



Exploring Sustainable Product Innovation in Chinese SMEs During the Covid-19 Crisis

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Abstract

The sudden outbreak of Covid-19 has thrown lives out of balance around the world, and the topic of sustainability is more worthy of study than ever. The purpose of this study is to analyze sustainable innovation from a triple end result (financial, environmental, and social) to help companies become more sustainable over time and to improve the way in which they face economic, natural, and humanitarian crises. This study combines sustainable innovation and the triple bottom line to explore the factors that move firms toward sustainable product innovation based on a natural-resource-based view and stakeholder theory as the theoretical framework. The research is based on a powerful quantitative methodology adapted to the research design, such as a partial least squares structural equation model, to validate and analyze the implementation of sustainable innovation by senior managers of 128 small and medium-sized companies in 11 different sectors in the Chinese context. The empirical results indicate that corporate profitability is one driving factor in sustainable product innovation, in addition to environmental and social sustainability, all of which contribute to corporate economic efficiency. Although this paper is based on cross-sectional data, the findings could encourage researchers to investigate the effects of other environmental, social, and financial variables with different types of sustainable innovation further the product. The management must promote environmental and social sustainability together with corporate profitability since it is clear how all of them promote the innovation of sustainable products. The main contribution of this research is a new empirical evidence on the joint influence of environmental, social, and economic development on sustainable product innovation. In addition, the study includes valuable data in an intermediate phase (July and August 2021) of the Covid-19 pandemic in the Chinese context. Evidence reveals that companies that have taken a triple bottom line approach to innovation even in adverse pandemic and post-pandemic contexts have succeeded in introducing sustainable product innovations on the market.

Extended author information available on the last page of the article

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Keywords Triple bottom line · Environment management practices · Corporate social responsibility · Corporate profitability · Sustainable product innovation · China · Small and medium-sized enterprises

Introduction

As a consequence of rapid industrial growth and technological development, which have resulted in environmental degradation, excessive energy consumption, and the depletion of natural resources, awareness of sustainability has increased. The United Nations World Commission on Environment and Development (WCED) has introduced the concept of “sustainable development” (WCED, 1987), which has received attention from governments, non-governmental organizations (NGOs), and society, and companies are being called upon to implement initiatives to achieve sustainable development to protect the environment and contribute to the long-term prosperity of the planet. Elkington (1998) integrates sustainability initiatives at a corporate level and proposes a triple bottom line (TBL) framework (i.e., economic, environmental, and social development) to achieve equilibrium among the three pillars from a business-model perspective.

The unexpected worldwide outbreak of Covid-19 in 2020 is regarded as the most severe public health event facing human society this century. Simultaneously, Covid-19 has affected the implementation of sustainable development goals significantly (Filho et al., 2020), leading to severe negative outcomes, including increased unemployment, the first rise in poverty and vulnerability of the population, and frequent extreme weather phenomena (Martinez-Martinez et al., 2023). Many countries have adopted isolation policies and even closed their borders, which has negatively affected sectors including tourism, catering, transportation, and manufacturing, resulting in significant losses to their gross domestic product (GDP). Businesses—particularly small- and medium-sized enterprises (SMEs) with limited resources—face great challenges to their survival (Kilintzis et al., 2020). Therefore, in the face of the Covid-19 crisis, research on the topic of sustainable development is more important than ever (Filho et al., 2020; Iuga & Wainberg, 2023).

The subject of the study proves to be of great interest not only in the current economic, social, and environmental context but also in the future. Our study successfully emphasizes and demonstrates that those companies relying on a triple-bottom-line approach, even during severe health, economic, and social crises such as Covid-19, have succeeded in remaining at the forefront of innovation, and very particularly sustainable innovation. Thus, they contribute to society with their products while continuing to promote a triple-bottom-line approach that directly affects the well-being of the planet. Therefore, the impact of new sustainable innovation products from SMEs on future global crises is significant, assisting in preparations for such events and mitigating their adverse effects on people, companies, and systems as a whole (Iuga & Wainberg, 2023).

