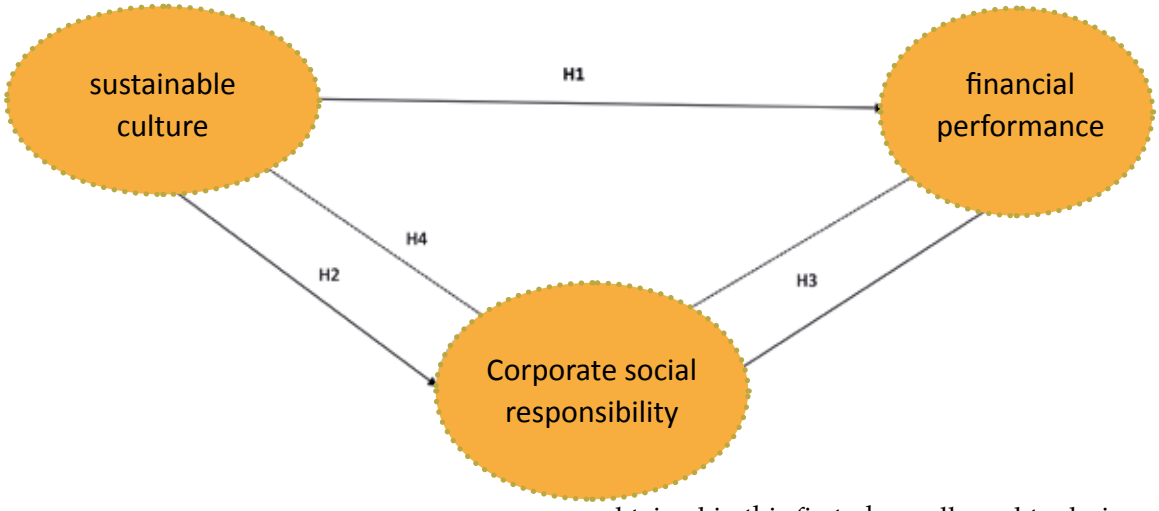
tices have employees and workers with attitudes supportive of the environment and sustainability, which contributes to the well-being of staff and organization (Malik *et al.*, 2021). Al-Suwaidi *et al.* (2021) considered that CSR adopted by companies also educates and trains staff, and changes their behavior within the organization, for which CSR improves the relationship between CS and DF of companies (Chen, 2022).

Additionally, when manufacturing companies implement CSR practices, their employees and workers are generally considered distinctive, respectable and a source of pride (Kumari *et al.*, 2021a), for which the inclusion of all personnel in SC strengthens the commitment of manufacturing companies to achieve the goals of social and financial responsibility (Matsuo and Aihara, 2021). As a result, more companies are adopting CSR as a business strategy (Latif *et al.*, 2022), allowing organizations to improve the relationship between SC and FP (Farid *et al.*, 2019), which allows establishing that CSR mediates and improves the relationship between SC and FP (Chen, 2022). Thus, considering the information presented above, the following research hypothesis is proposed:

H4 CSR mediates the relationship between sustainable culture and financial performance.

Figure 1 shows the three hypotheses raised in the research model.

Figure 1
Research Model



To answer the hypotheses raised in the research model, an empirical study was conducted in manufacturing companies in Mexico, using the business directory of the Business Information System of Mexico (SIEM) for the state of Aguascalientes in 2020 as a reference framework, which had a record of 1350 companies with more than ten workers. In addition, a "Business Panel" was conducted in which five automotive entrepreneurs participated, two representatives of government agencies related to financial support to companies, and three academics from the area of innovation to whom the survey was applied for its analysis and discussion. The results obtained in this first phase allowed to design a survey to collect information, which was applied to a pilot sample of ten firms in the manufacturing industry, making small adjustments in writing, appearance, and spelling. Pilot studies are essential to ensure validity when surveys are self-administered or contain self-developed scales (Hair *et al.*, 2019).

In addition, a survey was designed and given to the managers of the companies, who in turn trusted their staff to respond, and was applied to a sample of 300 manufacturing companies selected by simple random sampling; the survey was applied from February to May 2020. In addition,

this work is a quantitative study with a survey approach to examine the effects of SC on CSR and FP, and PLS-SEM analyzes in SmartPLS 4.0 software (Ringle *et al.*, 2022) were used to observe the effect of the independent variable as a predictor factor on the dependent variable (Im *et al.*, 2022). After considering the statistical equation proposed by Murray and Larry (2018), to reduce the sampling error and have a higher quality of the data, in this study the probabilistic size of the sample was calculated with 95 % confidentiality and a maximum error of 5 %, obtaining a sample of 284 companies. To demonstrate that it meets the desired statistical power of the sample, data were calculated through GPower, where the size of the sample N is calculated as a function of the power level 1 - β, significance level α, and the size of the population effect to detect, obtaining a sample of 300 manufacturing companies.

As a previous step to the reliability and validity analysis of the measurement scales used in this study, the measurement scales for SC, CSR and FP were defined. In this sense, the scale developed by Lumpkin and Dess (2001) was used to measure the SC, who considered that this variable can be measured through seven items. Regarding the FP measurement, the scale developed by Leonidou *et al.* (2013) was used, who established that this variable can be measured through seven items. Finally, to measure CSR the three most cited practices in the literature were considered, and the scale of Alvarado and Schlesinger (2008) was used, which considers that social responsibility is measured through six items; environmental responsibility is measured with six items and economic responsibility through seven items. All items of the scales were measured through a 5-Likert scale.

The reliability and validity of the measurement scales of SC, FP and CSR was performed using Cronbach's alpha, CRI, Dijkstra-Henseler rho and AVE (Hair *et al.*, 2019). Cronbach's alpha, CRI and Rho de Dijkstra-Henseler exceeded the recommended value of 0.70 (Hair *et al.*, 2019); while the AVE values were higher than the recommended value of 0.50 (Hair *et al.*, 2019), indicating, on the one hand, that the items effectively measure each of their variables and, on the other hand, the existence of reliability of the data obtained.

Discriminant validity was evaluated by the most important test in the literature of PLS-SEM: Fornell and Larcker criteria and heterotrait-monotrait (HTMT) relationship (Henseler, 2018). The results obtained are shown in Table 1 and indicate that Cronbach's alpha has values ranging from 0.818 to 0.943, CRI has values ranging from 0.868 to 0.961, and Dijkstra-Henseler rho has values ranging from 0.819 to 0.954, indicating that they are good values and are above the value 0.70, and AVE has values ranging from 0.525 to 0.744, which are higher than the value 0.50 recommended by Hair *et al.* (2019). The results obtained in this study show that HTMT values range between 0.150 and 0.434, which are higher than the recommended value of 0.08, indicating the existence of discriminant validity of the measurement scales of SC, FP and CSR.

Table 1
Reliability, validity and discriminant validity

Group A. Reliability and validity				
Variables	**Cronbach's alpha**	**CRI**	**Dijkstra-Henseler rho**	**AVE**
Sustainable culture	0.943	0.953	0.954	0.744
Financial performance	0.909	0.927	0.918	0.647
Economic Responsibility	0.856	0.891	0.865	0.564
Environmental responsibility	0.924	0.961	0.930	0.727
Social responsibility	0.818	0.868	0.819	0.524

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Variables	Group B. Fornell-Larcker criterion					Heterotrait-monotrait (HTMT) ratio			
	1	2	3	4	5	1	2	3	4
1. Sustainable culture	0.862								
Financial Performance	0.288	0.804				0.298			
3. Economic Responsibility	0.339	0.204	0.738			0.371	0.231		
4. Environmental Responsibility	0.343	0.137	0.310	0.853		0.359	0.150	0.344	
5. Social responsibility	0.299	0.206	0.364	0.252	0.724	0.337	0.244	0.434	0.285

Note. CRI: Composite reliability index; AVE: mean variance extracted. PANEL B: Fornell-Larcker criterion: Diagonal elements (bold) are the square root of the variance shared between constructs and their measurements (AVE). For discriminant validity, diagonal elements must be larger than diagonal elements.

Results

To respond to the hypotheses raised in the research model of this study, the statistical technique PLS-SEM was used with the software SmartPLS 4.0 (Ringle *et al.*, 2022), since PLS-SEM is generally used in theories that are poorly developed (Hair *et al.*, 2019), in various disciplines such as management (Cepeda-Carrión *et al.*, 2019), and human resources management (Ringle*et al.*, 2020). In addition, the use of PLS-SEM is essential, not only because it facilitates the explanation of the measurement error of the variables, which allows this method to be better than the multiple linear regression (Hair *et al.*, 2019), but also when the objective sought in the application of the structural equation model is to identify the sources of competitive advantage and the investigation of success factors (Sarstedt *et al.*, 2021). Table 2 presents in more detail the results obtained from the implementation of the PLS-SEM.

Table 2
Structural Model

Hypothesis	Standardized coefficient (t value; p value)	95% confidence interval	f^2	Support
SUC → FPE (H1)	0.294 (4.789, 0.000)	[0.173 - 0.406]	0.150	Yes
SUC → RSE (H2)	0.466 (10.287, 0.000)	[0.375 - 0.553]	0.275	Yes
RSE → FPE (H3)	0.109 (1.639, 0.098)	[0.002-0.222]	0.019	Yes
Indirect effects				
SUC → RSE → FPE (H4)	0,323 (8,828; 0,000)	[0,251 - 0,395]	0,182	Sí
Endogenous variable	**R^2 adjusted**	**Model Adjustment**	**Value**	**HI99**
		SRMR	0,042	0,059
FPE	0,195	dULS	1,072	1,416
RSE	0,276	dG	0,484	0,615
		NFI	0,786	

Note. SUC: Sustainable Culture; SPE: Sustainable Performance; CSR: Corporate Social Responsibility. One-row t-values and parenthesized p-values; 95% confidence intervals for starting (based on n = 5000 subsamples) RMUR: residual square-normalized mean square; dULS: unweighted least squares differences; dG: geodesic difference; NFI: normal fit index; HI99: bootstrap-based 99% percentiles.

Table 2 shows that the results obtained show acceptable statistical levels, with an adjusted R2 greater than 0.10, a value of SRMR. (0.042) less than the value 0.08, the values obtained from the geodetic difference (dG) and the difference of unweighted least squares (dULS) (0.484 and 1.072, respectively), lower than the values of HI99 (Sarstedt *et al.*, 2019; Hair *et al.* 2019), which allows to verify the significance of the research model (Hair *et al*., 2020). Additionally, the results obtained from PLS-SEM allow establishing that SC has significant positive effects in the FP of manufacturing companies (0.294; p-value 0.000), which provides empirical evidence in favor of the H1 hypothesis, and allows establishing the rejection of the possible absence of the phenomenon, thus indicating the possible presence of the phenomenon.

Likewise, the results obtained allow to verify that CS has significant positive effects on CSR in manufacturing companies (0.466; p-value 0.000), which provide empirical evidence in favor of the H2 hypothesis, and to establish the rejection of the possible absence of the phenomenon, therefore indicating the possible presence of the phenomenon. In addition, the results obtained verify that CSR has a positive impact on the FP of manufacturing companies (0.109; p-value 0.098), which provides empirical evidence in favor of the H3 hypothesis, which allows establishing the rejection of the possible absence of the phenomenon, thereby showing the possible presence of the phenomenon. Finally, Table 2 shows that the mediating effect generated by CSR (0.323; p-value 0.000) is positive in the relationship between SC and FP, which provides positive empirical evidence in favor of the H4 hypothesis and allows establishing that CSR can be considered as a variable that explains the relationship between SC and FP of manufacturing companies in Mexico.

Conclusions and discussion

Conclusiones

The results obtained in this empirical study have several conclusions. On the one hand, the research model on the effects of SC on CSR and FP of manufacturing companies shows that depending on the use and implementation of SC oriented to CSR in manufacturing companies there will be more opportunities to reach a higher level of market ranking and a better FP. On the other hand, this research model offers a holistic view of CSR by including the three most cited practices in the literature (economic, social and environmental). In addition, the effects of SC on CSR and FP have been poorly studied by researchers and academics, compared with studies that focus on its conceptualization. Therefore, it is possible to conclude that this study contributes to fill the theoretical gap in the literature by proposing a model based on a theory that integrates SC and FP activities, mediated by the three CSR practices.

Finally, although the work that focuses on the analysis and discussion of the effects of SC on CSR and FP in manufacturing companies are relatively scarce, it is also true that it is a topic that has recently attracted the attention of various researchers and academics, which allows concluding that the relationship between SC, CSR and FP is a topic open to discussion (Schönborn *et al.*, 2019). Therefore, it is possible to conclude that this study provides empirical evidence on the effects of SC on CSR and FP in manufacturing companies in a country with an emerging economy, as is the case of Mexico, which represents a significant percentage of the growth and development of the economy and society of the country.

Discussion

The results obtained support the H1 hypothesis (the existence of a relationship between SC and FP in manufacturing companies in Mexico), and are in line with those obtained by Khan *et al.* (2022), Beksultanova *et al.* (2022) and Aggarwal and Agarwala (2022), who found that SC has positive effects on FP. One of the possible reasons for this positive effect is that SC is currently considered one of the best ways for manufacturing companies anywhere in the world to develop critical environmental care capabilities, which affect not only the flexibility strategy, but also the FP of the organization, through the creation of a SC stronger within the company, and more visible outside the organization.

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The significant positive effect of SC on CSR of manufacturing companies in Mexico supports the H2 hypothesis, and is consistent with the results obtained by Pinzone *et al.* (2018), Schaltegger and Burritt (2018), and Schönborn *et al.* (2019), which found that SC substantially improves CSR. The main reason for this positive effect is that a SC motivates the company's staff to adopt a more responsible behavior with society, since the SC promotes a social and environmental behavior of environment awareness among the employees and workers of the organization, which translates into economic benefits not only for the society of the community where the manufacturing company is located, but also for the organization itself through the sale of more environmentally friendly products.

The positive effect of CSR on FP of manufacturing companies in Mexico supports the H3 hypothesis, and is in line with the results obtained by Al-Swidi *et al.* (2021), China (2021) and Pan *et al.* (2022), who found that CSR has positive effects on FP. One of the main reasons for this positive effect is that CSR not only acts as a self-regulated business model in which personal values generally act as catalysts for CSR practices, but also because the implementation of CSR allows the staff of manufacturing companies to be more likely to participate or demonstrate cooperation behaviors with the society and the environment, generating an increase in the financial participation of organizations.

Furthermore, this study provides empirical evidence that supports the H4 hypothesis (the mediating effect of CSR between SC and FP in manufacturing companies in Mexico), and is consistent with the results found by Matsuo and Aihara (2021), Chen (2022), and Latif *et al.* (2022), which indicate that CSR acts as an explanatory variable of the relationship between SC and FP. One of the main reasons for this positive effect is that the values, beliefs and attitudes of company managers and staff play an essential role in the adoption of CSR practices, which, in turn, will significantly influence the development of SC through the transmission of shared values, as well as the achievement of better economic and financial practices of manufacturing companies.

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Impact of the pro-environmental organizational climate on the commitment and sustainable behavior of workers in Peru

Impacto del clima organizacional proambiental en el compromiso y comportamiento sostenible de los trabajadores en Perú

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Abstract: organizations that are an important part of society have the challenge of implementing sustainable practices in their business management and also achieving good performance in a highly competitive market, for which it is necessary to have personnel committed to the organization. Therefore, the present study aims to propose a theoretical model where the pro-environmental organizational climate (CPA) impacts on the enthusiasm for the employer brand (EME), the affective organizational commitment (COA), the emotional attachment (AE) and the pro-environmental behavior in the workplace (CPLT). A survey was carried out through an online questionnaire, and information was collected from 863 workers of companies located in the city of Lima. To test the hypotheses of the proposed research model, the data was analyzed with the path modeling method of partial least squares with the SmartPLS software. The results showed a significant positive effect of CPA on EME, COA, AE and CPLT. In conclusion, it can be stated that organizations that adopt sustainable practices and promote a pro-environmental organizational climate not only contribute to caring for the environment but can also improve various aspects of the employees' work experience. Therefore, it is essential that organizations recognize the importance of a pro-environmental organizational climate and actively work to promote sustainable practices in the workplace.

Keywords: employer brand, emotional commitment, emotional attachment, pro-environmental commitment.

Resumen: las organizaciones que son parte importante de la sociedad tienen el desafío de implementar prácticas sostenibles en su gestión empresarial y además lograr un buen desempeño en un mercado altamente competitivo, para lo cual es necesario contar con personal comprometido con la organización. Por lo tanto, este estudio tiene como objetivo proponer un modelo teórico donde el clima organizacional proambiental (CPA) impacta en el entusiasmo por la marca empleadora (EME), el compromiso organizacional afectivo (COA), el apego emocional (AE) y el comportamiento proambiental en el lugar de trabajo (CPLT). Se realizó una encuesta mediante un cuestionario en línea, y se recolectó información de 863 trabajadores de empresas ubicadas en la ciudad de Lima. Para probar las hipótesis del modelo de investigación propuesto, los datos fueron analizados con el método de modelado de ruta de mínimos cuadrados parciales con el software SmartPLS. Los resultados mostraron un efecto positivo significativo del CPA en EME, COA, AE y CPLT. En conclusión, se puede afirmar que las organizaciones que adoptan prácticas sostenibles y promueven un clima organizacional proambiental no solo contribuyen al cuidado del medioambiente, sino que también pueden mejorar varios aspectos de la experiencia laboral de los empleados. Por lo tanto, es fundamental que las organizaciones reconozcan la importancia de un clima organizacional proambiental y trabajen activamente para fomentar prácticas sostenibles en el lugar de trabajo.

Palabras clave: marca empleadora, compromiso afectivo, apego emocional, compromiso proambiental, sostenibilidad.

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Introducción

Sustainability is a major global concern due to the environmental, social and economic challenges facing humanity (UNESCO, 2015), for this reason, the Sustainable Development Goals (SDGs) developed by the United Nations in 2015 focus national and international efforts to build a world free of social ills, with responsible actions with the environment and thus contribute to sustainability (UN, 2015). Organizations are an important part of society and have a key role in promoting sustainable practices (Aluchna and Boleslaw, 2018). In addition, consumers are increasingly becoming aware of the importance of responsible consumption (García-Salirosas and Rondon-Eusebio, 2022; Müller-Pérez *et al.*, 2022; Valenzuela-Fernández *et al.*, 2022). Therefore, an organization committed to promoting sustainability can not only reduce its negative impact on the environment, but also improve its image, its productivity and its long-term profitability (Cupertino *et al.*, 2020; Datta *et al.*, 2015; García-Salirosas and Gordillo, 2021; Zhou and Jin, 2023). Therefore, it is critical to conduct studies in this regard for companies and organizations interested in promoting a more sustainable future.

The sustainability of organizations in Latin America is a growing concern today. Despite advances in economic and social development in the region, many organizations face significant challenges in implementing and maintaining sustainable practices in their operations (United Nations, 2021). Lack of awareness of the importance of environmental protection and lack of knowledge of government incentives to implement sustainable measures are factors that contribute to this problem (Cuevas Zúñiga *et al.*, 2016). Many organizations in Latin America lack the financial and technical resources needed to implement sustainable practices (United Nations, 2018). High costs associated with clean technologies, staff training and sustainable certifications can be significant barriers for organizations, especially for small and medium-sized enterprises (Ociepa-Kubicka *et al.*, 2021; Purwandani and Michaud, 2021; Rizo *et al.*, 2016; Takacs *et al.*, 2022). In some cases, resistance to change and lack of awareness of the benefits of sustainability may limit the adoption of sustainable practices in Latin American organizations (United Nations, 2018). The business culture rooted in short-term production and profitability traditional models makes it difficult to integrate sustainability criteria into business strategies (Peñaflor-Guerra *et al.*, 2020; Rodríguez-Espíndola *et al.*, 2022).

Peru is a country with great diversity of natural resources and a rich biodiversity, but also faces significant challenges in terms of environmental, social and economic sustainability (Sánchez, 2019). In recent years there has been an increase in awareness of the importance of sustainability in Peruvian companies. Many organizations are recognizing the need to adopt responsible and sustainable business practices to minimize their environmental impact, contribute to social welfare and ensure their long-term viability (GRI, 2021). Companies are increasingly committed to their corporate social responsibility, seeking to contribute positively to the welfare of local communities and society in general (OCDE, 2020). This includes the promotion of education, health, social inclusion and community development initiatives. Companies are recognizing the need to adopt sustainable and responsible practices to meet the country's environmental and social challenges (Saenz, 2023). There are studies that indicate that promoting sustainability in their operations, companies not only contribute to the well-being of the environment and society, but can also improve their reputation, attract talent and ensure their long-term success (Barrena-Martínez *et al.*, 2015; Magbool *et al.*, 2016). In this sense, this study raises the following research question: What is the impact of a pro-environmental organizational climate (PEOC) on the enthusiasm for the employer brand (CEB), affective organizational commitment (AC), emotional attachment (EA) and pro-environmental behavior in the workplace (PEBW) in companies in Peru?, thus, the objective is to propose a theoretical model where the pro-environmental organizational climate (PEOC) impacts on the enthusiasm for the employer brand (CEB), affective organizational commitment (AC), emotional attachment (EA) and pro-environmental behavior in the workplace (PEOC). Research on the impact of pro-environmental organizational culture on different aspects

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of employee behavior in companies in Peru has significant relevance in the current context for sustainable and responsible development. The results of this research can provide valuable information to guide more sustainable business policies and practices, improve companies' reputation and attractiveness as employers, and contribute to progress towards a more environmentally conscious and sustainable society.

The structure of this paper is presented as follows: point 1 presents the literature review and theoretical model; point 2 presents the materials and methods; point 3 presents the results; and point 4 presents the discussion, implications, limitations, future research, and finally, the conclusions.

Proenvironmental Organizational Climate (PEOC)

The pro-environmental organizational climate focuses on environmental awareness in the workplace, which means that the company cares about the environment as a whole and promotes sustainable practices (Norton *et al.*, 2012; Zientara and Zamojska, 2018). It is achieved by fostering engagement, the use of green technologies, and fostering a culture of sustainability where all employees support and promote environmental awareness (Costa *et al.*, 2022; Mouro and Duarte, 2021). Numerous studies support the benefits of this philosophy. According to literature, employees in companies that adopted pro-environmental practices have better well-being and greater job satisfaction (Composto *et al.*, 2023; Patrasc-Lungu and Iliescu, 2022). In addition, the company can realize long-term economic benefits by reducing energy costs and resources (Albrecht *et al.*, 2022; Peng *et al.*, 2022). Therefore, the pro-environmental organizational climate is important to promote sustainability and the health of the planet, as well as to improve the welfare of employees and the economic performance of companies.

Proenvironmental organizational climate (PEOC) and pro-environmental behavior in the workplace (PEBW)

When workers perceive that the organization values and promotes sustainable practices, they feel more motivated and committed to adopt pro-environmental behaviors in their daily work (Composto *et al.*, 2023; Gusmerotti *et al.*, 2023), which can be seen in actions such as recycling, energy saving, resource efficiency and waste reduction (Costa *et al.*, 2022; Fatoki, 2020). When employees perceive that the organization actively supports the adoption of pro-environmental behaviors, they feel more empowered and motivated to participate in sustainability initiatives and projects (Mouro *et al.*, 2021). Leadership plays an important role in the organization as it promotes voluntary pro-environmental behavior of workers (Robertson and Carleton, 2017). When employees observe that their peers and superiors also adopt pro-environmental behaviors, a positive influence is created, reinforcing the collective commitment to sustainability (Dahiya, 2020). Studies have also shown that sustainable policies implemented in an organization are successful in promoting employee environmental behavior (Dahiya, 2020; Robertson and Carleton, 2017). Therefore, the following hypothesis is formulated:

H1 Proenvironmental organizational climate (PEOC) has a positive impact on pro-environmental behavior in the workplace (PEBW).

Proenvironmental organizational climate (PEOC) and enthusiasm for the employer brand (CEB)

Enthusiasm for the employer brand is a fundamental concept in the field of human resources and talent management in organizations. It refers to the passion and emotional connection that current and potential employees feel towards the company as an employer, motivated by the vision, values and culture of the organization (Meyer and Maltin, 2010). This phenomenon is a crucial aspect to attract and retain talent in an increasingly competitive and globalized labor market (Ahmad *et al.*, 2020). When a company promotes and values sustainable practices in its operation, this can have a positive impact on how employees perceive and feel about the employing brand (Huseynova and Matošková, 2022).

A pro-environmental organizational climate fosters a positive image of the organization as an employer committed to the well-being of the environment and society, which can attract talents committed to sustainability and looking to work in companies that share their environmental and social values (Schmidt Albinger and Freeman, 2000; App *et al.*, 2012). Potential candidates may be attracted by the opportunity to contribute to a larger cause and be proud to belong to an organization that cares about the environmental impact of its operations (Ahmad *et al.*, 2020; Deepa and Baral, 2017). Similarly, a pro-environmental organizational climate can generate a greater sense of belonging and pride among existing employees (Akuratiya, 2017). When employees perceive that the organization is committed to sustainable practices, they feel more connected to the employer brand and are proud on being part of it (Aranguren Gómez and Maldonado García, 2022; Kumar *et al.*, 2021). Based on the above, the following hypothesis is proposed:

H2 The pro-environmental organizational climate (PEOC) has a positive impact on the enthusiasm for the employer brand (CEB).

Proenvironmental Organizational Climate (PEOC) and Affective Organizational Commitment (AC)

Affective organizational commitment refers to the emotional and affective bond that employees develop with the organization (Meyer *et al.*, 2002; Meyer and Allen, 1996). Employees who experience a high level of affective organizational engagement feel an integral part of the organization and are emotionally linked to it in a positive way (Boles *et al.*, 2007). Affective organizational commitment contributes to the well-being and growth of the organization (Chordiya *et al.*, 2017). Affective organizational commitment is directly and fundamentally related to employee performance (Bhatti *et al.*, 2022; Wang *et al.*, 2021). To achieve this level of commitment, organizations must foster a culture of support, recognition and personal development, which will create a solid foundation for the emotional engagement of their employees (Chordiya *et al.*, 2017). In this sense, when workers perceive that the organization cares about the environment and promotes sustainable practices, it can generate greater emotional identification with the company (Pimenta *et al.*, 2023; Piñeros Espinosa, 2022; Zientara and Zamojska, 2018). Employees are proud to work in an organization that shares their values and concerns about the environment and society (Bhatti *et al.*, 2022; Zientara and Zamojska, 2018). In addition, a pro-environmental organizational climate can generate a sense of purpose and meaning in the employees (Nazir *et al.*, 2021; Yadav *et al.*, 2018). Knowing that their work contributes to a larger cause and benefits the environment can increase their job satisfaction and their sense of belonging to the organization (Schwarz *et al.*, 2023). Affective organizational commitment is strengthened when employees feel emotionally connected to the mission and vision of the company, and a pro-environmental climate can be a key factor in this emotional connection (Allen, 2015). Therefore, the following hypothesis arises:

H3 Proenvironmental organizational climate (PEOC) has a positive impact on affective organizational commitment (OAC).

Proenvironmental Organizational Climate (PEOC) and Emotional Attachment to Organization (EA)

Emotional attachment refers to the emotional bond between people and their environment (Brown and Raymond, 2007). The emotional attachment that employees develop with the company generates a sense of belonging, loyalty and commitment to the organization (Scrima, 2015; Zhu and Lo, 2022). From an environmental perspective, the authors have considered attachment to the workplace as a resource for employees (Rioux and Pignault, 2013). Studies have found that employees who are more attached to their workplace are more satisfied, show a lower tendency to quit their job and improve their perfor-

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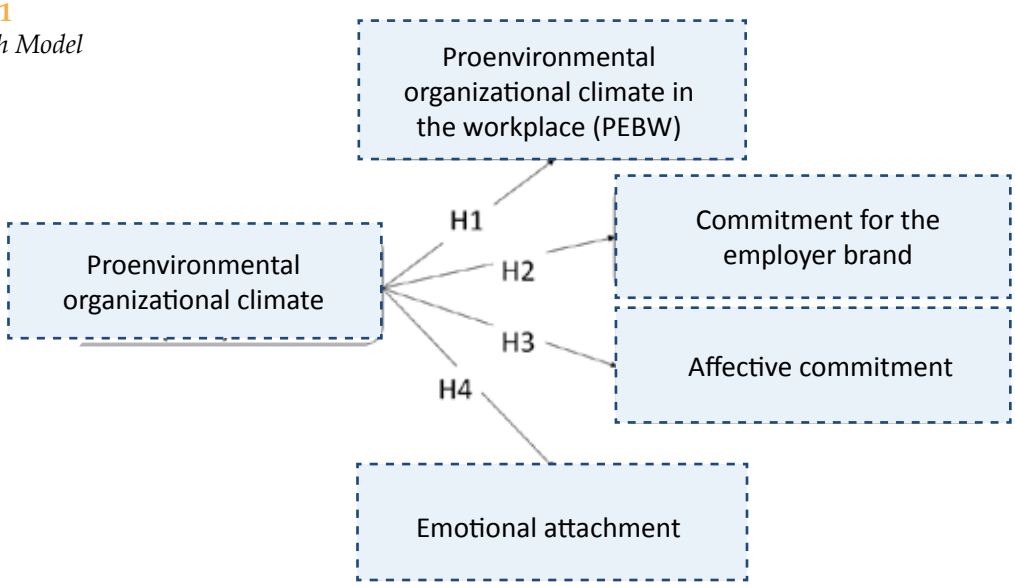
mance at work (Rioux and Pignault, 2013; Le Roy and Rioux, 2013).

When the organizational climate promotes and values sustainability and care for the environment, it can affect emotional attachment in several ways: knowing that the organization cares about the environment and engages in sustainable practices gives them a sense of purpose and meaning in their daily work (Nazir *et al.*, 2021). This sense of purpose strengthens emotional attachment, as employees feel part of a larger cause and identify with the values and mission of the company (Hicklenton *et al.*, 2019). Pride of belonging is a key element in emotional attachment (Dutta, 2020), as employees develop an emotional connection with the company and feel committed to its success and its image in the market (Aguinis and Bradley, 2014). Employees see that the organization cares about aspects beyond economic benefit, which strengthens confidence in their actions and decisions (Martin *et al.*, 2022). Confidence is an essential factor in developing a strong emotional attachment (Ayça, 2023), as employees feel safe and valued in their workplace and find happiness at work (Aboramadan and Kundi, 2022). Therefore, the following hypothesis is presented:

H4 Proenvironmental organizational climate (PEOC) has a positive impact on emotional attachment (EA).

According to the hypotheses, Figure 1 shows the theoretical model of the research.

Figure 1
Research Model



Methodology

A quantitative approach and a non-probabilistic sampling for convenience was used for collecting the data (Etikan, 2017). To evaluate the variables of commitment for the employing brand (CEB) and emotional attachment (EA), the scale developed by Fernandez-Lores *et al.* (2016) was used. To measure the variables of pro-environmental organizational climate (PEOC), pro-environmental behavior in the workplace (PEBW) and affective organizational commitment (AC), the scale developed by Peng *et al.* (2020) has been used. In total, the questionnaire consisted of 21 items (COP = 4 items, PEBW = 4 items, CEB = 4 items, EA = 4 items and AC= 5 items). All items were measured using a five-point Likert scale which was classified as (1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree and 5 = strongly agree) (see Annex 1). The data collection was done through a self-administered questionnaire, hosted on a Google form. In order to validate the

questionnaire, prior to its definitive application, a pilot test was conducted on 40 individuals, which showed a good understanding of the items. The study population consisted of people older than 18 years who were working in a company in the city of Lima, the sociodemographic profile of the participants can be seen in Table 1. All participants were informed of the objective of the study and participated voluntarily. To participate they had to provide their informed consent at the beginning of the digital form.

Table 1
Socio-demographic data (N= 863)

Demographic Information	Categories	Frequency (n)	Percentage (%)
Sex	Female	309	35.8
	Male	538	62.3
	I prefer not to say	16	1.9
Age	18-26	383	44.4
	27-39	345	40.0
	40-52	126	14.6
	53-61	9	1.0
Marital status	Married	244	28.3
	Cohabiting	102	11.8
	Divorced	17	2.0
	Single	489	56.7
	Widowed	11	1.3
Higher educational level	Graduate	51	5.9
	Primary	2	0.2
	Secondary	263	30.5
	Senior Technician	252	29.2
	University (undergraduate)	295	34.2
Years working in the company	Less than 1 year	233	27.0
	1 to 3 years	324	37.5
	3 to 5 years	178	20.6
	5 to 7 years	67	7.8
	7 to 9 years	37	4.3
	9 to 11 years	19	2.2
	Over 11 years	5	0.6
Size of the company	Enterprise large (> 200 employees)	654	75.8
	Medium enterprise (51-200 employees)	136	15.8
	Small Business (11-50 employees)	48	5.6
	Microenterprise (0-10 employees)	25	2.9
Type of enterprise	Private	845	97.9
	Public	18	2.1
Business Sector	Metalworking	366	42.4
	Services	240	27.8
	Commercial	185	21.4
	Others	72	8.4

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For data analysis, the partial least squares structural equation model (PLS-SEM) was used with the SmartPLS3 program. The validity and reliability tests provided by PLS-SEM help to analyze the important aspects of the variables that indicate the capacity of the measuring items. The research presented two models, the measurement and the structural. The first, tests the validity of the model through convergent and discriminant validity; and the second, tests and examines the hypothetical research framework (Memon *et al.*, 2021).

Data Analysis

This study used the partial least squares structural equation model (PLS-SEM) for data analysis. PLS-SEM can easily run regression analysis to test complex relationships between constructs. Due to the non-parametric nature of PLS-SEM, it does not require the assumption of normality and large sample size (Hair *et al.*, 2012). It is a multivariate technique that evaluates the structural and measurement model with a low variance of error. In this study, version 4 of the PLS-SEM software is used to test the conceptual framework and describe the relationships between the constructs (Hair *et al.*, 2014). PLS-SEM is suitable as it validates and simultaneously describes the relationship between the constructs (Hair *et al.*, 2014).

SmartPLS software PLS-SEM was used to perform data analysis in this study (Ringle *et al.*, 2015). A two-step evaluation approach including structural and measurement models was used to analyze the collected data (Hair *et al.*, 2017). There are several reasons for selecting PLS-SEM in this study. First, it is thought to be an ideal option when researchers intend to establish an existing theory (Urbach, 2010). Second, exploratory studies contain complex models that can ideally be addressed by PLS-SEM (Hair *et al.*, 2016). Third, instead of dividing it into parts, the complete model is analyzed as a unit in PLS-SEM (Goodhue *et al.*, 2012). Fourth, PLS-SEM provides concurrent analysis for both the structural model and the measurement, which subsequently results in clear and precise estimates (Barclay *et al.*, 1995).

Results

The model is contrasted using a two-stage procedure. The first is to evaluate the psychometric properties of the scale, such as reliability, convergent validity, and discriminant. The second stage consists of contrasting the hypotheses through the system of structural equations.

Converged Validity

Following Hair *et al.* (2017), an estimation of the construct reliability (Cronbach's alpha and composite reliability) and validity (discriminant and convergent validity) was proposed in order to evaluate the measurement model. Cronbach's alpha values are between 0.875 and 0.900, and the threshold value of 0.7 falls below these values (Hair *et al.*, 2017). Likewise, the composite reliability (CR) yields values between 0.876 and 0.904, which were above the suggested value of 0.7 (Kline, 2015). According to these findings, all constructs were considered error-free and construct reliability was established (see Table 2).

Table 2
Converged validity results

Construct	Items	Factorial load	Cronbach alpha	CR	AVE
Emotional attachment (EA)	EA1	0.846	0.894	0.894	0.759
	EA2	0.881			
	EA3	0.885			
	EA4	0.872			

Construct	Items	Factorial load	Cronbach alpha	CR	AVE
Affective commitment AC	AC1	0.827	0.900	0.904	0.714
	AC2	0.856			
	AC3	0.852			
	AC4	0.863			
	AC5	0.826			
Pro-environmental organizational climate (PEOC)	PEOC1	0.877	0.900	0.900	0.768
	PEOC2	0.874			
	PEOC3	0.868			
	PEOC4	0.887			
Pro-environmental behavior in the xworkplace PEBW	PEBW1	0.853	0.883	0.885	0.740
	PEBW2	0.849			
	PEBW3	0.870			
	PEBW4	0.868			
Commitment for the Employer Brand (CEB)	CEB1	0.876	0.875	0.876	0.727
	CEB2	0.836			
	CEB3	0.832			
	CEB4	0.866			

Note. The convergent validity results ensured acceptable values (Factor load, Cronbach alpha and composite reliability (CR) ≥ 0.70 and mean extracted variance (AVE) > 0.5).

The mean extracted variance (AVE) and the factor load should be tested for convergent validity (Hair *et al.*, 2017). According to Table 2, all factor loads had values above the suggested value of 0.7. In addition, Table 2 indicated that the AVE yields at values between 0.714 and 0.768 were above the threshold value of 0.5. These results satisfy the convergent validity for all constructs.

Discriminatory Validity

Two criteria were considered to determine the discriminant validity: (1) the Fornell-Larker criterion and (2) the Heterotrait-Monotrait (HTMT) relationship (Hair *et al.*, 2017). According to Table 3, the requirements were confirmed by the Fornell-Larker condition since all AVEs and their square roots are greater than their correlations with other constructs (Fornell and Larcker, 1981).

Table 3
Fornell-Larcker scale

	EA	AC	PEOC	PEBW	CEB
EA	0.871				
AC	0.598	0.845			
PEOC	0.609	0.584	0.877		
PEBW	0.601	0.606	0.637	0.860	
CEB	0.681	0.585	0.598	0.551	0.853

Note. The values of the diagonal bold represent the square of the average variance extracted (AVE).

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The results of the HTMT relationship are provided in Table 4, which shows that the threshold value of 0.85 is greater than the value of each construct (Henseler *et al.*, 2015) such as partial least squares, the Fornell-Larcker criterion and the examination of cross-loadings are the dominant approaches for evaluating discriminant validity. By means of a simulation study, these approaches do not reliably detect the lack of discriminant validity in common research situations. Therefore, we propose an alternative approach, based on the multitrait-multimethod matrix to assess discriminant validity: the heterotrait-monotrait correlation ratio. We demonstrate its superior performance by means of a Monte Carlo simulation study, in which we compare the new approach to the Fornell-Larcker criterion. Therefore, the HTMT relationship was established. Discriminant validity is determined according to these findings. According to the results of the analysis, there were no problems related to its validity and reliability for the evaluation of the measurement model. Thus, the structural model can be assessed by making greater use of the collected data.

Table 4
Heterortrait-Monortrait (HTMT) Ratio

	EA	AC	PEOC	PEBW	CEB
EA					
AC	0.664				
PEOC	0.678	0.646			
PEBW	0.676	0.674	0.713		
CEB	0.770	0.658	0.672	0.624	

Structural Model Analysis

The hypotheses proposed were tested using the PLS-SEM technique. Predictive relevance values were used for the fit of the model. The cross-validated redundancy values (Q2) represent the predictive relevance of the model. Q2 values should be greater than 0 for model accuracy (Hair *et al.*, 2014; Henseler *et al.*, 2015). The Q2 values were determined by the *blindfolding* method where all endogenous construction values were greater than 0, representing the model accuracy (see Table 5).

Table 5
R^2 of endogenous latent variables

Construct	R^2
Pro-environmental behavior in the workplace (PEBW)	0.510
Commitment for the Employer brand (CEB)	0.465
Emotional attachment (EA)	0.461
Affective Commitment (AC)	0.420

The values of the route coefficient, p-value and t-statistics were used to accept and reject the hypotheses as shown in Figure 2 and Table 6. The strength of the relationship between the variables can be examined through the values of the route coefficient. Route coefficient values close to +1 indicate a strong relationship and vice versa (Hair *et al.*, 2016). p-values and statistical t-values refer to the acceptance and rejection of the proposed hypotheses. In this study, the conceptual model contains four hypotheses. The results of the hypotheses tested are summarized in Table 6. H1

was accepted, which proposed that the pro-environmental organizational climate (PEOC) has a positive impact on pro-environmental behavior in the workplace (PEBW) (β = 0.714, p < 0.000, t = 23.204); H2 was accepted, which proposed that the pro-environmental organizational climate (PEOC) has a positive impact on the commitment for the employer brand (CEB) (β = 0.673, p < 0.001, t = 21.073); and H3 is accepted, which proposed that the pro-environmental organizational climate (PEOC) has a positive impact positive in affective organizational commitment (AC) (β = 0.648, p < 0.003, t = 19.671). Finally, H4 is accepted, which proposed that the pro-environmental organizational climate (PEOC) has a positive impact on emotional attachment (EA) (β = 0.679, p < 0.002, t = 23.844). Thus, all the hypotheses were tested, and it is evident that the pro-environmental organizational climate has a great impact on the four variables proposed in the theoretical model (see figure 1). Table 5 shows the endogenous latent variables where their respective R2 can be seen.

Figure 2
Structural Model

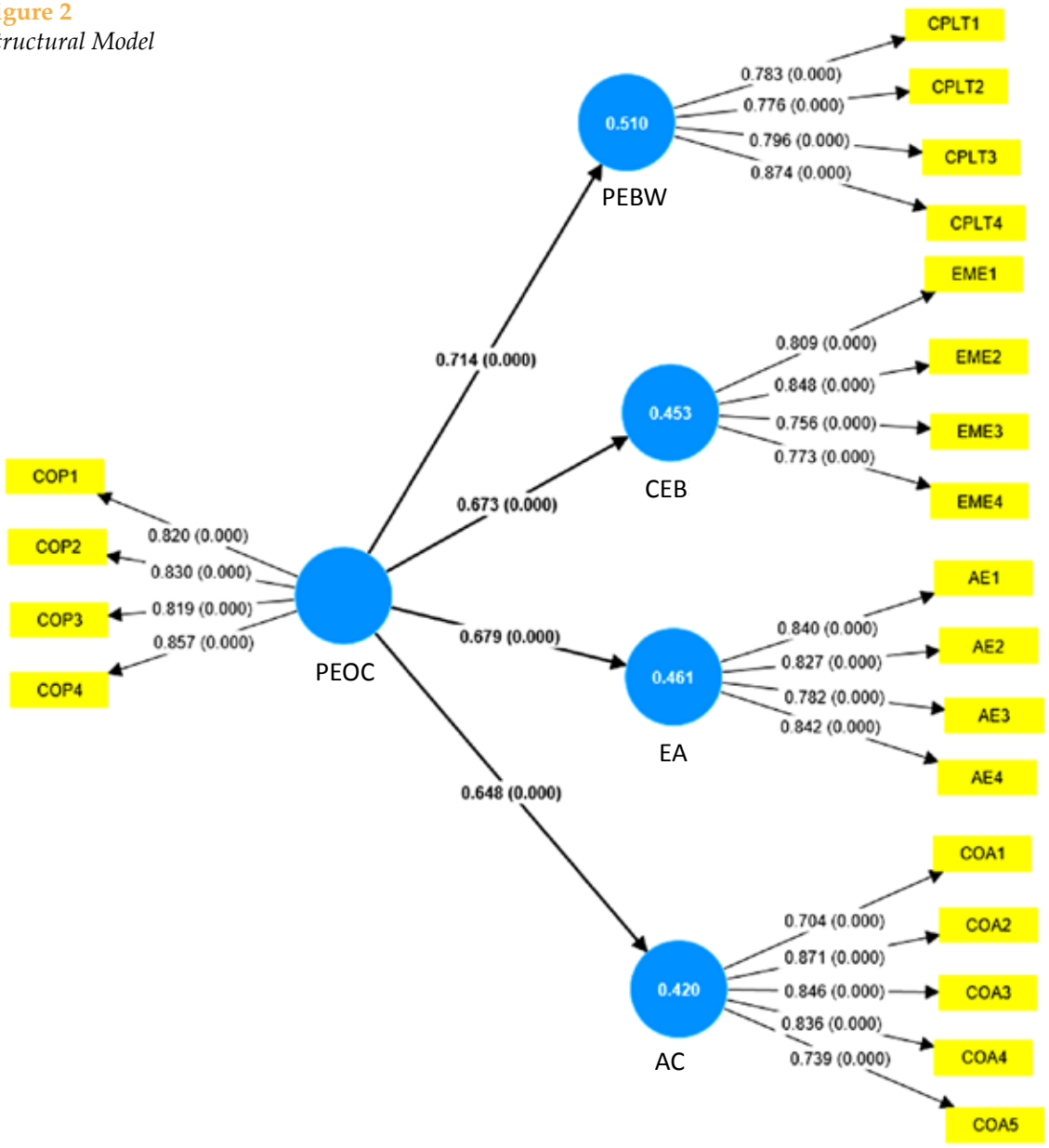

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Table 6

Results of the Structural Model

H	Hypothesis	Route coefficient	p-values	t-values	Address	Decision
H1	PEOC - PEBW	0.714	0.000	23.204	Positive	Accepted
H2	PEOC-CEB	0.673	0.001	21.073	Positive	Accepted
H3	PEOC-AC	0.648	0.003	19.671	Positive	Accepted
H4	PEOC-EA	0.679	0.002	23.844	Positive	Accepted

Discussion and conclusions

This study built a theoretical model based on the scientific literature, where the pro-environmental organizational climate (PEOC) impacts on the enthusiasm for the employer brand (CEB), affective organizational commitment (AC), emotional attachment (EA) and pro-environmental behavior in the workplace (PEBW). The findings of the study contribute to the literature of the study of the pro-environmental organizational climate and its impact on various aspects of the work experience of employees and suggest valuable information for entrepreneurs regarding the implementation of an organizational culture focused on sustainability. The current literature shows that very limited studies have been conducted on the impact of pro-environmental business orientation on the commitment of the employer brand that creates a competitive advantage and improves the sustainable performance of companies. The study of the impact of a pro-environmental organizational culture is still in the initial phase; therefore, this study will contribute theoretically and provide valuable information to entrepreneurs from the various business sectors, which will help them achieve sustainable business performance.