Many researchers have connected sustainable development to the TBL (Arowoshegbe, 2016; Ho & Taylor, 2007). While the environmental and economic dimensions of this framework are well developed, the social dimension remains

underdeveloped (Tate & Bals, 2018). The emergence of Covid-19 has made it clear that social issues should be taken seriously. Furthermore, sustainable innovation based on the TBL is less explored in the context of emerging economies (Kowalski, 2021; Longoni & Cagliano, 2018; Muñoz-Pascual et al., 2019). Achieving sustainable development is a dynamic process, and enhancing sustainability through a single management approach does not ensure long-term success, which requires the use of an integrated TBL concept to contribute to sustainable development.

Moreover, the relationship among the interactions within the TBL remains inadequately developed. Most studies have examined the relationship between elements of both, such as environmental and economic factors or social and economic factors (Dixon-Fowler et al., 2012; Endrikat et al., 2014; Wang et al., 2015). Venkatraman and Nayak (2015) have called for a simultaneous review of TBL at the organizational level. Their study, based on a sample of Australian firms, found a three-pillar weak positive correlation among them. Svensson and Wagner (2015) use a qualitative approach to suggest that economic factors affect society first and then the environment. In a similar vein, empirical evidence from Norway and Spain has clarified that social factors mediate economic and environmental factors, while, in a similar vein, empirical evidence from Norway and Spain has clarified that social factors mediate economic and environmental factors (Svensson et al., 2018). Griggs et al. (2013) point out that the hierarchical relationships within the structure are not equal and that environmental and social development are the top priorities for sustainability.

Within the Covid-19 context, the priority of sustainability has changed, as organizations have replaced the economic dimension with social issues as their current priority (Barreiro-Gen et al., 2020). In the aftermath of the epidemic, society faces many problems. Those enterprises that had difficulty sustaining themselves have had to cut salaries, lay off staff, or even close down, which has led to increased unemployment and poverty. The disposal of tens of thousands of items of medical waste (e.g., masks and gowns) is also a matter for consideration. Thus, the question of how sustainable development goals should evolve after the pandemic—in other words, whether the implementation of sustainable development can mitigate the current effects of Covid-19 and eliminate possible future crises—deserves to be explored (Filho et al., 2020).

Whereas most previous studies have focused on Western companies (Shi et al., 2019; Svensson et al., 2018), with less research in the context of emerging economies, this study extends sustainability research to China (Madni et al., 2022). As a populous developing country, China has focused on economic construction while being one of the world's essential manufacturing bases with a relatively well-developed industrial-development system. Although China's economy has developed and industrialized rapidly, it faces significant challenges: the overexploitation of resources, environmental-protection issues, and social inequalities. The Chinese government has expressed great concern about these issues. It has implemented a series of policies to address it, stating that a sustainable innovation path is the only way to resolve the conflict between the economy and the environment (Chan, 2005). From the perspective of environmental and economic globalization, sustainable development in China, as the largest and most populous

country in Asia, also has important implications for sustainable development in Asia and the larger world. Therefore, this study contributes to sustainable innovation from a Chinese perspective by examining SMEs in Chinese regions with different levels of economic development.

In summary, the purpose of this empirical study in the Chinese context is to address the following questions:

- (1) What are the interrelationships among economic, social, and environmental development?
- (2) What are the factors that lead companies to implement sustainable product innovation?
- (3) Given the current global effect of Covid-19, where sustainability is the achievement of long-term ecological stability, can sustainability contribute to the current Covid-19 crisis or a potential future crisis?

We explore the knowledge that leads companies (at the micro level) to obtain new wealth to innovate through the creation of new sustainable products in the Chinese context within the pandemic. To do so, we rely on solid theoretical contributions from the fields of management and economics and apply them in practice to the real Chinese context, providing solutions to real and complex problems in global crises in terms of sustainability and economic development.