The results of this study reveal the positive impact of pro-environmental organizational culture on pro-environmental behavior in the workplace, which corroborates the work of (Norton *et al.*, 2012; Zientara and Zamojska, 2018), showing that managers and senior executives of companies in Peru should foster a pro-environmental organizational culture in their organizations. In addition, the findings reveal that the pro-environmental organizational climate has a positive impact on the commitment of the employer brand of companies, which supports the work of (Ahmad *et al.*, 2020; Deepa and Baral, 2017; Huseynova and Matošková, 2022), indicating that a pro-environmental organizational climate is an important and integral component in the construction of the brand. Likewise, the results show that the pro-environmental organizational climate has a significant impact on affective commitment in companies, which is in line with the work of (Bhatti *et al.*, 2022; Chordiya *et al.*, 2017; Wang *et al.*, 2021). The findings of the study also confirm the positive impact of the pro-environmental organizational climate on emotional attachment to the organization, which supports the position of previous researchers who argued that the emotional attachment that employees develop with the company generates a sense of belonging, loyalty and commitment to the organization (Scrima, 2015; Zhu and Lo, 2022). As suggested by the researchers, organizations are an important part of society and have a key role in promoting sustainable practices (Aluchna and Boleslaw, 2018). An organization committed to promoting sustainability can not only reduce its negative impact on the environment, but also improve its image, productivity and long-term profitability (Cupertino *et al.*, 2020; Datta *et al.*, 2015; Zhou and Jin, 2023). Therefore, it is imperative that companies from different sectors in Lima implement strategies to promote a pro-environmental organizational culture and boost their environmental, social and economic performance.

The pro-environmental organizational climate has a significant influence on several aspects of the work experience of employees. It promotes pro-environmental behavior in the workplace, promotes enthusiasm for the employer brand, strengthens affective organizational commitment and fosters emotional attachment to the organization. Organizations that adopt sustainable

practices and promote a pro-environmental organizational climate not only contribute to the care of the environment but can also improve the satisfaction and commitment of their employees, probably leading to a positive impact on the reputation, talent retention, and overall performance of the organization.

In Peru, the pro-environmental organizational climate has a significant impact on pro-environmental behavior in the workplace, commitment for the employer brand, affective commitment and emotional attachment to the organization. Organizations in Peru that promote sustainable practices and a pro-environmental organizational climate generate a positive impact on the environment and strengthen their brand image as an employer. In addition, they foster greater employee engagement and emotional attachment, contributing to talent retention and organizational goals. Therefore, it is essential that Peruvian organizations know the importance of a pro-environmental organizational climate and work actively to promote sustainable practices and strengthen the emotional connection with their employees.

Although this study presented a new framework that addresses the pro-environmental organizational climate and its impact on key variables of human talent management, there are several limitations. Future research should investigate the impact of the pro-environmental organizational climate on other human talent management variables. Another limitation is related to the population of the study, which are workers of different companies in the city of Lima, which indicates that there may be generalization problems as different contexts may have different perceptions of workers. Therefore, it is suggested that future research try to draw conclusions from different emerging economies, which could be in Latin America and other global business context.

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Annex 1

Instrument for data collection

Construct	Cod.	Items
Proenvironmental Behaviors in the Workplace (PEBW)		**In my workplace...**
	PEBW1	I try to reduce my electricity consumption (e.g. turn off lights, machines, computers ...if I am not using them)
	PEBW2	I try to save water (e.g. I close the pipes if I am not using them...)
	PEBW3	I try to recycle, reuse and reduce the use of materials (e.g. double-sided printing)
	PEBW4	I offer ideas to reduce the negative environmental impact of the company.
Affective Organizational Commitment (AC)		**In the company where I work I feel that...**
	AC1	When someone criticizes it, it feels like a personal insult.
	AC2	When I talk about it, I usually say 'us' instead of 'them.'
	AC3	Its success is my success.
	AC4	When someone praises it, it feels like a personal compliment.
	AC5	If a news story criticized it, I would feel ashamed.

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Construct	Cod.	Items
Proenvironmental Organizational Climate (PEOC)		**Our company...**
	PEOC1	It publicly expresses an environmental policy.
	PEOC2	It promotes environmental measures in the workplace.
	PEOC3	It continuously trains employees in environmental education.
	PEOC4	The chiefs support the task of environmental protection.
Commitment for the Employer Brand (CEB)		**In the company where I work...**
	CEB1	I feel that its projects are mine.
	CEB2	I stand firm on my commitment.
	CEB3	Its problems affect me.
	CEB4	Its success is mine too.
Emotional Attachment (EA)		**In the company where I work...**
	EA1	I like your brand.
	EA2	I have developed a strong bond with your brand.
	EA3	I am emotionally attached to your brand.
	EA4	I feel the colors of your brand.

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Peruvian entrepreneurship in the framework of sustainable development

Emprendimiento peruano en el marco del desarrollo sostenible

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Abstract: in the Peruvian context, entrepreneurship has become a determining factor in driving the country's social and economic progress. In addition, it plays an active role in the achievement of the Sustainable Development Goals proposed by the United Nations. The main objective of the study was to establish the relationship between Peruvian entrepreneurship and sustainable development. A quantitative, non-experimental, correlational and cross-sectional approach was used the study population was established using data from the technical report Entrepreneurial Demographics of Peru, according to this report, 2,054 ventures were registered and established in the year 2021, with a life cycle of two years at the time of the study. For the sample, 746 ventures were purposively selected. A questionnaire composed of 40 items with Likert-type response options was used, was validated by five experts and its reliability was established through the Cronbach's Alpha measure, obtaining a very reliable coefficient of 0.93. The resulting data were analyzed using the SPSS version 25 statistical software. The results revealed a moderate positive correlation between entrepreneurship in Peru and sustainable development. In conclusion, entrepreneurship in Peru is significantly related to sustainable development, especially in terms of contributing to the SDGs and promoting innovation and adaptability. However, greater attention to community engagement is required to strengthen the relationship between entrepreneurship and the broader community.

Keywords: entrepreneurship, sustainable development, Sustainable Development Goals, community participation, community.

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Resumen: en el contexto peruano, el emprendimiento se ha consolidado como un factor determinante para impulsar el progreso social y económico del país. Además, desempeña un papel activo en la consecución de los Objetivos de Desarrollo Sostenible propuestos por las Naciones Unidas. El objetivo central del estudio fue establecer la relación entre el emprendimiento peruano y el desarrollo sostenible. Se utilizó un enfoque cuantitativo, no experimental, correlacional y transversal. La población de estudio se estableció utilizando datos del informe técnico Demografía Empresarial del Perú, según este informe, se registraron y establecieron 2054 emprendimientos en el año 2021, con un ciclo de vida de dos años en el momento del estudio. Para la muestra se seleccionaron intencionalmente 746 emprendimientos. Se utilizó un cuestionario compuesto por 40 ítems con opciones de respuesta tipo Likert, fue validado por cinco expertos y se estableció su confiabilidad a través de la medida Alfa de Cronbach, obteniendo un coeficiente muy confiable de 0.93. Los datos resultantes fueron analizados utilizando el programa estadístico SPSS versión 25. Los resultados revelaron una correlación positiva moderada entre el emprendimiento en Perú y el desarrollo sostenible. En conclusión, el emprendimiento en Perú está relacionado de manera significativa con el desarrollo sostenible, especialmente en términos de contribución a los ODS y la promoción de la innovación y adaptabilidad. Sin embargo, se requiere una mayor atención a la participación comunitaria para fortalecer la relación entre el emprendimiento y la comunidad en general.

Palabras clave: emprendimiento, desarrollo sostenible, Objetivos de Desarrollo Sostenible, participación comunitaria, comunidad.

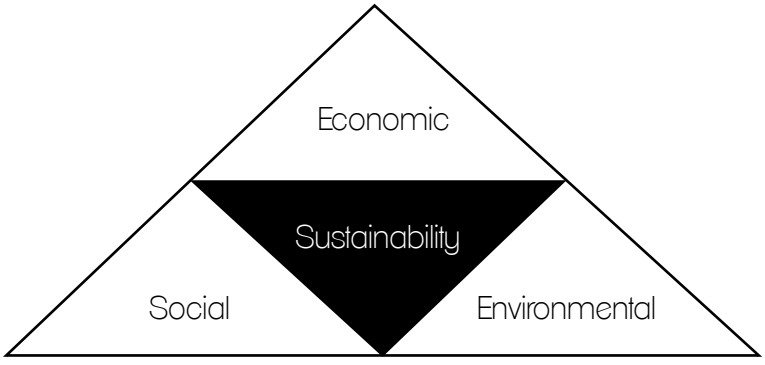
Introduction

Entrepreneurship in Peru has been an important driver for achieving not only the country's economic but also its social development, additionally it plays a key role in performing the sustainable development goals set by the United Nations. In a society aware of the need to address environmental and social challenges, sustainable entrepreneurship is proving to be a promising response to foster equitable and responsible growth (Calanchez *et al*., 2022; Huamán *et al*., 2022).

In recent years, the Peruvian entrepreneurial ecosystem has experienced remarkable growth, becoming a key factor in promoting the country's development. However, in a world where sustainability and environmental responsibility are increasingly important, it is essential to analyze the role of Peruvian entrepreneurship within the context of sustainability. This scientific article focuses on exploring and analyzing Peruvian entrepreneurship in relation to the principles and objectives of sustainable development (Martínez, 2023).

In this sense, development from sustainability, defined as the balance between increased economic elements, greater social inclusion and actions that ensure that the environment is protected (Figure 1), has become a global priority. The SDGs provide a road map to address the major challenges of today's world, such as poverty, economic disparity, climate mismatch and environmental crisis (Fernández and Gutiérrez, 2013; Aguado, 2023).

Figure 1
Intervening elements in the sustainable balance



Note. The figure shows the intervening elements in the sustainable balance where the terms of sustainability, the equitable, the bearable and the viable emerge, which are the subject of analysis. Based on Aguado (2023).

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In this context, sustainable entrepreneurship offers a unique opportunity to drive inclusive economic growth while addressing environmental and social challenges. By integrating sustainable practices into their business models, Peruvian entrepreneurs can generate a positive impact on both the local economy and the environment. Based on the above, the aim is to establish the relationship between Peruvian entrepreneurship and sustainable development. By studying this interaction, it is possible to understand the phenomenon and promote actions for its effectiveness.

This article develops important items such as entrepreneurship and sustainability from an economic, social and environmental perspective which offers a comprehensive and balanced framework. Likewise, entrepreneurship is considered as the skills of recognizing opportunities from the view of social entrepreneurship, focusing on a big difference between the traditional and the social.

Entrepreneurship and sustainability

Sustainable development has been considered a relevant aspect of the global agenda, which is intended to promote as it seeks to reconcile economic growth by including the environmental aspect and social welfare. This holistic approach understands the interdependence of the economic, environmental and social components of development and seeks to promote a harmonious balance between them (Montero, 2021). First, the starting point for sustainability is to fill current gaps or needs, without involving a potential risk to preserving future generations' satisfaction of their own. This principle, presented by the UN Committee on Environment and Development in its report "Our Common Future" (1987), shows the importance of long-term decisions and actions that promote intergenerational equality.

From an economic perspective, sustainability recognizes that economic growth must be accompanied by the efficient management of natural assets and the promotion of responsible business practices, requiring the adoption of business models that minimize negative environmental impacts and encouraging innovation in sustainable products and services. At the same time, recognizing the relevance of equality and economic inclusion ensures that the benefits of economic growth are distributed fairly (Zenck, 2018; Cuenca, 2020).

Therefore, from an environmental perspective, the purpose of sustainability is to save and preserve natural ecosystems, as well as mitigate the negative consequences of human actions on the environment, involving the implementation of sustainable production and consumption practices, minimizing the release of gases that contribute to the greenhouse phenomenon, protecting biodiversity and sustainably manage resources (Hernández-Huerta, 2018; Lozano *et al*., 2022). Simultaneously, it seeks to foster resilience to the impact of climate change and strengthen the resilience of natural systems. In the social sphere, sustainability focuses on promoting social balance and justice, as well as the well-being of all. This means addressing poverty, inequality, exclusion and ensuring equitable access to basic and fundamental services for society. In addition, it recognizes the importance of strengthening citizen participation, promoting gender equity, and respecting freedoms in all dimensions of development (Rendon *et al*., 2018; Bonifaz *et al*., 2021).

It can be argued that sustainable development provides a comprehensive and balanced framework for solving today's global challenges. Combining economic, environmental and social aspects, this approach aims to promote positive and sustainable changes in society. The effective implementation of the principles and practices of sustainable development requires the active cooperation of State entities, business organizations, social groups and citizens to ensure sustainability for present and future generations. Entrepreneurship, with its innovative and change-oriented approach, offers a unique platform for addressing environmental and social challenges. Entrepreneurs have the ability to recognize opportunities and generate innovative proposals to address market demands, while valuing the environmental and social effects that derive from their actions (Bailiff and Roman, 2020; Batista *et al*., 2023).

Hence, a sustainable enterprise characterizes by its commitment to a comprehensive approach

based on the environment, without prejudice to the economic and social values. These companies not only seek to generate profits, but also contribute to the well-being of people and the care of the planet. They adopt responsible business practices, incentivize efficient use of resources and minimize waste, care for social inclusion and seek innovative solutions to address sustainable development challenges (León *et al*., 2022).

Towards social entrepreneurship

It should be noted that entrepreneurship is based on the ability to recognize opportunities, develop innovative ideas and turn them into economic opportunities. Entrepreneurship has the power to transform economy through the creation of new businesses and the introduction of innovation in both new and existing organizations (Fernández-Bedoya, 2023). It involves the continuous pursuit of opportunities and creates value through invention and the ability to anticipate change and mobilize the necessary resources. In short, entrepreneurship is defined as the ability to identify opportunities, generate innovative ideas and use them to create economic and social value, thus promoting progress and development in various fields (Al Hussaini, 2019, Mellado, 2023).

In this sense, unlike traditional entrepreneurship, where profit generation is the priority, social entrepreneurship incorporates social and environmental dimensions in the search for innovative and sustainable solutions. Social entrepreneurs identify and solve social problems by implementing business models that positively impact communities and contribute to their well-being (Condes, 2023). Social entrepreneurship involves a unique combination of business and social components. By seeking innovative approaches to address challenges such as poverty, lack of accessibility to education, gender inequality, environmental degradation and other pressing social problems, these entrepreneurs seek to generate income and try to balance social value creation (Ruiz-Ruano and Puga, 2016; Odera, 2022).

Social entrepreneurship arises when entrepreneurs, in addition to pursuing economic profit, also work to solve social and environmental problems. These entrepreneurs have a broader vision and strive to achieve a positive impact in the community they live, through their business activities. In addition, social entrepreneurship is based on the cooperation and participation of various stakeholders, such as local communities, government entities, civil society and private business sector corporations. These actors come together in strategic alliances to comprehensively address social problems and generate more impact (Sánchez, 2018; Méndez-Picazo *et al*., 2021).

Likewise, this type of enterprise seeks not only to find short-term solutions, but also to generate long-term systemic change. This means implementing sustainable business models, promoting inclusion and equity, and creating positive impacts that extend beyond the economic dimension to society (Barrutia and Echebarria, 2010; Martínez, 2020). Traditional entrepreneurship focuses on making financial profits. However, with the growing awareness not only of social problems, but also of the environment that arise from corporate activities, the need to create social value in addition to economic value has been emphasized (Campo-Ternera, 2019). Sustainable entrepreneurship goes a step further, integrating economic, social and ecological value creation into a holistic approach. This means setting up, managing and growing companies focused on the triple economic, social and environmental benefits, in other words, innovating in a sustainable way.

Therefore, sustainable innovation is a process that allows to create and apply ideas, processes, products and services that not only generate economic benefits, but also bring benefits to society and the environment. This term refers to the way in which innovation evolves to be part of a sustainable approach, in which the satisfaction of current needs is sought without requiring the commitment of resources to meet the future demands of society (Infante, 2019; Alonso, 2022). This approach is in line with current global sustainable goals and responds to the growing demand for business practices that contribute positively to society and the environment (Fuertes *et al*., 2018). Sustainable innovation exerts a fundamental influence on this process, helping entrepreneurs to identify new profitable business opportunities

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favorable to society and the environment. Sustainable innovation provides a competitive advantage, increases business resilience and contributes to the achievement of the UN SDGs.

Therefore, sustainable entrepreneurship can have positive impacts at multiple levels. First, it can generate employment and economic opportunity in local communities, especially in disadvantaged areas. By fostering the creation of socially responsible businesses, local economies can be strengthened and poverty reduced (García *et al*., 2020). It also fosters innovation and responsible business practices. Entrepreneurs are constantly looking for more efficient and sustainable solutions in terms of resources, which can lead to improvements in waste management, energy efficiency, water conservation and emissions reduction (Silva *et al*., 2022; Lozano *et al*., 2022).

It can also have a significant impact on society, as it addresses pressing social problems. Entrepreneurs can focus on education and health, gender equality, access to clean energy and community development (Sánchez-Álvarez *et al*., 2022). By developing inclusive business models and affordable solutions, they can enhance citizens' wellbeing and contribute to progress in the conduction of the Sustainable Development Goals (Cuenca, 2020; Rivera Martínez *et al*., 2022). Importantly, the relationship between entrepreneurship and sustainable development requires a collaborative approach and the participation of multiple actors. The branches of government, business organizations and academic institutions must therefore work together to create an enabling environment for sustainable entrepreneurship, facilitating access to finance, promoting supportive policies and raising awareness and education about the importance of sustainable development.

Clearly, an important dimension related to entrepreneurship is economic sustainability, understood as the ability of a company to generate sufficient income to support its costs, reinvest in growth and provide reasonable returns to investors when needed. But in the context of sustainable entrepreneurship, economic sustainability has a broader meaning (Guevara *et al*., 2023). It is not just about making a profit, but also about how a profit is made. Businesses should consider how their business operations and practices impact society and the environment and strive to reduce negative impacts and spread positive impacts. This includes, for example, choosing fair-trade suppliers, investing in renewable energy, and implementing fair labor practices.

In relation to the previous idea on sustainable entrepreneurship, the aspects related to social and environmental impact are as important as economic sustainability. These aspects are related to the way in which a company impacts society and the environment through its operations and activities. The social dimension refers to the social contribution of the company. According to Mair and Marti (2006), this includes the development of new job positions and the improvement of the conditions of those already created, contributing to local communities, and supporting disadvantaged communities. This may also include implementing ethical business practices, developing diverse and inclusive environments, and addressing social issues by innovating business models including products and/or services.

In relation to the environmental aspect of entrepreneurship, it refers to the connection and collaboration between a company and its environment. According to Cohen and Winn (2007), it includes reducing a company's environmental footprint by promoting sustainable practices in the use of natural assets and species richness. It may also include the implementation of business practices that support a circular economy that minimizes waste and reuses or recycles resources (Álvarez-Aros, 2017; Gómez, 2022). Therefore, these aspects in sustainable entrepreneurship are seen as suitable scenarios for innovation and value creation rather than additional constraints and costs. Sustainable entrepreneurs seek ways to create economic value while having a positive impact on society and minimizing environmental impact. This holistic approach gives organizations a competitive advantage and contributes to their long-term resilience.

Materials and methods

This article shows the findings of a study that aimed to establish the relationship between en-

trepreneurship in Peru and sustainable development. The methodological approach used was quantitative and followed the stages of a non-experimental research, correlational approach and with cross-sectional design, as described in Hernández-Sampieri and Mendoza (2018). The study population was established using data from the technical report "Business Demography of Peru" (INEI, 2021), prepared by the National Institute of Statistics and Informatics. According to this report, 2,054 startups were registered and established in 2021, implying that they had a two-year life cycle at the time of the study. For the sample, an intentional approach was used and 746 enterprises were selected, this sample size guarantees a 95 % certainty in the results and a maximum error of 3 % (Monje, 2011).

Therefore, a survey was used to collect the data, in which a questionnaire composed of 40 items with Likert type response options was applied. The questionnaire was validated by five experts. In addition, its reliability was established through the Cronbach's Alpha measure, which resulted in a very reliable coefficient of 0.93. The analysis of the collected data was developed by the SPSS statistical program version 25, and graphs and tables were used to compare the results and obtain conclusions. Based on the literature review, the operationalization of the variables (entrepreneurship and sustainable development) was elaborated, which is shown in table 1.

Table 1
Operationalization of variables

Variables	Dimensions	Indicators
Entrepreneurship	Economics	Revenue Growth Employment generation Profitability and financial viability
	Social	Social inclusion Community impact Gender equity
	Environmental	Carbon footprint Efficient use of resources
Sustainable Development	Contribution to the SDGs	Scope of the SDGs Impact of the SDGs
	Community participation	Local Participation Collaboration with local actors
	Innovation and adaptability	Level of innovation Adaptability to change

Note. This table shows the variables under study, as well as the dimensions and indicators corresponding to each variable. Based on Chavez *et al*. (2023).

Based on the above, the following general hypothesis was established: there is a correlation between entrepreneurship and sustainable development. In addition to three specific hypotheses: a) There is a correlation between entrepreneurship and the contribution to the SDGs, b) There is a correlation between entrepreneurship and community participation, c) There is a correlation between entrepreneurship and innovation and adaptability. Finally, it is important to note that hypotheses will be accepted when the p-value is < 0.05.

Results

Table 2 presents descriptive statistics of the sample studied, which may help to identify biases for future research. There was a greater participation of entrepreneurs over 50 years old, 65 % of those consulted were women, and most of them have university studies.

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Table 2
Descriptive sample

Age	Frequency	Percentage
18-30 years	261	35%
31-50 years	216	29%
Over 50 years	269	36%
Sex	Frequency	Percentage
Women	484	65%
Men	262	35%
Level of education	Frequency	Percentage
University studies	403	54%
Secondary education	283	38%
No studies	60	8%
Total	746	100%

Note. This table presents the sample used to develop the research, considering social levels of individuals. Based on Chavez *et al*. (2023).

The Kolmogórov-Smirnov test was implemented in the research to examine the assumption of normality. This test compares the cumulative distribution of samples with an ideal normal distribution. The results obtained (table 3), showed a p-value of 0.000, representing a significant deviation from the normal.

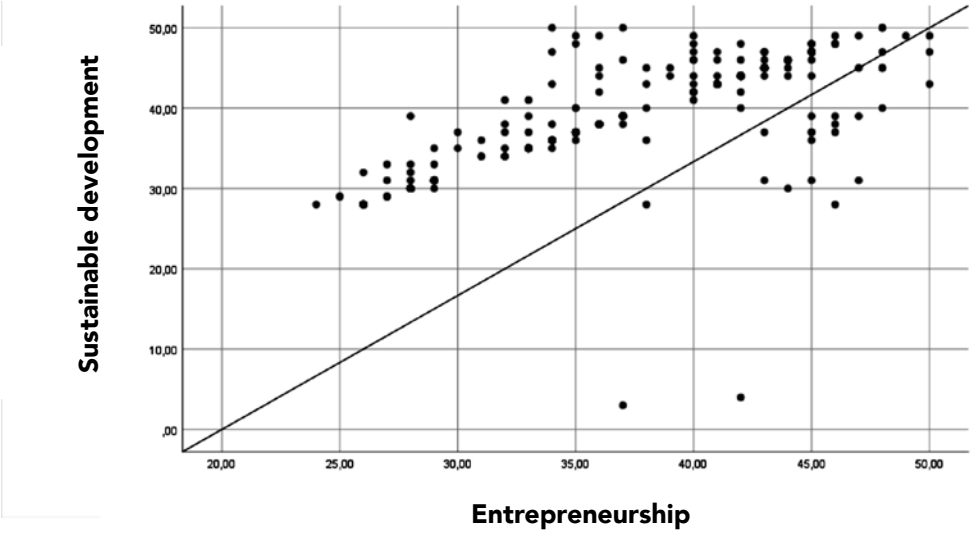
Table 3
Test for normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistical	gl	Sig.	Statistical	gl	Sig.
Entrepreneurship	.376	746	.000	.630	746	.000
Sustainable Development	.327	746	.000	.720	746	.000
a. Lilliefors' correction of meaning						

Note. This table shows the normality test to compare the cumulative distribution function of the sample data with the distribution. Based on Chavez *et al*. (2023).

This finding guided subsequent decisions regarding the choice of appropriate statistical techniques, in this case, the Spearman Rho coefficient was selected for the analysis. Figure 2 visually provides the dispersion of the variables.

Figure 2
Simple dispersion of the relationship of variables



Note. The graph represents the disposition of the relationships between the variables entrepreneurship and sustainable development. Based on Chavez *et al*. (2023).

Table 4
Relationship between entrepreneurship and sustainable development variables

			Entrepreneurship	Sustainable Development
Spearman's Rho	Entrepreneurship	Correlation coefficient	1,000	,693**
		Sig. (bilateral)	.	.000
		N	746	746
	Sustainable Development	Correlation coefficient	,693**	1,000
		Sig. (bilateral)	.000	.
		N	746	746

**. The correlation is significant at level 0.01 (bilateral).

Note. This table shows the relationship between entrepreneurship and sustainable development using Spearman's Rho coefficient. Based on Chavez *et al*. (2023).

As shown in Table 4, the correlation coefficient between entrepreneurship in Peru and sustainable development, presents a Spearman rho value of 0.693. This value indicates a moderate to strong positive correlation between the two variables. In addition, the established hypothesis is accepted. In other words, when the magnitudes of the entrepreneurship variable increase, so do the values of the sustainable development variable and vice versa. This positive correlation suggests that there is an ascending relationship between both variables. In other words, it is important to note that the correlation coefficient is closer to 1 than to 0, indicating that the relationship between entrepreneurship and sustainable development is not only positive, but also has moderate strength. This information supports the idea that entrepreneurship can play an important role in promoting sustainable development, since there is a significant connection between the variables.

On the other hand, according to García-Cabrera *et al*. (2020), who analyzed the relationship

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between entrepreneurship and development, their findings demonstrated a solid, outstanding, significant and positive connection between the variables studied in the context of Latin America, supporting the idea that entrepreneurship can contribute to sustainable development in the region. Likewise, Wennekers *et al*. (2018) in their study on global variables, found that entrepreneurship has a positive influence on the sustainable development of countries. They analyzed data from multiple countries, including Peru, and found a significant correlation between the level of entrepreneurship and the sustainable development index. These findings support the observed positive correlation.

It should be noted that Table 5 shows the results of the relationship between the entrepreneurship variable and the dimensions of sustainable development (contribution to the SDGs, Community participation and innovation and adaptability). Regarding the variable and the first dimension, a Spearman rho value of 0.688 was reached indicating a moderate positive correlation between entrepreneurship in Peru and contributing to the Sustainable Development Goals (SDGs). This means that there is a general trend in which, as the level of entrepreneurship increases, the contribution of entrepreneurs to the SDGs also tends to increase.

Table 5

Relationship between the entrepreneurship variable and the dimensions of sustainable development

			Contribution to the SDGs	Community participation	Innovation and adaptability
Spearman's Rho	Entrepreneurship	Correlation coefficient	.688	.385	.655
		Sig. (bilateral)	.000	.000	.000
		N	746	746	746

**. The correlation is significant at level 0.01 (bilateral).

Note. This table shows the relationship between the entrepreneurship variable and the dimensions of sustainable development using Spearman's Rho coefficient. Based on Chavez *et al*. (2023).

Regarding the relationship between entrepreneurship in Peru and the community participation dimension, a Spearman rho value of 0.385 was obtained, indicating a weak positive association between entrepreneurship in Peru and community participation. This means that there is a certain tendency in which, as the level of entrepreneurship increases, community participation also tends to increase, although this relationship is not very strong. In this sense, it is understood that a Spearman's rho value of 0.655 indicates a moderate to strong positive correlation between entrepreneurship in Peru and the innovation and adaptability dimension of sustainable development. This means that there is a clear trend in which, as the level of entrepreneurship increases, innovation and adaptability in the field of sustainable development also tends to increase.

However, the results show that entrepreneurship in Peru is positively correlated with different dimensions of sustainable development, such as contribution to the SDGs, community participation, innovation and adaptability. These correlations suggest that entrepreneurship can have a significant impact to promote sustainable development in the country.

Conclusions and discussion

The study found a significant moderate positive relationship with a tendency to strong between entrepreneurship in Peru and sustainable development, which implies that the increase in levels of entrepreneurship is associated with an increase in levels of sustainable development, and vice versa. The results reported are in line with León *et al*. (2022) who point out that entrepreneurship plays an essential role to achieve the sustainability of a country. They emphasize that entrepreneurs can generate innovative and

sustainable solutions that allow to face and overcome the economic, social and environmental challenges of the environment.

Entrepreneurship plays a fundamental role in the sustainable development of a country, since entrepreneurs are agents of change capable of generating innovative and sustainable solutions to face and overcome challenges and obstacles from social, environmental and economic indicators. However, it is important to know that the relationship between entrepreneurship and sustainable development is strongly influenced by the national context. Government policies, available infrastructure and access to resources play a crucial role in the ability of entrepreneurs to contribute to sustainable development (Cueva *et al*., 2021; Silva *et al*., 2022).

Similarly, Bailiff and Roman (2020) point out that the national context influences the way in which the variables studied are associated. They stress that government policies, infrastructure and access to resources can affect the ability of entrepreneurs to contribute to sustainable development. In Peru, contextual factors may be related to the observed coefficient.

An enabling environment with clear supportive policies, adequate infrastructure, and equitable access to resources, provides entrepreneurs with the tools needed to create and scale sustainable solutions. It is the responsibility of governments and other stakeholders to create and promote this enabling environment, thereby fostering sustainable entrepreneurship and enabling entrepreneurs to drive sustainable development for the contribution to society as a whole (Pazmiño *et al*., 2021; Lozano *et al*., 2022).

The results also coincide with those of Batista *et al*. (2023) who mention that formalized entrepreneurship is essential for sustainable development. When Peruvian entrepreneurs have secure access to property and can formalize their businesses, this allows them to access credit, establish legal contracts and participate fully in the economy. Formalized entrepreneurship generates employment, contributes to economic growth and reduces poverty, thus contributing to sustainable development. With the above result, the relationship between entrepreneurship and the dimensions of sustainable development is confirmed. Regarding the variable and the first dimension contribution to the SDGs, a moderate positive correspondence was obtained between entrepreneurship in Peru and collaboration to the Sustainable Development Goals (SDGs). This means that there is a general trend in which, as the level of entrepreneurship increases, the contribution of entrepreneurs to the objectives also tends to increase.

The study by Sánchez-Álvarez *et al*. (2022) also found a moderate positive contribution between entrepreneurship and the contribution to the Sustainable Development Goals (SDGs). Similarly, Lozano *et al*. (2022) in their study establish that entrepreneurship can have a key impact to play an essential role in generating disruptive and sustainable innovations to address these challenges. A positive relationship between entrepreneurship and its participation in achieving the SDGs means that entrepreneurs can help advance these goals.

These studies support the idea that entrepreneurship can be an effective tool to address sustainable challenges and achieve a positive impact on society. Both studies support the idea that entrepreneurship can be a driving force to achieve the Sustainable Development Goals. A positive relationship between entrepreneurship and the contribution to the SDGs is crucial to progress towards sustainable development. Entrepreneurship can generate social and environmental impact, create jobs, promote innovation, and mobilize resources, all of which contribute directly to the implementation of the SDGs and to achieving a fairer, more sustainable, and more prosperous society.

Regarding the relationship between entrepreneurship in Peru and the community participation dimension, a weak positive association was obtained between these aspects. Silva *et al*. (2022) indicated that entrepreneurship is associated with entrepreneurship and the search for individual opportunities. Entrepreneurs may be more focused on their own business goals and maximizing their profits than on engaging with the community in which they operate. They agree with García *et al*. (2020) who indicated that entrepreneurs generally focus on developing and growing their own busi-

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nesses, which involves dedicating time, resources and energy to their companies. On the other hand, community participation involves working for the benefit of the community at large, without an exclusive focus on individual commercial interests. This difference in objectives can make it difficult to collaborate and create synergies between entrepreneurs and the community.

According to Silva *et al*. (2022) and García *et al*. (2020), the weak association between entrepreneurship and community participation is because entrepreneurs focus on growing their own businesses and seeking personal opportunities, which can limit their involvement in community activities. The focus on maximizing profits and the focus on individual business interests hinders collaboration and synergy with the community. This discrepancy in objectives and approaches between entrepreneurs and community participation acts as an obstacle to establishing a solid relationship between both aspects.

The moderate to strong positive coincidence between entrepreneurship in Peru and the innovation and adaptability dimension of sustainable development indicates that there is a clear trend in which both concepts are positively related. In this context, this implies that Peruvian entrepreneurs are more willing to generate innovative ideas and solutions that address the challenges and demands of sustainability. These results coincide with those obtained by Alonso (2022), establishing that entrepreneurs are often agents of change and have a mindset oriented to action and problem solving. They are therefore more open to exploring new opportunities and finding creative ways to address the challenges of sustainable development. Moreover, entrepreneurship can be a key driver of innovation, as entrepreneurs are motivated to find innovative solutions that will enable them to excel in the market and outperform competition. This can lead to the generation of more sustainable products and services and the adoption of business practices that promote sustainable development.

On the other hand, sustainable development requires adaptability as it involves continuously adjusting and modifying business strategies and practices to adapt to changes in the economic, social, and environmental context. Entrepreneurs tend to be more flexible and adaptable to changes, allowing them to be more responsive and able to incorporate the dimension of innovation and adaptability in their business activities (Guevara *et al*., 2023). A positive relationship between entrepreneurship and sustainable development implies that entrepreneurship can become a valuable aspect to advance towards a development model that considers that the economic, environmental, and social aspects are sustainable over time. Entrepreneurs can generate innovation, create jobs, adopt responsible practices and promote a sustainable entrepreneurial culture, thus contributing to the achievement of goals for a sustainable future.

There were limitations when conducting the study, including the lack of data provided by government agencies on the subject studied, which made it difficult to compare the results with what the State indicated. In addition, Peru's cultural, social and economic conditions pose some challenges for a comprehensive understanding of sustainable entrepreneurship. Perceptions and approaches can vary widely across regions, social groups and economic sectors within a country. Therefore, it is important to consider these differences in circumstances to avoid inaccuracies in the study. Future research could explore the obstacles and challenges that Peruvian companies face in adopting sustainable practices. This may include exploring new business models, using energy efficiency systems and environmentally friendly practices.

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Eco-innovation in the hotel sector in Nuevo Nayarit, Mexico. A sustainable perspective

Eco-innovación en el sector hotelero de Nuevo Nayarit, México. Una perspectiva sustentable

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Abstract: the study of eco-innovation is a field of growing relevance in the scientific field, has been the subject of exhaustive analyses from different theoretical and methodological perspectives. The diversity of these approaches demonstrates the vast and complex nature of the construct in an attempt to understand its effects and contributions to the complex environmental problems faced by tourist destinations. In this sense, this research aims to analyse the influence of eco-innovation on the sustainability of the hotel sector in Nuevo Nayarit, Mexico. To achieve this, a quantitative, cross-sectional, and explanatory methodology was used, with the participation of 226 hotel workers in a convenience sample. A partial least squares structural equation model (PLS-SEM) was used to test the research hypothesis. The results show that eco-innovation has a significant and positive influence on the sustainability of the sector, where good operating practices and environmental management are the most explanatory and predictive aspects. This work contributes to the knowledge of tourism in its relationship with environmental sciences and business management, showing the reality of an international tourist destination on an emerging issue. As future lines of research, it is proposed that the study be adjusted to a larger sample of tourists.

Keywords: eco-innovation, sustainability, hospitality, PLS-SEM, tourism, Nuevo Nayarit, tourism sector, environmental management.

Resumen: el estudio de la eco-innovación es un campo de relevancia ascendente en el ámbito científico, y ha sido objeto de análisis exhaustivos desde distintas perspectivas teóricas y metodológicas. La diversidad de estos enfoques evidencia la amplia y compleja naturaleza del constructo en un intento de comprender sus efectos y contribuciones ante las problemáticas ambientales complejas con las que se enfrentan los destinos turísticos. En ese sentido, el objetivo de esta investigación es analizar la influencia de la eco-innovación sobre la sustentabilidad del sector hotelero de Nuevo Nayarit, México. Para lograrlo se utilizó una metodología con enfoque cuantitativo, de corte transversal y de alcance explicativo, con una participación de 226 trabajadores de la hotelería en una muestra por conveniencia. Para probar la hipótesis de investigación se utilizó un modelo de ecuaciones estructurales por mínimos cuadrados parciales (PLS-SEM). Los resultados comprueban que la eco-innovación tiene una influencia significativa y positiva sobre la sustentabilidad del sector, donde las buenas prácticas de operación junto a la gestión ambiental son los aspectos de mayor poder explicativo y predictivo. Este trabajo contribuye al conocimiento del turismo en su relación con las ciencias ambientales y la gestión empresarial, evidenciando la realidad en un destino turístico internacional sobre un tema de carácter emergente. Como futuras líneas de investigación se propone ajustar el estudio a una muestra mayor y considerar aspectos específicos de la política turística y ambiental.

Palabras clave: Eco-innovación, sustentabilidad, hotelería, PLS-SEM, turismo, Nuevo Nayarit, sector turístico, gestión ambiental.

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Introduction

The hotel business sector has faced increasing environmental challenges in recent years, where eco-innovation is seen as an organizational strategy that helps reduce negative ecological effects generated by the provision of its services, especially because various hotel chains have been publicly exposed for contributing to environmental degradation when carrying out their investment projects in international destinations (CEPAL, 2017; Hernández *et al*., 2018; Vargas, 2015). Such is the case of Nuevo Nayarit, a Mexican tourist development, which has been noted for having a disproportionate growth in tourism offer, affecting the natural environment to a turning point, impacting terrestrial and marine biodiversity, with a negative effect from the growth of hotel infrastructure, transforming the landscape and degrading the beaches (Massé *et al*., 2018).

In this sense, eco-innovation has recently become a key element to strengthen the sustainability of companies (Martínez-Rubio *et al*., 2021) and destinations (Corona and Zárraga, 2014). Existing research exposes the important role of eco-innovation in significantly improving sustainability activities (Maldonado *et al*., 2020; Huang *et al*., 2016), such as social performance, green management practices, training and staff awareness (Dangelico and Pujari, 2010; Hermundsdottir and Aspelund, 2021; Hermundsdottir and Aspelund, 2022; Larbi-Siaw *et al*., 2022); generating more responsible consumption, producing greener goods and services (Maldonado*et al*.,2020). However, few studies have addressed the relationship between both variables in tourism, further evidencing the limited literature around this binomial of eco-innovation and sectoral sustainability (Aboelmaged, 2018; Días *et al*., 2021; Wang *et al*., 2020).

The importance of eco-innovation in the hotel industry stands out from a strategic orientation, which contributes to improving the competitiveness and sustainability of companies (Velázquez, 2019), providing broader and structural measures for the management of green businesses such as the design and implementation of environmental policies, as well as monitoring, auditing and certification activities in the field of ecology (Dang and Wang, 2022). Similarly, eco-innovation is an alternative to maintain, improve and renew the quality of goods, services and processes, defining production patterns with added value by contributing directly to sustainability (Bossink, 2012).

In order to remain or improve their market position, companies in tourism develop and promote innovation processes and activities in favor of environmental sustainability (Kuo *et al*., 2022; Reyes-Santiago *et al*., 2109). Hotels implement eco-innovations due to environmental regulations and social pressures, being these some of their main drivers (Magadán-Díaz *et al*., 2019; Velázquez *et al*., 2016). Part of the research on eco-innovation in tourism has focused on explaining the existing relationship with stakeholders, either as a market stimulus or as a possibility to meet their needs (Segarra-Oña *et al*., 2018; Weng *et al*., 2015. Its influence on the environmental performance of companies has been analyzed (Aboelmaged, 2018; Magadan and Rivas, 2018), as well as the promotion of collaboration and co-production in favor of a transition towards more sustainable practices (Buijtendijk *et al*., 2018).

Researchers have identified some gaps in recent literature, where it is observed that eco-innovation is still incipient in the hotel industry on its way to sustainability, due to several economic, commercial and regulatory factors that frame the sector (Olivera-Menezes and kindl-da Cunha, 2016). There are works around stakeholders, however, an analysis is still needed from and to the sector staff (Munawar *et al*., 2022) and, local communities (Sánchez and Vargas, 2015). In addition, other topics of growing interest are certifications (Cántaro-Márquez *et al*., 2023) and business ethics, especially in destinations of mass tourism (Niñerola *et al*., 2019).

For this reason, the aim of the research is to analyze the influence of eco-innovation on the sustainability of the hotel sector in Nuevo Nayarit, Mexico. The paper is structured in five sections. First, the literature review that supports the research hypothesis. Subsequently, the methodology developed is specified, highlighting as central techniques the survey and statistics for data processing. In a third section, the results of the study that allow for discussion are shown.

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Finally, conclusions, limitations and future lines of research are presented.

Eco-innovation

Eco-innovation in tourism represents an opportunity for both the companies that implement it, and the community (Fernández *et al*., 2017), since it contributes to the reduction of negative environmental impact, at the same time it decreases operating costs, attends to the scarcity of natural resources, prevents pollution and mitigates ecological risks (Kuo *et al*., 2022). Hence, eco-innovation is conceived as a capacity where the innovation-nature binomial integrates for developing novel ecological solutions using elements and strategies that intervene to overcome the negative externalities generated by the operation of the tourism industry (Del Rio *et al*., 2010; ISO, 2015; Rovira *et al*., 2017).

One of the strongest supports that eco-innovation has is technology, referred to the set of methods, processes and tools designed to provide solutions that reduce environmental effects (Fressoli *et al*., 2015). Nowadays, environmental technologies are increasing, for example, renewable energies and systems that allow the recovery of materials and waste that are reused or transformed into new products (Olivera-Menezes and kindl-da Cunha, 2016). Other technology includes capture and oxidation that reduce pollutant emissions, thereby improving air quality (Bell and Ruhanen, 2016; Wang *et al*., 2020).

Authors such as Velázquez *et al*. (2016) state that technology allows to fulfill the purposes of eco-innovation within the tourist business context. On the one hand, by obtaining a new or improved good, service or process and, on the other hand, by granting a certain degree of business sustainability to the organization. In addition, green technology provides benefits such as cost savings, attention to environmental policies and compliance with regulatory and certification standards (Martínez-Rubio *et al*., 2021).

Another factor of eco-innovation is environmental management, which, from the organizational field, is conceptualized as the steps or actions of a company to control the use of resources and assess their environmental impacts (Vargas, 2015). This implies analyzing the operating conditions and the risks of ecological damage, allowing an adequate decision making that improves management and strengthens their legal responsibility (Ramírez *et al*., 2015). Environmental management executes a whole system of processes and mechanisms that impact the construction of a more sustainable tourist activity (Hall, 2019). Even authors such as Longoni *et al*. (2018) and Segarra-Oña *et al*. (2018), indicate that its multidimensional character is a source of solutions that favor different areas and organizational levels, generating sustainability of hotel companies as a whole.

In the tourism business area, instruments and actions are required to ensure the environmental quality of eco-innovative practices (Hernández *et al*., 2017). Certifications and audits fulfill this function of qualifying and quantifying ecological performance (Rosales-Lobo and Morillo-Moreno, 2018). This type of accreditation changes the behavior of workers, causing them to use natural resources more efficiently (Martínez-Rubio *et al*., 2021). In addition, they provide standards to provide security to guests and staff working in hotel establishments, since there is a guarantee that operational activities are executed correctly; their scope is so wide, that they affect the quality of life of communities as an example of environmental responsibility (Rosales-Lobo and Morillo-Moreno, 2018).

Unfortunately, the integration of environmental certifications and programs in the hotel industry is limited by the lack of interest and insufficient budget, being some of the barriers to their implementation (Vargas, 2015), since these are voluntary initiatives that are better perceived by large hotel chains, leaving small companies in the sector at a disadvantage. The truth is that international standardization in ecological matters establishes complete processes and lines of action to implement good operating practices. Therefore, environmental groups or committees are required to operate logistics aligned with business policy and law enforcement (Oliver-Solà *et al*., 2017). Thus, behind eco-innovation there are significant determinants for the hotel busi-

ness context, which go beyond achieving only an economic performance (Segarra *et al*., 2018).

Sectoral sustainability

Faced with intense global tourism competition to attract greater demand to destinations, companies in the sector seek new ways for differentiating and positioning in the market, leading them to align themselves with sustainability strategies (Sánchez and Vargas, 2015). It is important to know that the organizations have an action for environmental preservation and improvement of the quality of life of their internal and external agents, promoting social welfare (Hernández *et al*., 2021; Rosales-Lobo and Morillo-Moreno, 2018).

Sectoral sustainability refers to the ability of an economic sector to meet its needs and those of its stakeholders through actions that reflect economic, environmental and social responsibility, using activities and policies that allow its development (Camacho *et al*., 2013).

When managing the sector in a sustainable way, business models aligned with economic profitability are visualized, but with a humanistic sense that promotes organizational practices oriented to equity, transparency and equality (Sehnem *et al*., 2019; Yong *et al*., 2020). The principles of sustainability promote business actions in correspondence with community participation, employment generation, job security and compliance with obligations towards public administration (Chatterji *et al*., 2016), which maintain a significant relationship with innovation, environmental commitment, and diversity management, reflected in the daily actions of employees (Gándara *et al*., 2012; Sánchez and Vargas, 2015; Yong *et al*., 2020; Weaver, 2019).

Adopting a sustainable approach in the sector encourages the consumption of environmentally friendly goods and services (Yong *et al*., 2020). Similarly, information is given to tourists and the public to transform behavioral patterns and modify wrong habits of individuals (Carrillo, 2017; O'Ryan, 2017). Indeed, supporting sectoral sustainability includes guidelines that define the operation and management of actions from a responsible behavior on the part of the organization, and good operating practices involve acting ethically in all areas of the organization (Moreno and Álvarez, 2022). This involves fair and equitable treatment of workers, customers, suppliers and other stakeholders (ISO, 2010).

Transparency is another key aspect where the company commits to be clear in its operations, communicating in a timely and accessible way relevant information on its performance, practices and decisions (Chaudhary and Kumar, 2022). Likewise, the adoption of measures to prevent any form of discrimination in all interactions and decisions related to the sector includes compliance with business obligations, covering aspects such as environmental protection, safety of workers and tourists, payment of taxes and any other relevant legal obligations (Chaudhary and Kumar, 2022).

In the framework of labor practices, tourism companies adopt comprehensive and strategic measures, which involve the implementation of welfare programs for the human development of their employees (Munawar *et al*., 2022). This promotes their professional growth by ensuring fair working conditions, promoting safety and health in the workplace, along with standards to prevent accidents and occupational diseases, promoting a safe working environment (ISO, 2010).

Finally, eco-innovation under the current context takes on unquestionable importance, since it starts from the need to exert significant changes in favor of environmental balance, being essential to initiate a transformation based on the components of sustainability, which will generate a momentum to adopt practices that go far beyond simple business interests (Nill and Kemp, 2009; OECD, 2009; Lesakova, 2019). In summary, the research hypothesis proposed is:

> H1: Eco-innovation has a significant and positive influence on the sustainability of the hotel sector in Nuevo Nayarit, Mexico.

Materials and methods

The research was structured under the quantitative approach and the deductive hypothetical thinking method. The design is non-experimental

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and cross-sectional, since the variables used were not manipulated and the data registration was performed at a unique time, presenting the phenomenon as it occurs in that space. It also has an explanatory scope when seeking to answer how eco-innovation influences the sustainability of the hotel sector.

Sample

It was a non-probabilistic sample, whose selection technique was by convenience. It was composed of 226 workers of 18 hotels, mostly women (65.9%) in an age range between 26 and 40 years (71.35%) single and in cohabitation (82.5%), with a bachelor's degree (81.85%). Most representative place of birth is Mexico City (47.34%), however, the place of residence of respondents has more representativeness in Banderas Bay (66.81%). In terms of seniority in the workplace, it is between 1 and 5 years (58.40%), with the most active management workers (42.03%) belonging to hotels that are mostly five stars (41.59%) (Table 1).

Table 1
Sociodemographic data of the sample

Variable	Value	Frequency (f)	Percentage (%)	Variable	Value	Frequency (f)	Percentage (%)
Gender	Man	77	34.08	Place of residence	Puerto Vallarta	24	10.61
	Female	149	65.92		Campeche	38	16.81
Age	20 to 25 years	14	6.19		Bahía de banderas	151	66,83
	26 to 30 years	66	29.23		Other	13	5.75
	31 to 35 years	28	12.38	Level of education	High school	28	12.38
	36 to 40 years	67	29.64		Bachelor	185	81,85
	41 to 45 years	39	17.25		Graduate	13	5.77
	46 to 50 years	12	5.31	Seniority	Less than 1 year	14	6.19
Marital status	Single	81	35.84	Seniority	1-5 years	132	58.40
	Married	65	28.76		6 to 10 years	27	11.94
	Divorced	12	5.32		11 to 15 years	53	23.47
	Cohabiting	68	30.08	Position Level	Operating control	95	42,04
Place of birth	Tampico	25	11.09		Middle Control	66	29.20
	Mexico City	107	47.34		Steering control	65	28.76
	Guadalajara	27	11.94	Hotel Class (stars)	Three	37	16.37
	Veracruz	26	11.50		Four	52	23.22
	Colima	27	11.94		Five	94	41.59
	Tepic	14	6.19		Great tourism	14	6.19
					Other	29	12.63

Instrument design and data collection

The technique for data collection was the self-administered survey. The instrument was a questionnaire designed from the review of the scientific literature and the analysis of expert judgment. Once the pilot test was applied with 35 observations, the final items that measure the variables of eco-innovation and sectoral sustainability were determined. Thus, the instrument was composed of two sections, the first where the 25 items were evaluated (table 2) through a Likert-type scale of six points, whose values range from (1) to (6) totally in agreement, res-

pectively. The second section was a technical file that allowed to obtain the sociodemographic data of the workers and identify the hotel to which they belong.

The questionnaire was captured in digital format (online) on the Google Forms platform, where it was sufficient to have the link to the questionnaire and an electronic device with internet connection. It was carried out during the first half of 2021, for this, the authorization of the managers was requested, guaranteeing the confidentiality, anonymity and good use of the information obtained.

Table 2
Operationalization of study variables

Variable	Dimension	Authors	Unit	Code	Item
Eco-	Tecnologías ambientales (TA)	Bell y Ruhanen, (2016); Fressoli *et al.* (2015); Martínez-Rubio *et al.* (2021); Velázquez *et al.* (2016); Wang *et al.* (2020)	Energy Saving	ET_01	Adopts eco-technologies for energy saving.
			Solid waste recycling	ET_02	Uses technologies for solid waste recycling (e.g. plastic, cardboard, glass, metal or other).
			Reduction of gas emissions	ET_03	Employs technology to reduce the emission of toxic gases into the atmosphere.
Eco-Innovation (Eco-I)	Environmental management (EM)	Vargas, (2015); Ramírez *et al.* (2015); Hall, (2019); Longoni *et al.* (2018); Segarra-Oña *et al.* (2018)	Ecological processes of operation	EM_01	Maintains processes that use environmentally friendly inputs avoiding pollution.
			Environmental Impact control	EM_02	Introduces mechanisms to monitor or control its environmental impact.
			Environmental impact assessment	EM_03	Has methods for assessing its environmental impact.
			Environmental risk analysis	EM_04	Develops mechanisms for environmental risk analysis.
Sectoral sustainability (Su-S)	Participation in Community Development (PCD)	Sánchez and Vargas (2015); (Chatterji *et al.*, 2016); Hernández *et al.* (2021); ISO (2010); Rosales-Lobo and Morillo-Moreno (2018); Camacho *et al.* (2013); Sehnem *et al.* (2019); Yong *et al.* (2020)	Improving quality of life	PCD_1	Improves the quality of life of the local community.
			Community integration	PCD_02	Promotes the integration of the local community in tourism activities.
			Job Opportunities	PCD_03	Provides job opportunities for the local community.
			Links with the community	PCD_04	Links with community actors for its development.

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Variable	Dimension	Authors	Unit	Code	Item
Sectoral sustainability (Su-S)	Promotion of Responsible Consumption (PRC)	Carrillo (2017); Moreno and Álvarez (2022); O'Ryan (2017); Yong *et al.* (2020)	Environmental Campaigns	PRC_01	Carries out environmental campaigns (for example: reforestation, recycling, care of natural resources).
			Use of environmental products	PRC_02	Promotes the use of environmentally friendly products and/or services (e.g. biodegradable or organic products).
			Advertising	PRC_03	Informs about the consumption of products and services responsible for the environment.
	Good Operating Practices (GOP)	Moreno and Álvarez, 2022; (Chaudhary and Kumar, 2022),	Ethics	GOP_01	It is guided by ethical behaviors.
			Transparency	GOP_02	Develops transparently (they do not cover up facts).
			Non-discrimination	GOP_03	Maintains "non-discrimination" policies.
			Compliance with legal obligations	GOP_04	Fulfills its obligations under the laws and other legal instruments.
	Working Practices (WP)	Lesakova (2019). Munawar *et al.* (2022); Nill and Kemp (2009)	Social security	WP_01	Provides social security for its workers.
			Safety and hygiene	WP_02	Maintains conditions of safety and occupational health.
			Human Development	WP_03	Promotes activities for the development of talent, skills and competences of workers.

Processing of data

To analyze the influence of eco-innovation on sectoral sustainability as proposed in the hypothesis, structural equation modeling by partial least squares (PLS-SEM) was used with the support of the software Smart PLS. The starting point is the approach of a hierarchical component model (HCM) or second-order reflective-reflective model, where the measurement model is integrated by factors that manifests a dimension, which in turn reflects a variable (Hair *et al*., 2017). In this sense, the procedure followed was carried out in three phases. First, the measurement model was evaluated where the internal consistency and validity of the constructs were verified, the convergence was confirmed through the factorial load and the average variance extracted (AVE), while for discriminant validity the square root of the AVE and correlations were compared (Henseler *et al*., 2015). In accordance with the recommendations of Hair *et al*. (2017), collinearity was assessed using the Variance Inflation Factor (VIF).

As a next step, observing that the reflective model fulfilled the validity and reliability, the evaluation of the structural model was carried out where the determination coefficients (R^2) were analyzed as well as the size and significance of the path coefficients for each dimension, the size of the effects (f^2) and the predictive relevance (Q^2), based on the methodology proposed by Henseler *et al*. (2015)

The third phase consisted in the interpretation of the model. Additionally, a descriptive analysis was performed considering the means and standard deviations, and a correlations analysis using the Pearson coefficient for normal data, according to the values of asymmetry and kurtosis ±2 (Field, 2018).

Results

Measurement Model

The reliability of the instrument was demonstrated by Cronbach's alpha (α), rho_A and composite reliability (pj) tests; the values satisfactorily meet the established criteria being higher than 0.700 (Table 3) (Nunnally, 1980; George and Mallery, 2003; Hair *et al*., 2009; Salas and Escurra, 2014). Also, convergent and discriminant validity is fulfilled, having values above 0.500 for average extracted variance (AVE), the same happens with the square root, since in all cases the correlations between the dimensions of each construct were exceeded (Pérez-Cruz, 2023) (table 3).

Table 3
Reliability, convergent and discriminating validity

Variable	Dimension	Cronbach alpha (α)	rho_A	Composite	AVE	TA	GA	PyNA	PDC	PCR	BPO	PL
Eco-I	ET	ET	EM	PyNA	PCD	PRC	GOP	WP				
	EM	0.718	0.730	0.825	0.543	0.714	0.737*					
	PyNA	0.835	0.835	0.890	0.668	0.680	0.753	0.817*				
Su-S	PCD	0.809	0.810	0.875	0.636	0.736	0.637	0.598	0.798*			
	PRC	0.793	0.799	0.878	0.707	0.714	0.672	0.661	0.766	0.841*		
	GOP	0.831	0.833	0.888	0.664	0.704	0.618	0.622	0.770	0.738	0.815*	
	WP	0.762	0.764	0.863	0.679	0.738	0.673	0.604	0.763	0.745	0.792	0.824*

Note. * square root of the AVE.

Table 4 shows the cross factor loads per item, which have a value of at least 0.700; however, for item EM_04 that is below this value it was preserved because it is very close to the recommended estimate and because of its theoretical relevance for the study (table 4) (Hair *et al*., 2017). In addition, the variance inflation factor (VIF) was revised, verifying that there are no multicollinearity problems between the items.

Table 4
External Factorial Loads and VIF

Item	VIF	ET	EM	PyNA	PCD	PRC	GOP	WP
ET_01	1.711	0.849						
ET_02	1.596	0.801						
ET_03	1.282	0.768						
EM_01	1.979		0.761					
EM_02	1.306		0.712					
EM_03	1.544		0.808					
EM_04	1.416		0.658					
PyNA_01	1.739			0.804				
PyNA_02	1.855			0.824				
PyNA_03	1.889			0.827				
PyNA_04	1.734			0.815				

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Item	VIF	ET	EM	PyNA	PCD	PRC	GOP	WP
PCD_1	1.952				0.799			
PCD_02	1.613				0.784			
PCD_03	2.236				0.820			
PCD_04	2.059				0.787			
PRC_01	1.659					0.831		
PRC_02	1.653					0.855		
PRC_03	1.725					0.835		
GOP_01	1.644						0.786	
GOP_02	2.061						0.854	
GOP_03	2.356						0.805	
GOP_04	2.148						0.812	
WP_01	2.026							0.794
WP_02	1.787							0.865
WP_03	1.572							0.811

Structural Model

Regarding the degree of fit between the model and the data, the bootstrapping re-sampling technique was used with a simulation of 5000 cases. As seen on Table 5, the values of t and p for each of the relationships between items and constructs satisfactorily meet the criteria $t \geq 1.96$ and $p<0.001$. R^2 values are greater than 0.100 as recommended to guarantee an important predictive explanation model. The effect sizes (f^2) are large when they are greater than 0.350 and it shows a great predictive relevance having a value Q^2 to 0.100.

The goodness of fit of the model was acceptable to obtain 0.080 in the standardized residual mean square root (SRMR.), according to the complexity of the model and sample size for this study, where the variables are still at an exploratory level (Simms *et al*., 2002).

Figure 1 shows that the eco-innovation variable has a significant and strong influence on the sectoral sustainability variable ($\beta=0.809$; $f^2=1.891$; $p<0.001$), where the predictive capacity is high ($R^2=0.654$; $Q^2=0.355$) which supports the research hypothesis (H_1).

Table 5
Coefficient Model

Dimensions	Path Coefficient	Standard deviation	t-value	p-value	R^2	R^2aj	f^2	Q^2
ECO-I→SUS-S	0.809	0.034	23.499	0.000	0.654	0.653	1.891	0.355
ECO-I→ET	0.870	0.015	56.439	0.000	0.757	0.756	3.121	0.484
ECO-I→EM	0.911	0.014	65.262	0.000	0.829	0.829	4.862	0.444
ECO-I→PyNA	0.917	0.009	96.728	0.000	0.841	0.840	5.284	0.556
SUS-S→PCD	0.915	0.012	78.449	0.000	0.837	0.837	5.151	0.527
SUS-S→PRC	0.889	0.015	61.154	0.000	0.790	0.789	3.751	0.549
SUS-S→GOP	0.918	0.014	66.407	0.000	0.843	0.842	5.358	0.554
SUS-S→WP	0.903	0.014	66.246	0.000	0.815	0.814	4.405	0.548

Figure 1
Influence of eco-innovation on sectoral sustainability

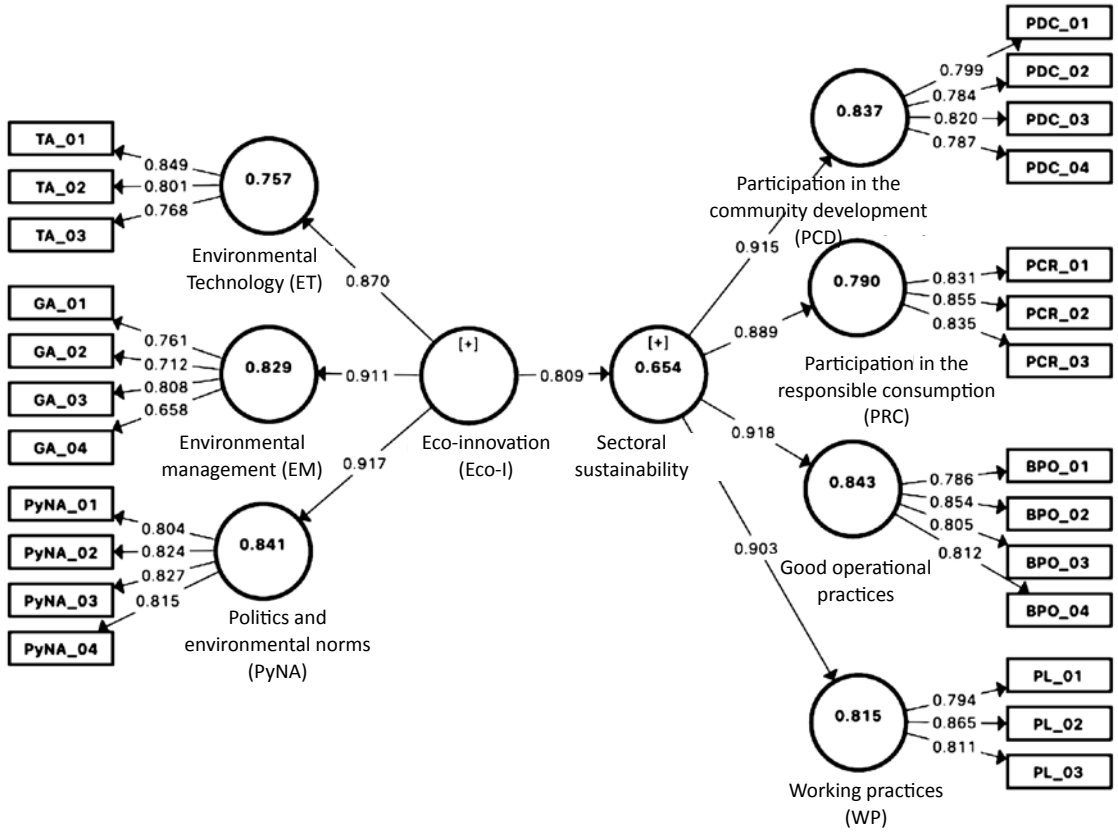

Table 7 shows that hotel companies are adopting eco-innovation and sectoral sustainability, although not enough, since the dimensions have been assessed as low positive ($\bar{x}$=4,187; σ=1.496 a $\bar{x}$=4,626; σ=1.462). When visualizing the estimation of items (table 6), environmental technology for solid waste recycling were the best evaluated ($\bar{x}$=4,491, σ=1.772), the same is true for the inclusion of ecological operating processes of the environmental management dimension ($\bar{x}$=4,496, σ=1.824); and in the case of environmental policy and standardization, some hotels are working with environmental committees ($\bar{x}$=4,350, σ=1.832).

Considering the answers for the sectoral sustainability variable, it is observed that the hotel companies promote job opportunities for the local community ($\bar{x}$=4.708, σ=1.581); also, the use of products and services friendly with the environment ($\bar{x}$=4,451, σ=1.723). Good operating practices, as well as labor practices were considered positive, but with a moderate evaluation degree, hence it is considered that companies maintain ethical behavior ($\bar{x}$=4,708, σ=1.724) and safety and hygiene conditions for their workers ($\bar{x}$=4,752, σ=1.676).

Regarding correlations, the association between good operating practices and labor practices stands out (r=0.792; p=<0.001), reflecting that actions of ethics, transparency, non-discrimination and compliance with the laws in hotels are intertwined with practices of social security, hygiene and human development for staff. The relationship between environmental technology and environmental management is also remarkable (r=0.785; p=<0.001), since it reflects the function that both factors must prevent and correct the effects that hotel activity produces on the environment.

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Participation in community development has a strong association with good operating practices (r=0.769; p=<0.001); as well as environmental technology with labor practices (r=0.742; p=<0.001).

Tabla 6
Estadísticos descriptivos por ítem

Eco-innovation			Sectoral sustainability					
Item	**Average**	**Std. Dev**	**Item**	**Average**	**Std. Dev**	**Item**	**Average**	**Std. Dev**
ET_01	4.438	1.820	PCD_1	4.549	1.687	PL_01	4.394	1.833
ET_02	4.491	1.772	PCD_02	4.319	1.730	PL_02	4.752	1.676
ET_03	4.221	1.765	PCD_03	4.708	1.581	PL_03	4.704	1.714
EM_01	4.496	1.824	PCD_04	4.469	1.762			
EM_02	4.190	1.716	PRC_01	4.385	1.776			
EM_03	4.009	1.769	PRC_02	4.451	1.723			
EM_04	3.832	1.861	PRC_03	4.159	1.614			
PyNA_01	4.350	1.832	GOP_01	4.708	1.724			
PyNA_02	4.128	1.844	GOP_02	4.588	1.790			
PyNA_03	4.133	1.781	GOP_03	4.637	1.838			
PyNA_04	4.137	1.863	GOP_04	4.571	1.827			

Table 7
Descriptive statistics and Pearson correlations

Dimension	Average	Standard deviation	Asymmetry	Kurtosis	ET	EM	PyNA	PCD	PRC	GOP	WP
ET	4.383	1.441	-0.615	-0.735	1						
EM	4.298	1.329	-0.512	-0.232	0.785**	1					
PyNA	4.187	1.496	-0.384	-0.880	0.673**	0.730**	1				
PCD	4.511	1.347	-0.544	-0.793	0.739**	0.739**	0.598**	1			
PRC	4.332	1.433	-0.642	-0.417	0.716**	0.731**	0.658**	0.760**	1		
GOP	4.626	1.462	-0.629	-0.764	0.707**	0.748**	0.623**	0.769**	0.731**	1	
WP	4.617	1.432	-0.535	-1.068	0.742**	0.737**	0.607**	0.764**	0.742**	0.792**	1

Note. ** =P< 0.001.

Discussion and conclusions

This research provides empirical evidence that eco-innovation (through the use of environmental technology, the implementation of environmental management actions and the integration of standardization instruments) positively influences the sustainability of the hotel sector where the development of the community, the promotion of responsible consumption, good operating practices and labor practices are included, as suggested by other research (Kuo *et al*., 2022; Martínez-Rubio *et al*., 2021; Longoni *et al*., 2018; Rosales-Lobo and Morillo-Moreno, 2018; Segarra-Oña *et al*., 2018; Velázquez *et al*., 2016).

Eco-innovation responds to the need to prevent pollution and mitigate environmental impacts (Kuo *et al*., 2022; Rovira *et al*., 2017). Hotel companies in Nuevo Nayarit are beginning to introduce technology primarily for energy saving and waste recycling, as found by Bell and Ruhanen (2016) and Wang *et al*. (2020). The analysis of environmental risks was the least valued aspect; it is necessary that hotels integrate preventive instruments of environmental management and that benefit the company, leading it towards sus-

tainability (Hall, 2019; Longoni *et al*., 2018 and Segarra-Oña *et al*., 2018).

The findings reveal that environmental policy and normalization are positive to generate sustainability in hotels, however, there is a greater relationship with the promotion of responsible consumption than with participation in community development, thus confirming how certifications and standards are reference for tourists and the general public to maintain a greener administration and responsible behavior (Carrillo, 2017; Dang and Wang, 2022; O'Ryan, 2017); while the possibility of improving the quality of life and job opportunities are limited (Sánchez and Vargas, 2015; Hernández *et al*. , 2021).

In terms of eco-innovation, the postulates of Rosales-Lobo and Morillo-Moreno (2018) are reaffirmed, where companies align their activities with the principles of sustainability and achieve a positive and moderate influence on actions that increase aspects such as job creation, job security and compliance with obligations, guaranteeing fair working conditions (Munawar *et al*., 2022; Moreno and Álvarez, 2022; ISO, 2010).

The research met its objective to determine the influence of eco-innovation on sectoral sustainability in the hotel industry of Nuevo Nayarit, Mexico. It was shown that eco-innovation when managed through preventive and control instruments defines the operation of activities for more responsible business conduct, ethics and compliance with their legal obligations.

It is evident that sectoral sustainability is explained by eco-innovation from environmental technology, which play an important role by being significantly associated with community development and labor practices, attending to employee safety and improving the quality of life of communities.

However, areas for improvement have also been highlighted, which reinforces the need to strengthen environmental policy and standardization in order to provide more structured and extensive measures for the management of a greener sector. This highlights the urgency of a stronger regulatory framework that can guide hotel companies in their transition to sustainability.

Sustainability requires a commitment that goes beyond mere participation, contributing to the generation of employment, job security and the fulfillment of obligations towards public administration. These aspects are vital for the sustainability of any sector, so they deserve priority attention in the agenda of hotel companies.

The relevance of sectoral sustainability for the hotel industry has been confirmed. However, while these practices are valuable, their implementation degree is still considered early, indicating that there is still room for improvement and expansion of these initiatives. In addition to the above, the ability of the economic sector to meet its own needs and those of its stakeholders through responsible actions is evidenced.

As limitations in this research, it was considered that the data collection was performed during the recovery of tourism activity (post-pandemic), where the appreciation of respondents could change during a stability phase. Therefore, caution is recommended when trying to generalize the conclusions obtained. The exhibition is also made up of employees of the hotel industry, which offers the perception of a single group.

In short, these variables must be investigated in other national and international tourist destinations. This approach would provide a more holistic view that would enrich the understanding of the relationship between eco-innovation and sector sustainability to build a more robust and accurate framework of reality analysis.

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Contribution to the country brand through the sustainability of production processes in Chile: B Corp

Contribución a la marca país a través de la sostenibilidad de los procesos productivos en Chile: Empresas B Corp

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Abstract: this article aims to demonstrate the existence of companies that contribute to the country brand by incorporating sustainable mechanisms into their processes, while generating profits and social value. The research was carried out using a mixed methodology and naturalistic method in five phases. 425 companies in Chile were analyzed, using the Corp B directory in Latin America and the Caribbean. The main findings reveal that the global pandemic and economic situation has prompted the adoption of the B Corporation model, focusing on social welfare, economic growth, and preservation of natural resources. This study highlights the contribution of B Corps to the country brand in Chile. These organizations are recognized for their commitment to sustainability, their social impact, and their ability to project the country's image globally. Their innovative and responsible business practices make them key agents for sustainable development. The scope has been limited to the Chilean context, which could restrict extrapolation to other geographical areas, with the existence of 4,000 companies with B Corp certification internationally. The results contribute knowledge to the administrative and social sciences, providing an understanding of how they generate value to the sustainability trilogy and in turn contribute to the country brand, which can serve as the basis for future studies and business strategies.

Keywords: B companies, B cop, country brand, sustainability, product, service, production processes.

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Resumen: el objetivo de este artículo es evidenciar la existencia de empresas que contribuyen a la marca país mediante la incorporación de mecanismos sostenibles en sus procesos, a la vez que generan utilidades y valor social. La investigación se realizó mediante una metodología mixta y método naturalista en cinco fases. Se analizaron 425 empresas en Chile, utilizando el directorio de la Corp B en América Latina y el Caribe. Los principales hallazgos revelan que la pandemia mundial y la situación económica han impulsado la adopción del modelo de Corporación B, enfocando en el bienestar social, crecimiento económico y preservación de recursos naturales. Este estudio destaca la contribución de las empresas B a la marca país en Chile. Estas organizaciones son reconocidas por su compromiso con la sustentabilidad, su impacto social y su capacidad para proyectar la imagen país a nivel global. Sus prácticas empresariales innovadoras y responsables las convierten en agentes clave para el desarrollo sostenible. El alcance se ha limitado al contexto chileno, lo que podría restringir la extrapolación a otras áreas geográficas, con la existencia de 4000 empresas con certificación B Corp a nivel internacional. Los resultados aportan conocimiento a las ciencias administrativas y sociales, proporcionando una comprensión de cómo estas generan valor a la trilogía de sostenibilidad y su vez contribuir a la marca país, lo que puede servir de base para futuros estudios y estrategias empresariales.

Palabras clave: empresas B, cop b, marca país, sostenibilidad, producto, servicio, procesos productivos.

Introduction

It is essential that companies align with their country's identity and values so that their contribution to the national brand is genuine and consistent. Close collaboration with the government and other relevant organizations can extend efforts to promote the country's image, allowing for more impactful and effective results (Pecotich and Ward, 2007; Sánchez-Ortega *et al*., 2021). This research is based on the idea that companies offering sustainable products and services can contribute to solving social, economic and environmental problems through reduced environmental impact, innovation and efficiency, social responsibility, ethical supply chain, fostering cultural change, attracting talent, among others. A country becomes a brand when it manages to establish a distinctive and recognizable identity globally, based on its cultural, historical, tourist, economic and social attributes (Abramovay *et al*., 2013). By building a strong country brand, the nation can project a positive and coherent image that attracts investors, tourists and international partners.

The country brand reflects the reputation of the nation and its products, services and values, strengthening its competitiveness in the international arena and facilitating the opening of new economic and diplomatic opportunities. According to Silva (2013), B companies in Latin America generate benefits not only for entrepreneurs, but also for their stakeholders and for the nation in which they offer their goods and services. This business model emphasizes the interest of organizations to assume joint responsibility for the positive-negative results that affect society and the planet.

Chile, as a nation, has set a precedent in business innovation and market evolution in this age of knowledge. In this context, it is known the need to incorporate new mechanisms as part of management models, innovative strategies and public policies oriented towards the sustainable contribution of companies (Suárez *et al*., 2017). The origin of this interest goes back to 2015 with the creation of the National Council for the Implementation of the 2030 Agenda. A main objective of this council is to transform the patterns of production and consumption in society (Suárez *et al*., 2017; De Oliveira *et al*., 2019).

Although initiatives aimed at the Sustainable Development Goals (SDGs) are not new in Chile, it is B corporations that are emerging as exponents of these ideas. These certified companies, which combine purpose and profit, are key players that significantly influence the perception of the nation (B Lab, 2020); furthermore, their regulatory framework requires them to consider the impact of their decisions in relation to their employees, customers, suppliers, community, and environment.

The challenges faced by companies in the context of Covid-19 in Chile, prompted them to look for ways of adaptation and concrete responses to stay in time (Bianchi *et al*., 2020). For this reason, B companies have taken the initiative to provide support, each from their field of expertise, through various initiatives with a common goal: to mitigate the effects of the global crisis and maintain its long-term sustainability. Promoting sustainable

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thinking in Chile since 2014, they attend the protection of natural resources, promote education in sustainability, social impact and growth of the economic factor of the nation (Bianchi *et al*., 2020). Hence, the aim of this research is to demonstrate the existence of companies that contribute to the country brand through the sustainability of its processes. In addition, to examine the impact of these companies in the resolution of social problems caused by external factors and existing environmental challenges.

The findings of this research pose a challenge to previous research, since they have identified a relationship between stigma and its manifestation in organizations of this type (Sanchís Palacio *et al*., 2020). These findings are linked to different business theories, such as the theory of resources and capabilities, the stakeholder theory, and the approach of creating shared value (CSV), which provides a solid foundation (Saiz-Álvarez *et al*., 2020). The study is based on a mixed methodology, since sustainable development is currently a qualitative and quantitative process of social change that promotes economic growth, environmental conservation and social equity, ensuring a comprehensive approach in the analysis of the data collected.

The country brand through organizational sustainability

Organizational sustainability plays an essential role in the country brand construction (Sevin, 2014). When an organization adopts sustainable practices, it manifests its commitment to the preservation of natural resources, social welfare and corporate responsibility (Lim *et al*., 2020), contributing to strengthen the image of the entity and the perception of the country in terms of sustainability and sustainable development. A country brand is an intricate system that encompasses a variety of interrelated concepts (Pecotich and Ward, 2007). Brand management implies understanding that it is not a static element, but a dynamic and living entity, in line with the cities and nations it represents (Lim *et al*., 2020). Building an integral brand of a city or country requires three essential pillars: the management of the environment, the structure of the brand and the construction of links.

Twenty-first century society finds an overriding need in the integration of sustainable development in its daily life, considering social, economic and institutional aspects to improve the quality of life (Suárez *et al*., 2017). Although the term sustainable development gained popularity in the 1990s, its implementation has suffered some wear and tear, and its definition and collective action are sometimes not entirely clear. However, organizational sustainability emerges through companies that, when marketing products and services, address current needs without compromising the future and contribute positively to the perception of the country brand (Salgado-Beltrán and Beltrán-Morales, 2011; Esteves and Fernandes, 2016). By articulating organizational sustainability with the construction of the country brand, a solid link is established between the business reputation and the national image, generating an effect that amplifies the benefits of both. In this sense, the work of these companies not only transcends the economic, but also projects fundamental values and commitments that reflect the identity and vision of the nation in the global landscape.

Companies that contribute to the country brand: sustainable products and services

Some companies stand out in the business area for their positive contribution to the image and reputation of a country (Lim *et al*., 2020). These companies are characterized by excellence, innovation, social responsibility and contributions to economic development (Barua and Ioanid, 2020). Consumers seek transparent companies in their practices, providing clear information about the supply chain, ingredients used and environmental impacts associated with their products and/or services. This notion reflects the use of goods, products and services that meet basic needs and improve the quality of life, without compromising the needs of future generations.

The concept of companies that contribute to the country brand has gained popularity in recent decades (Salgado-Beltrán and Beltrán-Morales, 2011; Harrison *et al*., 2016). Sustainable consumption is not just about consumption, but about reducing the use of energy and resources in the production process (Gasco *et al*., 2020). Sustainable products cover a wide range of articles that stand out for their reduced environmental, social and/or ethical impact (Donadei, 2019). These products generate less negative social, environmental and economic impacts throughout their value chain (Rodrigo-Cano *et al*., 2019).

B companies, particularly in Chile, show a growing interest in the development of sustainable products and/or services (Bianchi *et al*., 2020). This approach should not be considered merely as philanthropy, but as a new way of assessing organizational performance from four perspectives: economic (long-term profitability), social (internal and external impacts), environmental (care of the environment and natural resources) and institutional (business culture) (Suárez *et al*., 2017, Mejía-Giraldo, 2020) (table 1).

B Companies: certified B Corp in Chile

The assessment for B Corp certification is carried out by an independent organization called B Lab. By obtaining certification, these companies are legally committed to making decisions considering not only financial well-being, but also the impact on natural resource care (B Lab, 2017). This implies that managers must consider social and environmental aspects when making decisions, not only the economic benefit. With the rise of society's value in social and environmental responsibility, the B-company movement has gained momentum in recent years and has captured the attention of world leaders (Chen and Kelly, 2015).

In the context of sustainable development, companies can contribute by creating innovations that positively impact the market and society (Paeleman *et al*., 2023), innovation understood as the process of discovery, creation, evaluation and exploration of opportunities to develop goods and services that promote sustainable development. These opportunities are analyzed from an academic perspective considering how they are recognized, developed and explored to offer goods and services of economic, social and ecological value.

To be certified, companies must undergo a rigorous evaluation process that measures the impact they generate in five key areas of the business model: Governance, Workers, Environment, Community and Customers, as shown in Figure 1 (Zebryte and Jorquera, 2017).

Figure 1
Certification model for B companies

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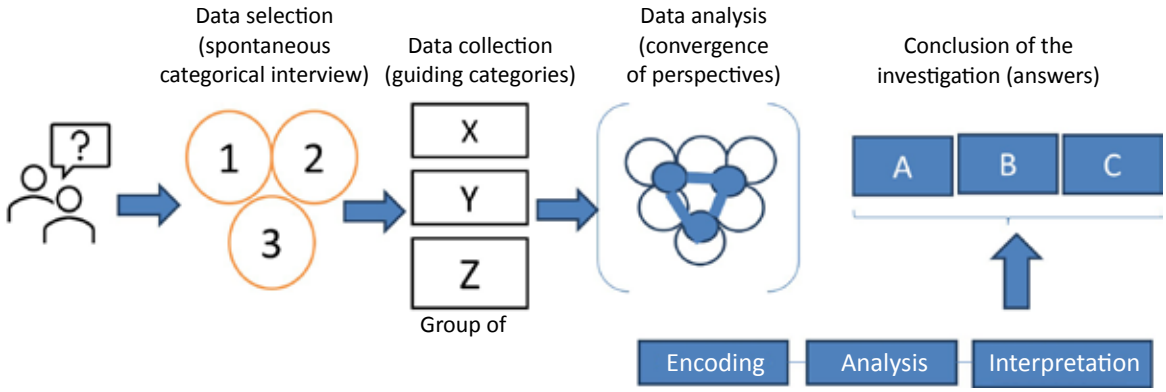
Materials and methods

The research methodology used in this study is mixed (Bianchi *et al*., 2020). In order to carry out this research, both the phenomenological approach and the grounded theory of Strauss and Corbin (1990) were used with the aim of supporting an argumentative perspective towards the protection of the representation of the reality of a country and the contribution of organizations to the challenges of sustainability. In this line, the mixed approach was framed in a naturalistic orientation, following the procedure outlined by González-Díaz *et al*. (2021). These authors structured the analysis into five phases, as presented in Figure 2. The methodology was based on the combination of grounded theory with data from a database of more than 4000 organizations listed in the B Corp System Registry globally. Of this group, 425 organizations are located in Chile, covering the period from 2014 to 2023.

Figure 2

Procedural diagram of the qualitative-naturalistic route for management studies of González-Díaz et al. (2021)



Step 1. Population and Question Problem (PQP): there are more than 4000 certified B companies worldwide of which 1000 are in Latin America and the Caribbean, for research purposes 425 companies were explored as a representative sample, with a margin of error of 5 % and a confidence level of 95 % and 50 % of heterogeneity given to the information found in the B companies directory. The study answers three key questions: What are the mechanisms incorporated by companies that contribute to the country brand through the sustainability of production processes? To what extent do B companies in Chile become ambassadors of the country's identity and values on the global stage? What is the impact of B companies in addressing social crisis problems caused by globalization and environmental challenges in the community?

Step 2. Spontaneous Categorical Interviews (SCI): these were extracted from the official directory of B companies where key informants express their experiences when managing a company of this type to be able to determine the guiding categories. Interview documents are not available in this document due to space economy.

Step 3. Guiding categories (GC): taking into account the answers of the key informants of the different companies under study, and under the following criteria: Purpose (pc01), stakeholders and interest groups (pc02), social contribution, economic growth and human development (pc03), certification (pc04), Impact to the country brand (pc05), a word cloud was done to determine a coding group and to be able to establish the GCs, which respond to companies that contribute to the country brand through the sustainability of production processes. The distribution of the unit of analysis is presented in Table 1.

Step 4. Convergence (C): the convergence of respondents is grouped according to the guiding categories using citations and open source codes. With this, a semantic network was established

where the rooting and density of each category stands out, and subsequently the concurrency index was evaluated. Finally, the management of discourse that evidences grounded theory from empirical findings is established, which indicates the average range of mentions of rooting and density, to determine those indicators that are above the average and thus be able to give an interpretation of results.

Step 5. Analysis and interpretation of results (AIR): to achieve the objective of the study, Atlas.Ti9 software was used to obtain semantic networks with open codes, rooting and density tables, Sankey diagram and emergency calculation with quantitative data. These pre-codes were supplemented with additional codes (axial coding, acxx) that were interpreted as emerging and relationship functions, such as "cause-effect", "dependence", "synergy" and "influence". These analyzes allowed the formulation of a final resulting proposal (rpxx).

Analysis Unit

The Directory of B Companies in Latin America and the Caribbean has been used to contact CEOs and managers working in B Companies. For the purposes of this research and in line with ethical criteria, emphasis will only be placed on the number of companies existing in Chile, considering selection criteria determined in Table 1, and highlighting its characteristics, including the impact according to B Lab measurement and standards. (2022) According to the impact B assessment is 1-100, a general score is obtained according to the actions performed by the company. B Corp works with an average score of the ordinary companies that complete the evaluation. From business model indicators, governance, workers, community, environment, customers and sub-indicators such as General Impact B Score, qualifies for B Corp certification, this impact serves as a roadmap to assess and create post-crisis improvement paths and increase the positive impact of companies that have this sense of belonging towards economic growth, social development and natural resource protection (see table 1).

Table 1

B companies dedicated to sustainable products and services in Chile

Industry	Number of enterprises	Certification	Product	Services	Areas of Impact	Impact	Companies in Evaluation
Consultancy and Advisory Agency	69	2014	13	56	Customers/Environment/Community	37/13/7	12
Sustainable Products	54	2016	33	21		27/12/11	4
Education	41	2017	32	9		26/6/3	6
Recycling	31	2019	17	14		19/6/6	3
Communication and Marketing	25	2020	8	17		10/4/3	8
Support and Entrepreneurship	21	2022	5	16		13/3/2	3
Power	16	2015	12	4		9/6/2	
Agriculture Livestock or Agribusiness	19	2018	12	7		12/2/2	3
Agriculture Livestock or Agribusiness	19	2018	12	7	Customers/ Environment/ Community	12/2/2	3
Human Resources	15	2015		15		13/3/1	1
Tourism Hotels	18	2016	5	13		6/5/4	3
Design	17	2019	8	9		5/4/4	4

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Industry	Number of enterprises	Certification	Product	Services	Areas of Impact	Impact	Companies in Evaluation
Construction And Real Estate	17	2020	5	12	Customers/Environment/Community	8/3/2	5
Exports	12	2019	9	3		6/2/1	3
Financing and Investment	11	2021	1	10		8/2	1
Employability	9	2022		9		7	2
Technology and Computing	9	2022	1	9		4/3	2
Textile, Clothing and Accessories	11	2022	7	4		2/6/4	1
E-Commerce	10	2022	6	4		4/4/1	1
Energy	11	2022	4	6		3/5/1	2
Community Management	9	2022	2	7			3
Total	425	-	180	245	-	-	67

Note. Own production based on the B Company System in Latin America and the Caribbean.

Table 1 shows B companies in Chile dedicated to the commercialization of products and provision of certified services from 2014 to 2022, it is important to mention that given the rigor many of them are supervised annually, resulting 425 sustainable organizations participating in these categories, showing that the most challenging difficulties of society are not determined only by actors of the State and companies, but also by other organizations that empower the economy of a nation (Nigri and Del Baldo, 2018).

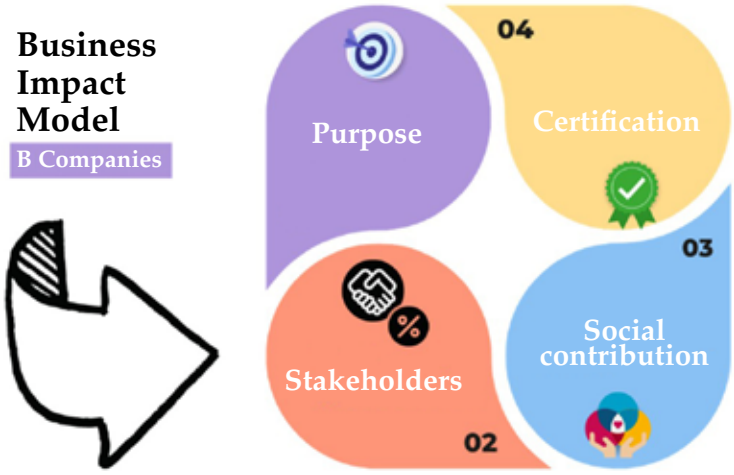
Results

Based on grounded theory and after analyzing various companies, it was found that these combine economic, social and ecological profits along with social development to create a production model that is defined by the impact of the company in four key components: purposes, stakeholders, social contribution and certification. Once the interviews were conducted, they were analyzed in Atlas.Ti9 to create a word cloud, which allows a quick and visual identification of concepts related to the model and philosophy of B Companies (Saiz-Álvarez *et al.*, 2020) (see figures 3 and 4).

Figure 3
Word Cloud

The analysis of the word cloud can allow a quick and visual identification of concepts related to the philosophy of B Companies, these terms are essential for research and serve as the basis for a more in-depth analysis (see Figure 4).

Figure 4
Business Impact Model



The business impact model needs to have a well-defined purpose, it must be clear and aligned with the generation of a positive impact in economic and social terms, in addition to being related to the creation of a sustainable value in the nations that aim to be benchmarks. The identification of stakeholders is related to the expectations held as employees, customers, suppliers, local communities and environment, with this the model will allow to address the needs of stakeholders. On the other hand, the certification represents an external validation with official recognition that guarantees that a company meets the standards and criteria related to a social, environmental or ethical impact.

After the qualitative analysis of the interviews with key informants, the following semantic network is generated (Figure 5), which illustrates the construction of meanings from the speeches of the interviewees, according to the following group codes: Speeches about a purpose (PC-01), stakeholders and interest groups (PC-02), Social contribution, economic growth and human development (PC-03), Certification (PC-04) and Impact Decision (PC-05).

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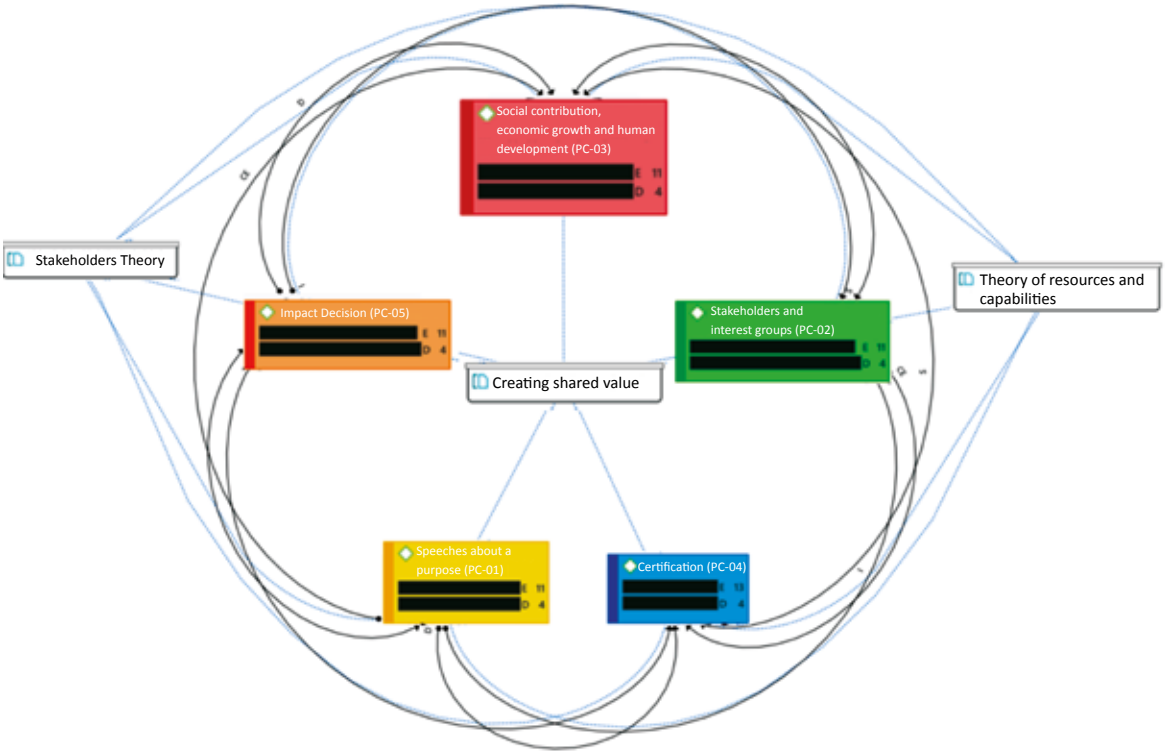
Figure 5
Convergence of testimonies and relationship



The semantic network makes interrelated connections between the five group codes: "stakeholders and interest groups", "purpose discourse", "social contribution", "economic growth and human development" and "certification and impact on the country brand". The stakeholder theory is critical to understanding the expectations, needs, and interests that encompass relevant stakeholders. This theory provides the basis for identifying key stakeholders and for understanding how their perspectives intertwine with the various aspects addressed in each of the codes.

Similarly, the theory of resources and capabilities addresses how an organization leverages its internal resources and skills to achieve its objectives and competitive advantages. In this context, it is essential to identify the resources and capacities needed in the implementation of initiatives related to the "discourse on a purpose" and the "social contribution". This theory provides a lens through which to analyze how organizations mobilize their resources to support their actions and contributions towards a concrete social purpose and benefits.

Table 2
Guiding categories, group codes and emerging categories

Hermeneutic approach	Orientation Category	Encoding	Group Code	Emerging Category
Companies B Corp (products and services)	Stakeholder theory	PC01	Speeches about a purpose	•
		PC02	Stakeholders and interest groups	
	Theory of resources and capabilities	PC03	Social contribution,	
	Creating Shared Value	PC04	economic growth and human development	
		PC05	Certification	•
Impact to country brand				

Table 2 explains the research path to follow, where the orientation categories (OC) direct the course of the study, from them are detailed below the discourses obtained by the informants and the interconnection that exists between them as group codes (GC) in order to determine the emerging categories (EC).

Orientation category analysis for stakeholders

Table 3
Relationship between code and document for the stakeholder theory

Orientation Category	CGr=13		CSCEDH-Gr=11		DPGr=11		IMPGr=11		PIGr=11		Totals	
	Abs	Rel	Abs	Rel	Abs	Rel	Abs	Rel	Abs	Rel	Abs	Rel
rSHR=30; GS=18	3	10.00 %	2	6.67 %	11	36.67 %	4	13.33 %	10	33.33 %	30	100 %

Note. Extracted from Atlas.ti9.