The remainder of this study is organized as follows. The “[Literature Review](#)” section outlines the theoretical framework and reviews the previous literature. The “[Hypothesis Development](#)” section proposes the research model. The “[Research Methodology](#)” section describes the data collection, variables’ measurements, and empirical methodology. The “[Results](#)” section reports the testing process and results. The “[Conclusion](#)” section concludes this work, identifies its limitations, and offers suggestions for future research.

Literature Review

Any activity and type of business innovation necessarily involve a series of activities related to the management and accumulation of knowledge. Companies will be able to develop sustainable product innovations through the application of knowledge to improve productivity by creating new products, services, and/or systems and processes; in short, innovate and apply new activities and experiences in environmental, social, and economic matters. In this way, the development of sustainable product innovations will be able not only to provide more complex and market solutions to increase business productivity but also to provide solutions to global crises (human and health) such as Covid-19 in environmental and social matters.

The following subsections define the basic concepts of sustainable innovation and the triple bottom line (TBL). Secondly, the natural-resource-based view

(NRBV) and stakeholder theory are used as the theoretical support framework for this study. Finally, a review and analysis of sustainable innovation research in the Chinese context is presented.

Conceptual Framework

The term “sustainable development” was first coined by the United Nations World Commission on Environment and Development and is defined as “seeking to meet the needs and aspirations of the present without compromising the ability to meet those of the future” (WCED, 1987). In the evolution of sustainable development, innovation is an important driving force in achieving sustainability (Maier et al., 2020), and sustainable innovation combines both concepts for long-term survival and success.

A review of the literature on sustainable innovation reveals that researchers have offered different definitions of *sustainable innovation*. Scholars working on environmental sustainability issues have proposed the concepts of “green innovation” (Chen, 2008), “eco-innovation” (Rennings, 2000; Triguero et al., 2013) and “environmental innovation” (Horbach, 2008). Much of the literature uses these three concepts interchangeably, and Schiederig et al. (2012) point out that they can be categorized as nearly synonymous. *Sustainable innovation* differs from these concepts; however, in that it also focuses on innovation’s social dimension.

As this study focuses on the broader concept of sustainable innovation, *social development* is essential to achieving holistic sustainability, following Bos-Brouwers (2010) in defining sustainable innovation as “the renewal or implementation of a product, service, technological, or organizational process not only delivers an improved economic performance, but also an enhanced environmental and social performance, both in the short and long term.”

Elkington (1998) extends this multidimensional sustainable innovation to the corporate level, requiring companies to move from a single goal of maximizing profits to maximizing overall economic, social, and environmental goals. In brief, companies need to achieve an optimal balance among economic prosperity, environmental protection, and social welfare while pursuing development to ensure their long-term success. Environmental, social, and economic development are also referred to as the *three pillars* or *triple bottom line* (TBL).

Environmental development implies that enterprises minimize the damage caused to the environment by their processes, technologies, and products. More specifically, companies strive to reduce environmental pollution in their operations; decrease energy consumption; optimize air, water, and land resources; and protect ecosystem integrity and sustainability (Linnenluecke et al., 2009; Moldan et al., 2012). Environmental management is the coordination and monitoring of a company’s operational activities to reduce negative effects on the natural environment and is used widely in business models (Bansal, 2005).

Society has developed based on the cultural context of individual countries. Bansal (2005) defines it as *equity*—the equal distribution of resources and opportunities to members of society, valuing and enhancing the capabilities of employees

and their well-being, having a good quality of life, promoting connections within and outside of society, with such equity being able to continue into each generation. Since it is difficult to agree on the definition and measurement of the social dimension (McWilliams et al., 2006), this study will adopt an integrated concept: *corporate social responsibility* (CSR).