For the stakeholder theory, 18 documents were obtained (GS) related to a total of 30 citations (Gr). The certification obtained three mentions with the equivalent of 10%; the social contribution, economic growth and human development with two citations represented by 6.67%; discourse with purpose with 11 opinions and 36.67%; impact to the country brand with four citations and 13.33%; and stakeholders and interest groups with 10 mentions and 33.33% relative.

Based on these results, it can be observed that the emerging category "discourses about a purpose" stands out with 36.67%, since all the informants highlighted the importance that this topic has for B companies.

The analysis of the graph allows identifying at its highest point the discourses with purpose that stood out in mentions and for which it is considered as an emerging category.

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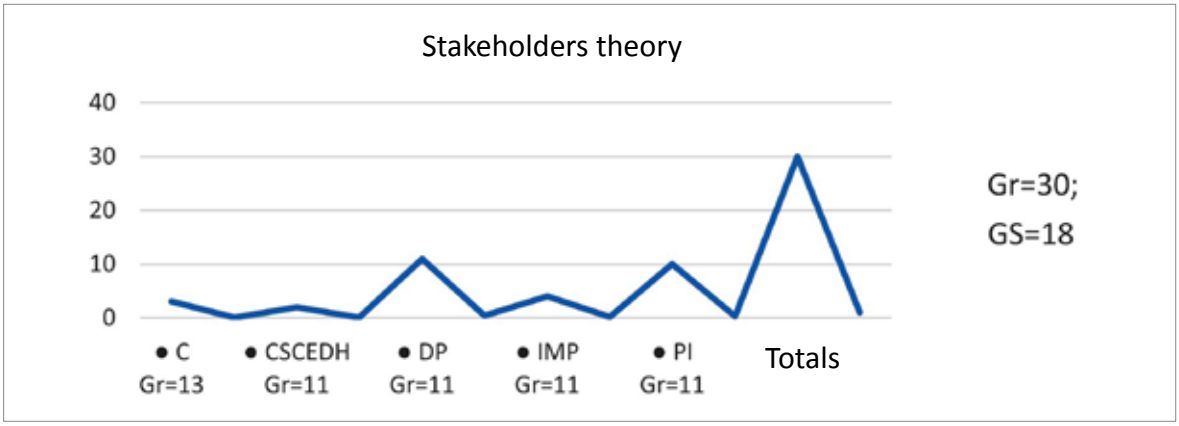
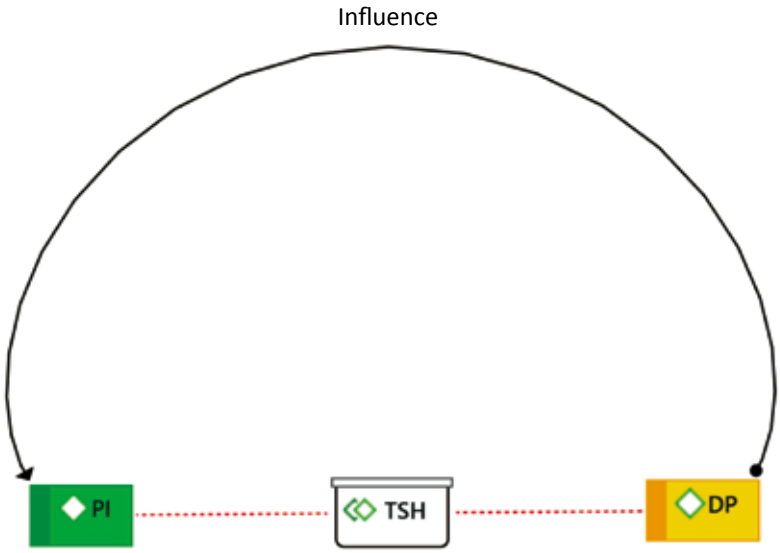
Chart 1
Emerging Category for the Stakeholder Theory



Discourse about a purpose (PC01)

B Corps are an innovative type of organizations that seek the common good through lucrative economic activity. Their focus goes beyond economic benefit, as they also focus on creating positive social and ecological impact. These companies stand out for maintaining high standards of transparency and accountability. Like civil enterprises, their goal is to use the power of enterprise to generate a positive impact on society and the environment. Below are presented the testimonies collected, evidencing the pre-codes of B companies in Chile (see figure 6).

Figure 6
Semantic Network of the Stakeholder Theory



Density (D) refers to codes that will always be related to each other with a value of 4, rooting (E) indicates that out of the total key informants only 11 interviewees had opinions regarding the discourses on a purpose (DP) and stakeholders and interest groups (PI). The way they receive these codes influence each other because not only they must have a purpose of financial success,

but also there must be actions that intervene in interest groups.

Stakeholders and interest groups (pc02)

By analogy, it is observed the intention to use market forces to address social and/or environmental problems in the communities in which they operate (Groppa and Sluga, 2015). This response is materialized through the products and services they offer, as well as through their labor and environmental practices. Perhaps the most outstanding difference between the two groups lies in the focus on formal and objective procedures to fulfill their specific mission.

Analysis of the theory of resources and capabilities

Table 4

Relationship between the Code and Document for the Theory of Resources and Capabilities

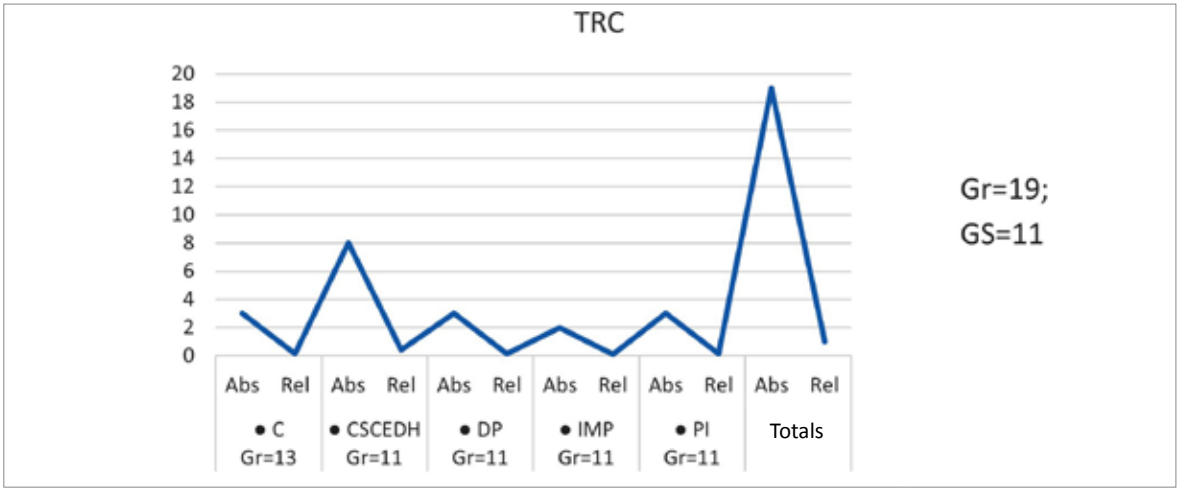
Orientation Category	CGr=13		CSCEDH-Gr=11		DPGr=11		IMPGr=11		PIGr=11		Totals	
	Abs	Rel	Abs	Rel	Abs	Rel	Abs	Rel	Abs	Rel	Abs	Rel
TRC Gr=19; GS=11	3	15.79 %	8	42.11 %	3	15.79 %	2	10.53 %	3	15.79 %	19	100 %

As seen in Table 4, for the theory of resources and capabilities, 11 documents were obtained (GS) related to a total of 19 citations (Gr). The certification obtained three citations with the equivalent of 15.79%; the social contribution, economic growth, and human development with eight citations represented by 42.11%; discourse with purpose with three opinions and 15.79%; impact to the country brand with two citations and 10.53%; and stakeholders and interest groups with three mentions, and 15.79% relative.

With these results, it is observed that social contributions, economic growth and human development are an emerging category with 42.11%, showing the importance given to the theory analyzed.

Figure 2

Emerging Category for the Theory of Resources and Capabilities



The analysis of the graph allows to identify at its highest point the social contributions, economic growth and human development with more citation and for which it is considered as an emerging category.

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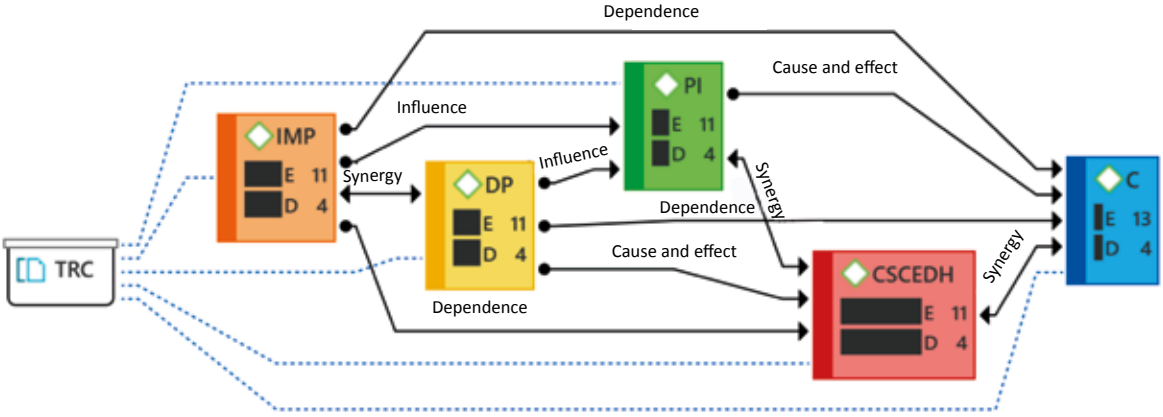
Social contribution, economic growth and human development (pc03)

These types of organizations share many points in common with those of Economics of the Common Good (EoC), although they also present some differences (Palacio and Climent, 2018). A prominent similarity is the intention to use market forces to address social and/or environmental problems in the communities in which they operate (see Figure 7).

Figure 7
Theory of resources and capabilities



Density (D) refers to codes that will always be related to each other with a value of 4, rooting (E) indicates that out of the total of key informants 11 documents yielded data related to the way they are involved either dependently, synergistically or exerting cause-effect. The impact of the country brand is related to certification as a cause and effect; it influences stakeholders and interest groups; it synergizes with purposeful speeches and depends on social considerations, economic growth and human development, the latter in turn synergizes with stakeholders.

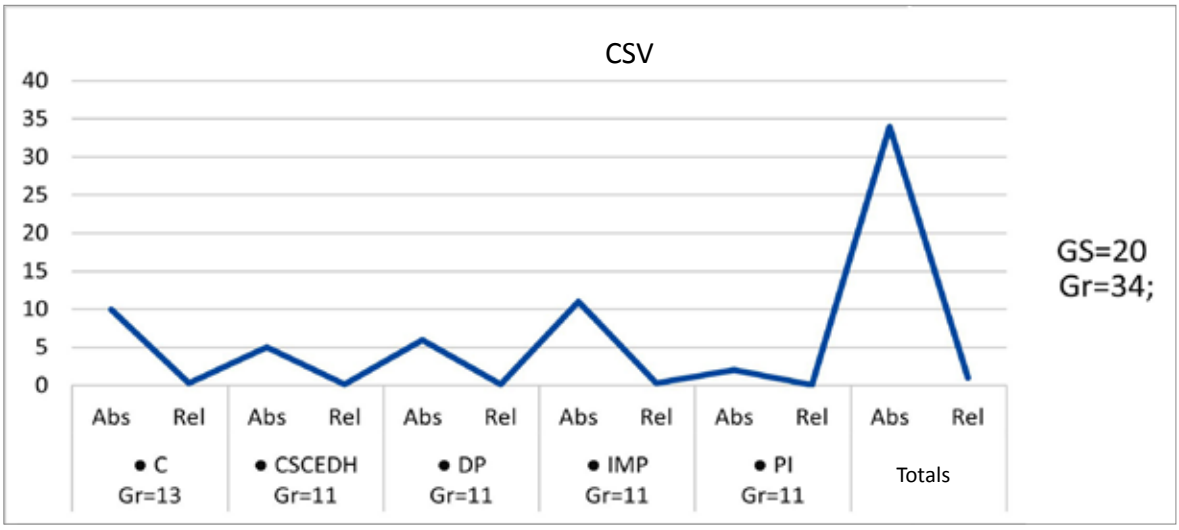
Analysis of the theory of shared value creation

Table 5
Document code relationship for shared value creation

Orientation Category	CGr=13		CSCEDH-Gr=11		DPGr=11		IMPGr=11		PIGr=11		Totals	
	Abs	Rel	Abs	Rel	Abs	Rel	Abs	Rel	Abs	Rel	Abs	Rel
rGC=34; GS=20	10	29.41 %	5	14.71 %	6	17.65 %	11	32.35 %	2	5.88 %	34	100 %

For the creation of shared value, 20 documents related to a total of 34 citations were obtained (Gr) (Table 5). The certification obtained ten citations with the equivalent of 29.41%; the social contribution, economic growth and human development with five citations represented by 14.71%; discourse with purpose with 6 opinions and 17.65%; impact to the country brand with 11 citations and 32.35%; and stakeholders and interest groups with two mentions, and 5.88% relative. With these results it can be observed the impact on the country brand as an emerging category with 32.35%.

Figure 3
Emerging category for shared value creation



The analysis of the graph allows identifying at its highest point the impact of the country brand with the highest citation and for which it is considered as an emerging category.

Certification (pc04)

To be certified as B Company, companies must meet rigorous social, environmental and transparency standards. In addition, it is essential that they commit to consider the long-term interest of all groups linked to them as a criterion for decision-making (B Lab, 2020). This certification process covers the review of five areas: governance, workers, environment, community and customers. To obtain the certificate, it is necessary to reach a minimum of 80 points out of 200. It is important to emphasize that certification is not binary (meets-does not meet), but it encourages continuous improvement. In this way, training and networking are designed so that companies can improve their score year after year (see Figure 8).

Country Brand Impact (pc05)

The CEOs of these companies face the challenge of balancing the rights of shareholders to receive profits with the interests of other interest groups, such as employees, the value chain, the environment and the communities where they operate (Jin, 2018). These actions also have an impact on the country's image and reputation internationally. In fact, companies play a crucial role in the construction of the country brand, as their activities and behaviors influence the perception of the country of origin (Rocha and Wyse, 2020). Therefore, it is of the utmost importance that companies make legal amendments to their statutes if they did not adopt this perspective from the outset, in order to achieve certification (B Lab, 2017). In Latin America, the organization that coordinates and groups B companies is Sistema B, which has a presence in several countries, including Chile.

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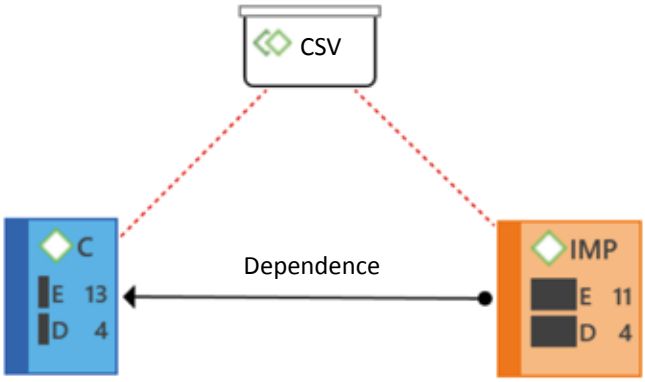
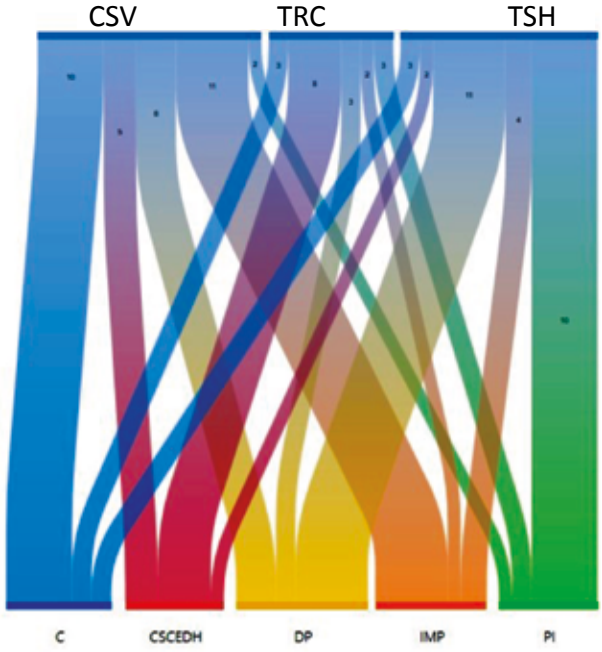
Figure 8
Creating Shared Value



CSV

Density (D) refers to the codes that will always be related to each other with a value of 4, rooting (E) indicates that out of the total key informants only 11 interviewees commented on the impact of the country brand (IMP) and 13 respondents pointed to topics on certification (C). Certification can have a positive impact on the country brand by demonstrating that the country's companies and products meet certain standards and norms in terms of sustainability, social responsibility, quality, among other important aspects.

Figure 9
Sankey diagram for emerging categories



The diagram represents the information flows obtained through surveys, each bar is connected by nodes that show the direction of the flow, all related to each other; the number of each node

represents the absolute values of each encoding and the sum between them allows to determine the emerging categories, resulting in CSV with absolute value 34 and TSH with 30 citations, respectively.

Table 6
Results code-document for the analysis of b companies in Chile

Guiding categories	CGr=13		CSCEDH-Gr=11		DPGr=11		IMPGr=11		PIGr=11		Totals	
	Abs	Rel	Abs	Rel	Abs	Rel	Abs	Rel	Abs	Rel	Abs	Rel
rGC=34; GS=20	10	12 %	5	6 %	6	7%	11	13 %	2	2 %	34	41 %
rGTR=19; GS=11	3	4 %	8	10 %	3	4%	2	2 %	3	4 %	19	23 %
rSHR=30; GS=18	3	4 %	2	2 %	11	13%	4	5 %	10	12 %	30	36 %
Totals	16	19 %	15	18 %	20	24%	17	20 %	15	18 %	83	100 %

Table 6 shows the guiding categories of the research, which are: Creation of shared value (CSV) with 20 interviewees and 34 citations; Theory of resources and capabilities (TRC) with 11 respondents and 19 citations; and Stakeholder Theory (TSH) with 18 respondents and 30 citations. The group codes allowed to identify the absolute and relative relationships between them. Regarding Certification (C), opinions were obtained from 16 people, representing 19% of the total sample; for Social Contribution, Economic Growth and Human Development (CSCEDH) responses were recorded from 15 respondents, equivalent to 18% of the sample; for discourses about a purpose (PD) there were 20 respondents, with a relative frequency of 24%; for the Impact of the country brand (IMP) 17 documents were found, representing 20%; and finally, for interested parties and interest groups (PI) opinions were collected from 15 respondents, covering 18% the sample analyzed.

Through this analysis, it is observed that in the last decades an entrepreneurial movement has emerged that seeks to integrate the social and environmental purpose in its DNA, which is reflected in the various categories identified and in the opinions of the interviewees. These trends indicate a significant change in the way organizations approach their social responsibility and country brand impact.

Discussion and conclusions

The objective of the research was to demonstrate how these companies have assumed their role as ambassadors of the identity and values of the country through their productive processes, as well as the motivations that have led them to be part of this type of companies with social and commercial purposes (Kim *et al*., 2019, Campos, 2016). It has been shown in the results of this research that the actions, values and behaviors of these companies can exert a significant influence on the perception and assessment of Chile at a global level through the Theory of Resources and Capacities (TRC), Stakeholder Theory (TSH), Certification (C), Social Contribution, Economic Growth and Human Development (CSCEDH), Stakeholders and Interest Groups (PI) and Country Brand Impact (IMP). In this sense, it is important that B companies are fully aware of their responsibility in the construction and promotion of the country brand, adopting practices that contribute to a positive image and reputation (Saiz-Álvarez *et al*., 2020).

The research has highlighted the relevance of B companies as a fundamental and independent variable in their objective of positively impacting society (Rocha and Wyse, 2020). Based on Bianchi *et al*. (2020), the need for these organizations to focus on the well-being of society is emphasized, beyond the traditional conception of a "society of organizations". In order to achieve this, the information provided by organizations promoting the movement of B companies and certifiers has been considered crucial (Boffa *et al*., 2023). The findings have also highlighted that these companies identify deeply with their philosophy and

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principles, conducting an internal review of their processes and business models to identify a social purpose that contributes positively to society and is recognized through B certification (Stubbs, 2017).

Consequently, it has been shown that B companies in Chile play a crucial role as agents of change and generators of social welfare. Based on the above, Stubbs (2017), manifests its focus on addressing social crisis problems and environmental challenges in the community, as well as its positive impact beyond national borders, which has positioned Chile as a country with a strong and favorable image in the international arena from the aspects that contribute to sustainable development. This research brings new knowledge to the field of administrative and economic sciences, providing a deep understanding of how B companies can contribute to the country brand and sustainable development. The research prospective aims to identify and analyze the mechanisms used by these companies to provide a solid basis for creating effective strategies in both the business and government. However, it is recognized that this research has certain limitations; the study has focused exclusively in Chile, which could limit the generalization of the results to other regions or countries. On the other hand, it is necessary to consider the representativeness of B companies in Chile with respect to other companies without this certification. Therefore, it is suggested for future research to expand the geographic scope and consider different cultural and economic contexts in the region where these companies are positioned, according to the directory of B Corp in Latin America and the Caribbean, as well as compare with the rest of the companies.

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Gaussian process regression´s hyperparameters optimization to predict financial distress

Optimización de hiperparámetros de regresión del proceso gaussiano para predecir problemas financieros

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Abstract: predicting financial distress has become one of the most important topics of the hour that has swept the accounting and financial field due to its significant correlation with the development of science and technology. The main objective of this paper is to predict financial distress based on the Gaussian Process Regression (GPR) and then compare the results of this model with the results of other deep learning models (SVM, LR, LD, DT, KNN). The analysis is based on a dataset of 352 companies extracted from the Kaggle database. As for predictors, 83 financial ratios were used. The study concluded that the use of GPR achieves very relevant results. Furthermore, it outperformed the rest of the deep learning models and achieved first place equally with the SVM model with a classification accuracy of 81%. The results contribute to the maintenance of the integrated system and the prosperity of the country's economy, the prediction of the financial distress of companies and thus the potential prevention of disruption of the given system.

Keywords: financial distress, Gaussian process regression, deep learning, investment financing, financial risk prediction, Gaussian regression, financial ratios, deep learning models.

Resumen: la predicción de las dificultades financieras se ha convertido en uno de los temas más importantes en el área contable y financiera debido a su correlación significativa con el desarrollo de la ciencia y la tecnología. El objetivo principal de este trabajo es predecir la dificultad financiera con base en la Regresión de Procesos Gaussianos (GPR) y luego comparar los resultados de este modelo con los resultados de otros modelos de aprendizaje profundo (SVM, LR, LD, DT, KNN). El análisis se basa en un conjunto de datos de 352 empresas extraídos de la base de datos de Kaggle. En cuanto a los predictores, se utilizaron 83 ratios financieros. El estudio concluyó que el uso de la GPR logra resultados muy relevantes. Además, superó al resto de los modelos de aprendizaje profundo y logró el primer lugar por igual con el modelo SVM con una precisión de clasificación del 81 %. Los resultados contribuyen al mantenimiento del sistema integrado y a la prosperidad de la economía del país, a la predicción de las dificultades financieras de las empresas y, por lo tanto, a la posible prevención de perturbaciones del sistema en cuestión.

Palabras clave: dificultades financieras, regresión del proceso gaussiano, aprendizaje profundo, financiamiento de inversiones, predicción del riesgo financiero, regresión gaussiana, coeficientes financieros, modelos de aprendizaje profundo.

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Introduction

Financial knowledge is essential for a given business entity. The financial health expresses the good financial situation of the company. A company is financially healthy if it guarantees the invested funds (yield, profitability), is financially stable, is not limited in its decision-making by other entities (indebtedness, financial structure), can pay its obligations and thereby guarantee the existence and appreciation of the invested funds (Gavurova *et al.*, 2020; Krulicky and Horak, 2021).

On the other hand, a financial distress can be defined as a situation in which the cash flow of a company is restricted for some reason. This restriction may be temporary if directors have the opportunity and ability to conduct corrective procedures (Liew *et al.*, 2023). Horak *et al.* (2020) mention similar characteristics of financial distress, and define it as a state in which the financial health of the company is significantly weakened. The authors also say that in case of financial distress, the company finds it challenging to draw up a payment schedule and pay its financial obligations on time within the pre-agreed maturity dates, thus exposing the company to the potential risk of legal enforcement. In such a situation, the company shows serious liquidity problems (ability to pay), and the solution amounts to significant changes in the company's operational activities and funding method (Vochozka *et al.*, 2020). The financial distress is also the final stage of organizational decline before bankruptcy. Therefore, the financial distress differs from bankruptcy as it prescribes a time when the borrower cannot pay the debts to the creditor (Hantono, 2019). The exact definition of financial distress has not yet been determined, but economic difficulties are known to have varying degrees. Mild financial distress refers to the temporary distress in cash flow and concepts such as insolvency, default, etc. The most dangerous of these degrees is bankruptcy or business failure (Shi and Li, 2019).

The importance of predicting financial distress has evolved gradually since almost half a century ago when this contemporary phenomenon appeared with the development of business establishments, where the sudden collapse of many companies was incomprehensible. Kliestik *et al.* (2018) claim that several scientific works have devoted to the issue of predicting financial distress, in order to predict the company's failure and classify the company according to its financial health. For this purpose, several methods have been used that differ in their assumptions and complexity. Anticipating financial distress before they occur, however, remains one of the solutions that have proven effective in preventing them. Initially, statistical techniques were used to build models with predictive capacity, and model building was associated with the development of science and technology. The more science develops, the more scientists and researchers who design more complex, accurate, and quality models that fill the gaps in earlier studies. The development of science has led to a revolution in the field of forecasting, where artificial intelligence techniques have been exploited in this field, achieving impressive results that are almost perfect (Bonello *et al.*, 2018). Artificial intelligence techniques to predict financial problems became common in the 1990s, with the development of computer techniques (Paule-Vianez, 2019). Deep learning has emerged and is progressively evolving into a robust technique for various uses, and has helped solve various problems in the economy and business, such as speech recognition, natural language processing, automatic driving, computer vision, prediction of financial difficulties and credit assessment (Qu *et al.*, 2019).

Several scientific studies on the subject of financial distress and forecasting of bankruptcies have proposed various predictive models for this purpose. Most published studies used data from a year before distress. Only some studies used data from 2-3 years before distress. The results showed that the data corresponding to two years before distress reduced the ability of the model to predict financial distress (Fernández-Gámez *et al.*, 2016), with accuracies of 72.0% and 95.5%, 86.2%, 100% using genetic algorithms and neural network one, two and three years before distress. Some authors compared the classification accuracy of forecasting models based on Polish industrial companies. Through R programs, the research tested neural networks, logistic regression, supporting vector machines, classification trees, k-NN

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algorithms, bagging, random forests, discriminatory analysis, empowerment and naive Bayes (Costa *et al*., 2022). Other authors have studied several intelligent and statistical models, such as particle swarms optimization integrated into semiconductor virtual machines (SVMs), decision trees, linear discriminant and genetic algorithms, using logistic regression of SVMs, self-organizing maps and quantification of learning vectors. The results show that statistical techniques are more suitable for large data sets, and smart techniques are more suitable for smaller data sets (Zhou *et al*., 2019). This improved method combines features of fuzzy sets, and machine learning can be compared to probabilistic neural networks in terms of clustering performance. The aim of this study is to predict the decline using the GP method and its subsequent comparison with logistic regression machines and support vectors. The research is based on accurate data on bankruptcy, and concluded that Gaussian processes outperform other methods in predicting bankruptcy with high accuracy (Liu *et al*., 2023).

This study aims to establish a general idea of the advantages that can be applied to the various actors, both academic and professional. The economy of a State functions as an interconnected system that encompasses many factors that contribute to the establishment of a strong and prosperous society. If any of these factors fail to meet their targets, the entire system will fail. Since economic enterprises play a fundamental role in a country's economy, it is necessary to ensure their continuity by all possible means. As a result, the importance of predicting financial distress arises as a method based on the advancement of statistical and intelligent techniques that help companies avoid bankruptcy and the cessation of their operations.

Our paper stands out among the limited number of scientific publications that address this topic, distinguishing itself by its focus on predicting financial distress using the GPR model, therefore, preliminary tests were performed on the GPR model. Our main goal is to improve academic research and make significant contributions to its advancement. For this research, two research questions were defined: Is the GPR model suitable to predict financial distress? Did the GPR model hold up against the logistic regression model to predict financial distress?

The article is structured as follows. Section 1 presents a brief review of the literature, section 2 provides information on the investigation procedure, data and variables, section 3 presents the results obtained, section 4 analyzes the results obtained and provides an overall summary of the results of the research, including the proposed recommendations.

Methodology

Data and Variables

This dataset encompasses two distinct types of variables. First, there is the independent variable X, which is a quantitative variable encompassing a range of 83 financial ratios. Unfortunately, the specific names to these ratios were not explicitly provided; instead, they were named X1, X2, ..., X83. Although this lack of accurate identification is an inconvenience, it was chosen to use these data because of its alignment with the main objective of the study, which involves assessing the predictive capacity of the model for financial difficulties after the optimization of its hyperparameters. The identification of the set of financial ratios that exert the greatest influence on the dependent variable served as a secondary objective, especially after the application of the PCA technique to enhance data quality.

The second type of variable corresponds to the dependent variable, named Y, which is a qualitative variable representing the model's outputs and covers two fundamental scenarios: financial distress, denoted as 0, and non-financial distress, named as 1. These data provide an accurate description of the actual circumstances of all financial cases, taking into account the importance of the indicators (83). Consequently, this data s*et al*lows us to effectively train the model and assess its predictive capacity.

We are relied on a ready-made data set that includes data from 352 companies extracted from the Kaggle database. We divided these data into a

training sample and a test sample, where the training sample contained the data of 187 companies for different years, and the number of financial cases (fiscal years) reached 2001 financial cases divided into 896 cases of financial distress and 1105 cases of non-financial distress, while the test sample included the data of 165 companies for a period of four years, where data for the rest of years were excluded. The number of financial cases (fiscal years) in the test sample reached 660 financial cases, divided into 351 cases of financial distress and 309 cases of non-financial distress. As for the predictors used in this study, 83 financial ratios are included, representing a considerable number of independent variables, which is desirable, since it will help us extract the most influential components in dependent variability after activating the Principal Component Analysis (PCA) technique. The key variables on which this study is based are shown in Table 1.

Table 1
Main study variables

Variable	Function
Gaussian Process Regression	Non-parametric Kernel-based probabilistic model. There is a latent variable f(xi) introduced for each observation $_{xi}$, which makes the GPR model non-parametric. In vector form, this model is equivalent to $$P(y\backslash f,X) \sim N(y\backslash H\beta + f, \sigma 2I),$$ Where $$X=\begin{pmatrix} x_1^T \\ x_2^T \\ \vdots \\ x_n^T \end{pmatrix}, y=\begin{pmatrix} y_1 \\ y_2 \\ \vdots \\ y_n \end{pmatrix}, H=\begin{pmatrix} h(x_1^T) \\ h(x_2^T) \\ \vdots \\ h(x_n^T) \end{pmatrix}, f=\begin{pmatrix} f(x_1) \\ f(x_2) \\ \vdots \\ f(x_n) \end{pmatrix}$$ The combined distribution of the latent variables f(x$_{1)}$ $f(x2)$, ..., f(xn) in the GPR model is as follows: $$P(f\backslash X) \sim N(f\backslash 0, k(X, X)),$$ close to a linear regression model, where K(X,X) looks like this: $$K(X,X)=\begin{matrix} k(x_1,x_1) & k(x_1,x_2) & k(x_1,x_n) \\ k(x_2,x_1), & k(x_2,x_2), & k(x_2,x_n) \\ k(x_n,x_1) & k(x_n,x_2) & k(x_n,x_n) \end{matrix}$$
Kernel Function	In supervised learning, points with similar predictive values $_{xi}$, are expected to have $_{yi}$ near response (target) values $_{yi}$. In Gaussian processes, the covariance function expresses this similarity. This specifies the covariance between the two latent variables f(xi) and f(xj), where xi and $_{xj}$ are vectors of $_{xd}$-by-1. In other words, it determines how the response at one point xi is affected by the responses at other points xj, i ≠ j, i = 1, 2, ..., n. The covariance function $k(_{xi,xxj})$ can be defined by several Kernel functions. It can be analyzed in terms of the Kernel parameters in the vector θ. Therefore, it is possible to express the covariance function as $k(_{xi,xj}\backslash\theta)$.
Optimizing Hyperparameters	Changing the functions of the model to improve its performance.
Analysis of principal components	The analysis of principal components is a quantitatively rigorous method for achieving this simplification. The method generates a new set of variables, called principal components. Each principal component is a linear combination of the original variables. All principal components are orthogonal to each other, so there is no redundant information. The main components as a whole constitute an orthogonal basis for the space of the data.

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Variable	Function
Rational quadratic Kernel	This covariance function is defined by $$k(xi,xj\backslash\theta)=\sigma_f^2\left(1+\frac{r^2}{2\alpha\sigma_l^2}\right)^{-\alpha}$$ when $_l$ is the characteristic length scale, α is a scale mixing parameter with a positive value; and $$r=\sqrt{(x_i-\boldsymbol{x_j})^T(x_i-\boldsymbol{x_j})}$$
Square exponential Kernel	This is one of the most commonly used covariance functions. The square exponential function of the kernel is defined as $$k(xi,xj\backslash\theta)=\sigma_f^2\exp\left[\frac{1}{2}\frac{(x_i-\boldsymbol{x_j})^T(x_i-\boldsymbol{x_j})}{\sigma_l^2}\right];$$ where $_{\alpha l}$ is the characteristic length scale and f is the standard deviation of the signal.
Matern 5/2 Kernel	This covariance function is defined by $$k(xi,xj)=\sigma_f^2\left(1+\frac{\sqrt{5r}}{\sigma_l}+\frac{5r^2}{3\sigma_l^2}\right)exp\left(-\frac{\sqrt{5r}}{\sigma_l}\right)$$ where $$r=\sqrt{(x_i-\boldsymbol{x_j})^T(x_i-\boldsymbol{x_j})}$$
Exponential Kernel	This covariance function is defined by $$k(xi,xj\backslash\theta)=\sigma_f^2\exp\left(-\frac{r}{\sigma_l}\right)$$ where $_{\alpha l}$ is the characteristic length scale; and $$r=\sqrt{(x_i-\boldsymbol{x_j})^T(x_i-\boldsymbol{x_j})}$$
Matern 3/2 Kernel	This covariance function is defined by $$k(xi,xj\backslash\theta)=\sigma_f^2\left(1+\frac{\sqrt{3r}}{\sigma_l}\right)\text{expexp}\left(-\frac{\sqrt{3r}}{\sigma_l}\right)$$ where $$r=\sqrt{(x_i-\boldsymbol{x_j})^T(x_i-\boldsymbol{x_j})}$$

Methods

In this study, a descriptive methodology was used in the theoretical section, using accredited sources and peer-reviewed indexed academic journals. On the other hand, the section applied had a comparative approach using an analytical method. Two primary inquiries were made, and after extracting the results related to the improvement of the quality of the GPR model, a comparison with deep learning models was made. The findings were thoroughly discussed and the main research was addressed.

Matlab was used to build the model, optimizing its hyperparameters and being able to show the resulting graphs. Excel was used to calculate the error measures (MSE, RMSE, MAE), as well as to determine the elements of the confusion matrix (Sensitivity, Specificity, Accuracy). The SPSS was used to perform the R^2 statistical test. The statistical evaluation of the model was performed using the measure R^2, widely considered as one of the most significant statistical tests due to its ability to assess the correlation between real and predicted values. No additional statistical tests were performed, with the exception of the R^2 test, as the researcher believed that the R^2 test adequately captured the statistical significance of the model. In addition, it should be noted that PCA was deemed ineffective. The model was subjected to a mathematical evaluation using several significant mathematical measures, including MAE, RMSE and MSE, to quantify the error of the model. Additionally, the evaluation involved the examination of the matrix of confusion and its associated metrics, such as Sensitivity, Specificity, Accuracy. These measures were used to compare the performance of the GPR model with that of deep learning models.

The temporal and spatial scope of this study is not available, and as noted above, these data were extracted from the Kaggle database, and are available at the following link: https://bit.ly/3DZxGr1. Unfortunately, despite the importance of these two aspects, the data available do not provide specific information on time and space coverage. However, due to the need for valuable and meaningful results and the absence of superior alternatives, we have chosen to rely on this dataset. The dataset is remarkable, as its owner reports that it possesses the following attributes: well-documented, well-maintained, clean, and original data. In addition, it covers a wide time range, although the exact period is not specified. This scope allows us to evaluate the predictive capacity of the models in forecasting financial distress four years prior to its occurrence.

In the first phase of this study, five types of GPR models will be formulated, each one distinguished by the type of Kernel function used. Subsequently, these models will be subjected to training using the training sample provided, after which a comparative analysis will be performed to identify the most optimal model that exhibits the minimum error value. The selected model then goes to the second stage for testing. Additionally, after evaluating this model, additional types of models will be formulated using the same Kernel function that achieved the best results in the previous phase, but varying in terms of the base function used. Again, a selection process will be carried out to determine the most optimal model, which will then move to the final phase that requires comparison between the extracted models and the commonly used machine learning models.

By using Gaussian processes, a good framework for probability regression can be provided (Yang *et al.*, 2023). The Gaussian process method has recently reborn due to the advent of artificial intelligence and Kernel-based machine learning. These models provide various uses in various areas of research and a complete nonlinear Bayesian method (Antunes *et al.*, 2017). GPR is a non-parametric model that depends on the probability distribution of Gauss and is defined as a set of random variables. Each finite GP number of this random variable has a common Gaussian distribution. Thus, GP is fully specified by the second-order statistic:

$$f(x) \sim GP(m(x), k(x, x')) \quad (1)$$

Where $m(x)$ and $k(x,x')$ are the covariance and mean functions of a real process $f(x)$, respectively (Ferkousl *et al.*, 2021). It only defines the covariance and mean functions to simplify a function from

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a Gaussian process. The k covariance function models the articular variability of the random variables from the Gaussian process, and returns the modeled covariance between the pair of inputs (Herfurth, 2020). The Gaussian process is a robust non-parametric method with precise uncertainty models, mainly used in classification and regression issues. It is not parametric because the Gaussian process tries to infer how all measured data are correlated rather than adjusting the parameters of the chosen base functions (Wang *et al.*, 2023). A Gaussian process is an operational probabilistic regression method, originally pioneering in statistics and geophysics, that has since found a strong user base in machine learning. A Gaussian process, considered a probabilistic regression technique, takes a kernel and dataset as input and gives the distribution of a function as output (Asante-Okyere *et al.*, 2018).

GPR can be considered as a generalization of the more standard Bayesian linear regression, and similarly, the classification of the Gaussian process can be considered a generalization of the logistic regression. The activation of the logistic function was given by $a = wT \varphi(x)$. Therefore, Gaussian processes can be allowed not to linearize the function by directly manipulating the function space (Hamoudi *et al.*, 2023). Therefore, we can replace the linear model $wT \varphi(x(n))$ with a Gaussian process f considering the set of latent variables for $n \in \{1, N\}$. In addition, we are interested in the probability of membership of $\pi(x^\star) = p(y = 1 \mid x^\star) = \sigma(f(x^\star))$ given an observation $x^\star$. The inference process is similar to the previous one, so the distribution of $x^\star$ is calculated as:

$$p(f^\star \mid D) = \int p(f^\star \mid D,f)\, p(f \mid D)\, \partial f \qquad (2)$$

Where $p(f \mid D) \propto p(D \mid f)\, p(f)$ is the posterior obtained by applying the Bayes rule (Taki *et al.*, 2018).

Given the function of covariance, making predictions for new test points is simple, because it is about manipulating algebraic matrices. However, in procedural application, it may be necessary to recognize which covariance function to use. Of course, the reliability of the regression depends on how well the parameters required by the chosen covariance function were selected (Wang *et al.*, 2023).

Results

In this section, we will present the results obtained through experimentation and discuss these results clearly. Having organized and distributed the data into a training sample and test sample, we will proceed to build and develop multiple models to assess its ability to predict financial distress. However, first, a comprehensive review of the data will be carried out. Box diagrams are used to illustrate the data for several reasons. First, box diagrams provide valuable information about data dispersion or variability. Second, they provide reliability of the distribution of securities. Third, they help identify regions where sample values are most densely clustered or scarce. Due to the large number of independent variables, namely 83, it is not practical to create a separate cash flow chart for each variable. Therefore, we will selectively show the box diagram for a specific set of variables, namely X1, X2, X6, X24, X30 and X81, chosen at random only for illustrative purposes. Figure 1 shows outliers, represented in red, that are seen in two areas of the figure, either above the maximum value after outliers are excluded or below the minimum value after outliers are excluded.

Figure 1
Box of Whiskers Plot

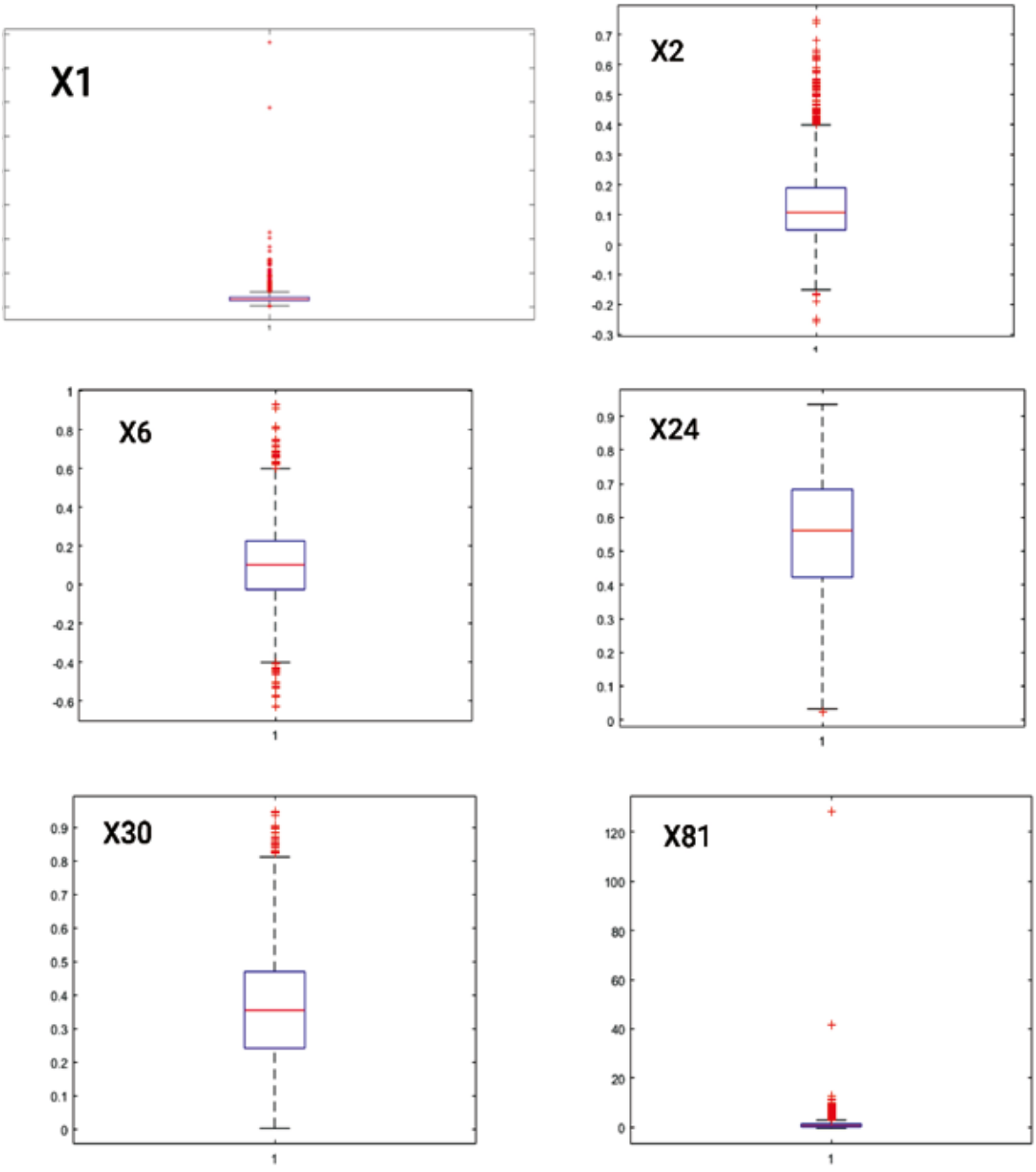

Table 2 illustrates the design features of the GPR models and provides a clear overview of all the details, as detail below.

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Table 2
Design Process Variables

Kernel Function	Base Function	Kernel Sigma	Isotropic Kernel	Standardized	Optimize Numeric Parameters
Rational quadratic	Constant	0.3517075	True	True	True
Exponential Square	Constant	0.3517075	True	True	True
Matern 5/2	Constant	0.3517075	True	True	True
Exponential	Constant	0.3517075	True	True	True
Matern 3/2	Constant	0.3517075	True	True	True

Table 2 presents the main objective of the research in the design of diverse GPR models in order to compare their outcomes and identify the most optimal model. It is important to note that throughout the design phase, all parameters remained fixed and were not affected by variations in the Kernel function type. In addition, several non-essential fields, such as prediction speed and training time, were omitted from the analysis as they hold lesser significance. As shown in Table 2, during the first phase, the PCA feature was used to extract the main components and reduce the number of predictors, due to the substantial incorporation of financial ratios. By using this widely recognized and indispensable technique, we can effectively eliminate variables that do not contribute to research objectives and hinder the attainment of accurate predictions regarding financial distress. The results obtained from the training of GPR models after the activation of the PCA technique are presented in Table 3.