Economic development refers to firms' need to survive in the long term in a changing business environment, where gaining economic efficiency is a prerequisite and primary goal for the survival of all firms. Dyllick and Hockerts (2002) define economic development as ensuring that a firm has sufficient cash flow and generates excellent returns for shareholders, emphasizing persistent profitability, as well as making decisions with the most equitable and rational allocation of investments possible (Mensah, 2019) to provide economic prosperity for future generations. This study assesses economic sustainability by focusing on financial performance: i.e., profitability.

Theoretical Framework

According to the *resource-based view* (RBV; Barney, 1991), firms use both tangible resources and intangible resources (i.e., those that are rare, valuable, inimitable, and irreplaceable) to gain competitive advantage. A different view of RBV, however, has been put forward by some scholars. Oliver (1997) argues that RBV does not consider the social context of resource-selection decisions and that it ignores the interactions between firms and their natural environment (Hart, 1995). Given the increased focus on ecological issues and the fact that businesses are considered one source of this problem, it is important that businesses implement their business activities with natural resources in mind.

Hart (1995) focused on the interactions between companies and their natural environment, proposing a *natural-resource-based view* (NRBV). This extends the RBV by arguing that resources and capabilities for activities that promote sustainability are a source of competitive advantage: i.e., these are resources and capabilities that lead to good performance and have short- and long-term value for society and the environment.

The term *stakeholders* is also widely used in this field. Freeman (1984) describes stakeholders as 'any group or individual who can affect or is affected by the achieving of the organization's objectives'. In short, stakeholders are people who have a "stake" in the success of the business; they can be primary (e.g., shareholders, customers, employees, or suppliers) or secondary (e.g., government, competitors, or media). The core idea of stakeholder theory is that organizations should balance the interests of each stakeholder while building and maintaining good relationships with each group (Donaldson & Preston, 1995).

Companies maintain strong relationships with their stakeholders to help grow their financial performance and create greater value and competitive advantage (Choi & Wang, 2009; Harrison et al., 2010; Hillman & Keim, 2001). Companies cooperate with different stakeholders in what is essentially a mutually beneficial relationship (Hörisch et al., 2014), incorporating each stakeholder into organizational

decision-making, where both parties work toward achieving common interests, thus enhancing the organization's competitive advantage. At the same time, it is also necessary for companies to include more secondary stakeholders (e.g., government or investment institutions) by increasing their competitive attractiveness, thus increasing the size and competitiveness of these companies.

There are usually many stakeholders involved in the implementation of sustainable innovation. They influence companies to raise awareness of sustainability and try to respond to their needs practically, which not only helps them obtain the resources they need to further their organizational goals (Greenwood, 2007) but also increases stakeholders' willingness to invest. For instance, Chinese companies seeking to go international must make social and environmental disclosures as well as comply with international sustainability standards (e.g., ISO14001 certification) to meet the expectations and needs of customers in international markets (Dong et al., 2014; Qi et al., 2011).

Table 1 presents the main conceptual and theoretical framework.

Sustainable Innovation in the Chinese Context

As a result of its rapid economic development and industrialization, China has achieved a certain position in the international scene. Nevertheless, the consequence of pursuing economic growth is a severe shortage of natural resources and consumptive production, further worsening ecological and environmental problems (Liao & Shi, 2018) and exacerbating the large gap between the rich and poor, as well as other social inequities. The Chinese government has expressed great concern about this issue and has actively taken various legal and administrative measures related to sustainable development to rectify it (Chan, 2005). Like governments of other developing countries (Abrar et al., 2023; Ghazinoory & Hashemi, 2023), China believes that sustainable development is an essential objective within the corporate agenda.

A critical analysis of the examined studies and comprehensive review of the literature on the drivers of sustainable innovation in Chinese firms over the last fifteen years has been conducted (Table 2). There are three aspects of mainstream research that can be found in the literature: institutional pressures, organizational resources and capabilities, and the role of inter-organizational collaboration.

Grigorescu and Ion (2022) conducted a literature review of 48 articles on the use of sustainability and innovation in the textile industry and concluded that in the last 30 years there has been concern among stakeholders about the use of sustainable and durable practices and products in the textile industry.

According to DiMaggio and Powell (1983), coercive, mimetic, and normative pressures can lead firms to adopt similar strategies. Institutional pressures usually come from stakeholders like regulators, policymakers, stakeholders, and competitors. Many studies have addressed different types of institutional pressures (Chen et al., 2018; Liu et al., 2010) and their sources (Liu & Anbumozhi, 2009). Chinese governance is characterized by top-down management, and different results suggest that Chinese firms are more vulnerable to the external

Table 1 Conceptual and theoretical framework for sustainable product innovation

Conceptual and theoretical framework	Authors	Rationale
Sustainable development	(WCED, 1987)	Seeking to meet the needs and aspirations of the present without compromising the ability to meet those of the future
Sustainable innovation	(Chen, 2008; Rennings, 2000; Triguero et al., 2013; Horbach, 2008; Schiederig et al., 2012)	Different definitions: “green innovation, “eco-innovation” and “environmental innovation.” However, in that it also focuses on innovation’s social dimension
Triple bottom line (TBL)	Elkington (1998)	Integrate sustainability initiatives at a corporate level and propose a triple bottom line (TBL) framework (i.e., economic, environmental, and social development) to achieve equilibrium among the three pillars from a business-model perspective
Environmental development	(Linnenluecke et al., 2009; Moldan et al., 2012)	Implies that enterprises minimize the damage caused to the environment by their processes, technologies and products. More specifically, companies strive to reduce environmental pollution in their operations; decrease energy consumption; optimize air, water, and land resources; and protect ecosystem integrity and sustainability
Social development	(Bansal, 2005; McWilliams et al., 2006)	Society has developed based on the cultural context of individual countries. The equal distribution of resources and opportunities to members of society, valuing and enhancing the capabilities of employees and their well-being, having a good quality of life and promoting connections within and outside of society, with such equity being able to continue into each generation
Economic development	(Mensah, 2019)	Define economic development as ensuring that a firm has sufficient cash flow and generates excellent returns for shareholders, emphasizing persistent profitability, as well as makes decisions with the most equitable and rational allocation of investments possible to provide economic prosperity for future generations. This study assesses economic sustainability by focusing on financial performance: i.e., profitability
Resource-based view (RBV)	(Barney, 1991)	Firms use both tangible resources and intangible resources (i.e., those that are rare, valuable, imitable, and irreplaceable) to gain a competitive advantage
Natural-resource-based view (NRBV)	(Hart, 1995)	This extends the RBV by arguing that resources and capabilities for activities that promote sustainability are a source of competitive advantage: i.e., these are resources and capabilities that lead to good performance and have short- and long-term value for society and the environment

Table 1 (continued)

Conceptual and theoretical framework	Authors	Rationale
Stakeholders theory	(Freeman, 1984; Donaldson & Preston, 1995)	“Any group or individual who can affect or is affected by the achieving of the organization’s objectives.” Stakeholders are people who have a “stake” in the success of the business; they can be primary (e.g., shareholders, customers, employees, or suppliers) or secondary (e.g., government, competitors, or media). The core idea of stakeholder theory is that organizations should balance the interests of each stakeholder while building and maintaining good relationships with each group