Table 3
Training results using the PCA technique

Kernel Function	RMSE	MSE	MAE	R^2
Rational quadratic	0.497	0.247	0.494	0.00
Exponential Square	0.497	0.247	0.494	0.00
Matern 5/2	0.497	0.247	0.494	0.00
Exponential	0.492	0.242	0.483	0.02
Matern 3/2	0.497	0.247	0.494	0.00

Root mean square error (RMSE), mean square error (MSE) and mean absolute error (MAE) were used to measure the error value. The coefficient of determination, denoted as R^2, was used as a statistical metric to evaluate the quality of the model and to understand the correlation between the independent variables and the dependent variable, as well as the correlation between the observed values and the predicted values. When analyzing Table 3, it was observed that the results obtained could have been more satisfactory. Surprisingly, upon examining Table 3, it was observed that the obtained results could have been more satisfactory. However, these outcomes are inadequate for progressing to the second phase, namely "testing." In this phase, it was noticed that the measures of prediction accuracy were excessively inflated and almost identical across all models. Additionally, the R^2 values were nearly zero for all models, indicating a lack of correlation between the predictors and the dependent variable, rendering the models statistically insignificant. Consequently, this suggests the possibility of an imbalance resulting from the utilization of the Principal Component Analysis (PCA) technique. This observation is perplexing and contradictory, as the PCA technique typically contributes to reducing error and enhancing prediction quality. However, this expected improvement is not evident in this case. Therefore, it is necessary to

investigate the causes behind the inflated error measures and the absence of the coefficient of determination. It is proposed to disable the PCA technique and assess whether the results will exhibit improvement or further deterioration. Subsequently, in Table 4, the PCA technique is disabled, yielding the following set of results.

Table 4
Training results without using the PCA technique

Kernel function	RMSE	MSE	MAE	R^2
Rational quadratic	0,369	0,136	0,297	0,45
Exponential square	0,372	0,138	0,303	0,44
Matern 5/2	0,371	0,138	0,299	0,44
Exponential	0,370	0,137	0,295	0,45
Matern 3/2	0,371	0,137	0,298	0,44

By analyzing Table 4, a noticeable decline in the values of prediction accuracy measures becomes apparent, suggesting a decrease in error rates. This signifies an enhancement in the prediction quality of the models, which is further corroborated by the substantial increase in the values of R^2. However, it is important to note that these values did not approach 1 but remained considerably distant from zero. Consequently, the models have achieved statistical significance and can effectively elucidate the relationship between the predictors and the dependent variable with a correlation coefficient of 0.444. Hence, we can infer that the employment of Principal Component Analysis (PCA) primarily contributed to the substandard performance of the models. Upon comparing the prediction accuracy measures, it is evident that the initial model employing the Rational Quadratic Kernel function exhibits lower error values compared to the other models, as well as higher R2 values. Additionally, this model attains the highest level of statistical significance. Consequently, we will disregard the remaining models and opt to employ this particular model for testing in the subsequent phase. The test results of the Rational Quadratic model, based on the same aforementioned measures, are presented in Table 5.

Table 5
Testing results (overall)

Kernel Function	RMSE	MSE	MAE	R^2	Accuracy
Rational quadratic	0,380	0,144	0,318	0,42	0,80

Table 5 shows the results after testing the Rational Quadratic model using the test sample. We note that the prediction accuracy measures increased compared to the training phase, which is expected. On the other hand, it is positive because the error values increased only slightly, and this indicates that the model was able to build the appropriate formula that serves the objective of the study, and this can be confirmed by the prediction accuracy rate of 80%, which is a very appropriate rate and reflects the strength of the model in predicting financial distress. In order to further clarify the results of the model test, we will rely on Figure 2 and Table 6 to provide more detailed information.

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Figure 2
Predicted Vs. Actual Plot (RQ-Constant)

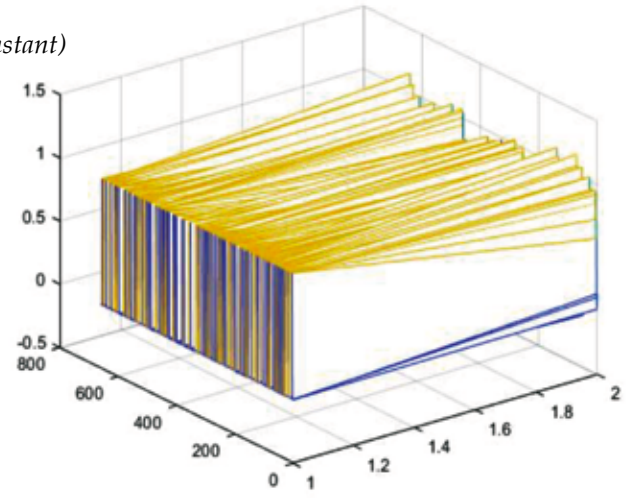


Table 6
Testing results (particular)

Kernel Function	Year	RMSE	MSE	MAE	R^2
Rational quadratic	N-1	0206	0042	0087	0,31
	N-2	0183	0033	0075	0,45
	N-3	0174	0,0305	0072	0,52
	N-4	0194	0037	0082	0,39

The model's accuracy in predicting financial distress was assessed at different time points: one year before distress occurrence, two years ago, three years ago, and four years ago. It is worth noting that the error values were highest in the first year, accompanied by a clear decrease in the R^2 value. This observation is intriguing since the classification model's performance in the initial year was expected to be superior to subsequent years, and then it begins to decline gradually. However, the opposite was correct, as the quality of prediction improved the farther away the possibility of distress occurrence. Therefore, it can be said that the model is promising because it achieved relevant results, and therefore we will optimize the model's hyperparameters to improve the results. Matlab allows us to make several modifications in the design phase of the model and before training it. Perhaps an essential feature that can be modified is related to the primary function because we have made several other modifications. However, they did not achieve appropriate results, so it is unnecessary to comment on these modifications. As shown in Table 7, the program offers three types of Basis functions, enabling the construction of three new GPR models based on these functions. However, only two new models will be created, as the Rational Quadratic model utilizing the Constant Basis function has already been constructed in the previous phase.

Table 7
GPR-RQ Hyperparameters Optimization (Training results)

Base Function	RMSE	MSE	MAE	R^2
Constant	0,369	0,136	0,297	0,45
Zero	0,368	0,136	0,296	0,45
Linear	267,13	71356	11,273	-287973

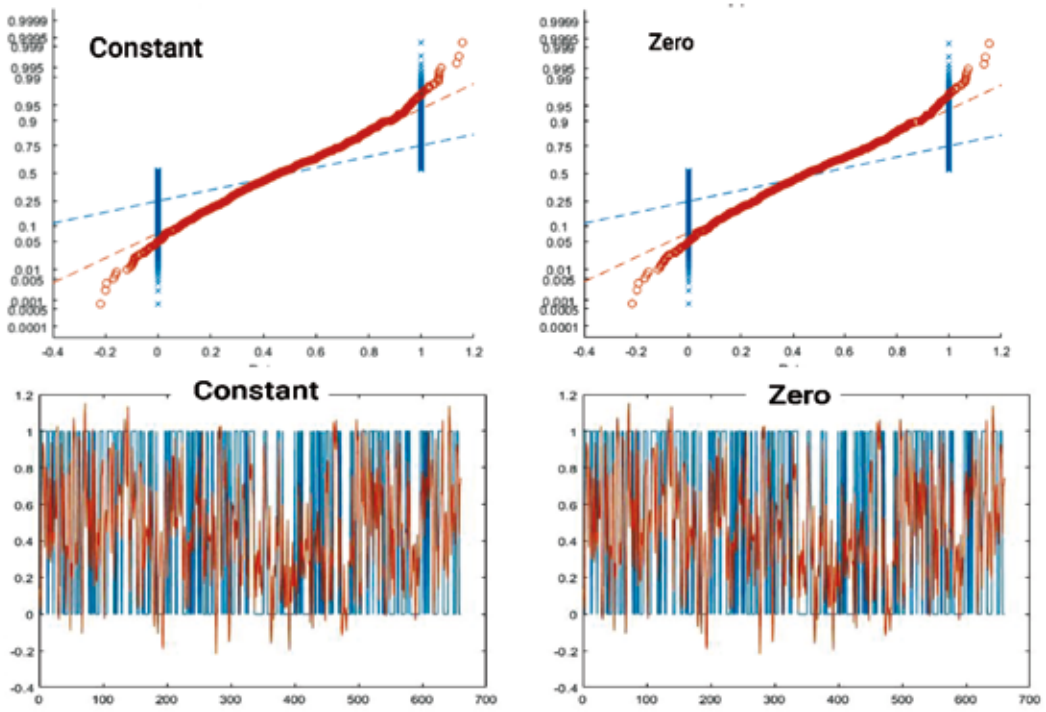
Training results of the linear relationship model were unsatisfactory and are therefore omitted. Based on the training results of the remaining two models, it is observed that both the error values and the R^2 values show convergence, although the Zero model has shown a slightly higher performance. These findings provide impetus to proceed to the testing phase and conduct a comparative analysis of the two models, as the training results have indicated the potential for enhancing the accuracy of the Rational Quadratic model. The results outlined in Table 8 present the following outcomes.

Table 8
Testing results (overall)

Basis Function	RMSE	MSE	MAE	R^2	Sensitivity	Specificity	Accuracy
Constant	0.380	0.144	0.318	0,42	0,82	0,78	0,80
Zero	0377	0142	0315	0,43	0,83	0,79	0,81

It should be noted that the RQ-Zero model showed superior performance compared to the RQ-Constant model for all metrics presented in Table 7. Thus, results have improved, albeit marginally. For a more complete view of the test results for both models, we will use Figure 3 and Table 9 to present more complex and detailed information. We present the Constant-GPR and Zero-GPR model figures, because the results of these two models were valuable compared to previous models. We hope to clarify the difference between the two models through the residual graph, but as observed, Figure 3 does not show a significant difference between the two models due to the convergence of the results.

Figure 3
Residual Plot



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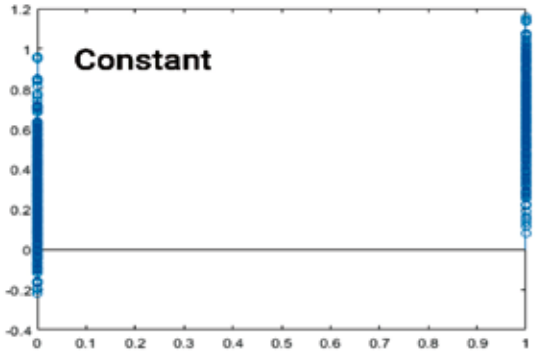

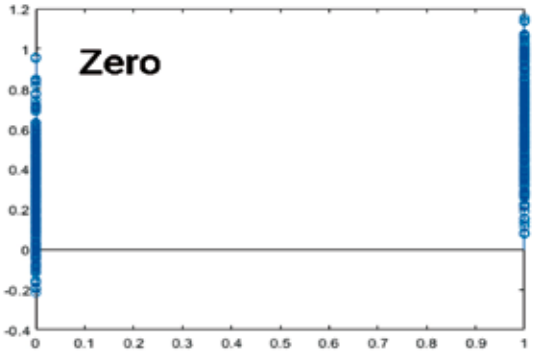

Table 9
Testing results (particular)

Función de base	Año	RMSE	MSE	MAE	R^2
Constante	N-1	0206	0042	0087	0,31
	N-2	0183	0033	0075	0,45
	N-3	0174	0,0305	0072	0,52
	N-4	0194	0037	0082	0,39
Cero	N-1	0204	0042	0086	0,32
	N-2	0182	0033	0075	0,45
	N-3	0172	0029	0072	0,53
	N-4	0193	0037	0081	0,40

Based on the data presented in Table 9, all available evidence suggests the superiority of the RQ-Zero model. It is worth noting that a similar problem found in the first model also occurred in the RQ-Zero model, where the error values were higher in the first year. This trend can also be observed in the R^2 value, as the classification capacity of the model was expected to be higher in the first year and to decrease gradually in subsequent years. The opposite was observed in this case. In the final stage, once the optimal model was identified from the GPR models, we proceeded to compare this selected model with deep learning models such as the decision tree model, linear discriminant, logistic regression, support vector machine and K-Nearest Neighbor.

Table 10
Comparison of deep learning models

Model	RMSE	MSE	MAE	R^2	Sensitivity	Specificity	Accuracy
GPR-RQ-Zero	0377	0142	0315	0,43	0,83	0,79	0,81
Decision Tree	0539	0290	0290	0,17	0,68	0,73	0,71
Linear Discriminant	0503	0253	0253	0,24	0,78	0,71	0,75
Logistic regression	0506	0256	0256	0,24	0,72	0,77	0,74
Svm	0436	0190	0190	0,38	0,87	0,74	0,81
K-nn	0539	0290	0290	0,17	0,65	0,71	0,68

This outcome was unforeseen, particularly in the context of comparing the GPR model with commonly used deep learning models for classification purposes. It is worth highlighting that the RQ-Zero model demonstrated noteworthy performance, positioning it at the forefront of the rankings alongside the Svm model. This accomplishment is significant, as the RQ-Zero models have demonstrated their capacity to effectively learn and attain appropriate classification outcomes. Additionally, slight distinctions between the Svm and RQ-Zero models have been observed, rendering it challenging to determine the optimal model between them, particularly due to the equivalent classification accuracy they exhibit.

Discussion and conclusion

It was found that it is necessary to carry out more surveys that focus on predicting financial distress using the Gaussian regression method. For this reason, the following text will focus on the results of surveys devoted to predicting the financial crisis of the company through various methods. First, we can immediately mention the study by Jeong and Kim (2022), who designed a model to predict the financial distress of construction companies, considering three, five, and seven years before the prediction point. To construct the prediction model, they chose the financial ratio as an additional input variable, adopted in existing studies of medium- to long-term predictions in other industries. They compared the performance of single-machine and ensemble models to compare the performance of prediction models. A comprehensive comparison of the performance of these models was based on the average value of the prediction performance and the results of the Friedman test. The development of the comparison determined that the random subspace (RS) model showed the best performance in predicting the financial situation of construction companies in the medium to long term.

Rahman *et al.* (2021), in turn, investigated the application of a predictive model of financial distress, which uses the F-score method, including its components, in order to identify companies with a high risk of failure. The dataset was created on the basis of the UCLA-LoPucki Bankruptcy Research database, where 81 publicly traded American companies in financial distress were specifically monitored for the period 2009-2017. The survey concluded that the relationship between the F-score and the likelihood of a company becoming financially distressed is significant. Among other things, the results also show that companies in crisis have negative cash flow from operations (CFO) and show a more significant decrease in return on assets (ROA) in the year before the crash.

As part of their research, the authors Chen and Shen (2020) applied hybrid machine learning methods that integrate stepwise regression, regression and classification trees, selection and the least absolute shrinkage operator, and random forests. They used all these methods in order to create models with which it will be possible to predict the financial distress of the company. The authors used a total of 14 financial variables and 6 non-financial variables for the research. The results show that the CART-LASOO model has the highest level of accuracy, namely 89.74%. We can also mention the study by Chen and Du (2009), who used data mining and neural network clustering to predict financial distress. Here, 33 variables of a financial nature and 4 variables of a non-financial nature were applied to the research. The conclusions of the study show that better accuracy is achieved by models designed using artificial neural networks. In order to predict financial distress, Gregorova *et al.* (2020) method – LR (logistic regression), RF (random forests) and NN (neural networks), using 14 financial ratios. The best performance was assigned to the NN model with an accuracy result of 88.6%. Chen and Jhuang (2020), who also use ANN and CHAID, SR-C5.0 methods, were responsible for another model used to predict financial distress. Using 18 variables of a financial nature and 3 non-financial variables, they found that the SR-C5.0 model showed the highest level of accuracy. The overall accuracy rate was 91.65%. The main goal of Jan's (2021) study was to create highly efficient and accurate models that will be able to predict financial distress using deep neural networks (DNN) and convolutional neural networks (CNN). Based on the results, the authors

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concluded that the highest financial distress prediction accuracy rate of 94.23% and the lowest type I error rate and type II error rate which are 0.96% and 4.81% respectively.

Thanks to the above results, it is now possible to proceed with the answers to the research questions.

1. Is the GPR model suitable for predicting financial distress?
2. Although, according to the analysis of the existing literature dealing with this issue, the GPR model is not a widely used tool in practice for financial distress, the results of this survey show that the GPR model is excellent for these needs. This is mainly because the model achieves very satisfactory results, with a classification accuracy of 81%.
3. Did the GPR model hold up against the logistic regression model for predicting financial distress?

After comparing the results of this model with deep learning models, respectively, with the linear regression model, it was found that the GPR model outperformed this commonly used model. As mentioned above, the GPR model achieved a classification accuracy of 81%, while the linear regression model achieved only 74%.

In the first phase, we identified the most suitable model among the GPR models by comparing their Kernel functions, and the model was RQ. In the subsequent phase, focused on enhancing the model's performance through hyperparameter optimization, we were able to identify the optimal model from the GPR models based on the variation in Basis function, which was named RQ-Zero. After comparing the results of this model with the results of other deep learning models, we concluded that the model performance was excellent because it achieved very relevant results, as it outperformed all other commonly used models equally with the SVM model, and this prompts us to ask, why has not the GPR model been tried in predicting financial distress based on the difference of the size and type of test sample in a way that makes it commonly used in predicting financial distress or predicting bankruptcy? Moreover, this is even though GPR achieves very relevant results. We also conclude that there is an inverse relationship between the error values and R^2, as the lower the error values, the higher the R2 value. This indicates the accuracy and quality of the model in predicting financial distress, and the opposite is correct. On the other hand, the PCA technique did not achieve the desired objective of its use unusually, as an improvement in the results was achieved after disabling this technique. Finally, we recommend testing the GPR model in predicting financial distress based on a different study sample.

The importance of predicting financial distress using GPR is underscored by the findings of this research paper. GPR has demonstrated a remarkable capacity for accurate prediction, particularly when its hyperparameters are optimized. This model has exhibited superior performance compared to other deep learning models and is on par with Support Vector Machines (SVM), which in itself is a noteworthy achievement. To the best of our knowledge, GPR is an infrequently employed technique, particularly in the context of predicting distress or bankruptcy. Thus, this study aims to alter researchers' perspectives regarding the utilization of GPR in this domain. By exploring novel variations of GPR models and subjecting them to new and diverse study samples, it is possible to identify and address the limitations of previous research, including the present study. Such efforts can expand the outcomes and benefits for all stakeholders involved in this subject, including lenders, auditors, investors, government entities, and particularly companies. This is because the continuity of a company is interconnected with the overall stability of the state's economy. Accurately predicting a company's financial distress facilitates the maintenance of prosperity, minimizes losses, increases investment rates, preserves job opportunities, avoids layoffs, and sustains a mutually beneficial environment for all parties involved.

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Determining factors of informal enterprise closure by gender: a microeconometric study applied in Senegal

Factores determinantes del cierre de empresas informales por género: un estudio microeconómico aplicado en Senegal

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Abstract: this article aims to investigate the factors influencing the closure of informal businesses during the COVID-19 pandemic, with a specific focus on the differences between businesses led by women and men. The research employed a logistic regression approach and utilized the matching method to evaluate the pandemic's impact. The study relied on a database created by the Development Policy Analysis Laboratory, Cheikh Anta Diop University, Dakar, which encompassed 923 informal businesses operating in diverse sectors in Dakar. The findings demonstrate that businesses managed by women experienced a more severe impact from the pandemic, leading to a higher likelihood of temporary closure. These results underscore the disproportionate effect of the crisis on women entrepreneurs within the informal sector and emphasize the necessity for tailored measures to support this vulnerable population during and after the pandemic. Such measures should address the unique challenges faced by women-led informal businesses and help foster their recovery and long-term sustainability.

Keywords: COVID-19, business closures, propensity score matching, informal sector, gender disparities, logistic regression, female-led businesses, male-led businesses.

Resumen: el objetivo de este artículo es examinar los factores determinantes del cierre de empresas informales durante la pandemia COVID-19, centrándose en las diferencias entre las empresas dirigidas por mujeres y las dirigidas por hombres. Para ello, se utilizó un enfoque de regresión logística, junto con el método de emparejamiento para evaluar el impacto de la pandemia. El estudio se fundamenta en una base de datos elaborada por el Laboratorio de Análisis de Políticas de Desarrollo, Universidad Cheikh Anta Diop, Dakar, que comprende 923 empresas informales de diversos sectores en Dakar. Los resultados revelan que los negocios manejados por mujeres se vieron más afectados por la pandemia, con una mayor probabilidad de cierre temporal. Estos resultados subrayan el impacto desproporcionado de la crisis sobre las mujeres empresarias del sector informal, y ponen de relieve la necesidad de medidas específicas para apoyar a esta población vulnerable durante y después de la pandemia.

Palabras clave: COVID-19, cierre de empresas, coincidencia de puntuaciones de propensión, sector informal, disparidades de género, regresión logística, empresas dirigidas por mujeres, empresas dirigidas por hombres.

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Introduction

The COVID-19 pandemic had a significant impact on businesses and working environments. The public health measures put in place forced many establishments to close suddenly, while the risk of infection prompted rapid adoption of modern sales and communication technologies to avoid physical contact. School closures also added childcare responsibilities for many working parents. These changes have put particularly strong pressure on small businesses, where central responsibilities are often shared between just a few people (Buffington *et al*., 2020).

During the 2009 financial crisis, women-led businesses faced a higher probability of permanent closure. In addition, these companies experienced a greater decline in long-term sales than those run by men (Ahmed *et al*., 2020). At the same time, they also experienced a more pronounced contraction in credit supply (Aristei and Gallo, 2022). This disparity in performance between female- and male-led businesses can be explained by a variety of factors, such as gender-based discrimination, limited access to finance and a lack of professional networks and support (Chaudhuri *et al*., 2020). Indeed, women entrepreneurs often encounter more difficulties in obtaining financing and bank loans than their male counterparts (Shoma, 2019), which can hamper their ability to keep their businesses afloat during a period of economic crisis.

During the COVID-19 pandemic, businesses across various sectors experienced significant disruptions in both supply and demand, leading to adverse impacts on sales, employment, and financial stability (Apédo-Amah *et al*., 2020; Bloom *et al*., 2020; Karalashvili and Viganola, 2021; Amin and Viganola, 2021). Moreover, a study conducted in 24 countries globally revealed that women-led businesses had a higher likelihood of remaining temporarily closed and for extended durations compared to businesses led by men during the COVID-19 pandemic (Liu *et al*., 2021).

Various studies have demonstrated that, in general, firms led by women exhibit lower productivity and smaller size compared to firms led by men (Islam *et al*., 2019; Kiefer, 2022; Oladipo *et al*., 2023). Additionally, it is common for these businesses to face challenges in accessing necessary financial resources (Andriamahery and Qamruzzaman, 2022). In the context of the COVID-19 crisis, which has particularly affected the retail sector and other service sectors, it is crucial to understand the specific effects of this crisis on women-led enterprises. Such understanding would enable the design of policies aimed at supporting these vulnerable businesses.

Gender inequality remains a pervasive problem in developing economies, significantly hampering economic development (Bui *et al*., 2018; Ud Din *et al*., 2018). Recent studies by Gezici and Ozay (2020) and Montenovo *et al*. (2022) have highlighted a worrying trend towards greater job losses among women than men. For example, Dang and Nguyen (2021) analyzed data from several countries, including the USA, UK, Italy, Japan, South Korea and China, and found that women were 24% more likely to suffer permanent job loss, and should expect a 50% greater reduction in labor income than men.

Further evidence from Bennett *et al*. (2021) based on Norwegian data revealed that following a positive long-term economic shock, such as the discovery of oil and gas in 1969, male workers saw their income increase by 7%, while their female counterparts suffered a decline of up to 14%.

The COVID-19 pandemic exacerbated these inequalities, as shown by Kikuchi and al. (2021), who observed that the Japanese labor market was disproportionately affected, with a greater negative impact on women. In addition, women-owned businesses, particularly in developing economies, suffered unfair consequences during the COVID-19 crisis (Liu *et al*., 2021; Nieves *et al*., 2021).

When we examine the influence of sector and company size, absolute gender disparities tend to decrease (Chaudhuri *et al*., 2020), probably because female entrepreneurs often operate in sectors with lower profit margins and smaller workforces than their male counterparts (Mroczek-Dąbrowska, 2020).

Notably, cross-national studies have demonstrated that businesses led by women tend to achieve greater success and scale in sectors predominantly dominated by men (Campos *et*

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al., 2019). Nevertheless, it is imperative to acknowledge that company characteristics alone do not fully account for disparities in productivity, sales, and profits. Even after accounting for a variety of factors, incorporating an extensive set of controls, Islam *et al.* (2020) discovered that the gender-based gap in labor productivity persisted without significant change.

Moreover, a focused investigation into the garment industry in Ghana conducted by Hardy and Kagy (2018, 2020) uncovered that male-owned microenterprises achieve notably higher profits than female-owned microenterprises, even after accounting for diverse firm, firm owner, and product characteristics.

Women are often confronted with societal expectations that place primary responsibility for care on them. In the aftermath of the pandemic, many countries implemented containment measures and imposed closures on schools and small businesses. These restrictions and closures could potentially exacerbate gender inequalities, given that women generally take on a greater share of household tasks (Power, 2020).

Existing research indicates that the COVID-19 pandemic has had different effects on men and women in the workforce. For example, women's productivity has fallen more than men's, and they are more likely to reduce their working hours (Collins *et al.*, 2020; Cui *et al.*, 2022; Alon *et al.*, 2022).

Considering the literature prior to the COVID-19 pandemic, it is pertinent to emphasize gender differences as a significant factor in business performance. Typically, companies owned or managed by females demonstrate lower levels of labor productivity and total factor productivity compared to those owned or managed by males (Alibhai *et al*., 2018; Munyegera and Precious, 2018; Islam *et al*., 2020). Furthermore, recent research indicates that the COVID-19 crisis has had an unequal impact on female entrepreneurs (Chawla *et al*., 2020; Jaim, 2021).

Regarding the COVID-19 pandemic and its relevance to our research, there is a substantial body of recent studies and reports in mainstream media indicating that the impact of the crisis has been disproportionately felt by female entrepreneurs. This phenomenon has been well-documented through cross-country data sets by reputable organizations like ANDE (2020a), Facebook, OECD, and World Bank (2020). Furthermore, country-level investigations conducted in Bangladesh (Jaim, 2021), India (ANDE 2020b; Chawla *et al.*, 2020), the United Kingdom (Reuschke *et al*., 2021), the United States (Fairlie, 2020; Manolova *et al*., 2020; Bloom *et al*., 2021), and other regions have provided additional supporting evidence for this claim. It is essential to acknowledge that some of these studies, particularly those centered on developing countries, rely on relatively small sample sizes, typically encompassing only a few hundred firms or even fewer. Additionally, certain studies utilize sampling methods that may not be well-suited for drawing accurate inferences about a target population (Schneider, 2020).

Given these realities concerning gender inequalities and the predominance of the informal sector in many contexts, it is essential to look at the complex interactions between these two aspects. Indeed, understanding the dynamics of the informal sector can shed crucial light on persistent gender disparities.

On the one hand, progress in reducing gender gaps in various areas cannot be considered sufficient, as substantial inequalities persist in key sectors such as education, health, employment, and others (Klasen, 2020; Islam and Amin, 2023). To promote women's empowerment and effectiveness, it is therefore crucial to recognize the prevalence and consequences of these inequalities (Wodon and de la Brière, 2018).

On the other hand, a relevant approach to understanding these gender gaps lies in analyzing the informal or unregistered sector. Due to its significant scale in developing economies, where it accounts for around a third of GDP and employs nearly 70% of the workforce (Ohnsorge and Yu, 2021), the informal sector plays a decisive role in the economic lives of many women.

In addition, women are more frequently found in the informal sector than in the formal sector, accounting for a significant share of self-employed workers in low- and lower-middle-income countries (Hyland and Islam, 2021). While this may sometimes be a choice motivated by the search for flexibility between caring responsibilities and

economic activities (Elgin *et al*., 2021), other factors, such as limited opportunities in the formal sector or constraints imposed by social norms and discriminatory laws, may also influence this concentration (Hyland and Islam, 2021).

Hence, analyzing gender gaps within the informal sector is crucial for gaining a comprehensive understanding of the overall gender inequality landscape and identifying the factors that contribute to women's economic participation and empowerment.

Using a database established by the Laboratory of Development Policy Analysis of the Faculty of Economics and Management of the Cheikh Anta Diop University of Dakar, we analyze a representative sample of 923 informal enterprises operating in various sectors in Dakar. The aim of this research is to investigate potential disparities in the impact of women-led versus male-led enterprises in Dakar. To do so, we seek to answer two main questions:

First, what are the determinants of business closure in dakar? Using the Marginal Effects of Probit models, we identified several factors with a significant influence on the probability of temporary business closure since the start of the pandemic. Among these factors, we observed that the gender of the company's manager plays an important role, as do declining sales, bankruptcy, and the company's sector of activity. These results highlight the importance of taking factors such as the gender of the manager into account when analyzing the impact of the pandemic on companies.

Secondly, we investigate the likelihood of business closure during the pandemic in relation to the gender of the business owners. Our findings indicate that businesses led by women exhibit a higher probability of closure compared to those led by men. To be precise, the propensity score matching results reveal that female-led firms face a disadvantage with a 16% increased likelihood of closure compared to male-led firms.

COVID-19 in Senegal

The World Health Organization (WHO) declared in March 2020 the COVID-19 outbreak as an official global pandemic. As of the end of September 2021, the virus had impacted nearly 30 million individuals worldwide, leading to almost one million fatalities.

In addition to the direct effects on health and well-being, the pandemic has amplified pre-existing situations of vulnerability and discrimination affecting various people, including women and children. This is seen through repercussions on their economic activities, as well as restricted access to essential social services such as health, reproductive health, nutrition, education, protection, and other aspects linked to gender dynamics and intra-family or community relations.

Senegal is a Sahelian country in West Africa, with an estimated population of 16,705,608 in 2020, according to demographic projections by the National Institute of Statistics and Demography. Among these inhabitants, there are 8,391,358 women (50.2%) and 8,314,250 men (49.8%). Most of the population concentrates in the Dakar region, which accounts for around 30% of the total, as well as in the outlying regions of Dakar, namely Thiès and Diourbel, which account for 62% of the population according to 2020 estimates. The population is expanding rapidly, with an annual growth rate of 3.8%. In less than 7 years, it has gone from 12 million to 16 million inhabitants. Over 55% of the population is under 20, and the average age is 19. The average fertility rate is 5 children per woman. Most Senegal's inhabitants, over half (53.3%), live in rural areas, while 46.7% live in urban areas.

Like many other countries around the world, Senegal has been facing a sustained spread of the coronavirus epidemic since March 2020. Since the first case was detected on March 2, 2020, the country has recently surpassed 10,000 positive cases and ranks among the countries most affected by the pandemic in Africa. As of September 24, 2020, Senegal has recorded 14,816 confirmed cases of COVID-19, with 11,818 people cured and 304 deaths. All 14 regions of the country are affected, but higher cases are observed in highly urbanized areas such as Dakar (10,165 cases) and Thiès (1,696 cases). Men are more affected than women,

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with a ratio of 1.39 (i.e., 139 men for every 100 women, or 14 men for every 10 women)[1].

Senegal learned from its experience during the Ebola epidemic in 2013 and 2014 and quickly took stringent measures to try and limit the spread of the disease. For example, in addition to introducing a curfew, schools and universities were closed, prayers in places of worship were banned, travel between regions was restricted and strict hygiene rules were imposed. Although these measures helped to contain the epidemic, they also led to a deterioration in living conditions for households, which in many cases were deprived of resources. Some 85% of households reported a drop in income[2].

To limit the economic impact of this health crisis, the government has created a response and solidarity fund called Force-COVID-19, with a budget of 1,000 billion FCFA (around 164 million US dollars). An amount of 50 billion FCFA (around 82 million US dollars) has been specifically allocated to the purchase of foodstuffs for emergency food aid.

In Senegal, informal employment is the main source of employment, accounting for 95.4% of total non-agricultural employment, and the vast majority (97%) of the country's economic units are informal businesses (ANSD, 2019). Following the outbreak of the first case of Covid-19 on March 2, 2020, the government implemented several measures from March 15, 2020, such as a ban on gatherings, the temporary suspension of cruise ship hospitality and the closure of schools and universities (MEPC, 2020).

The most restrictive measures were taken on March 23, 2020 with the introduction of a state of emergency and curfew, resulting in the regulation and prohibition of travel between Senegal's cities and regions. From May 29, 2020, the prefecture of Dakar, as part of the state of emergency, took measures to set the days and hours when markets would be open and prohibit sales in public spaces (MEPC, 2020).

These decisions have consequences for the activities of informal sector workers, particularly those in the food industry in the Dakar region. This region, densely populated with nearly four million inhabitants, is home to around a quarter of Senegal's population in an area covering less than 3% of the national territory (ANSD, 2016). It concentrates most of the country's economic activity, particularly informal trade, processing, food transport and catering, which are likely to be hard hit by the restrictive measures imposed by the Senegalese government.

The main aim of this article is to present evidence concerning the effects of the crisis on the population, with a particular focus on women, especially female managers of informal enterprises in the Dakar region.

Description of the sample

The data used came from the survey conducted in 2022 on the impact of the Covid-19 pandemic on informal businesses in Dakar. The aim of this survey is to provide an in-depth understanding of the conditions and challenges faced by informal and formal businesses in Dakar as a result of the pandemic. The survey was carried out by the Laboratory of Political Advances and Development of the Faculty of Economics and Management of the University Cheikh Anta Diop of Dakar on a sample of 923 informal businesses in different sectors of activity in the city of Dakar.

Data were collected using a structured survey with questions on company characteristics, economic activity, size, access to finance and resources, the effects of the pandemic on their business and future prospects.

Table 1 provides an overview of the variables used in this study, together with descriptive statistics for each. Variables include the gender of the company director, the company's sector of activity, company size, sales decline since the start of the pandemic, company bankruptcy, temporary closure of the company since the start of the pandemic, and permanent closure of the company since the start of the pandemic.

1 Response to the epidemic of the new coronavirus COVID-19, Senegal. Situation report no. 58 of September 24, 2020, Ministry of Health.

2 Bulletin 1 ANSD, World Bank, DGPPE, household welfare impact monitoring; September 2020.

Table 1
Presentation and statistical description of the variables

Variables	Modality	Mean	Standard deviation
Gender of the business leader.	**1:** Woman **0:** Man	0,627907	0,4836591
Marital status of business leader.	**1:** Married **2:** Divorced **3:** Single **4:** Widowed	1,531212	1,03579
Education level of business leader.	**1:** Superior **2:** Secondary **3:** Primary **4:** No education	3,228886	0,8315164
Loss of customers since the beginning of the pandemic.	**1:** Yes **0:** No	0,6156671	0,4867351
Government support in response to the COVID-19 pandemic.	**1:** Yes **0:** No	0,0636475	0,2442735
Temporary closure of the business since the start of the pandemic.	**1:** Yes **0:** No	0,4320685	0,4956673
Sales down since the start of the pandemic.	Proportional drop in sales since the beginning of the pandemic.	53,14311	22,50299
Sector of activity	**1:** Commerce **2:** Service **3:** Industry	2,887393	1,296507

Note: Authors based on data from the survey on the impact of the covid 19 pandemic on informal businesses in Dakar (2022).

Figure 1 shows a graphical representation of the proportion of businesses headed by women and men. This visualization enables us to better understand the distribution of management positions between the two sexes, and to measure the representativeness of women and men in these roles. By examining the respective proportions, we can observe whether women are under- or over-represented in management positions compared to men.

The data presented in Figure 1 shows the proportion of businesses run by women, with the data indicating that 63% of businesses are run by women, while 37% are run by men. This information highlights the significant presence of women in business leadership positions, although the proportion of male-led businesses also remains significant.

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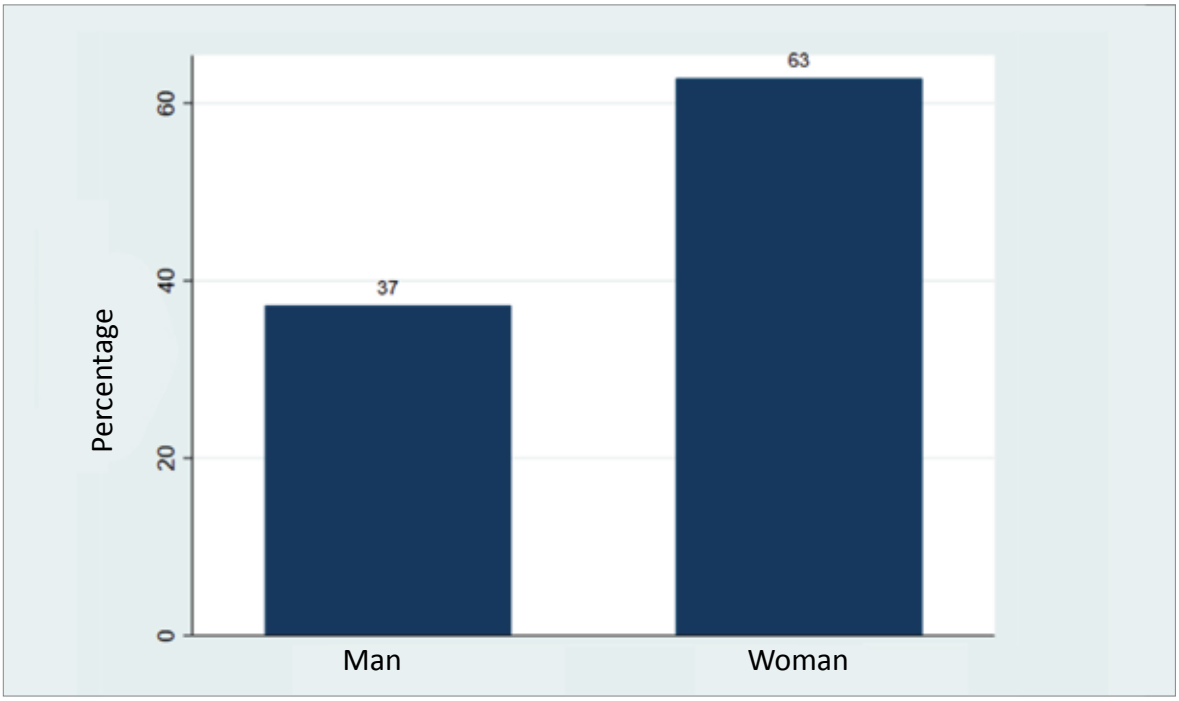
Figure 1
Proportion of business led by a woman or a man



Note: Authors based on data from the survey on the impact of the covid 19 pandemic on informal businesses in Dakar (2022).

Figure 2 illustrates the proportion of temporary closure of female/male-run businesses due to the COVID-19 pandemic. The results show that during the pandemic, 30% of female-led businesses closed temporarily, while 13% of male-led businesses experienced a temporary closure. In contrast, 32% of female-led businesses and 24% of male-led businesses did not experience a temporary closure during the pandemic.

This difference in the proportions of temporary closures may be due to several factors, such as the business sector, company size, financial capacity and management skills. Businesses run by women may have been more affected because they operate in sectors more affected by the pandemic, are smaller in size and may have fewer financial resources to cope with the crisis.

Figure 3 shows that only 3% of businesses received government support, either at national or local level, in response to the COVID-19 pandemic. This means that most businesses, 97%, did not receive government support during this difficult period.

Figure 2
Proportion of temporary closure of businesses run by women/men due to the pandemic

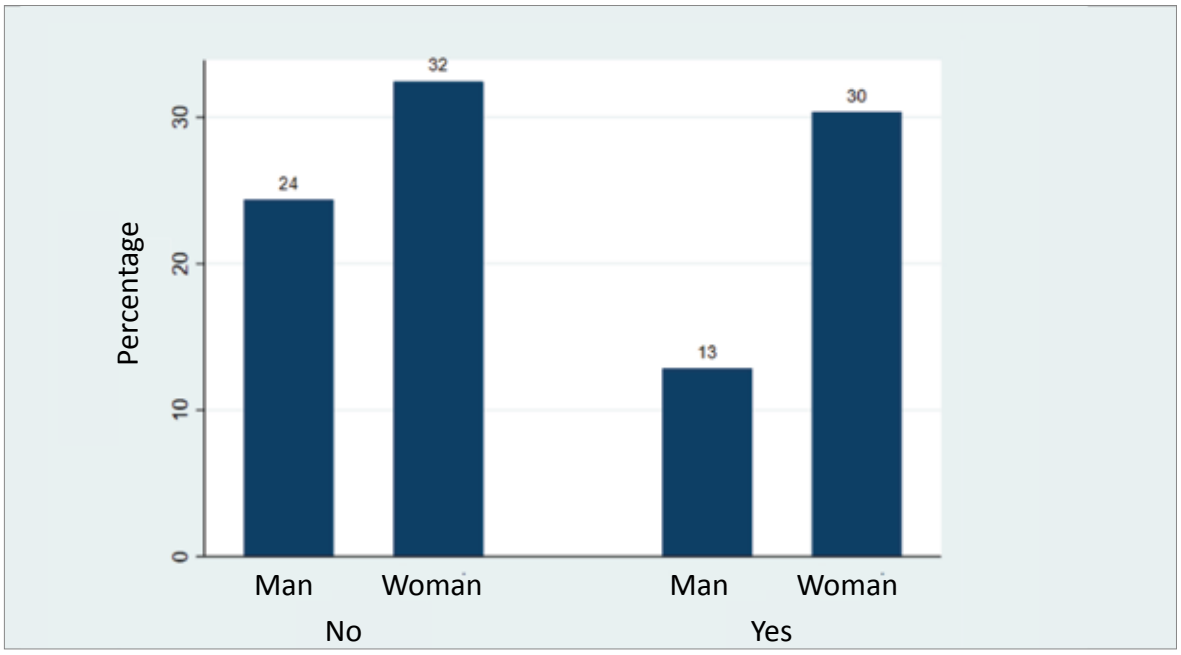
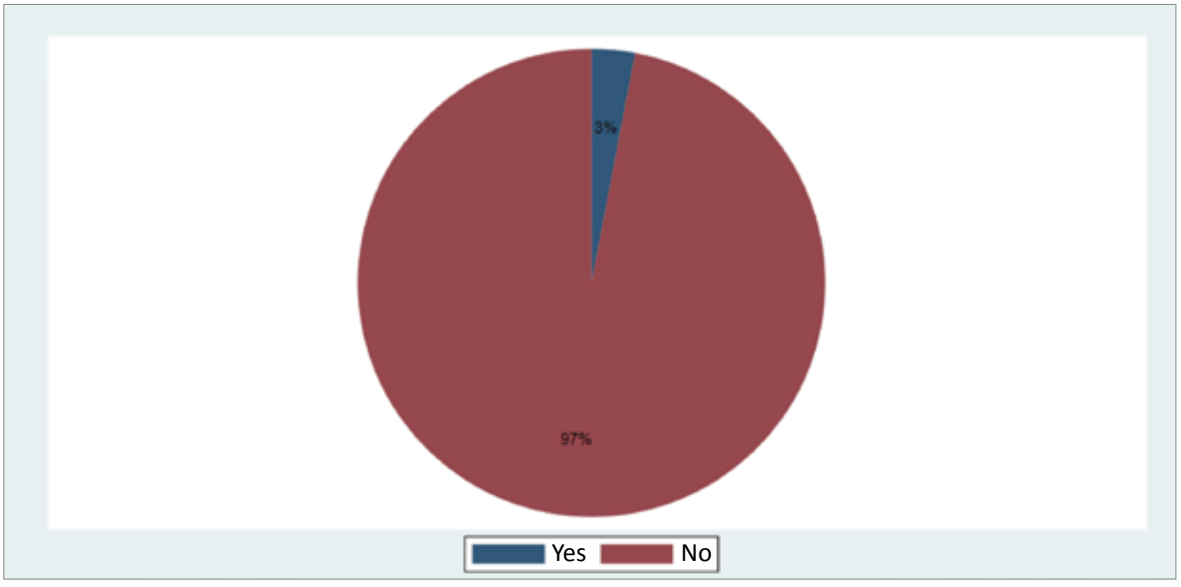


Figure 3
Proportion of businesses that received government support, whether national or local, in response to the COVID-19 pandemic



Note: Authors based on data from the survey on the impact of the covid 19 pandemic on informal businesses in Dakar (2022).

This underlines the importance of putting in place effective support measures to help businesses through crisis situations such as this to preserve jobs and the economy in general. It is

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essential that governments take steps to help businesses in need, in order to reduce the economic impact of the COVID-19 pandemic.

Empirical methodology

This section presents the empirical methodology selected to address the problem. Indeed, the literature proposes numerous econometric techniques for identifying the causal relationship of a program. In our case, we opted for a propensity score matching procedure. This method was chosen for the following reasons: ideally, to identify the effects of business closures during the COVID-19 period, it would be necessary to be able to compare the closure of a business run by a woman with that of the same business run by a man. However, this comparison is not always possible in practice. Using the propensity score matching procedure, we can construct a control group made up of businesses similar to those run by women, but run by men, enabling us to measure the impact of business closures by gender.

As stated by Rosenbaum and Rubin (1983), matching is a non-experimental approach utilized to estimate the impact of a program or intervention when random assignment is not feasible. This method offers the advantage of mitigating potential sources of bias by endeavoring to create treated and untreated groups that share similar characteristics.

Formally, we can express the treatment effect Δ_{it} on a business *i* at time *t* as the difference between the potential outcome Y_{it}^{T} for a female-led business and the potential outcome Y_{it}^{C} for a male-led business. In other words, *T* refers to the treatment group, while *C* refers to the treatment group, while

$$\Delta_{it} = Y_{it}^{T} - Y_{it}^{C}$$

However, a direct comparison of potential results could introduce a bias into our analysis. To avoid this, it is preferable to compare the average effects that the gender of the manager would have on a randomly selected business in the population. This measure is known as the Average Treatment Effect on the whole population (ATE) and can be expressed using the mathematical expectation operator E(.) :

$$ATE = \mathrm{E}(Y_i^T) - E(Y_i^C) = E(Y_{i1} \mid T_i = 1) - E(Y_{i0} \mid T_i = 0)$$

The ATE estimator, also known as the naive estimator, assumes that the simple difference in mean results between the treatment and control groups. However, this does not necessarily correspond to what we are seeking to measure, which is the difference in average outcomes between businesses run by women (treatment businesses) and those run by men (control businesses). Therefore, to obtain an appropriate estimate, we need to use the ATT, i.e., the average effect of the treatment on treated businesses, which is calculated using the following formula:

$$ATT = E(Y_i^T - Y_i^C \mid T_i = 1) = E(Y_{i1} \mid T_i = 1) - E(Y_{i0} \mid T_i = 1)$$

The PSM method involves creating a statistical comparison group (also known as a counterfactual group) based on the conditional probability of participating in treatment T, as a function of observed characteristics X. This probability is represented by the propensity score, denoted $P(X)$=Pr (T=1 | X). This matching is based on two main assumptions: the conditional independence assumption (CIA) and the common support assumption.