Source: own elaboration

Table 2 Summary of Chinese corporate sustainability literature

Authors	Research focus	Provenance	Methodology	Objectivity	Persuasiveness	Sustainability aspects
(Chang et al., 2018)	Testing the relationship between sustainability attitudes and performance for different firm sizes in the construction industry	Recent scientific findings on the sustainability of the Chinese construction industry	The relative importance value (RIV) and relative performance value (RPV) of each aspect were calculated to determine the relative ranking of the CSAs (critical sustainability aspects)	Yes	Performance on various economic, social and environmental sustainability aspects, and testing the association between firm size and the sustainability attitude and performance	Environment, social, economic
(Guo et al., 2019)	Explored the impact of different types of knowledge on environmental and economic performance	Recent scientific findings on environmental innovation knowledge	Structural equation model	Yes	High levels of technical knowledge acquisition and market knowledge acquisition were positively related to SMEs' performance	Environment, economic
(Chen et al., 2018)	The relationship between different types of institutional pressures and green innovation is examined	Recent scientific findings on corporate green innovation in China's top companies	Econometric model with main effect and moderating effects	Yes	The government should strengthen the implementation of coercive tools, the media should play roles of "muckraking," "catalyst," and the "vanguard" of public inquiry to insert normative pressure, and firms should rationally allocate slacks to improve green innovation	Environment

Table 2 (continued)

Authors	Research focus	Provenance	Methodology	Objectivity	Persuasiveness	Sustainability aspects
(Liu et al., 2010)	External institutional pressure, internal strategy, and learning orientation led firms to environmental sustainability	Recent scientific findings and primary historical materials	Econometric model	Yes	The drivers affecting the proactive environmental management level	Environment
(Song et al., 2020)	The impact of environmental innovation practices and creative climate on green product innovation	Recent scientific findings	Structural equation model	Yes	Firm's managers should shape the organizational creativity climate and encourage green creativity to enhance their firm's sustainability	Environment
(Zhao et al., 2018)	External stakeholder drivers of green product innovation	Recent scientific findings	Hierarchical moderated regression analyses	Yes	Customer involvement and supplier involvement have positive effects on green product innovation	Environment
(Kolk et al., 2010)	A comparison of the social dimension of sustainable development of Chinese and foreign retailers	Recent scientific findings	Structural equation model	Yes	Analysis of social responsibility in China. There are differences between the Chinese and international retailers as well with the former reporting more on economic dimensions, including philanthropy, and the latter more on product responsibility	Social

Table 2 (continued)

Authors	Research focus	Provenance	Methodology	Objectivity	Persuasiveness	Sustainability aspects
(Wu et al., 2015)	Based on case studies and interviews, the impact of lean, green, and social management on the three pillars performance is explored	Recent scientific findings	Case-study methodology	Yes	Integrated sustainable practices model incorporating the most popular lean	Environment, social, economic
(Chang, 2016)	The mediating role of CSR on organizational culture and green product innovation	Recent scientific findings	Structural equation model	Yes	Corporate environmental commitment positively affects green product innovation performance directly and positively influences it indirectly via green adaptive ability	Social

Source: own elaboration

environment, especially to the coercive pressure from regulatory authorities to implement sustainable innovation strategies (Cai et al., 2013; Chen et al., 2018; Zhu et al., 2007).

The second pressure comes from the firm's resources and capabilities. A firm's tangible and intangible resources are powerful weapons for gaining a competitive advantage (Barney, 1991). In particular, intangible resources and capabilities have received more attention than tangible ones (Khan et al., 2019), by way of example, knowledge (Chen, 2016; Lin, 2007; Wong, 2013), absorption capability (Shan et al., 2018; Zhang et al., 2020), and human-resources management (Chang, 2016; Paillé et al., 2014; Park, 2018) to enhance employees' specific competencies for superior performance.