The first hypothesis posits that all variables responsible for selection bias are observable. This implies that the average causal effect of treatment can be determined solely by considering observable variables, denoted as X, which may include factors like gender, age, educational background, parental socio-economic status, and other relevant characteristics. These observable variables contain all the necessary information to characterize the potential outcomes of individuals. Stated differently, the assumption of selection based on observables means that the unobserved outcome variables (Y_i^T, Y_i^C) are independent of treatment assignment (T) given the observable variables (X), i.e., X, i.e. $(Y_i^T, Y_i^C) \perp \mathrm{T} \mid \mathrm{X}$.

Matching treated and control individuals becomes challenging when attempting to match based on observable data that involves a large number of variables. This difficulty arises from

the struggle to find two comparable individuals in two different groups.

To address this constraint, Rosenbaum and Rubin (1983) introduced a conditional independence hypothesis (CIA) that relies on propensity scores[3]

$$PS = P(X) = P(T = 1|X)$$

The second hypothesis (the common support hypothesis), introduced by Rosenbaum and Rubin (1983), asserts that there is at least one individual, if not several, in the comparison group with the same observable characteristics or the same probabilities of accessing treatment as each participant. This hypothesis can be expressed by the following equation:

$$0 < \Pr(T=1 \mid X=x) < 1 \text{ for all } x$$

Results and discussion

Before examining the effect of female leadership on businesses with the propensity score matching method, it is planned to conduct a logistic regression analysis to understand the factors that influence business closure. This will enable us to identify the variables that have the greatest impact on business survival and control for them when assessing the effect of female leadership. Once controlled these variables, we will be able to examine more precisely the effect of female leadership on business performance. Logistic regression is a statistical method used to model the probability of a business closing as a function of various explanatory variables. Using this method, we can identify the factors that have the greatest impact on business survival.

The Probit model is used to study the determinants of business closure, given that the variable to be explained is a binary dummy variable. Consequently, the probit model is defined as follows:

$$Prob(close)=\beta_0+\beta_1 gender_i+ \beta_2\ reduc\_sales_i+\beta_3\ mar\_status_i+\beta_4\ educ\_level_i+\beta_5\ client\_loss_i+\beta_6\ bankruptcy_i+ \beta_7\ gov\_sup_i+ \beta_8 sector_{i+\varepsilon\_i}$$

The dependent variable indicates whether a business has temporarily closed since the start of the pandemic (suspension of services or production) by taking the value 1, and 0 otherwise. The gender variable is a dichotomous variable that takes the value 1 if the business is run by a woman, and 0 if it is run by a man. The reduc_sales variable represents the proportion of sales decline. The variables mar_status and educ_level indicate the marital status and level of education of the business leader, respectively. The variable client_loss is binary and takes the value 1 if the business has lost customers since the beginning of the pandemic, and 0 otherwise. The bankruptcy variable is also binary, taking the value 1 if the business has declared bankruptcy or insolvency. Finally, the variable gov_sup takes the value 1 if the business has received any support from the national or local government, and 0 otherwise.

Table 2 shows the estimated marginal effects of probit models on the determinants of business closure in Dakar. The results of the analysis show that certain factors have a significant influence on the probability of temporary business closure since the start of the pandemic. These factors include the gender of the business leader, sales decline, bankruptcy and business sector.

The results of the analysis indicate that several factors are associated with the probability of temporary closure of businesses in Dakar since the start of the pandemic. Specifically, businesses run by women have a 21% higher probability of temporary closure than those run by men. This difference could be explained by gender differences in management and decision-making.

On the other hand, reduced sales are an important factor in increasing the likelihood of temporary closure, which is not surprising given the economic impact of the pandemic on business activities. In addition, businesses that have already experienced financial difficulties, such

3 Rosenbaum and Rubin (1983) introduce the concept of "propensity score" (PS), which represents the probability of an individual with specific characteristics receiving a particular treatment. In other words, the PS denotes the conditional probability of an individual benefiting from a treatment, given the observed covariates.

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as bankruptcy, also have a higher probability of temporary closure.

Finally, the business sector is another important factor, with some industries more affected than others by the health crisis. For example, the retail and construction sectors are particularly vulnerable, which may explain their higher probability of temporary closure.

Table 2
Marginal effects of Probit models on closure determinants

Closure	dy/dx	Std. Err	z	P>|z|	[95% Conf. Interval]	
Gender	0,2133393	0,0386664	5,52	0,000***	0,1375545	0,2891241
Reduc_sales	0,0054907	0,0008224	6,68	0,000***	0,0038788	0,007026
mar_status	-0,0104316	0,0185012	-0,56	0,573	-0,0466933	0,0258301
educ_level	-0,0237368	0,023567	-1,01	0,314	-0,0699273	0,0224536
client_loss	0,0228739	0,0409622	0,56	0,577	-0,0574106	0,1031583
bankruptcy	0,2402105	0,0527635	4,55	0,000***	0,136796	0,343625
gov_sup	0,0917198	0,0799703	1,15	0,251	-0,0650191	.2484588
Sector	0,0317902	0,014484	2,19	0,028**	0,0034021	0,0601783

Note: Authors' calculations, STATA software. Note :*: p<0.1; **: p<0.05; ***: p<0.01.

Having investigated the marginal effects of Probit models on the determinants of business closure, we now turn to the impact of gender on this phenomenon during the COVID-19 pandemic. To do this, we will use the propensity score matching method.

More specifically, we will seek to understand whether gender plays a role in the probability of business closure during the health crisis. To do this, we'll use the propensity score matching method, which creates comparable groups of female and male entrepreneurs with similar characteristics in terms of business size, sector of activity, level of qualification, etc.

Table 3 displays the disparities in means and standard deviations of the variables employed in our analysis. These variables were utilized in the estimation process to enhance the comparability between the two groups. Specifically, the outcomes of the Student t-test reveal that, on average, the two groups exhibit similarities across all variables, except for marital status, level of education of the business owner, and sector.

Table 3
Difference in variable means

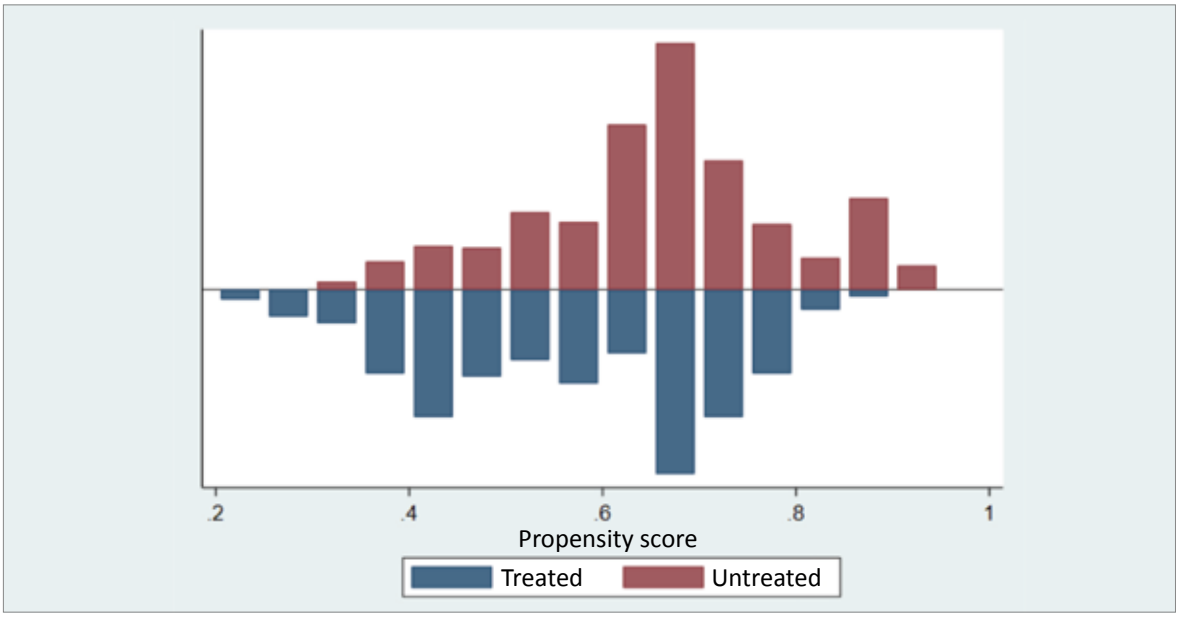
Variable	Treated			Control			Statistic T
	N. Treated	Mean	Std. Err	N. Control	Mean	Std. Err	
Reduc_sales	335	53,81493	1,174545	224	52,13839	1,599685	-0,8630
mar_status	513	1,664717	0,0516367	304	1,305921	0,0404279	-4,8515
educ_level	513	3,274854	0,0350268	304	3,151316	0,0509421	-2,0567
client_loss	513	.5945419	0,0216985	304	0,6513158	0,0273773	1,6131
bankruptcy	513	.1559454	0,0160338	304	.1282895	0,0192115	-1,0826
gov_sup	513	0,0584795	0,0103701	304	0,0723684	0,0148847	0,7854
Sector	513	2,65692	0,0459933	304	3,276316	0,0897997	6,7799

Note: Authors' calculations, STATA software.

Once the Student's t test has been carried out, we will proceed to test the common support hypothesis. This step enables us to ensure that individuals have similar observable characteristics, unaffected by the treatment variable. Common support thus enables us to identify businesses run by men and those run by women, which have virtually identical propensity scores.

In other words, the common support represents the area where the propensity score curves of the two groups overlap perfectly. In our case, the common support obtained lies between 0.3251008 and 0.9078215, as shown in Figure 4.

Figure 4
Distribution of propensity scores in the common medium



Note: Authors' calculations, STATA software.

Once the propensity score and the common support region have been identified, the units in the treatment group can be matched with those in the comparison group with the most similar score. This can be done using a variety of methods, including the four-propensity-score-based matching methods: Kernel[4], Nearest neighbor[5], Stratification[6] and Radius[7].

The matching results for the whole sample show a statistically significant difference in outcome variables between businesses run by women (treatment group) and those run by men (control group) with similar observable characteristics (table 4).

4 In the matching process, multiple individuals from the control group are paired with each treated individual, with the assignment of weights inversely proportional to the distance between the treated and untreated individuals.

5 An individual who has received treatment is paired with an untreated individual based on their closest propensity score.

6 Propensity score stratification involves estimating the effect of treatment within strata defined most often by propensity score quintiles or deciles.

7 An individual from the untreated group is paired with an individual from the treated group based on their closest propensity score, ensuring that the maximum distance between them is not exceeded.

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Table 4
Average effect of treatment on outcome variables

Method	n. treated	n. control	ATT	Std. Err	t
Closure of business					
Nearest neighbor	513	256	**0,167**	0,063	**2,656**
Kernel	513	291	**0,163**	0,035	**4,716**
Radius	387	250	**0,225**	0,053	**4,240**
Stratification	513	291	**0,145**	0,045	**3,234**
Bankruptcy					
Nearest neighbor	513	256	0,058	0,045	1,291
Kernel	513	291	**0,068**	0,023	**2,895**

Note: Authors' calculations, STATA software.

The results of the four analysis methods (Kernel, Nearest neighbor, stratification and radius) confirm that the gender of the manager has a significant causal effect on the variable of business closure during the Covid-19 pandemic. Businesses run by women have a 14% higher probability of closure using the stratification method, a 16% higher probability using the nearest neighbor and kernel methods, and a 22% higher probability using the radius method, compared with those run by men. These results are all statistically significant at the 1% level.

These findings reinforce the idea that the gender of the manager may have an impact on the resilience of the business to the economic difficulties generated by the pandemic. Indeed, this is confirmed by the marginal effects of the Probit models on the determinants of closure, presented in Table 2. These results show that the gender of the manager is a significant variable in the probability of business closure.

These results from are in line with those obtained by Liu *et al.* (2021), who also showed that businesses run by women tend to close more often during the Covid-19 pandemic.

For the bankruptcy outcome variable from the estimates, female-led businesses have a higher probability of bankruptcy during the COVID-19 crisis, with a difference of 7% compared to male-led businesses. This may be a cause for concern for women's businesses, which may be more vulnerable to the negative economic effects of the pandemic.

Having calculated the average treatment effect on the outcome variables, which include business closure and bankruptcy, we will now proceed to calculate the treatment effect on the closure of businesses that received financial support from the national or local government. This step is particularly important, as it enables us to understand the real impact of financial support programs on business survival.

Table 5
The average effect of gender on the closure of businesses with or without financial support from national or local government

	Coef.	Std. Err	z	P>|z|	[Conf. Interval 95%]	
gov_sup=0	0,1705906	0,0503605	3,39	**0,001*****	0,0718859	0,2692954
gov_sup=1	0,0944444	0,2390417	0,40	0,693	-0,3740687	0,5629576

Source: Authors' calculations, STATA software.

Businesses run by women and receiving no financial support from national or local government are around 17% more likely to close than those run by men and receiving no similar su-

pport. This disparity can be attributed to various factors such as gender discrimination, gender stereotypes, differences in access to financing and to the market. On the other hand, the impact of gender on the closure of businesses benefiting from such support is not significant.

The COVID-19 pandemic has had a significant impact on women-led businesses, as our study shows. The results show that these businesses were harder hit than those run by men. One notable consequence is that women-led businesses were more likely to temporarily close their operations during the pandemic (Islam *et al*., 2019).

This disparity in the impact of the pandemic on women-led businesses can be attributed to several factors. Firstly, the economic sectors most affected by containment measures, such as personal services and creative industries, are often dominated by female entrepreneurs (Amin and Islam 2014). As a result, these sectors have been particularly vulnerable to the economic disruption caused by the pandemic.

In addition, women entrepreneurs often face pre-existing structural barriers and inequalities, such as limited access to finance and professional networks (Ahmed *et al*., 2020). The health crisis has exacerbated these disparities, making it more difficult for women to maintain their businesses and cope with the economic challenges caused by the pandemic.

Conclusions

The COVID-19 pandemic, like other crises, exhibits a gender-disparate impact, as crises are inherently non-gender-neutral. The pandemic has significantly affected businesses and work environments, with small and informal enterprises being particularly affected. Women-led businesses, in comparison to those led by men, are more likely to experience longer and more frequent temporary closures during the COVID-19 pandemic.

In developing economies, women often face societal norms that assign them caregiving responsibilities, placing additional strain on female business owners during the pandemic. When formulating policies to support vulnerable businesses, it becomes crucial to comprehensively understand the specific impact of the crisis on women-led businesses and endeavor to mitigate unconditional gender disparities in productivity, revenues, and profits.

This article investigated the impact of the COVID-19 pandemic on businesses led by women and men. The research findings revealed that female-led businesses experienced a more significant adverse effect from the pandemic compared to those led by men. Specifically, these businesses were more prone to temporary closures than their male-led counterparts.

These outcomes raise concerns, considering that women-run businesses generally tend to be smaller and less productive than businesses run by men. Moreover, women entrepreneurs encounter additional hurdles, including gender discrimination, limited access to financial resources, and a lack of professional networks and support. The COVID-19 pandemic has exacerbated these pre-existing challenges, underscoring the urgent need for proactive measures to support women-led businesses.

This article emphasizes the considerable impact of the pandemic on informal businesses led by women. It underscores the necessity for targeted measures to provide support and enhance the long-term resilience of these enterprises. Policymakers and development stakeholders should consider these findings when formulating policies and programs that specifically address the challenges faced by women entrepreneurs in the informal sector.

Despite its valuable insights into the impact of the COVID-19 pandemic on women-led informal businesses, this article acknowledges certain limitations that warrant consideration. Primarily, the study's focus solely on the city of Dakar restricts its generalizability to other geographical and cultural contexts. Replicating this research in different regions would be valuable to gain a deeper understanding of potential variations in the pandemic's effects on women-led informal businesses.

In terms of future research, it would be interesting to dig deeper into the analysis of factors that have contributed to the pandemic's disproportionate impact on women-led informal businesses.

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For example, it would be useful to examine in detail the specific obstacles they face in terms of access to finance, resources and markets. An in-depth study of the coping and resilience strategies implemented by these women entrepreneurs could also provide valuable information to inform policies and support programs.

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Availability of data and materials

The authors are willing to provide the data upon a reasonable request and with the authorization of the Development Policy Analysis Laboratory at Cheikh Anta Diop University of Dakar (UCAD).

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Trade and inclusive economic growth: China and Latin America (2004-2021)

Comercio y crecimiento económico inclusivo: China y América Latina (2004-2021)

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Abstract: China has consolidated itself as a global economic power, and its growth has been remarkable. China's economic influence in Latin America has significantly increased, and the country has become one of the region's most important and relevant trade partners. Therefore, the trade relations between Latin America and China are considered "strategic." In this context, the purpose of this study is to analyze the relationship between international trade with China and inclusive economic growth in Latin America from 2004 to 2021, using data from 13 countries in the region (Uruguay, Peru, Paraguay, Panama, Mexico, El Salvador, Ecuador, Costa Rica, Colombia, Chile, Brazil, Bolivia, and Argentina). Our research is quantitative in nature, with a non-experimental design and a correlational scope. The econometric model used panel data and the Newey-West estimator to account for first-order autocorrelation in the error. The results indicate a statistically significant and negative relationship between Latin American exports to China, which has a 10% impact on inclusive economic growth. Similarly, imports from China to Latin America show a statistically significant and negative relationship of 5% with inclusive economic growth. However, no discernible evidence was found to support a relationship between China's foreign direct investment (FDI) in Latin American countries and inclusive economic growth.

Keywords: international trade, foreign direct investment, panel data, inclusive economic growth, Newey-West estimator, Latin America, China, Newey-West estimator.

Resumen: China se ha consolidado como una potencia global y su crecimiento ha sido notable. La influencia económica china en América Latina ha aumentado significativamente y el país es uno de los aliados comerciales más relevantes de la región. Por lo tanto, la relación comercial entre América Latina y China es estratégico. En este contexto, el estudio tiene como propósito analizar la relación entre el comercio internacional con China y el crecimiento económico inclusivo en América Latina entre 2004 y 2021, utilizando datos de 13 países de la región (Uruguay, Perú, Paraguay, Panamá, México, El Salvador, Ecuador, Costa Rica, Colombia, Chile, Brasil, Bolivia y Argentina). Nuestra investigación es de naturaleza cuantitativa, su diseño es no experimental y su alcance es correlacional. El modelo econométrico utilizado empleó datos de panel y el estimador Newey-West para tener en cuenta la autocorrelación de primer orden en el error. Los resultados indican una relación estadísticamente significativa y negativa entre las exportaciones latinoamericanas hacia China, lo cual tiene un impacto del 10 % en el crecimiento económico inclusivo. De manera similar, las importaciones desde China hacia América Latina muestran una relación estadísticamente significativa y negativa del 5 % con el crecimiento económico inclusivo. No se identificó evidencia que respalde una relación entre la inversión extranjera directa (IED) china en los países latinoamericanos y el crecimiento económico inclusivo.

Palabras clave: comercio internacional, inversión extranjera directa, datos de panel, crecimiento económico inclusivo, estimador Newey-West, América Latina, China, estimador Newey-West.

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Introduction

China's status as a global powerhouse and its remarkable growth have had significant attention. From 1990 to 2010, China achieved an average annual GDP growth rate of 10%, an impressive feat (World Bank, 2022). Currently, China proudly holds the position of the world's second-largest economy, trailing only behind the United States (International Monetary Fund, 2022). China's accession to the World Trade Organization (WTO) in 2001 marked a pivotal moment in global trade dynamics, profoundly shaping international commerce (InT). Since then, China has assumed a central role, leveraging its potential as a manufacturing hub within global value chains, leading to a substantial surge in its worldwide exports and establishing itself as a frontrunner since 2010 (Nicita and Razo, 2021).

According to the World Bank (2023a), China held the title of the world's largest exporter and second-largest importer until 2019. In 2021, China contributed to 15.07% of global exports, equivalent to an impressive US$3,363,835 million, and accounted for 11.90% of global imports, totaling US$2,688,634 million (WTO, 2022). In the realm of foreign direct investment (FDI), China stands as the world's second-largest recipient, attracting a sum of US$181,000 million in 2021, reflecting a notable 21% increase. Additionally, it ranks as the fourth-largest source of FDI overall, despite experiencing a 6% decline, with a contribution of US$145,000 million (UNCTAD, 2022). China's paramount economic and international cooperation strategy, the Belt and Road Initiative (BRI), was unveiled by Xi Jinping in October 2013. The BRI encompasses five primary objectives: political coordination, spatial connectivity, barrier-free trade, economic integration, and people-to-people bonds (The Green Finance and Development Center, 2023). As of March 2022, the BRI has garnered cooperation agreements with 32 organizations and 146 countries, and China's investments in BRI-affiliated nations from 2013 to 2021 have amassed to a staggering US$890,000 million.

The economic influence of China in Latin America has undergone a significant expansion (Feng and Zeng, 2021). Traditional partners of the region, such as the United States and Europe, now find themselves in competition with China for investments in this area (Zanabria, 2015; Lopes-Alfonso *et al*., 2021). The Ministry of Commerce of the People's Republic of China (2022a) reported a remarkable 41.1% increase in China-Latin America trade in 2021, amounting to US$451.590 million. Chinese exports surged by 52%, reaching US$229,010 million per year, while Chinese imports grew to US$222.580 million, signifying an annual increase of 31.4%. Brazil, Mexico, Chile, Peru, and Colombia stand as China's top five trading partners within the region (Ministry of Commerce of the People's Republic of China, 2022a).

The trade relationship between China and Latin America is strategically significant. China heavily relies on essential natural resources, such as soybeans, iron ore, and oil, abundant in Latin America. Moreover, Latin America serves as a significant consumer market for Chinese goods, particularly manufactured products (Lopes-Alfonso *et al*., 2021). In 2020, Latin America's primary exports to China included raw materials and minerals, with respective values of US$101,284,796 and US$46,836,546 (World Integrated Trade Solution, 2023). Notably, China's top imports from Latin America were capital assets and machinery, totaling US$97,112,863, and electrical equipment valued at US$90,063,973.

Kakwani and Pernia (2000) introduced the concept of inclusive economic growth (IEG), aiming to ensure that economic advancement benefits all members of society, particularly those who are less privileged. Wang *et al*. (2020) say that social exclusion occurs when individuals are unable to participate in specific activities, restricting their opportunities and depriving them of the skills needed for success. To mitigate social exclusion, inclusion strives to reduce disparities and eradicate poverty, fostering progress with equitable opportunities for all segments of society (Kuss *et al*., 2021; Saher *et al*., 2022).

Samuelson and Nordhaus (2009) contend that sustained economic growth is crucial for a nation's long-term success, whereas Stiglitz (2016) argues that excessive economic inequality can impede such growth. It is important to note that in low-income countries, both economic growth and equitable resource distribution are pivotal for

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lifting the incomes of the impoverished (UNDP, 2020). However, the benefits of economic advancement are not always evenly distributed, as evidenced in Latin America, where the continuous expansion between 1990 and 2000 failed to improve income inequality (Jalles and Mello, 2019).

Liu *et al*. (2022) and Topuz (2022) also shed light on the intricate connection between income disparity and economic growth. These authors emphasize that varying levels of wealth among different countries lead to diverse outcomes. In low-income nations, inequality has little effect on redistribution, while in developed nations, it contributes positively (Kraveishvili and Gogorishvili, 2022). Similarly, the impact of inequality on saving rates is less pronounced in low-income countries compared to high-income ones. Recent research delves into the role of entrepreneurial ecosystems in fostering environmentally and socially inclusive growth, as exemplified by Yoruk *et al.* (2022).

Stojkoski *et al.* (2023) have also incorporated trade data along with patent applications and research publications to formulate models that effectively and substantially augment the explanatory prowess of economic complexity measurements concerning global disparities in inclusive green growth. Their research underscores that complexity measurements grounded in patent and trade data are capable of prognosticating future economic development and wealth inequality. Nations that attain high scores across all three categories are predisposed to manifest lower emission intensities.

The research conducted by Ofori *et al*. (2023) is pertinent to foreign direct investment. This study addresses three key concerns related to inclusive green growth (IGG) in Sub-Saharan Africa (SSA). Firstly, it employs macro data to scrutinize the influence of FDI and economic freedom on IGG across 20 SSA nations. The findings indicate that, in isolation, FDI lacks statistically significant impact on promoting IGG. Secondly, the paper explores the interplay between economic freedom and FDI in fostering IGG. It unveils that SSA's "Moderately free" economic framework yields a negative impact of FDI on IGG. Lastly, the study identifies a critical threshold of 66.2% (Moderately free) economic freedom that is necessary for FDI to effectively encourage IGG. This report offers valuable insights for promoting inclusive green growth in the region by underlining the investments required to align SSA's economic structure with FDI.

Recent years have witnessed a surge in research on the interplay between InT and inclusive economic growth (IEG), as observed by Angulo-Bustinza *et al*. (2022) and Sadullaev (2023). However, a research gap still exists regarding how InT, particularly with China, can contribute to promoting IEG, especially within developing countries.

Moreover, the utilization of panel data to study inclusive economic growth is a recurring theme in recent works. Employing a quantitative, nonexperimental approach, Angulo-Bustinza *et al.* (2023) identify the determinants of inclusive economic growth in Latin America. A panel data model was employed to assess the impact of various variables on inclusive economic growth across 14 Latin American countries over a 25-year span (1995-2019). Results indicate that public expenditure and foreign trade have a positive influence on inclusive economic growth, whereas inflation, unemployment, and crises have negative effects. Meanwhile, Yang *et al.* (2023) employ diverse statistical methods, including "the linear dynamic panel GMM-IV estimator, panel corrected standard errors (PCSE) linear regression, and contemporaneous correlation estimator". Investigating the significance of inclusive growth and economic freedom in financial development, this study explores the connection between effective financial management and socioeconomic conditions conducive to technological innovation and long-term economic growth. The analysis spans from 2009 to 2017, encompassing 72 nations classified as less financially developed. The findings highlight how inclusive growth bolsters economic freedom, fostering overall financial development.

The aim of this paper is to explore the relationship between InT with China and IEG in Latin America from 2004 to 2021. IEG measurement relies on the proxy suggested by Anand *et al.* (2013) and Aoyagi and Ganelli (2015), and the panel data encompasses 13 Latin American countries (LAC). Estimates are computed using robust standard errors of Newey-West, considering the presence of first-order autocorrelation in the error term.

Methodology

Our research adopts a quantitative approach, employing a non-experimental longitudinal design and focusing on correlational analysis. To gather the requisite data, we drew upon sources such as COMTRADE (2023), the Ministry of Commerce of the People's Republic of China (2006, 2015, 2022b), and the World Bank (2022, 2023a, 2023b). All the information used in this study is publicly accessible. Table 1 presents the examined variables, encompassing: (i) Real per capita GDP growth - change in net inequality, (ii) China's investment in LAC, (iii) Exports from LAC to China, and (iv) Imports from China to LAC.

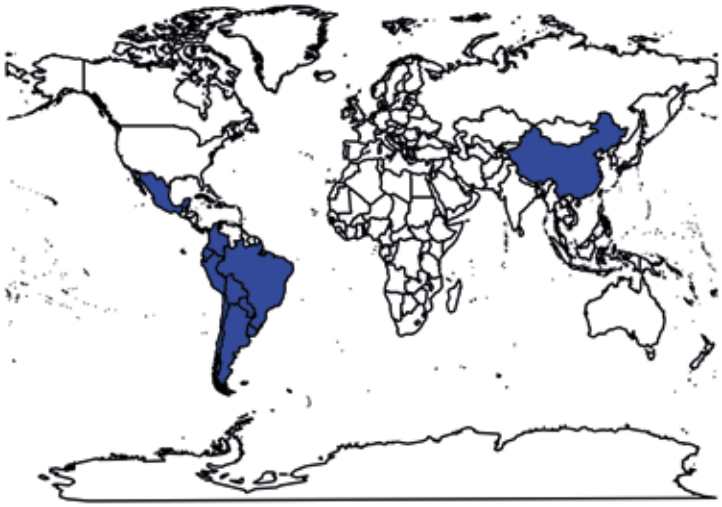
For the analysis, we compiled data spanning from 2004 to 2021, encompassing a total of 13 countries (Uruguay, Peru, Paraguay, Panama, Mexico, El Salvador, Ecuador, Costa Rica, Colombia, Chile, Brazil, Bolivia, and Argentina). This extensive dataset constitutes the foundation for conducting the panel data model, as elaborated in sections 2.1 and 2.2. Correlative and econometric analyses were conducted utilizing the Stata 14.0 trial version (StataCorp, 2015).

Table 1
Operacionalization of variables

Variable	Symbol	Indicador	Unidad de medida	Origen
IEG	CEI	Real per capita GDP growth - change in net inequality	Percentage	Own calculation from World Bank (2023b) and Solt (2020)
Foreign Direct Investment	FDI	China's investment in LAC	Millions of dollars	Ministry of Commerce of the People's Republic of China (2006, 2015, 2022b)
Export	EXP	Exports from LAC to China		COMTRADE (2023)
Import	IMP	Import from China to LAC		

Note: The sample includes 13 countries (see Figure 1): Uruguay, Peru, Paraguay, Panama, Mexico, El Salvador, Ecuador, Costa Rica, Colombia, Chile, Brazil, Bolivia and Argentina. The period is 2004-2021.

Figure 1
Countries included in the research



Note. Own elaboration using Philcarto (Waniez, 2023).

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Specification of the model

In empirical research, researchers benefit from utilizing panel data in several ways. Firstly, it fosters a deeper understanding of underlying dynamics by permitting the assessment of individual and time-specific impacts. The utilization of panel data also enhances statistical power by providing a larger sample size and mitigating the impact of omitted variable bias. Moreover, panel data facilitates the analysis of alterations across cross-sectional and time-series dimensions, thereby offering crucial new insights into the relationships under scrutiny. The Newey-West estimator employed in this study is especially advantageous due to its consideration of potential autocorrelation in the error term. This aspect ensures robust and precise parameter estimates. Consequently, this correction enhances the credibility and accuracy of statistical inferences derived from the data by addressing concerns related to serial correlation and producing accurate standard errors.

The research is based on the theoretical model:

$$CEI_i, t=F(FDI_{i,t,}\ EXP_{i,t},\ IMP_{i,t}) \quad (1)$$

F is a linear and static function, "i" represents the countries, and "t" the years of the horizon. The equation indicates that IEG (CIS) in Latin America is related to foreign direct investment (FDI, considered as the control variable), export to China (EXP), and import from that country (IMP) (Table 2). The following econometric model was used to test it:

$$CEI_{i,t}=\alpha+\beta_1 Log(FDI_{i,t})+\beta_2 Log(EXP_{i,t})+\beta_3 Log(IMP_{i,t})+e_{i,t} \quad (2)$$

$\beta_1>0,\ \beta_2>0,\ \beta_3>0$

"e" corresponds to the error; the introduction of the logarithm sought to reduce the range.

Panel data methodology

The characteristic of specification (2), a pooled model, is that it assumes the same intercept (α) for all countries, and its estimation by Ordinary Least Squares (MCO) is feasible. Furthermore, to capture the individual character of each country, a random effects model is specified:

$$CEI_i, t=\alpha+ui+\beta_1 Log(FDI_{i,t})+\beta_2 Log(EXP_{i,t})+\beta_3 Log(IMP_{i,t})+e_{i,t} \quad (3)$$

Where $_{ui}$ represents the intercept by country.

Alternatively, differences may be fixed, specifying:

$$CEI_{i,t}=v_i+\beta_1 Log(FDI_{i,t})+\beta_2 Log(EXP_{i,t})+\beta_3 Log(IMP_{i,t})+e_{i,t} \quad (4)$$

This is called a fixed effects model, and vi is a dichotomous variable corresponding to each country.

The choice between specifications (2), (3), and (4) consists of the following:

1. Apply the Breusch-Pagan test for random effects under the following hypotheses:

H_0: select the pooled model.

H_1: select the random effects model..

If H_0 is accepted, the process ends here.

2. Ask ourselves if the data correspond to all individuals in the population or if only a representative sample is used. In the case of the second response, a fixed-impact model should be estimated.
3. Utilize the Hausman test to determine the appropriate model, whether it be random effects or fixed effects, based on the given hypothesis:

H_0: "select the fixed effects model".

H_1: "select the random effects model".

Then the chosen estimate is validated with the statistical criteria (normality of errors, individual and joint significance) and econometric (low degree of multicollinearity, non-correlation, and homoscedasticity). After that, the model is interpretable.

Results

Descriptive results

According to Silveira (2017), Chinese investment in Latin America primarily focuses on public service concessions such as energy, telecommunications, and transportation. Additionally, it includes direct investments like company financing, the construction of road and rail networks, and the extraction of mineral resources. Meanwhile, Nedopil (2022) observes that 20 LAC are participating in the BRI initiative, resulting in LAC becoming one of the fastest-growing destinations for Chinese FDI. Chinese FDI in LAC has significantly increased in recent years, with an upsurge from US$16,656.51 million in 2020 to US$26,158.51 million in 2021. The "Ministry of Commerce of the People's Republic of China" (2022b) reported that the primary countries for FDI are the Cayman Islands, the British Virgin Islands, Peru, and Argentina.

Chinese companies operating in LAC have signed new contracts worth US$19,980 million in 2021, which resulted in US$7,970 million in sales. According to Figure 2, Asia is the region that receives the highest FDI inflows from China, with a total value of US$128,000 million in 2021, and LAC is second. Peru was the Latin American country that received the highest FDI inflows from China in 2021, as shown in Figure 3. Table 2 displays the major product types imported and exported between 13 LAC and China, revealing that the region mainly imports non-traditional products from China, while traditional products are exported to China.

Table 2

Main types of export and import products from Latin American countries with China (13 countries)

Country	Importing		Exporting	
	1	2	1	2
Argentina	Capital assets	Machinery and electrics	Raw materials	Vegetable
Bolivia	Capital assets	Machinery and electrics	Raw materials	Minerals
Brazil	Capital assets	Machinery and electrics	Raw materials	Vegetable
Chile	Consumer goods	Machinery and electrics	Intermediate goods	Metals
Colombia	Machinery and electrics	Capital assets	Raw materials	Fuels
Costa Rica	Consumer goods	Machinery and electrics	Machinery and electrics	Capital assets
Ecuador	Capital assets	Machinery and electrics	Raw materials	Animal
El Salvador	Consumer goods	Machinery and electrics	Intermediate goods	Food products
Mexico	Capital assets	Machinery and electrics	Raw materials	Minerals
Panama	Consumer goods	Textiles and clothing	Raw materials	Intermediate goods
Paraguay	Machinery and electrics	Capital assets	Intermediate goods	Raw materials
Peru	Capital assets	Machinery and electrics	Raw materials	Minerals
Uruguay	Consumer goods	Capital assets	Raw materials	Animal

Note. Based on data from World Integrated Trade Solution (2023).

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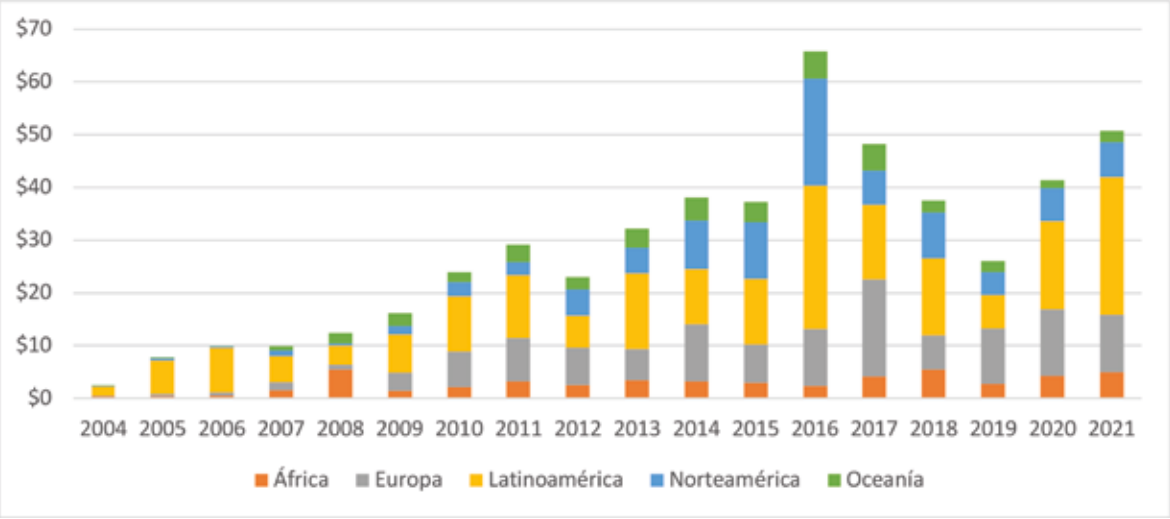
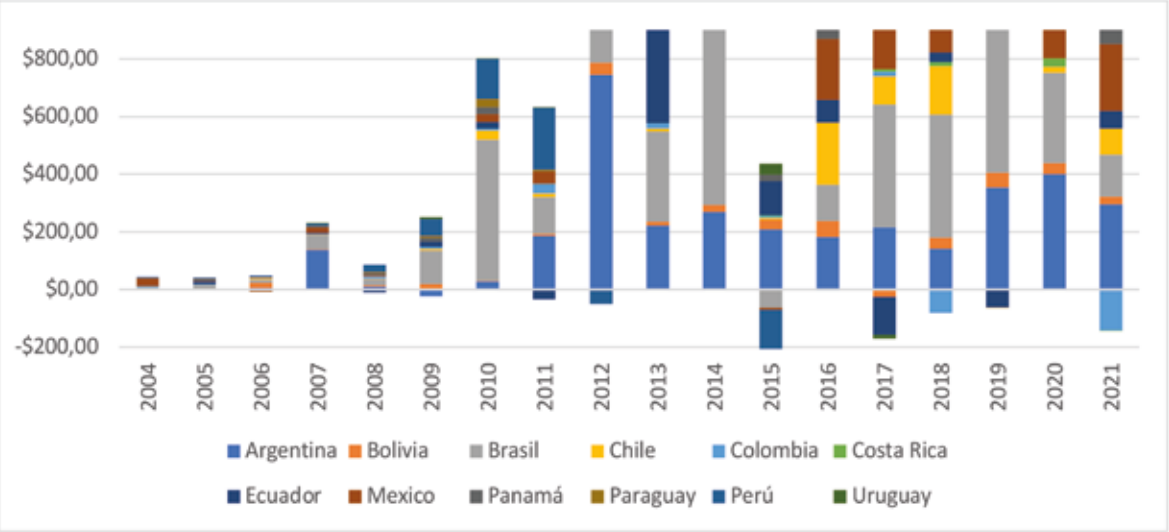
Figure 2
China's outward FDI flows by World Regions 2004-2021 (Asia excluded, Thousands of Millions of US$)



Note. Based on data from the "Ministry of Commerce of the People's Republic of China" (2006, 2015, 2022b).

Figure 3
China's outward FDI flows by Latin American countries 2004-2021 (Millions of US$)



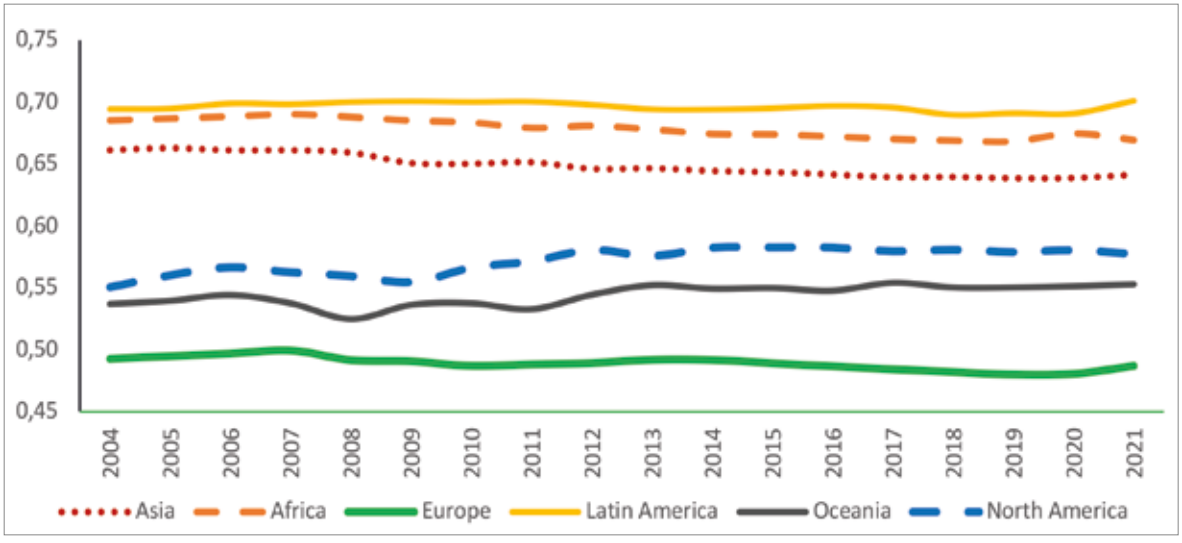
Note. Based on data from the "Ministry of Commerce of the People's Republic of China" (2006, 2015, 2022b).

As of 2021, the Latin American and Caribbean region has had considerable attention due to its distinction in displaying some of the highest levels of inequality globally, as outlined by the United Nations Development Program (UNDP). Cerezo and Landa (2020) even deem Latin America the most unequal region in the world. The widely used GINI index, ranging from 0 (perfect equality) to 1 (perfect inequality), serves as a measure of inequality, as reported by ECLAC (2021). Remarkably, Latin American countries exhibit the highest GINI index scores, as highlighted

by Drobotya *et al.* (2021). Evidently depicted in Figure 4, Latin America consistently holds the highest GINI index among other regions like Africa and Asia. In contrast, North America, Oceania, and Europe maintain GINI indexes below 0.60, indicating their success in sustaining lower levels of inequality.

Equally notable, Figure 5 portrays alterations in income distribution and national per capita GDP across the top 1%, 10%, and the bottom 50% of the population in the largest economies of Latin America spanning from 2004 to 2021. Despite periods of economic growth within this timeframe, income distribution has remained skewed towards the top 1% and 10% of society. Over the period of 2004 to 2021, Chile and Colombia witnessed the most substantial reductions in income concentration within the top 1% of the highest-income bracket, declining from 24.3% to 22.9% and from 19.2% to 17.8%, respectively. In contrast, Peru and Mexico experienced an expansion in income concentration, rising from 25.6% to 28.1% and from 16.6% to 26.8%, respectively. Meanwhile, Brazil and Argentina witnessed more pronounced improvements, with the lowest 50% of income distribution growing from 9.0% to 9.2% and from 11.8% to 13.2%, respectively, between 2004 and 2021.

Figure 4
GINI index in the world (2004-2021)



Note. Own elaboration based on World Inequality Database (2023).

However, despite the significance of InT for IEG as highlighted by numerous scholars, both traditional and endogenous growth theories have encountered challenges in achieving more efficient resource allocation, fostering heightened technology incentives, and reaping trade benefits from larger economies of scale (Kang *et al*., 2017). Huang *et al*. (2022) elaborate that the impact of InT on income inequality is contingent upon the developmental stage of each country, an aspect they correlate with the Heckscher-Ohlin (HO) standard model. This relationship is reversed in developed countries. The authors assert that "there is compelling evidence that trade diminishes income inequality in middle-income and high-income countries, yet it lacks statistical significance in low-income countries' income inequality" (Huang *et al*., 2022).

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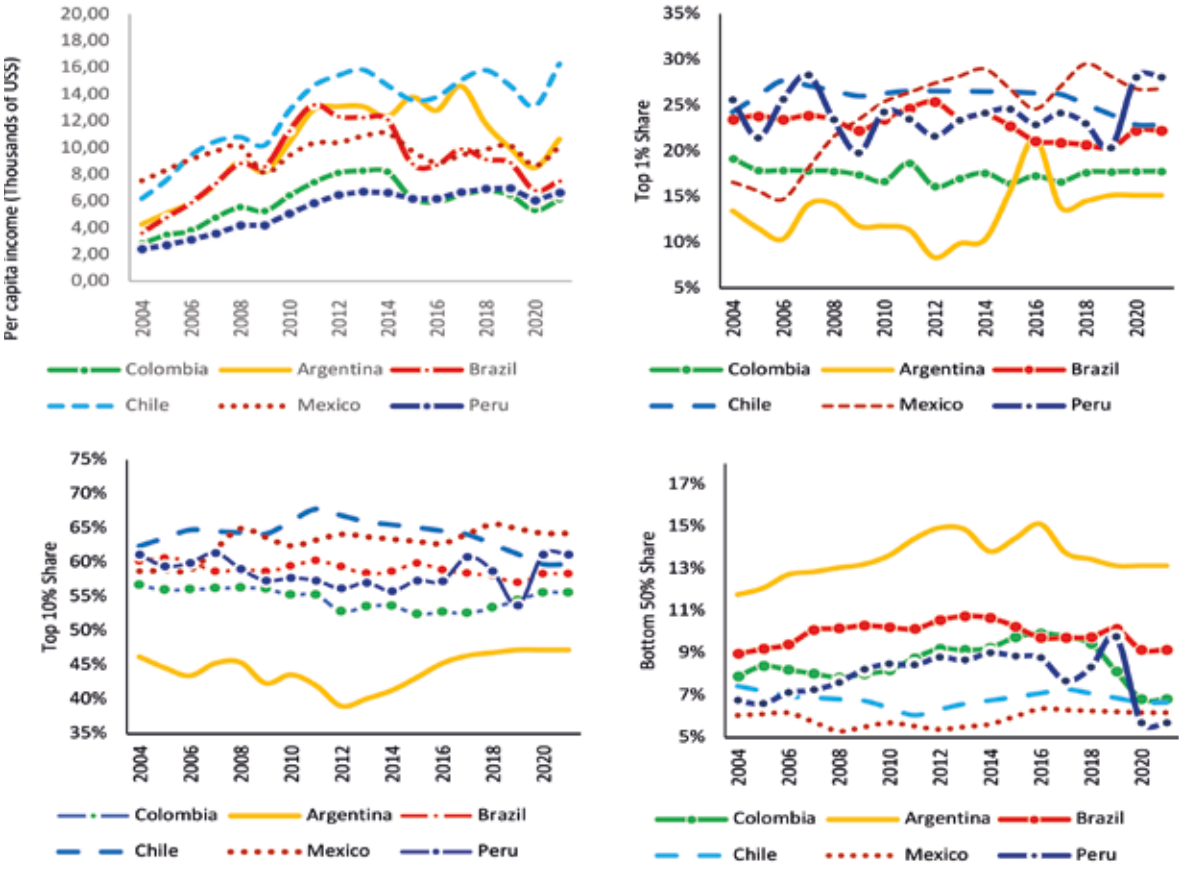
Figure 5

Per capita income, Top 1%, Top 10%, and 50% lower Latin America (2004-2021)



Note. Own elaboration based on World Inequality Database (2022).

Results of the model

The Breusch-Pagan test for random effects serves as a statistical methodology aimed at determining whether a random effects model is requisite or if a simpler pooled model suffices. This test involves comparing the variance of error terms for each panel unit within a random effects model to that of a pooled model. If these variances show similarity, a pooled model is deemed appropriate. Conversely, disparate variances signify the necessity for a random effects model.

In the present context, the p-value of 0.10 implies that the error term variances do not exhibit significant dissimilarity across panel units. This outcome suggests that opting for a random effects model might not be warranted. Consequently, a pooled model can be employed to evaluate the interrelation between IEG in LAC and FDI and InT with China within the period spanning 2004 to 2021.

The normality of the errors was analyzed with the Jarque-Bera test, whose hypothesis is:

H_0: "errors follow approximately a normal distribution"

H_1: "errors do not follow approximately a normal distribution"

With a probability value of 0.26 (greater than 5% significance), errors in the estimated model are normal, so subsequent statistical tests are valid. The t-test was used to analyze the individual statistical significance of the parameters:

H_0: "$\alpha=0$, $\beta_i=0$ (i=1, 2, 3)"
H_1: "$\alpha \neq 0$, $\beta_i \neq 0$ (i=1, 2, 3)"

The probability value associated with each estimator shows that only import from China (0.03<5%) is a statistically significant variable. Meanwhile, the goodness of fit was analyzed with the F test.

H_0: "$\beta_1=\beta_2=\beta_{3=0}$"
H_1: "at least one $_{\beta i} \neq 0$ (i=1, 2, 3)"

It is concluded that all variables together are significant for the adjustment of IEG, given that their probability value (0.00) is less than 5%.

Regarding econometric criteria, the degree of multicollinearity was measured with the variance inflation factor (FIV):

$FIV_j=1/(1-R^2_j)$ (j=1, 2, 3)

Where R^2_j represents the goodness of fit between the j-th explanatory variable of the model and the rest. Table 3 indicates that the multicollinearity of the model is low grade (FIV<5).

Table 3
FIV per variable and mean value

	FDI	EXP	IMP
FIV	1,18	1,10	1,07
Mean	1,12		

The second validated econometric assumption is homoscedasticity, with White's test and its hypotheses:

H_0: "errors are homoscedastic"
H_1: "errors are heteroscedastic"

With a probability value of 0.35 (greater than 5%), H0 is accepted; therefore, the model satisfies the assumption of homoscedasticity.

Finally, the Durbin-Watson test was used to validate the assumption of no autocorrelation, whose hypotheses are:

H_0: "the model does not have first-order autocorrelation"

H_1:"the model has first-order autocorrelation" with a Durbin-Watson statistic of 0.07, between 0 and the test's lower limit (1.68), H0 is rejected. Finally, the Newey-West consistent estimator was used to make the model interpretable (see Table 4)[1]. Table 4 shows the estimated parameters for three different models used in the analysis.

Table 4
Estimated parameters

Variable	Newey-West	Fixed effects	Random effects
Constant	8,30*** (1,11)	12,58*** 2,54	8,62*** 1,53
FDI	-0,12 0,09	-0,06 0,11	-0,11 0,10
EXP	-0,21* 0,12	0,01* 0,42	-0,20 0,14

1 This estimator is designed to correct potential biases that can emerge in panel data analysis due to autocorrelation, which occurs when observations in one period are correlated with observations in adjacent time periods.

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Variable	Newey-West	Fixed effects	Random effects
IMP	-0,36** 0,15	-1,12** 0,45	-0,41** 0,19
Additional information			
N° of observations	155		
Fitting criterion (R^2)	8,70%	9,20%	

Note. * significant at 10%, ** significant at 5%, *** significant at 1%,

Fixed random and fixed effects models are only shown to be neither interpretable nor comparable.

In summary, the analysis leads us to the conclusion that InT with China exerted a noteworthy and statistically significant adverse influence on the inclusive economic growth (IEG) of Latin America within the period from 2004 to 2021. Specifically, each 1% escalation in Latin American exports to China correlated with a 0.21% decline in the region's IEG (β2); simultaneously, equivalent increases in Chinese imports to Latin America resulted in a more pronounced reduction of 0.36% in the region's IEG (β3). However, there is insufficient evidence to substantiate a significant correlation between IEG and Chinese FDI (β1=-0.12). It is pertinent to acknowledge that the model's estimated capacity only accounts for 8.70% of the observed variability in Latin America's IEG throughout the span of 2004 to 2021. Despite this limitation, the model furnishes valuable insights into the interrelationships among the study variables.

Discussion and conclusions

Chinese investment has experienced a marked upswing in Latin America in recent times, particularly in sectors such as energy, telecommunications, transportation, and the extraction of mineral resources. The Belt and Road Initiative (BRI) has been instrumental in driving this influx of investment, with Peru emerging as the principal beneficiary of Chinese foreign direct investment (FDI) within the region. However, it remains notable that numerous countries in the region continue to import non-traditional goods from China while concurrently exporting traditional products.

The primary objective of this study is to scrutinize the correlation between international trade with China (InT) and inclusive economic growth (IEG) in Latin America spanning the period from 2004 to 2021. The researchers harnessed panel data encompassing 13 countries from the region and employed the Newey-West estimator, accompanied by robust standard errors, to address first-order autocorrelation inherent in the error term.

Our findings unveil a significant adverse correlation between Latin America's exports to China and IEG, bearing a 10% level of significance. Furthermore, a statistically significant adverse correlation surfaces between China's imports into Latin America and IEG, achieving a 5% level of significance. These outcomes align with prior investigations conducted by Kang and Martinez-Vazquez (2021) as well as Osabohien *et al.* (2021), who concluded that trade liberalization bears a detrimental impact on inclusive growth. Osabohien *et al.* (2021) reported a reduction of 1.91% in inclusive growth attributable to trade liberalization.

This negative association could be attributed to various factors and mechanisms that interact with each other. Below, we explain some potential reasons behind this negative relationship:

- Unequal competition: China is a highly competitive and productive economy capable of producing goods at relatively low costs. As a result, Chinese imports to Latin America may unfavorably compete with local products in terms of price and quality. This could impact local businesses and sectors, especially those that are not competitive in the transnational market,

leading to a decline in production and employment in those sectors.

- Productive specialization: Many Latin American countries have tended to export primary products and raw materials, such as natural resources, food, and agricultural products. These goods are often subject to price fluctuations in international markets and can be vulnerable to external economic shocks. If Latin American exports are highly concentrated in these products, dependence on China as a trading partner could increase the economic vulnerability of the region.
- Employment impact: Cheap imports from China may negatively affect certain local manufacturing sectors in Latin America, resulting in job losses in those industries. This could have a detrimental impact on income distribution and increase economic inequality in the region.
- Trade balance impact: If the value of imports from China significantly exceeds the value of exports to China, it could lead to a trade deficit in the region. Prolonged trade deficits can have adverse effects on the economy, such as reducing international reserves and the need to finance the deficit through external borrowing.
- Dependency on Chinese demand: If some countries' economies are reliant on Chinese demand for their exports, any economic slowdown in China could negatively affect exports and economic growth in the region.
- Challenges for industrialization: If cheap imports from China replace local production in key industries, it could hinder the industrialization and economic development in LAC.

Numerous research papers have delved into exploring the interrelation between trade openness and economic growth, poverty reduction, and inclusive growth within developing nations. Onakoya *et al.* (2019) unearthed those countries heavily reliant on imports experienced adverse effects on economic growth and poverty alleviation due to trade openness. In contrast, Kang *et al.* (2017) established a positive and substantial correlation between InT and inclusive growth. However, Adeleye *et al.* (2021) concluded that trade liberalization's impact on inclusive growth is statistically insignificant. The pronounced levels of inequality pervasive in Latin America and the Caribbean may accentuate the detrimental influence that InT with China has on the region's inclusive economic growth. Evidently, Latin America holds the highest global rates of inequality. Fosu and Gafa (2022) posit that inequality can impede economic growth in the Latin American context.

In accordance with our findings, there exists no discernible relationship between China's foreign direct investment (FDI) in LAC and inclusive economic growth (IEG). This outcome mirrors the observations of Ofori *et al*. (2023), who contend that, in the absence of other factors, FDI's impact on promoting inclusive green growth is statistically insubstantial. This result stands in contrast to the findings of Kang and Martinez-Vazquez (2021), who noted a positive effect of FDI on inclusive growth within nations boasting well-established infrastructure and sizable manufacturing sectors. Moreover, Onakoya *et al.* (2019) unveiled a positive and statistically significant correlation between foreign direct investment and the Human Development Index. It is noteworthy that despite the escalating influx of China's Foreign Direct Investment (FDI) in sectors like energy, telecommunications, transportation, and mineral resource extraction, many Latin American countries persist in importing non-traditional goods from China while concurrently exporting traditional products.

One limitation of this study is that the estimators are not interpreted as an impact since the model does not determine whether the independent variables precede IEG or if there are other variables that explain the relationship found. The authors recommend analyzing the type of goods traded to identify the basket that favors IEG in Latin America within the methodological framework. Another constraint of the paper relates to the availability of data. For this study, it was only possible to include information up to 2021.

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A potential extension of the study would involve incorporating data from subsequent years.

Further empirical research is needed to explore the relationship between InT and IEG in developing countries using both macro- and micro-level data while considering the distributional effects of trade, with emphasis on gender. Moreover, valuable research should examine policies and strategies to decrease the negative impact of trade on income inequality and promote more IEG. A future line of research is to measure the impact of international trade with China on the IEG by type of flow, for example, capital goods, inputs, and others. The relationship between variables can even be studied by differentiating the country with which a trade agreement is maintained, which would give signs of winners and losers of the treaty.

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Inter-business coopetition. Theoretical description and application to technological sectors

La coopetencia interempresarial. Descripción teórica y aplicación a sectores tecnológicos

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Abstract: coopetition is a dual relationship between companies through which they compete and cooperate simultaneously. The objective of the work is to analyze its theoretical foundations and demonstrate its main benefits. The methodology used has been twofold: a bibliometric analysis, carried out through the Web of Science, and from which its evolution, authors and theories and typology have been deduced; and an analysis of cases (automobile and telephony), using different magazines and articles as sources of information, and from which its main benefits and costs have been deduced. The results of the work show the main benefits that can be achieved thanks to the synergies that are achieved with coopetition. With the study of different companies in the automotive sector and specifically the case of Samsung-Apple in the telephone sector, it is concluded that cooperation is a challenge, but at the same time it is a very useful choice to face all the advances technologies in a constantly evolving market, where both companies achieve mutual and proportionally greater benefits. It is necessary to carry out empirical studies, both qualitative and quantitative, that demonstrate the usefulness of coopetition as an innovation strategy in highly technological sectors and as a source of competitive advantage for companies.

Keywords: co-opetition, competence, cooperation, alliances, theory of games, automotive, telephony, Samsung-Apple.

Resumen: la coopetición es una relación dual entre empresas a través de la cual estas compiten y cooperan de forma simultánea. El objetivo del trabajo es analizar sus fundamentos teóricos y demostrar sus principales beneficios, en especial en los sectores tecnológicos. La metodología utilizada ha sido doble: un análisis bibliométrico, realizado mediante la Web of Science, y del cual se ha deducido su evolución, autores y teorías y tipología; y un análisis de casos, en los sectores de la automoción y de la telefonía, utilizando como fuentes de información diferentes revistas y artículos, y del cual se ha deducido sus principales beneficios y costes. Los resultados del trabajo muestran los principales beneficios que se pueden conseguir gracias a las sinergias que se consiguen con la coopetición. Con el estudio en profundidad de diferentes empresas de automoción y en concreto el caso de Samsung-Apple del sector de la telefonía, se concluye que la coopetición es un reto, pero a la vez es una elección muy útil para afrontar todos los avances tecnológicos en un mercado en constante evolución, donde ambas empresas consiguen beneficios mutuos y proporcionalmente mayores. Se hace necesario la realización de estudios empíricos, tanto cualitativos como cuantitativos, que demuestren la utilidad de la coopetición como estrategia de innovación en sectores altamente tecnológicos y como una fuente de ventajas competitivas para las empresas.

Palabras clave: coopetición, competencia, cooperación, alianzas, teoría de juegos, automoción, telefonía, Samsung-Apple.

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Introduction

Competition is a dual relationship between companies through which they compete and cooperate simultaneously. In its beginnings, it has been treated as the dilemma between competition and cooperation. At present, there is a need to understand how it affects business models and the benefits it produces in companies (Dorn *et al*., 2016).

The competition strategy has been gaining relevance since its origins 25 years ago, largely due to the evolution of industry and society, and the continued development of knowledge and technology-based industries. In addition, the main reason is the need for companies to cooperate with other companies in the same sector to obtain the necessary resources and skills to achieve sustainable competitive advantages.

The aim of this paper is to define the theoretical framework of competition through its concept, scope, typologies and benefits for companies, and apply it to the technological sectors, by studying cases in the automotive and telephony sectors.

The methodology used in the work has been twofold. First, a bibliometric analysis of the competition has been carried out through the Web of Science database to determine the existing publications in this field. Secondly, a case analysis has been conducted, which has served to determine the benefits of competition to the companies that use it.

The work has been structured in four sections, in addition to the introduction. The second section defines the selection criteria used for bibliometric analysis within the period 2005-2020. The third section describes the state of the issue, by developing the theoretical framework of competition, conceptualizing the term object of study and its evolution and analyzing its different approaches, as well as its different typologies. In the fourth section, a case study has been carried out in the automotive and telephony technology sectors (Samsung-Apple) to identify the main benefits that competition produces in organizations. The fifth and final section contains the main conclusions of the work.

Corpus selection criteria

The term competition is a neologism of Anglo-Saxon origin and is formed by the union of two terms: cooperation + competition. Research on this term has come a long way since Nalebuff and Brandenburger introduced it and applied it to companies in 1996. Several authors have contributed different information and visions to the term during the following years.

Methodology

A bibliometric analysis has been made through the Web of Science, one of the largest literature databases available with quality and reliable websites (Meho and Yang, 2007).

According to Tranfield *et al*. (2003), a systematic literature review consists of five methodological steps: 1) identify keywords and create search based on those keywords; 2) choose the studies from outstanding research databases; 3) analyze the articles found based on inclusion and refinement criteria; 4) extract the information in a proprietary reference management database; and 5) data synthesis and conclusions development (Johnson and Schaltegger, 2016).

First, word identification was performed, and a search string based on coopetition was constructed. In order to reduce the large amount of literature available, several criteria for inclusion and refinement have been established, based on a similar systematic review process perfected by Moustaghfir (2008). In our case, the selection was based on social sciences as a research domain, articles and review as document types, and a research area.

The idea was to start the search from 1996 because it is the year of emergence of the term, but since it is not until 2005 when the first publication appears, the analysis has been carried out from 2005-2020. The theoretical discussion presents the articles with more citations or with more relevance to explain each of the aspects analyzed in the theoretical discussion.

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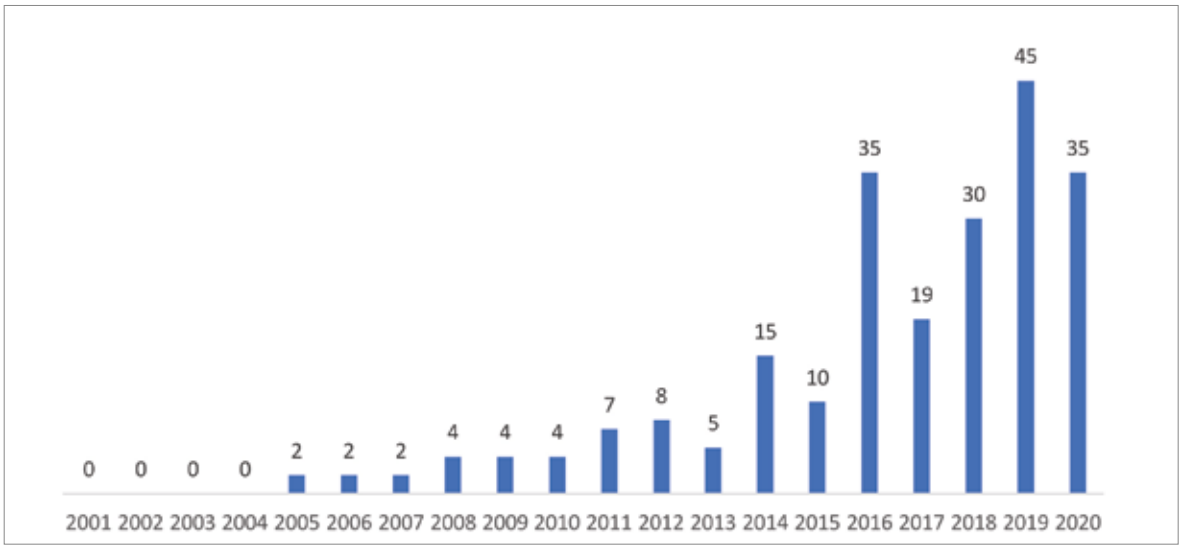
Results obtained

A total of 216 references have been obtained with a total of 5751[1] citations in articles of the Web of Science. All the data has been imported into an Excel sheet and the information obtained has been examined methodically.

Figure 1 shows publications by year, with a large increase from 2016 to 2020. Figure 2 shows the corresponding citations, observing an increasing trend since 2005 and a strong increase from 2016 onwards. It follows, therefore, that coopetition is a topical term to companies and research.

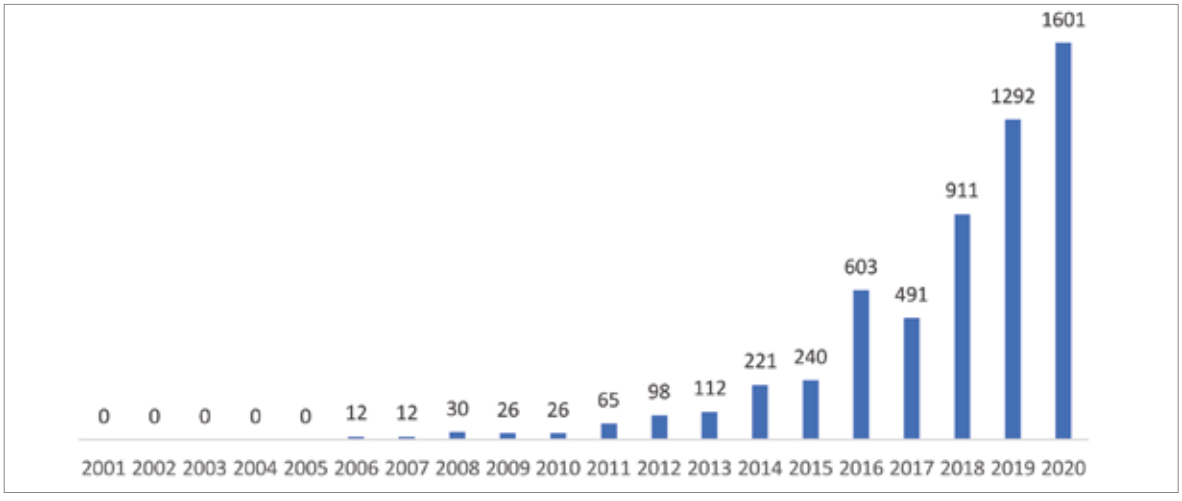
Graph 1

Publications on coopetition by year 2001-2020



Graph 2

Citations on coopetition by year 2001-2020



Note. Web of Science, 2021.

1 This is the total number of citations for all items in the result.

Table 1 lists the most published journals. The 216 references obtained are divided into 19 different journals. Publications are widely distributed in different journals: 52% in journals with only one, two or three publications. This analysis gives us a view of the heterogeneity and topicality of the term studied. In addition, there are very few journals that have carried out a continuous analysis of the term, demonstrating how little this term is investigated and the great development path it has. Three journals stand out: Industrial Marketing Management with 30 publications, Routledge Companion to Coopetition Strategies with 15 and Review of Managerial science and Journal of Business and Industrial Marketing with eight each.

Table 1
Journals with more publications on coopetition

Journal	Number of publications	Average % Publications
Industrial Marketing Management	30	14 %
Routledge Companion to Competition Strategies	15	7 %
Review of Management Science	8	4 %
Journal of Business & Industrial Marketing	8	4 %
Long Range Planning	7	3 %
British Journal of Management	6	3 %
Technological Forecasting and Social Change	6	3 %
International Journal of Technology Management	6	3 %
Journal of Business Research	5	2 %
Technology Analysis & Strategic Management	5	2 %
European Management Journal	4	2 %
Management	4	2 %
TOTAL	216	100%

Note. Web of Science, 2021.

The publications that have had the greatest impact, with more than 100 citations, have been published between 2009 and 2015 (Gnyawali and Park, 2009, 2011; Wu *et al*., 2010; Hutter *et al*., 2011; Ritala, 2012; Bouncken and Kraus, 2013; Fernandez *et al*., 2014; Ritala *et al*., 014; Bengtsson and Kock, 2014; Bouncken *et al*., 2015).

Discussions on the state-of-the-art

The study on coopetition has become more relevant since its origin in 1996 with the work of Brandenburger and Nalebuff (1996), especially during the last five years. Its objective is to express a hybrid behavior between two different terms, cooperation and competition, where competition is included in collaborative systems and where competition and cooperation are simultaneously (Brandenburger and Nalebuff, 1996; Bengtsson and Kock, 2014).

Conceptualization and evolution of the term coopetition

Ray Noorda introduces the concept for the first time in order to characterize Novell's strategy in the 80s (Rusko, 2015). But it is not until 1996 with the work of Nalebuff and Brandenburger that the concept gains popularity. Its formal definition is created from two different but related concepts (Figure 1).

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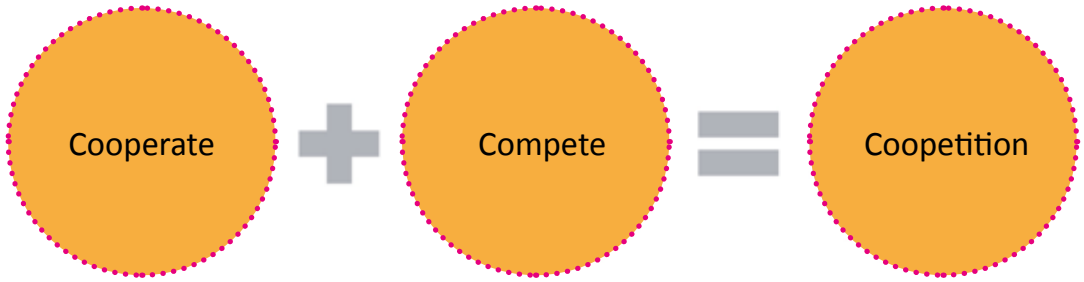
Figure 1
Definition of coopetition



Note. Own elaboration based on Rusko (2015).

Coopetition has been studied from three different organizational approaches: Resource Based Theory (RBS), Resource Dependency Theory (RDT) and Game Theory (JT).

RBS describes the company as a set of resources and capabilities that distinguish it from competing entities and that are a source of competitive advantage (Barney, 1991; Zakrzewska-Bielawska, 2013, 2015). Coopetition favors the acquisition and accumulation of resources and the ability to make good use of them and thus ensure efficient resources from their environment to maintain and improve their operational performance by taking advantage of opportunities (Olavarrieta and Ellinger, 1997). Access to these resources enables companies to maintain competitiveness in the market and create new forms of competitive advantage, as these resources are the main competencies. The same resource can be used for both collaboration and competition, being effective in coopetition to develop complementary and synergistic skills (Bengstsson and Kock, 2000).

Lavie (2006) looked at network resources in alliance environments and how the companies benefit from the resources generated within that network, even though they do not have ownership or control of those resources. However, this theory is insufficient to understand the reason of coopetition, since it only covers the simple fact of obtaining or maintaining access to external or complementary resources; therefore, it is necessary to analyze it from the RDT (Zacharia *et al*., 2019), which explains the basis of companies in developing competitive relationships in uncertain market conditions and environments (Hillman *et al*., 2009; Bouncken and Fredrich, 2012).

Grant and Baden-Fuller (2004) claim that building alliances for coopetition is a search for resources. According to Zacharia *et al*. (2019, p. 417), RDT explains the link between market and environmental uncertainty and the tailored collaboration strategies of a company. Given dynamics, technological developments and customer demands in a market reinforce the vision of RDT for companies and make them more aware and willing to rely on the possibility of forming competitive relationships.

However, coopetition means working and collaborating with competitors, which requires a greater understanding through the GT, whose classic formulation (Neumann and Morgenstern, 1947) indicates that the goal is to create value through a multi-winner game. This theory analyzes from the rational part of mathematics the conflicts between human beings (mistrust) and mathematically explains the interactions of the winning-winning strategies. This approach allows to identify the balance strategies of companies when they participate in a coopetition project. The objective is to find a way to be able to establish the type of game we want, starting from the management of relationships and development of other proposals that encourage innovation in organizations (Boschma, 2005; Jakobsen and Steinmo, 2016). Arthanari *et al*. (2015) propose a GT model to examine horizontal cooperation in supply chains where they determine conditions that would lead to effective collaboration between partners. Baglieri *et al*. (2016) propose a mathematical model of competitive games, where they consider coopetition as an n-dimensional variable and demonstrate that cooperative efforts

are necessary and beneficial, even if the partners are competitors (Zacharia *et al*., 2019).

Ultimately, each of the three theories provides its particular perspective on the factors that affect and influence the need and reasons why competitors choose to cooperate in the supply chain. None of the three theories offers a complete explanation, both complement each other and provide reasons to choose coopetition as a strategy that gives benefits and value to the company: access to resources, improvement of relationship results or cost reduction (Zacharia *et al*., 2019).

From 1992 to the present, several authors have given meaning to coopetition, offering different approaches in the way of seeing or understanding this concept. Table 2 lists the main definitions of the term from its origins to the present.

Table 2
Conceptualization of coopetition

Author	Definitions
Branderburger and Nalebuff (1996)	New ways of thinking about business. Some see other businesses as competition, and think they are at war and accept that they cannot win if there is no one to lose. Others understand business as cooperation-teams and partnerships; thus, business is both cooperation and competition.
Bengtsson and Kock (2000)	A dyadic and paradoxical relationship arises when two companies cooperate in some activities and simultaneously compete in other activities.
Dagnino and Padula (2002)	System of actors whose interaction is based on a partial goal of consistent interests.
Luo (2004)	Freely coupled system in which agents maintain some interdependence without losing their organizational separation.
Padula and Dagnino (2007)	Competition intervenes in a cooperative game structure. It provides a more realistic view of cooperative relationships.
Yami *et al.* (2010)	Strategy that benefits managers in the fight to improve profitability.
Dagnino (2012)	Complex system of interaction and co-adaptation between companies, where competing companies are complex subsystems, allowing defining competitive areas such as self-design and self-organization of entities.
Della Corte and Sciarelli (2012)	Constructive tension between companies, networks or systems where collaborative relationships interact, making them compete in some or the same markets.
Lorgnier and Su (2014)	Neologism that defines a hybrid behavior of cooperation and competition within a company, between companies, or at the network level.

Note. Chim-Miki and Batista-Canino (2016).

They all refer to coopetition as a concept formed by two "opposing" actions that when put together creates a beneficial strategy in a system, game structure or situation where everyone comes out ahead.

Types of coopetition and applications

An interesting perspective is to analyze the place of coopetition in relation to the paradigms of cooperation and competition, and to compare it with related concepts such as collusion or alliances. Collusion is seen as another form of coopetition; however, it is a more restricted concept, as the benefit of such collaboration is directed to companies by increasing the surplus of product through monopoly power or price increases and therefore consumers are penalized, resulting in a decrease in the total surplus or social welfare. Another difference is the violations of legislation that occur with respect to regulating competition in downstream activities (pricing) (Walley, 2007; Rusko, 2011). A collusion is competitive if the companies that are part of the agreement compete with each other. Strategic alliances are coopetitive

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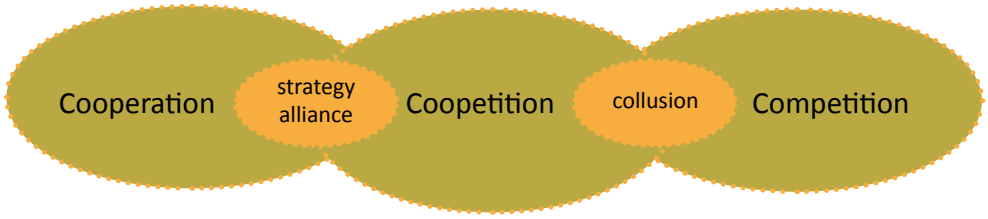
if they include competitive movements (Bengtsson and Kock, 2000).

Figure 2 shows these typical relationships between strategic alliances, competition and collusion. The degree of cooperation is higher in strategic alliances than in competition, and collusion has a higher degree of competition than competition.

Figure 2
Typical relationships of strategic alliances, coopetition and collusion



Note. Rusko (2011).

Coopetition can be analyzed as a process or as a result, depending on the importance attached to some or other factors. As shown in Table 3, different studies have analyzed different variables and their effects on coopetition.

Table 3
Coopetition as a process and as a result

Process		Result	
Establish the conditions that favor the creation of this behavior and the dynamics of networks between companies. Depending on the company's place in the value chain, they cooperate in activities farther away from their customers and compete in activities closer to their customers.		Apply a new strategy so that the company retains the value created by the group that is both cooperating and competing.	
The *trade-off* of coopetition focuses on the option of creating improvements in companies that are part of the process in a long-term relationship (Bengtson and Kock (2000).	Number of participants in the network (Dagnino and Padula, 2022).	Consequences in the co-creation production of value and innovation (Ritala and Hurmelinna-Laukkanen, 2009).	The results of the shared risks (Park and Russo, 1996) and the results on the exit rate (Silverman and Baum, 2022).
The variables that act directly to compete —mutual trust— (Della Corte and Sciarelli, 2012) or interdependence and complementarity (Tsai, 2002).	The level of commitment to create a market or develop technology among the individuals involved (Garraffo, 2022).	Companies in the same sector are cooperating by completing themselves to create a market where they are competing for this distribution (Schiavone and Simoni, 2011).	The effect on productivity and profitability of companies (Oum *et al*., 2004) or the one that seeks that relationship with financial performance (Luo *et al*. 2007).

Note. Chim-Miki and Batista-Canino (2016).

If coopetition is analyzed based on the level of application, then there would be four classifications from highest to lowest interdependencies/agent level: individual level, organizational level, interorganizational level and internetworks level (Chim-Miki and Batista-Canino, 2016). Crisan (2013) refers to coopetition as a hybrid behavior where according to the level of analysis, the competitive and cooperative parts are part of a continuum (individual, team and organizational)

or are distanced by activity and/or space limits (inter-organizational and network).

When analyzing coopetition in terms of the degree of coopetition or intensity with which they collaborate or compete, different typologies appear depending on the intensity level according to the context of the network formed: cooperation, competition-based coopetition or symmetric coopetition. The Eriksson scale classifies five types of behavior: pure cooperation, cooperation-based coopetition, symmetric coopetition, competition-based coopetition and pure competition.

Lado *et al.* (1997) performed a scale to measure competitive behavior called *ren-seeking* behavior. Chin *et al*. (2008), considering the intensity of cooperation or competition, made a similar scale. As seen on Table 4, there are four different coopetition models depending on the ability to cooperate and the ability to compete.

Table 4
Model of the different types of coopetition

		Abilities to compete →	
Ability to cooperate	↑	Collaborative/Partner	Syncretism/Adaptive
		Monopolist/Monoplayer	Competitive/Contender

Note. Lado *et al*. (1997) and Chin *et al*. (2008).

There are different types of scales depending on the variation of the coopetition degree in the behavior of the participants of the organizational network, where each gets close to the two extremes that form the hybrid coopetition (Luo, 2004).

Table 5 shows the existence of 12 different types of coopetition, resulting from the combination of the types proposed by Luo (2004), Lamberg *et al*. (2007), Rusko (2011), Bengtsson and Kock (2000) and Dowling *et al*. (1996).

Table 5
New types of coopetition

Types of coopetition		**Ascending Movements Entry/ cooperation activities**	**Movimientos descendentes Actividades de salida/ competencia**	
		Relationship typically dominated by cooperation	**Equality Relationship**	**Typically competitive relationship**
High	**Coopetition with rivals**	Ascending and factor-based dyadic competition with rivals without customer proximity.	Dyadic coopetition, for example, in semi-finished products, with rivals.	Descending dyadic coopetition based on product and market with rivals, and with the proximity of the consumer market.
Degree of external coopetition	**Coopetition with the government**	Multifaceted factor-based coopetition with rivals and the government.	Multifaceted coopetition with the government.	Multifaceted competition in the descending direction.
Low	**Coopetition with alliance partners**	Factors-based internal coopetition with alliance partners.	Internal mid-way coopetition with alliance partners.	Descending internal coopetition with alliance partners.
	Coopetition within the company	Based on internal company factors.	Inter-company coopetition.	Descending competition within the company.

Note. Bengtsson and Kock (2000), Dowling *et al*. (1996), Luo (2004) and Rusko (2011).

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Therefore, there are different types of coopetition depending on the point of view or approach given to some factors or others. Regardless of the type of relationship, degree, application or typology, the key to this strategy is that it is a coopetition management over a market, where two or more agents (who are competitors) seek to collaborate to achieve a common benefit that would be much slower or difficult to achieve separately.

Benefits, costs and risks of coopetition

Many companies still do not trust these types of agreements with other competing companies in their sector, as they think they will have to show their cards and do not trust the intentions of the other party, thus perceiving more costs and risks than benefits. Potential opportunistic behavior by one of the partners is also a significant risk (Hamel, 1991).

According to Brandenburguer and Nalebuff (1996), coopetition has three fundamental advantages: it enables firms to discover new opportunities, reduces the resilience of competing firms and encourages a reduction in destructive retaliation by competing firms.

With coopetition, companies seek benefits that have a positive impact on their competitiveness. In coopetition relations, companies interact according to two logics: cooperation and competition. On the cooperation side, firms gain access to external resources that they individually could not obtain; and on competition, firms seek to create a competitive advantage over competing firms.

Coopetition means incorporating competition into cooperative relationships, creating inter-organizational networks with mutual benefits. The maxim of coopetition (known as *win-win*) is that if there is a winner there is no need to be any loser; both parties can gain by benefiting from the agreed strategy. In addition, authors such as Luo *et al*. (2006), concluded that greater value is generated when there is a combination of both forms, where companies improve their performance by producing social bounds of cooperation that are united in a broader framework of competition (Li and Hsieh, 2009).

Some companies involved in coopetition processes have carried out studies in this regard. According to most studies (Morriz *et al*., 2007), in general terms the greatest benefits of coopetition are: 1) a greater breadth of services when there is a division in efforts and investments in the place they occupy in the market, the progress of a brand or in logistics, leading to greater quality services being offered to customers; 2) the generation of business synergies that drive a good relationship that generates new business ideas, opportunities or the systematic sharing of work or production; 3) internal and external growth, since when the collective potential of both companies increases, common activities and projects that produce synergies take place, leading to greater efficiency; and 4) the dissolution of the workload, since companies delegate certain activities through subcontracting or franchising, and thus see more appeased their production chain by focusing on other more essential aspects.

Coopetition is not a necessity, but a coherent strategy to achieve risk reduction and resource utilization (Morriz *et al*., 2007). It should be kept in mind that coopetitive relationships are competitive in nature, where there is a risk of opportunism and loss of knowledge (Ritala and Humelinna-Laukkanen, 2009). As mentioned by Morris *et al*. (2007), some of the costs of coopetition are financial costs and loss of control over key activities or resources. However, if talking about costs in the competition, they are mentioned as an advantage by reducing or sharing these costs.

One of the main difficulties of coopetition is the individual management of people in each company since workers have always been educated, creating a sense of great rivalry and spirit of competitiveness. Cooperation with rivals therefore has an important emotional part, where there are individuals who do not see clearly the idea of multiple winners and one who does not. Therefore, it can be concluded that it is necessary to achieve an adequate choice of people, with a dual mentality of coopetition, thus developing a mental flexibility that allows a correct idea of risks and rewards (Brandenburger and Nalebuff, 2021).

Contributions to the state-of-the-art: comparative analysis in technological industries

High-tech industries face unique challenges and opportunities, making them more competitive (Gnyawali and Park, 2009, 2011; Pereira and Leitão, 2016). There is a great evolution in customer preferences, resulting in shorter product life cycles and companies having to step up their innovation efforts by collaborating with competitors to create value from the customer's point of view, which is very important in high growth sectors (technology, communication or information) (Lynn and Akgün, 1998).

The automotive and telephony are two of the sectors in which more competition strategies have been implemented. Both have in common the technological factor, which is evolving rapidly and where synergies are key to be leaders in the market. There are different selections of cases in the automotive sector, where different styles of coopetition strategy are observed chronologically showing this evolution. In the case of the telephony sector, Apple and Samsung companies have been selected, because they have several variables that usually affect the business strategies of coopetition. They have been selected because they are currently the biggest rivals in the sector and both manage to strengthen their companies after choosing the joint business strategy.

Automotive: success stories

Over the past 20 years, the automotive sector has become increasingly competitive and global, thus increasing the complexity of the business. Faced with this situation, companies must act flexibly, choosing strategies to adapt to changes in customer preferences and to achieve the ability to respond quickly to innovation. With coopetition, they manage to create value for the customer by securing the product and service, from a production system integrated in the logistics chain.

Six different cases between leading companies have been analyzed from scientific articles and dissemination. One of the automotive companies that has used the competition the most is Toyota, both to promote synergies between its suppliers by sharing best practices (Lado *et al*., 1997; Wilhelm, 2011), and through its cooperation with Ford for the design of the hybrid Atlas Ford F-150, the best-selling hybrid in the sector (Santolaya Sanz *et al*., 2019). Also Ford, in addition to the agreement with Toyota, has competed with General Motors (its main competitor) to share transmission technologies in a complementary way and with Volkswagen to jointly invest in a startup of autonomous vehicles (Argo AI) (Brandenburger and Nalebuff, 2021). There is also a coopetition case involving six different companies (BMW, Daimler, Ford, Hyundai, Kia and VW) for the creation of the Joint Venture Tome Ionity dedicated to the manufacture of ultrafast electric charging stations throughout Europe (Brandenburger and Nalebuff, 2021). Finally, the most recent cases of coopetition in the automotive sector are Volvo and Uber for developing an autonomous car and BMW and Mercedes for creating an industrial platform for small vehicles (Retina, 2019).

Most of these agreements have been developed to meet new markets and customer needs in relation to new mobility trends and environmental commitment. These agreements are therefore focused on innovation, both in products (hybrid car, electric car and batteries) and in markets (socially responsible customers) (Retina, 2019).

Table 6 summarizes the main characteristics of the six competition cases analyzed in the automotive sector.

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Table 6
Cases analyzed and main results

Case	Year	Corporations	Results
Case 1	2012	Toyota and suppliers	Synergy among providers.
Case 2	2013	Toyota and Ford	Best-selling hybrid in the automotive industry.
Case 3	2013	Ford and General Motors	Although they shared complementary capabilities, they did not exploit it to a sufficient extent for not ceding control, although they did have benefits.
Case 4	2019	Ford and Volkswagen	The geographical complementarity ended in the dominance of markets worldwide for both.
Case 5	2019	Tome Ionity (BMW, Daimler, Ford, Hyundai, Kia and VW)	Numerous business agents with an open mind manage to overcome the limits with the presence of complexity.
Case 6	2020 / 2021	Volvo and Uber BMW and Mercedes	Historic rival players manage to evolve to be on the front line of the automotive market.

Telephony industry: Samsung-Apple case

Samsung and *Apple* are two competing companies operating in virtually the same markets and offering similar products. The work of *Santolaya Sanz et al*. (2019) and Brandenburger and Nalebuff (2021) has been used for the analysis of the case.

Although the two companies compete with the same product type (*Samsung* Galaxy and *Apple* iPhone), *Samsung* is one of *Apple*'s leading suppliers (Santolaya Sanz, 2019). One side shares its "secret formula" to reach another's customer base, though doing so carries risks for both. When *Samsung* came up with the opportunity to choose the strategy of competing with *Apple* by supplying it with its industry-leading display, it could have temporarily negatively affected *Apple* in the high-end smartphone market if it chose not to do so. However, if it had not accepted this strategy, *Apple* could have gone to LG or BOE (companies that also supplied these screens). It is also important to note that *Apple* is also known for helping its suppliers improve quality. In this way, through this cooperation, *Samsung* would obtain this important benefit, in a context and in a sector where quality is increasingly appreciated by customers. In addition, as Brandenburger and Nalebuff (2021) point out, *Samsung*'s benefit as a technology provider is twofold, since, as mentioned, accepting this cooperation prevented *Apple from* offering this agreement to other competing companies and, therefore, from benefiting from this aid in improving quality, which could give them a competitive advantage, as well as a large increase in profits. Therefore, this coopetition between *Apple* and *Samsung* was an advantage for both parties. On *Apple* it had a loyal customer base and on *Samsung* it had the best display. None of the company would have achieved the extra value of putting the top screen on the new iPhone without this strategy (Brandenburger and Nalebuff, 2021).

On the other hand, the agreement took place while a legal battle between the two companies was unfolding. As Brandenburger and Nalebuff (2021) point out, while they were reaching this agreement, they were at the same time fighting in the courts a lawsuit of millions of dollars because of a confrontation over patent infringements. Thus, *Apple* cooperated with an autonomous part of *Samsung*, while competing and suing another.

This event only highlights the current importance of coopetition in which two companies with a great rivalry and disputing legal battles can put aside their differences, reaching important agreements and providing mutual help. In this way, both companies are able to obtain positive synergies with each other, as well as to achieve competitive advantage and significant benefits.

Discussion and conclusions

Coopetition since its first appearance in the 80s, its conceptualization in 1996 with its two

creators and the different approaches and theories from which it has been studied, is a term that has gained popularity over time. It is also a term with different levels, degrees or related concepts. It can be analyzed as a process or as a result, depending on the level of application, of analysis or degree of intensity. It is also characterized by its hybrid behavior, where depending on the level of analysis, the competitive and cooperative are part of a continuum (individual, team and organizational) or are separated by activity and/or spatial boundaries (inter-organizational and network).

The coopetition strategy, like any strategy, has different benefits, costs and risks for organizations. However, the literature suggests that the benefits of coopetition outweigh the risks and costs. The benefits include new opportunities, synergies, reduced resilience, greater access to external resources, development of competitive advantages, etc. But there may also be financial costs, risks of opportunism or poor choice in people, loss of knowledge or control, etc.

The bibliometric analysis has identified 216 references published on coopetition with almost 600 citations, distributed during the period 2005-2020. It is from 2016 when there is a significant increase in publications, becoming a term of great interest for companies and academia. Coopetition has been shown to be directly related to innovation and technology, and therefore it has been considered appropriate to apply it to specific cases within high-tech sectors, such as automotive and telephony.

With the in-depth study of different companies in the automotive sector and in Samsung-Apple case in the telephony sector, we can conclude that coopetition is a challenge, but at the same time is a very useful choice to face all technological advances in a constantly evolving market, where both companies achieve mutual and proportionally greater benefits. It has also been shown that coopetition between giants, such as Samsung and Apple, leads to subsequent coopetitions between companies linked to advanced technological development. This can set an example and open the way for coopetition to the rest of the companies, since we are in a very competitive context, with huge needs and demands for cutting-edge technology and knowledge.

For this reason, it is necessary to carry out empirical studies, both qualitative and quantitative that would demonstrate the usefulness of coopetition as an innovation strategy in highly technological sectors and as a source of competitive advantage for companies in general. This research points in this line, but it does not go far enough. The objective of this paper has been to demonstrate the lack of publications on this subject and at the same time the growth experienced by it during the last four years. Having achieved this objective, the next step must be to carry out an in-depth analysis on the impact of coopetition on the economy and on businesses by studying other cases in other economic sectors.

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Innovation and public policies as factors to promote the development of tourism organizations in Colombia

Innovación y políticas públicas como factores para promover el desarrollo de organizaciones de turismo en Colombia

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Abstract: the tourism sector plays a crucial role in the economic and social development of regions, making it important to analyze it from various perspectives. One such perspective is the dynamics underlying organizational innovation within the sector, as influenced by state actions and their impact on outcomes. Therefore, the aim of this research is to examine the relationship between public policies and innovation in tourism companies, recognizing it as a fundamental factor for promoting actions that enhance organizational competitiveness. This correlational study focused on analyzing data obtained from a survey administered to 100 small and medium-sized tourism enterprises in a specific region of Colombia between 2020 and 2021. The collected data were analyzed using a second-generation multivariate method called partial least squares structural equation modeling (PLS-SEM) through SmartPLS software. The findings of this study confirmed the existence of a significant relationship between the management of public policies, specifically observed through transparency, and the level of innovation within the analyzed organizations. Moreover, the structural model exhibited a satisfactory fit, and all four hypotheses formulated for the transparency construct and its relationship with innovation were supported. Therefore, by enhancing governance practices such as good governance and anti-corruption measures, organizations can foster a culture of innovation that permeates throughout their operations.

Keywords: tourism, innovation, transparency, governance, public policies, good government, business development, legitimacy.

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Resumen: el sector turismo por su importancia en el desarrollo económico y social de los territorios merece ser analizado desde diferentes perspectivas, como, por ejemplo, la dinámica que subyace a la innovación de las organizaciones del sector; por cuenta de las acciones del Estado y su injerencia en los resultados de estas. En ese sentido, el propósito de esta investigación es establecer la relación entre las políticas públicas y la innovación de las empresas del sector turismo, como factor fundamental para promover acciones dirigidas a fortalecer la competitividad de las organizaciones. Este estudio correlacional analizó los resultados obtenidos de un instrumento aplicado a 100 pequeñas y medianas empresas turísticas en una región de Colombia durante 2020-2021. Los datos se analizaron utilizando un método multivariado de segunda generación, conocido como modelado de ecuaciones estructurales de mínimos cuadrados parciales, a través del software SmartPLS. Fue posible verificar la validez de la relación entre la gestión de las políticas públicas, observada a partir de su transparencia, y la innovación en las organizaciones analizadas. Igualmente, el valor del modelo estructural mostró un buen ajuste y las cuatro hipótesis propuestas para el constructo de transparencia y su relación con la innovación son válidas, por lo que, al mejorar la gobernanza desde pilares como el buen gobierno y prácticas anticorrupción, se puede favorecer la generación transversal de innovación en las organizaciones.

Palabras clave: turismo, innovación, transparencia, gobernanza, políticas púbicas, buen gobierno, desarrollo empresarial, legitimidad.

Introduction

Tourism is known as a strategic activity that promotes economic development by fostering interaction among various actors and generating a significant flow of migration and foreign exchange. Consequently, tourism has a pivotal place in the economic agenda of countries, seeking to strengthen this sector through public policies aimed at the efficient management of the resources and capacities of their territories (Spasojevic *et al*., 2019).

According to the World Tourism Organization (UNWTO), this sector plays a crucial role in the recovery of the global economy, with an estimated growth of 4% in 2022 and 3.5% in 2023, figures that are far from the pre-pandemic period, where tourism ranked third as an economic activity in terms of employment and development, behind only fuels and chemicals (UNWTO, 2022).

Although tourism has been impacted by the health crisis that affected the contribution to the Gross Domestic Product of the country (Rastegar *et al*., 2021), it is recognized its importance in aspects such as employment generation and per capita income. This is a critical factor for the legislative body to adopt timely actions aimed at strengthening the sector through the consolidation of competitive advantages, which must be based on good behavior of the State, seeking transparency in spending associated with ethics in the exercise, among other aspects (Salem *et al*., 2022).

Authors such as Pan *et al*. (2021) recognize that promoting transparency, based on the comprehensive compliance of government plans and programs, is an important aspect that favors foreign direct investment, particularly in the sector, which strengthens business dynamics, which aim to strengthen competitive and innovative tourism (Kock *et al*., 2019).

However, there are gaps such as the consolidation of a value-added supply of tourism services (Ramires *et al*., 2018), aspect that should consider the revitalization of the R&D&I system, in favor of the empowerment or generation of goods or services, the improvement of processes and the organizational system, as well as marketing activities; this according to the innovation categories proposed by the Oslo Manual, published by the Organization for Economic Cooperation and Development (OECD) and Eurostat (2018).

This puts in context the urgent need to work for the formulation and orientation of a public policy, based on criteria such as innovation and the generation of shared value, among other attributes that should motivate the normative spirit of the sector, seeking compliance with the agreements agreed from transparency, good legislative practices and reduction of corruption, among other aspects that should characterize governance (Law *et al*., 2019).

Therefore, the purpose of this work was to address public policy from the dimension of transparency and innovation of tourism organizations in a region of Colombia. A data collection instrument was applied, which was treated by means of a structural equations model (Smar-

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tPLS), to validate four hypotheses that aim to recognize the elements that influence the generation of organizational innovation in services, processes and marketing.

An approach to innovation and public policies

It is important to mention the efforts made to establish the relevance between public policy, from its transparency, and its supposed relationship with innovation in organizations, while there is theoretical evidence, which tends to establish causal relationships between both constructs. In the words of Sarthou (2018), the policy agenda must promote several competitive factors, such as innovation, to stimulate the development of territories.

Tourism in micro, small and medium enterprises (MSMEs) in Colombia has benefited thanks to a regulatory framework supported in the promotion of the service, acting through subsidies, tax benefits, attraction of Foreign Direct Investment, among others. However, the policy that has been adopted has not yet managed to go beyond aspects of innovation (Volgger *et al*., 2021); at the same time, doubts remain about the effectiveness of instruments in terms of equity and transparency, which have finally affected the generation of value in the value chains that are part of the tourism cluster (Chandra and Kumar, 2021).

According to the literature, innovation is classified into four categories that account for the design or launch of new or improved products or services; process improvement; organizational or management innovations and marketing. Innovation in tourism is known as a creative act that results in the incremental or disruptive modification of services or products related to gastronomy and other activities; the processes necessary for their elaboration or provision of the service; the activities associated with marketing to favor communication and customer focus and, finally, organizational issues to improve performance in the sector (Wadho *et al*., 2019). Thus, the changes arise as a consequence of the conjugation of knowledge and technological tools developed in organizations on their own or through collaborative networks, which in any case are energized by the action of political management (García-Cortijo *et al*., 2019).

An aspect of public policy that favors innovation, as a route to strengthen tourist activity, focuses on the development and maintenance of relationships based on clear regulations on good behavior of the Public Function, its due disclosure, as well as monitoring and surveillance mechanisms to ensure their comprehensive compliance. Prior to this, the process of managing dynamic actions, which emerge from the initiative of the executive body (as a genesis of state policies) leads to reflect on the various expectations of actors, seeking to reach common agreements, as an initial stage in the development of the activities under study (Rincón, 2019; Dwyer, 2022).

One of the main concerns that have revolved around tourism planning and management is the urgent need to promote successful governance processes, through open, participatory processes that convene the various stakeholders (Sofyani *et al*., 2022). Nunkoo *et al*. (2012) say that the transparency of the agents involved in the management of tourism reinforces the good development of the activities that make it up. Thus, transparency from public management has been positioned as a success factor in tourism companies in the 21st century (Lai and Wong, 2020). In fact, the transparency of public action has a dynamizing effect on the competitive attributes of tourism, leading to a supply of services with added value, among other benefits associated with the promotion of innovation in its different typologies (Seraphin *et al*., 2018).

Marrero (2014) indicates that public policies on innovation should focus on the coherence and coordination of their instruments with the management developed by companies, encouraging production systems based on the use of smart technologies and systems to achieve a sustainable and competitive business, focused on the permanent development of new processes and products.

Zabala-Iturriagagoitia (2017) argues that there are gaps in Colombia regarding the promotion of innovation, particularly in the development of new tourism services; in this sense, the State should seek to allocate sufficient and permanent financial resources to encourage investment in

research, development, and innovation, which allows on behalf of an efficient management of the budget, to enhance the development of new tourism products or improved processes.

Likewise, it is necessary to address an articulation of the actors of the innovation system, which, in a kind of institutional governance, is able to generate a virtuous circle in the production of highly innovative goods and services (Nogare *et al*., 2022). Based on the above, two hypotheses are proposed:

H1 Transparency in public policy management positively affects innovation in tourism products/services.

H2 Transparency in the management of public policies has a positive impact on innovation in the processes of the sector.

Public policy, on the other hand, can influence the development and diffusion of innovation in marketing, by formulating a regulatory framework that protects intellectual property rights, stimulates free competition and quality in the market (through monitoring and control with technical quality parameters), ensuring continuous improvement in distribution practices, marketing or improving customer satisfaction and therefore strengthening the corporate image (Arundel, 2019).

Likewise, the State, through the instrumentalization of its government programs, should promote a competitive scenario, where the digitalization of marketing strategies are a key pillar in the dissemination and promotion of goods and services, through the effective use of digital channels and other convergent technologies (Edwards-Schachter, 2018).

The strengthening of the digitization of business models has a transversal scope in the management of organizations (Nawrocki and Jonek-Kowalska, 2023), therefore its implementation, besides achieving a significant increase in operational income (considered as an organizational innovation variable according to the Oslo Manual), leads to the generation of competitive advantages, which as a result of the modernization process, pays in greater operational efficiency, associated with lower production costs and other benefits compared to the management and development of businesses (Buchana and Sithole, 2023). Thus, the study aims to demonstrate the validity of hypotheses three and four, which are presented below:

H3 Transparency in public policy management positively affects organizational innovation in the sector's MSMEs.

H4 Transparency in the management of public policies positively affects the innovation in marketing of the sector's MSMEs.

This document constitutes an effort to identify the relationship between public policies -from transparency, as a mediating variable- and innovation of companies in the tourism sector, as a fundamental factor to promote actions aimed at strengthening the competitiveness of organizations, considering the capacity of the State to promote actions based on pillars such as accountability, continuous improvement, zero corruption, good governance practices, among other aspects, that generate trust and legitimacy to the different actors of the economy and help boost business fabric positively.

In line with the contributions of Calzada and Peña (2020) who consider the close relationship between transparency in public management and the incidence in innovation processes in the tourism sector, the research aimed to address these constructs, particularly in the MSMEs of the tourism sector of a city in Colombia.

To measure and assess the association between the construct of innovation and public policy, a scheme of dimensions and variables was built, which have been validated in various investigations. The scheme relates through a multivariate model to establish its possible association and validate the hypotheses.

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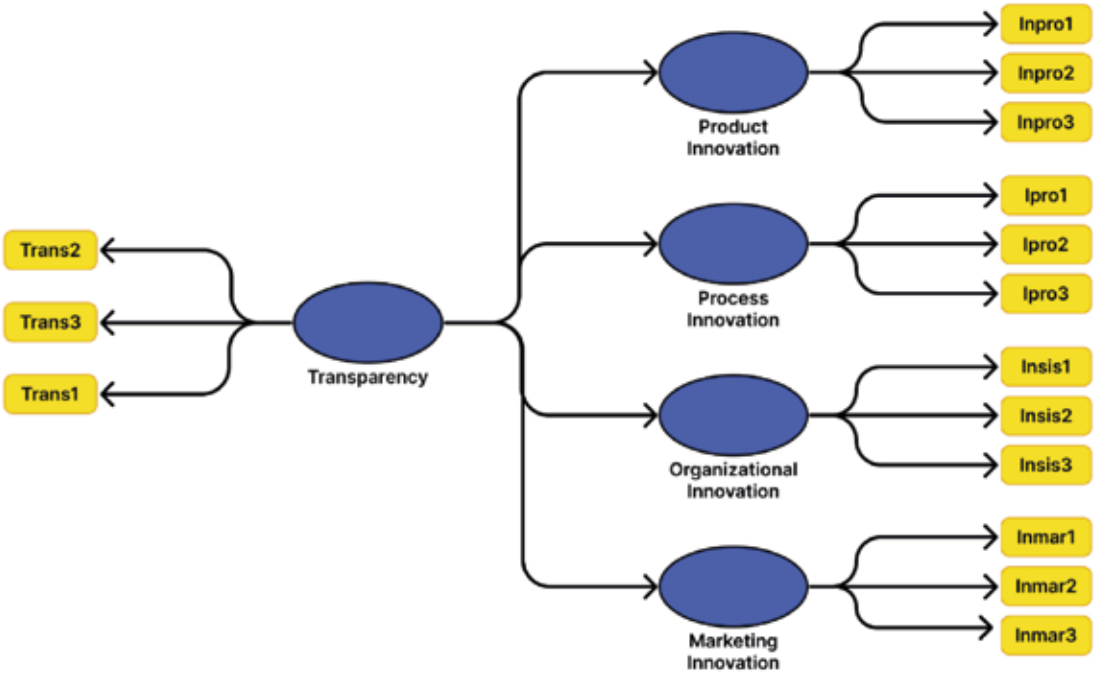
Table 1
Constructs, dimensions and variables considered in data collection

Construct	Dimensions	Variables	Reference
Public Policy	Transparency	Public administration takes seriously criticism and suggestions for improving good governance (Trans 1)	Villoria and Iglesias (2017); Beshi and Kaur (2020)
		Public administration is prepared for public and media exposure (Trans 2)	Osorio-Sanabria and Barreto Granada (2022); Sofyani *et al.* (2022)
		Public administration takes seriously the errors found by state control bodies (Trans 3)	Lugo (2016); Moore (2018)
Innovation	Products / Services	Changes or improvements to existing products / services (Inpro 1)	Alcalde (2016); Arenas (2017); Edwards-Schachter (2018)
		Marketing of new products / services (Inpro 2)	Zuñiga-Collazos *et al.* (2019); Nogare *et al.* (2022)
		Research and development to create new products (Inpro 3)	Sarmiento *et al.* (2022); OECD (2018)
	Processes	Changes or improvements in production / service processes (Ipro 1)	Zuñiga-Collazos *et al.* (2019); Fuglsang *et al.* (2021)
		Purchase of new assets and equipment (Ipro 2)	OECD (2018); Paredes-Frigolett *et al.* (2021)
		Coordination of the improvement areas of the company (Ipro 3)	Nogare *et al.* (2022); Gault (2018)
	Organizational	Direction and management (how to run and manage the company) (Insis 1)	Edwards-Schachter (2018); Buchana y Sithole (2023)
		Purchases and acquisitions (how to direct and carry out the purchase and acquisition of what the company needs) (Insis 2)	Mendoza-Silva (2021); Nawrocki y Jonek-Kowalska (2023).
		Trading / Sales (Insis 3)	Wadho *et al.* (2019); Arosa *et al.* (2022)
	Marketing	Application of marketing strategies that improve customer satisfaction (actions undertaken to satisfy customers) (Inmar 1)	Zuñiga-Collazos *et al.* (2019); OECD (2018)
		Application of marketing strategies focused on meeting customer needs (actions undertaken to meet needs) (Inmar 2)	OECD (2018); Mendoza-Silva (2021)
		Application of marketing strategies focused on improving the image of the products and services of the company. (actions undertaken to improve the image) (Inmar 3)	Arundel *et al.* (2019); Edwards-Schachter (2018)

Then, the theoretical model considered for the research is shown, which integrates the theoretical positions and reflections associated with the considered constructs.

Figure 1
Theoretical model. Transparency with types of innovation



Materials and methods

The study considered a correlational research using a second generation multivariate method known as partial least squares structural equation modeling (PLS) with SmartPLS software. This technique is a quantitative research approach that allows visualizing the interactions and interdependence relationships between the variables that represent the hypotheses to study. For variables, the database was debugged, where the scatter values are in a range less than 0.2. In this sense, according to Hair *et al*. (1998), the use of the Pearson correlation coefficient is justified, since the sample has a normal distribution.

This technique has the purpose of estimating the equations that show the possible relationships between explanatory and predictive variables, as well as the measurement model that identifies the relationships between the constructs and their indicators, which allows defining each level of construct and evaluating its reliability.

The research was carried out through a random probabilistic sampling, guaranteeing the representativeness of the sample and the elimination of biases, which favors the rigor of the study. It should be noted that the population considered as object of study is composed of MSMEs of the tourism sector in Santiago de Cali, registered with the Chamber of Commerce and corresponding to 2434 business units (SITUR, 2020).

Santiago de Cali, capital of Valle del Cauca, is the third most important city for its contribution to the national GDP, while Valle del Cauca is the third city with the highest population density, having an estimated population of 4 532 152 inhabitants by 2020, according to a census conducted by the National Administrative Department of Statistics (DANE, 2018).

For its calculation, the parameters for a finite population according to Hernández *et al*. (2014) were considered, which for a confidence level of 95 %; probability of success of 50 % and a maximum error of estimate of 10 %, assumes that 92 MSMEs constitute a random sample that turns out to be representative, guaranteeing that the results conform to the central parameter of the total population, which is 2434 companies. However, due to the freedom of judgment, it was decided to approach the sample and apply the instrument

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to 100 companies of the tourism sector located in the city of Santiago de Cali.

The companies were randomly selected from the database provided by SITUR (2020), where 52% have up to ten workers (micro-enterprise); 34% between 11 and 50 (small enterprise) and the remaining 14% between 51 and 200 (medium enterprise). Out of these, 45% correspond to the lodging subsector; 23% are restaurants; 16% travel agencies; while the other 16%, declared to belong to other subsectors. Finally, 80% of companies have been in the market for more than 4.1 years, 11% for 2.1-4 years and only 9% for up to two years.

A survey was applied as an instrument consisting of 15 variables, presented in detail in Table 1, of which three items measure the construct of public policy and 12 of innovation. To assess each of the proposed variables, a five-point Likert scale was used, ranging from minor to very important, in order to know the perception of the participants against the transparency and confidence of the policies developed around the tourism sector in Colombia, as well as to investigate whether the policies have promoted any change or improvement in the different typologies considered.

In 2020 and 2021, a closed political poll was applied to legal representatives or managers of tourism MSMEs, whose results are presented graphically using SmartPLS software.

Validation of the scale

In order to accept the measurement model, the validity of the selected indicators and their internal consistency were analyzed, in that sense the test was carried out through the convergent-discriminant validity and the Cronbach coefficient, together with the composite reliability. It is accepted that the measurement of a construct turns out to be valid, when the implemented variables aim to assess with precision the established items (Parapari *et al*., 2022). Discriminant and convergent validity was used as a mechanism to ensure the reliability of the valuation (Peñaherrera-Zambrano *et al*., 2020), while the Cronbach coefficient and composite reliability were used to measure the reliability of a measurement scale. According to the literature, a minimum value of 0.70 for the Cronbach coefficient is suggested, while Fornell and Larcker (1981) refer to values greater than 0.70 and 0.5 for the composite reliability index [IFC] and convergent validity (reliability of the indicator and the mean variance extracted) [AVE], respectively.

As for internal consistency, the results allow establishing the reliability of the applied instrument, in addition, the scale reliability indicators for the first-order constructs meet the requirements of convergent validity, so it is shown that the set of indicators effectively measures the specific construct and are not addressing a different one.

Table 2
Reliability of the first-order construction scale

	Cronbach's Alpha	IFC	AVE
Product Innovation	0.717	0.760	0.839
Marketing Innovation	0.789	0.805	0.876
Process Innovation	0.713	0.715	0.839
Organizational Innovation	0.726	0.727	0.845
Transparency	0.796	0.803	0.881

In addition, the Fornell and Larcker criterion (1981) and the HTMT matrix (Henseler *et al*., 2016) were applied for discriminant validity, in which according to the authors mentioned, a construct is considered valid in terms of discrimination when its AVE is higher than the square of the correlations between that construct and the others. According to table 3, the discriminant validity is confirmed.

Tabla 3
Fornell and Larcker criteria

	Product Innovation	Marketing Innovation	Process Innovation	Organizational Innovation
Product Innovation	0.798			
Marketing Innovation	0.622	0.838		
Process Innovation	0.699	0.635	0.796	
Organizational Innovation	0.737	0.693	0.780	0.803
Transparency	0.496	0.269	0.405	0.410

The success rate in internal consistency and convergent-discriminant validity reinforces the suitability of the instrument, so the measurement scales are reliable to relate public policy (from transparency) and innovation of tourism MSMEs in Valle del Cauca.

Results

The result of the SEM model is presented in Figure 2, where it is assumed that 40.5%, 41% and 26.9% of the results in process of innovation, organization, and marketing, respectively, are explained by favorable situations (or improvements) in the transparency of government actions. This positive relationship shows that transparency is a principle of good governance that improves the decision-making process and generates confidence in the business to advance innovation actions, which is essential to competitiveness.

Figure 2
Resultant model of the PLS algorithm

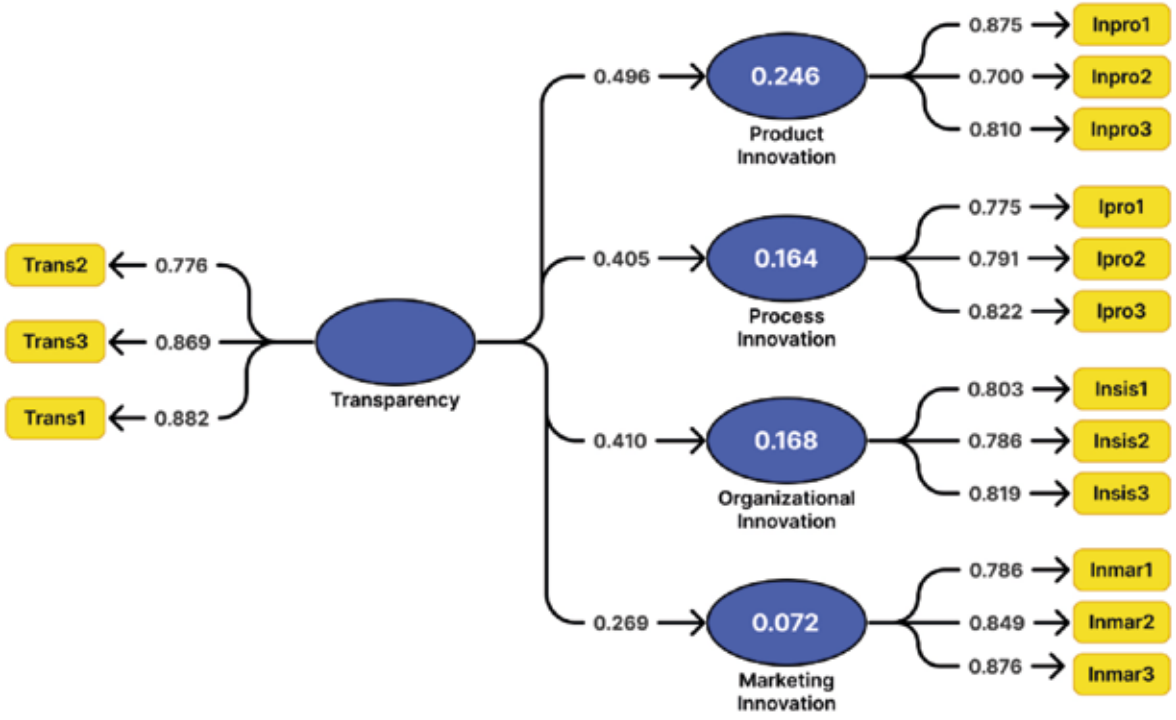

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Table 4 presents the results of the determination coefficient for innovation and its four dimensions, observing the presence of a positive relationship between them. As the results are statistically significant, it is considered that the dimensions of innovation are interdependent and that, in turn, a change in transparency (as predictive variable) has a directly proportional (positive) influence on the development of services in the sector and its continuous improvement (as a sine qua non characteristic of innovation). In addition, the PLS results are conclusive in terms of the association between each dimension and its variables (represented in the yellow rectangles), reason enough to validate the model.

Table 4
Innovation determination coefficient (R square)

Construct	R Square	Adjusted R Square
Product Innovation	0.246	0.240
Marketing Innovation	0.072	0.066
Process Innovation	0.164	0.158
Organizational Innovation	0.168	0.162

On the other hand, table 5 shows the level of significance of the hypotheses, considering as criteria the value T >1.965 and the p-value <0.05 (the p-value is defined as the probability that a calculated statistical value is possible given a certain null hypothesis); it is concluded that the four hypotheses are significant and approved. The value of the standardized root mean quadratic residue (SRMR.) of the structural model is 0.069, so according to Hu and Bentler (1999) it meets an optimal goodness of fit. According to Hair *et al*. (2021) and Ringle *et al*. (2014), the goodness of fit index of the model is based on the criteria of numerical validity, convergent and discriminant validity; likewise, when running the model with PLS and obtaining the SRMR, these criteria allow its validation, and according to the ranges defined by the authors mentioned above, it is assumed that meets goodness of fit. Likewise, the mean square root error index of the RMSEA approximation is 0.041, while the Tucker-Lewis Index (TLI) is 0.6541, so, according to Levy and Varela (2006) and Kline (2011), it is possible to show that the model of confirmatory factor analysis fits satisfactorily (Reyes-Ramirez *et al*., 2022).

Table 5
Hypothesis testing

Hypothesis	Original Sample	Average of sample	Standard deviation	T Statistics	P-values	2.5%	97.5%	C / NC
Transparency -> Product Innovation	0.496	0.502	0.084	5.875	0.000	0.337	0.648	C
Transparency -> Innovation Marketing	0.269	0.276	0.109	2.467	0.014	0.080	0.474	C
Transparency -> Process Innovation	0.405	0.414	0.087	4.636	0.000	0.237	0.568	C
Transparency -> Organizational Innovation	0.410	0.418	0.090	4.549	0.000	0.237	0.581	C

*C = Confirmed *NC=not confirmed.

The model offers a goodness of fit, so it is acceptable under the estimated function to establish a possible association between the constructs addressed; in this sense it is recognized that before participatory processes in public administration, which consider the gaps or shortcomings detected by the different actors as a feedback mechanism and continuous improvement in political management, it is possible to positively impact the innovation results of the MSMEs. This scenario allows validating the fact that transparency offers an institutional framework that makes viable the actions of the State, positively affecting the public agenda and the State programs that aim for the strengthening of the business (Calzada and Peña, 2020). The statistical analysis states that 49.6% of the cases where innovation in goods or services occurs (which is the strongest relationship), is due to transparency in public policies of the sector.

Conclusions and discussions

The purpose of this research was to know the relationship between public policies and innovation of MSMEs in the tourism sector, as a key factor to promote the competitiveness of these companies. A positive relationship was found between transparency in the management of public policies and innovation in the organizations studied, so it is possible to increase the innovative capacity of companies to the extent of consolidate the actions of respect and equity between the different actors.

Through an in-depth literature review, it has been shown that the influence of the state is vital to dynamize the innovation of the business (Sainaghi and Baggio, 2021), however, there is not enough empirical evidence to study both constructs from transparency, taking as reference MSMEs for its analysis in the tourism sector. Therefore, the purpose of this work was to address the dimension of transparency and tourism innovation in a region in Colombia. For which, a data collection instrument was applied, which was treated through the modeling of structural equations (SmartPLS), in order to test four hypotheses that aim to specify elements that affect the generation of organizational innovation in services, processes and marketing.

The research allows us to suppose that the results of innovation in services/products, processes, marketing and organization are favored by the transparency in the management of public policies of the State, important reasons to consolidate a governance system that manages to balance the interests of all actors, achieving ethics, integrity and good practices, in order to consolidate competitive scenarios for the region. By empirically validating the hypotheses proposed in the work, it is assumed that transparency in the management of public policies in the tourism sector positively affects the four types of innovation; so that when the government develops a management that transmits confidence in the private sector, it is achieved to impact 49.6% of product innovations (H1); 41% in the development of organizational innovation (H3); 40.5% of cases in processes (H2) and 26.9% in marketing aspects (H4) —ordered from highest to lowest impact—.

The fact of empirically validating the four hypotheses offers an important contribution to knowledge, since the business innovation system can be significantly influenced in a political scenario where transparent behaviors are promoted. However, considering that the relationship between transparency in public policy and product innovation (H1) has the best explanatory adjustment, it can be concluded that the most representative results for organizations in the tourism sector, on behalf of the association between constructs, have been changing or improving in existing products/services, marketing of new products/services and research and development to create new products.

This empirically supports Briceño and Morales´s hypothesis (2017), who conclude that government actions should refocus on the innovation needs of SMEs, guaranteeing widely known instruments and ready to be improved from the feedback of actors, hence leading to a successful performance for the business system.

In fact, for Volgger *et al*. (2021), the transparency of public action has a dynamizing effect on the competitive attributes of tourism, leading to an offer of services with added value, among other benefits associated with the promotion of innovation (Yuniarti *et al*., 2022). In this sense, it

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is required that public policy consider the creation of a regulatory scenario, recognizing the specificities of the sector and the possible asymmetries or intra-sectoral differences between small and large companies, outlining long-term goals for the development of the sector (Roth, 2010). However, the responsibility of the State is not limited to the economic level or expectations expected by the actors; there is also the responsibility to promote accountability associated with their management and results. In other words, there must be transparency in their practices not only to promote governance but also to legitimize the actions of the State. These are important aspects that reflect confidence and promote a favorable image abroad as a tourist destination, which positively impacts on the dynamism of the sector and the activities that make up its productive chain (Wan *et al*., 2022).

The results of this work support other findings, such as those of Lee *et al*. (2020), who affirm that innovation underlies the proper behavior of the legislative power and its interest in consolidating competitive development scenarios that are prolific for organizations. To this end, it is essential that their actions harbor principles of ethics and zero corruption; thus, the premise that the results of innovation are conditioned by the transparency of the State is accepted.

Other studies such as Calzada and Peña (2020) had already mentioned the importance of internal mechanisms for disseminating information as a key space for dialogue with actors. Through the consolidation of the social aspect, it contributes to generate a sense of transparency and continuous improvement in the management of quality of the State; as a key element of governance, which should promote the development of innovative programs that target organizational needs, among other things, (Zheng *et al*., 2022).

This phenomenon may be due to the positive effect that the legal policy environment has had on the innovation ecosystem; thus, in the presence of an ethical regulatory framework and anti-corruption practices, which promote the implementation of properly managed business development instruments, R&D&I activities are favored, particularly in SMEs of tourism (Shin *et al*., 2022).

Thus, a possible association between the dimensions considered is contextualized, which deserve to be taken into account in the instrumentalization of public policies and which are consistent with other studies that mention how the variables innovation and transparency are indissoluble from aspects such as public procurement or program management or simply innovation in public management (Ramírez-Alujas, 2012). Therefore, the findings of this research constitute a significant advance, which will serve as input for future studies that want to deepen on the constructs in question.

This study makes a valuable contribution to scientific knowledge, especially in the field of tourism, by providing from a quantitative technique and a rigorous method, empirical evidence that recognizes transparency in public policies as a factor with a moderate influence on different types of innovation, product innovation being the relationship with the greatest strength. This leads to estimate that the role of the State, from its good practices and efficient management, has a significant impact on the generation of significant improvements in business activity, in this case, for developing a tourism offer with differential values (as a result of new or improved tourist packages or services). In any case, the four hypotheses proposed for the construct transparency and its relationship with innovation are significant (with a T-value >1.965 and P-value <0.05.), being accepted according to the result of the SEM.

As for the limitations of the study, there were difficulties in the implementation of the questionnaire due to the Covid-19 pandemic, which significantly delayed the generation and transfer of results. Finally, as a future perspective of research, it would be interesting to carry out other studies, taking as reference various public policy variables, such as the quality of management or other constructs such as performance and competitiveness, in order to assess the influence of government in generating innovation and business strengthening of organizations, not only in the tourism sector, but also in other economic sectors.

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Infographics

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Impact of the pro-environmental organizational climate on the commitment and sustainable behavior of workers in Peru

Authors
Elizabeth Emperatriz García-Salirrosas

Objective

To propose a theoretical model where the pro-environmental climate (PEOC) impacts on the commitment for the employer brand (CEB), affective commitment (AC), emotional attachment (EA) and pro-environmental behavior in the workplace (PEBW)

Methodology

An online survey was conducted, and information was collected from 863 workers of companies located in Lima. The data were analyzed with the partial least squares path modeling method using SmartPLS software to test the hypotheses of the proposed research model.

Results or Conclusion

The results showed a significant positive effect of the pro-environmental organizational climate on the commitment for the employing brand and the affective commitment.

Results or Conclusion

In conclusion, the organizations that adopt sustainable practices and promote a pro-environmental organizational climate not only contribute to take care of the environment but can also improve several aspects of the work experience of employees.

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Peruvian entrepreneurship in the framework of sustainable development

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Rosana A. Meleán-Romero
Kerwin José Chávez-Vera
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Objective

To establish the relationship between Peruvian entrepreneurship and sustainable development to contribute to the social and economic progress of the country and the achievement of the United Nations Sustainable Development Goals.

Methodology

The methodology used is based on the quantitative approach. A sample of 746 entrepreneurs was selected to which a questionnaire of 40-Likert type options was applied. The Kolmogórov-Smirnov normality test was used, and the Spearman Rho coefficient was used for the analysis.

Results or Conclusion

A moderate positive correlation was found between entrepreneurship and the contribution to the Sustainable Development Goals (SDGs), as well as a moderate to strong positive correlation between entrepreneurship and innovation and adaptability in the field of sustainable development.

Results or Conclusion

The study suggests that entrepreneurship in Peru is significantly related to sustainable development, especially in terms of contributing to the SDGs and promoting innovation and adaptability.

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UNIVERSIDAD POLITÉCNICA SALESIANA ECUADOR | Retos

Contribution to the country brand through the sustainability of production processes in Chile: B Corp

Authors
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Agustín Pablo Álvarez-Herranz
Wileidys Artigas

Objective

To demonstrate the existence of companies that contribute to the country brand by incorporating sustainable mechanisms in their processes, while generating profits and social value.

Methodology

The research was conducted using a mixed methodology and naturalistic method in five phases. 425 companies in Chile were analyzed using the Corp B directory in Latin America and the Caribbean.

Results or Conclusion

This study highlights the contribution of B companies to the country brand in Chile. These organizations are recognized by their commitment to sustainability, their social impact, and their ability to project the country's image globally. Their innovative and responsible business practices make them key actors for sustainable development.

Results or Conclusion

This article highlights the prominent role of B companies in Chile as drivers of sustainability and influential agents in the construction of the country brand. Its progressive approach not only contributes to the country brand, but also promotes sustainable and responsible development.

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Gaussian Process Regression´s Hyperparameters Optimization to Predict Financial Distress

Authors
Amine Sabek
Jakub Horák

Objective

To predict financial difficulty based on Gaussian Process Regression (GPR) and then compare the results of this model and other deep learning models (Support Vector Machine-SVM, Logistic Regression-LR, Linear Discriminant-LD, Decision Tree-DT, K-Nearest Neighbor-KNN)

Methodology

The analysis is based on a dataset of 352 companies extracted from the Kaggle database. Out of the predictors, 183 financial ratios are used. Five types of GPR models are formulated to identify the most optimal model, which is compared with commonly used machine learning models.

Results or Conclusion

The study concluded that the use of GPR achieves significant results. In addition, it outperformed other deep learning models and achieved first place alongside the SVM model with 81% classification accuracy.

Results or Conclusion

The result for highly accurate prediction of firms' financial distress will facilitate maintenance, minimize losses, increase investment rates, preserve job opportunities, prevent layoffs, and maintain a win-win environment for all parties involved.

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Determining factors of informal enterprise closure by gender: a microeconometric study applied in Senegal

Authors
Ayoub Saadi
Assane Beye
Mariem Liouaeddine

Objective

To analyze the impact of the COVID-19 pandemic on informal businesses, specifically comparing those run by women and men. Factors that influence closures were analyzed, highlighting the greater vulnerability of companies run by women.

Methodology

The research used a logistic regression approach and matching method to analyze the impact of the COVID-19 pandemic on informal businesses led by women and men.

Results or Conclusion

The most important result is that businesses run by women experienced a more severe impact on the COVID-19 pandemic, leading to a higher likelihood of temporary closure compared to businesses run by men.

Results or Conclusion

The COVID-19 pandemic had a disproportionate impact on businesses run by women, resulting in more frequent and longer temporary closures compared to businesses run by men, indicating the need for gender-specific support measures.

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Trade and inclusive economic growth: China and Latin America (2004-2021)

Authors
Harold D. Angulo-Bustinza
Jenny Paola Lis-Gutiérrez

Objective

To analyze the connection between China's trade with Latin America and the GEI in the period between 2004 and 2021, exploring how trade dynamics between both regions influence income distribution and economic exclusivity.

Methodology

The research collects data from 13 Latin American countries using quantitative methods and a longitudinal design, and it uses panel data models to evaluate the relationship between InT and IEG, considering the influence of China's foreign direct investment (FDI).

Results or Conclusion

The analysis reveals a negative and significant correlation between Latin American exports to China and inclusive economic growth (IEG) in the region, suggesting that an increase in exports is associated with a decrease in the IEG

Results or Conclusion

Dependence on trade with China may be contributing to inequality and the deterioration of inclusive economic growth in Latin America. It suggests the need for policies to mitigate the negative impacts of trade with China on income distribution and foster more inclusive growth

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Inter-business coopetition. Theoretical description and application to technological sectors

Authors
Carmen Blázquez-Jiménez
Joan Ramon Sanchis

Objective

The paper defines the theoretical framework of the competition, identifying its concept, scope, typology and benefits, and applying it to the technological sectors of automotive and telephony.

Methodology

A bibliometric analysis of the competition was carried out through the Web of Science database to determine the existing publications in this field.

Results or Conclusion

Competition has become a business strategy aimed at obtaining additional resources and capabilities capable of generating a competitive advantage for the company.

Results or Conclusion

There has been an increasing trend in the number of publications since 2005, suggesting that this is a growing term of current interest for research.

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Innovation and public policies as factors to promote the development of tourism organizations in Colombia

Authors
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José Fabián Ríos-Obando
Lina Marcela Vargas-García

Objective

To recognize the relationship between public policies and innovation of MSMEs in the tourism sector, as a key factor to promote the competitiveness of these companies.

Methodology

A data collection instrument was applied, which was treated by means of a structural equation modeling (SmartPLS), to validate four hypotheses that aim to recognize the elements that influence the generation of organizational innovations in services, processes and marketing.

Results or Conclusion

40.5%, 41% and 26.9% of the results in process innovation, organizational aspects and marketing, respectively, are explained by favorable situations (or improvements) in the transparency of government actions.

Results or Conclusion

Transparency is a principle of good governance that improves the decision-making process and generates confidence in the business fabric to advance innovation actions, which is a pillar towards competitiveness.

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Basic writing rules

Universidad Politécnica Salesiana del Ecuador

General information

"Retos" is a bilingual scientific publication by the Universidad Politécnica Salesiana de Ecuador, which has been edited on a bi-annual basis since January 2011. The journal focuses on Development and transdisciplinary issues including Public Administration, Social Economics, Marketing, Tourism, Entrepreneurship, Management, Administrative and Economic Science, etc.

It is an arbitrated Scientific Journal that uses an external evaluation system known as *peer-review*, employing *double-blind review*, in accordance with the American Psychological Association (APA) style rules. By using this system, the authors have access to an objective, impartial and transparent review process, which facilitates their publication being included in databases, repositories, and international indexed references.

"Retos" is indexed in the selective directory and catalog of the Online Regional Information System for Scientific Journals in Latin America, the Caribbean, Spain, and Portugal (Latindex), in the REDALYC Scientific Information System, the Directory of Open Access Journals in repositories, libraries, and specialized catalogs in Ibero-America.

The Journal is published with two different editions: printed (ISSN: 1390-62911) and electronic (e-ISSN: 1390-8618), in Spanish and English, and each article is identified with a DOI (Digital Object Identifier System).

Scope and policies

Themes

Original contributions in Development issues, as well as related fields: Public Administration, Social Economics, Marketing, Tourism, Entrepreneurship, Management...and all other disciplines related to the central thematic issue.

Contributions

"Retos" preferably publishes the results of empirical research about Development, written in Spanish and/or English, while reports, studies, and proposals are also accepted, as well as reviews of state-of-the-art literature.

All of the publications must be original, never have been published in any other journal, and not be undergoing any arbitration or publication processes. Contributions to the journal can include any of the following:

- **Research:** 5,000 to 6,500 words of text, including the title, abstracts, keywords, tables, and references.
- **Reports, Studies, and Proposals:** 5,000 to 6,500 words of text, including the title, abstracts, tables, and references.
- **Reviews:** 6,000 to 7,000 words of text, including tables and references. Justified, current, and selective references shall be evaluated, and should include around 70 publications.

"Retos" is published bi-annually (20 articles per year), in April and October, and each edition has two sections with five articles each, the first containing a **Monograph** theme edited by subject matter experts, and a second **Miscellaneous** section, made up of diverse contributions related to the publication's theme.

Presentation, structure, and submission of manuscripts

Papers are to be presented with Arial 10 typeface, single line spacing, all justified, without indentation or blank spaces between paragraphs. A space is only to be included between the major sections (title, authors, abstracts, keywords, credits, and epigraphs). All margins on each page must be 2 cm.

The papers are to be presented in Microsoft Word format (.doc or .docx), and the file is to be anonymous in the File Properties such that the author(s) is(are) not identified.

Manuscripts are to be submitted only through the OJS (Open Journal System), in which all authors must first register. Original papers sent via email or another interface are not accepted.

Manuscript Structure

For papers that are empirical research, the manuscripts are to follow IMRDC structure, while Notes and Contributions epigraphs are optional. Papers that constitute reports, studies, proposals, and reviews are afforded greater flexibility in terms of epigraphs, especially in relation to Materials and Methods, Analysis and Results, and Discussion and Conclusions. All types of papers are required to include References.

2. **Title (Spanish) / Title (English):** Concise but informative, the first line in Spanish and the second, in English. Maximum 80 characters are accepted, including spaces. The Editorial Board is allowed to propose changes to the author's title.
3. **First and last names:** of each of the authors, organized in order of priority. Maximum three authors are accepted per original paper, although justified exceptions may be allowed, based on the theme, complexity, and length. The names are to be followed by the professional category, workplace, each author's email address and ORCID number. It is mandatory to include whether the author has a doctorate degree (Dr. before the name).
4. **Abstract (Resumen, Spanish) / Abstract (English):** This section can contain a maximum of 230 words, first in Spanish and then in English. The abstract shall concisely contain the following, and in this order: 1) Justification of the theme; 2) Objectives; 3) Methods and sample; 4) Main results; 5) Main conclusions. It should be written impersonally "This paper analyzes..." In the abstract, automatic translation is not accepted due to its poor quality.
5. **Keywords (descriptores, Spanish) / Keywords (English):** Six keywords are to be included for each language, and must be directly related to the paper's theme. This requirement shall be scored based on whether the keywords can be found in the UNESCO Thesaurus.
6. **Introduction and State of the Question:** The section proposes the question, the context of the issue surrounding it, justification, basis, and proposal for the study, using bibliographic references, including the most important up-to-date literature on the theme, both nationally and internationally.
7. **Material and Methods:** This is to be composed in such a way that the reader can easily understand how the research was performed. As appropriate, describe the method, sample,

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sampling, and refer to the type of statistical analysis used. If it is an original method, present the reasons for applying it, and describe any possible limitations.

8. **Analysis and Results:** This section should seek to highlight the most important observations, and without including any value judgments, describe the methods used. Throughout the text, essential tables and figures shall be included in a logical sequence, without repeating any data.
9. **Discussion and Conclusions:** This section summarizes the most important findings related to any observations from relevant studies, pointing out contributions and limitations, without repeating data from other sections. The discussion and conclusions paragraph is to include inferences and new lines of research for the future.
10. **Contributions and acknowledgment (optional):** The Science Editors Board recommends that the author(s) specify the financing source for their research. Priority shall be given to work endorsed by competitive national or international projects. Regardless, for the manuscript to be scientifically evaluated, it is to be anonymized with an XXXX only for the initial evaluation, in order to avoid identification of any of the authors or research teams, which are to be named in the Cover Letter and later, in the final manuscript.
11. **Notes** (optional) are included, only if necessary, at the end of the article (before the references). They are to be included manually, since the Word footnotes are not recognized by the layout systems. Note numbers are to be included using superscript, both in the text and in the final note. Notes including simple bibliographic references (without comments) are not allowed, since these are supposed to be included in the references.
12. **References:** Bibliographic references are to follow the text references. Under no circumstances should references be included that have not been cited in the text. There should be enough references in order to contextualize the theoretical framework, and be based on criteria of contemporary relevance and importance. They are presented alphabetically, according to the author's last name (if the last name has more than one word, based on the first word of the last name).

Rules for references

Periodical publications

Journal article (one author) Valdés-Pérez, D. (2016). Incidencia de las técnicas de gestión en la mejora de decisiones administrativas [Impact of Management Techniques on the Improvement of Administrative Decisions]. *Retos, 12*(6), 199-2013. https://doi.org/10.17163/ret.n12.2016.05

Journal article (up to six authors): Ospina, M.C., Alvarado, S.V., Fefferman, M., & Llanos, D. (2016). Introducción del dossier temático "Infancias y juventudes: violencias, conflictos, memorias y procesos de construcción de paz" [Introduction of the thematic dossier "Infancy and Youth: Violence, Conflicts, Memories and Peace Construction Processes"]. *Universitas, 25*(14), 91-95. https://doi.org/10.17163/uni.n25.%25x

Journal article (more than six authors): Smith, S.W., Smith, S.L. Pieper, K.M., Yoo, J.H., Ferrys, A.L., Downs, E.,... Bowden, B. (2006). Altruism on American Television: Examining the Amount of, and Context Surronding. Acts of Helping and Sharing. *Journal of Communication, 56*(4), 707-727. https://doi.org/10.1111/j.1460-2466.2006.00316.x

Journal article (with no DOI). Rodríguez, A. (2007). Desde la promoción de salud mental hacia la promoción de salud: La concepción de lo comunitario en la implementación de proyectos sociales. *Alteridad, 2*(1), 28-40. (https://goo.gl/zDb3Me) (2017-01-29).

Books and chapters of books

Complete books: Cuéllar, J.C., & Moncada-Paredes, M.C. (2014). *El peso de la deuda externa ecuatoriana*. Quito: Abya-Yala.

Chapters of a book: Zambrano-Quiñones, D. (2015). *El ecoturismo comunitario en Manglaralto y Colonche.* En V.H. Torres (Ed.), Alternativas de Vida: Trece experiencias de desarrollo endógeno en Ecuador (pp. 175-198). Quito: Abya-Yala.

Electronic media

Pérez-Rodríguez, M.A., Ramírez, A., & García-Ruíz, R. (2015). La competencia mediática en educación infantil. Análisis del nivel de desarrollo en España. Universitas Psychologica, 14(2), 619-630. https://doi.org.10.11144/Javeriana.upsy14-2.cmei

All reference that have a DOI (Digital Object Identifier System) must be included in the References (which can be obtained at http://goo.gl/gfruh1). All of the journals and books that do not have a DOI are to appear with a link (to the online version, if available, shortened using Google Shortener: http://goo.gl) and the date of query in said format.

Journal articles are to be listed in English, except for those that are available in Spanish and English, in which case, both languages are to be included in brackets. All internet addresses presented are to be shortened in the manuscript, except for the DOI, which are to be included in the established format (https://doi.org/XXX).

Epigraphs, Tables, and Graphs

The epigraphs in the article's body are in Arabic numbers. These are to avoid all capital letters, underlining, or bold text. Numbering should use maximum three levels: 1. / 1.1. / 1.1.1. A carriage return is to be used at the end of each epigraph.

Tables are to be included in the text in Word format, according to their order of appearance, with Arabic numbering and captioned with a description of their content.

Graphics or figures should be kept to a minimum and incorporated into the text, in accordance with their order of appearance, with Arabic numbers and captions with a short description. Quality should be no less than 300 ppp, if necessary, using TIFF, PNG, or JPEG formats.

Submission process

The papers are to be submitted in two files through the journal's OJS system:

1. **Cover letter and title page,** which includes the title in Spanish and English, first and last names of the authors (standardized format) with ORCID number, abstract in Spanish and English, keywords in Spanish and English, and a declaration that the manuscript constitutes an original contribution that has not been sent for evaluation in another journal, confirmation of the authorship, acceptance (as the case may be) of formal changes to the manuscript according to the rules, and partial transfer of copyright to the publishing house (use the official format).
2. **Completely** anonymized manuscript in accordance with the preceding rules.

All authors are to register on the OJS platform, even if only one of them will be in charge of correspondence. No author can submit two manuscripts simultaneously, with a penalty of not being able to participate in four consecutive editions (2 years)..

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