The last pressure is that of the role of inter-organizational collaboration. To innovate, companies must look beyond their internal resources and capabilities and instead look externally for the resources they need. Inter-organizational collaboration can facilitate this innovation (Pereira & Franco, 2023; Lima-Figueiredo et al., 2023). Firms may feel pressured by stakeholders to adopt sustainable innovation, then collaborate directly with stakeholders, such as suppliers and clients (Lee & Kim, 2011; Zhao et al., 2018), to make product innovation more efficient and effective. In this line, governments from different countries have formulated a lot of policies in order to foster collaboration. The research shows that collaboration and the inter-organizational trigger the jumping development of innovation and achievement transformation. Besides, the help of enterprise funding on the innovation is a previous and basic step in Chinese context (Cheng et al., 2023). Others like Zhan and Xie (2023) show, within the Chinese context, that knowledge generation activities such as innovation are directly linked to cooperation between companies and the connection between them for the generation of external knowledge that leads them to generate new innovations.

Finally, the recent review of the literature on cooperation, collaboration, and innovation by Freire and Gonçalves (2022) concluded that, in large data sets studied for European and Chinese companies, positive correlations are always found between cooperation and collaboration between organizations and innovation, taking into account the different peculiarities of the collaborations.

The overview provided by Table 2 reveals that most of the previous studies about the drivers of sustainable innovation have focused on external organizational environmental and contextual factors and on very specific sectors, regions, and industries. Furthermore, most have been discussed from one or two dimensions, and fewer studies have empirically demonstrated all three pillars at the same time in different industries and sectors. Therefore, this study contributes to both sustainable innovation and TBL in the full and broad sense for the Chinese context (Calzón, 2022). Based on stakeholder theory and the NRBV, this study uses environmental management practices, CSR, business profitability, and sustainable product innovation as its main variables. An empirical study examines the factors that drive Chinese SMEs toward sustainable innovation from a TBL perspective.

Hypothesis Development

Environmental Management Practices

Companies may be motivated by voluntary or enhanced environmental policies, and environmental management practices are becoming more widespread (Girón et al., 2021; Montabon et al., 2007). The essence of environmental management is to reduce the negative effect on the natural environment during a company's strategy and business operations. The relationship between corporate environmental management practices and financial performance is much debated among researchers (Mesagan, 2022).

On the one hand, some scholars have shown that this relationship is negative (Li, 2014; Yang et al., 2011), due to the fact that implementing environmental management requires a significant investment of resources and additional costs, thereby reducing profitability.

On the other hand, empirical results from Montabon et al. (2007) and Song et al. (2017) suggest that this relationship is positive. Environmental management practices lead to cost savings through reduced energy and raw material consumption, while also enhancing corporate reputation and increasing competitive advantage, making environmental and economic benefits a “win–win” situation. The lack of consensus on the relationship may be due to inconsistent results because of differences in research design and the characteristics of the subjects studied. Other studies have suggested a dynamic view of the relationship over time (Claver et al., 2007; Tsai et al., 2020).

By showing concern for environmental issues, companies can help gain consumer trust and increase awareness of relevant products, thereby increasing product sales and market share, and may even attract stronger potential investors (Kuchinka et al., 2018), such as governments or large investment institutions (Liu & Anbumozhi, 2009). From an NRBV perspective, a focus on sustainability can help companies to improve operations, innovate, grow strategically, and provide sustainable value to the broader society (Dao et al., 2011). Therefore, environmental management practices can contribute to corporate profitability and economic growth.

Environmental management practices can also improve a company's public image (Morrow & Rondinelli, 2002). As the concept of environmental protection takes root, consumers will be more willing to choose environmentally friendly products. Corporate environmental management can enhance the attractiveness of a company's products to its consumer base, improving the company's competitiveness and thus leading to good financial performance, for example: the design of a code of environmental ethics for all members of the company and its business partners, implementation of energy saving practices, implementation of reverse logistics practices, development of productive activity with ecological products or advanced training in eco-innovation, and social and environmental needs among others. As organizations develop environmentally friendly technologies, the marginal cost of environmental protection can decrease over time.

In addition, improved operational efficiency and other sustainable initiatives can stimulate innovation. In short, environmental management practices can contribute to corporate profitability (Banday & Kocoglu, 2023). Therefore, the hypothesis is proposed:

H1: Environmental management practices are positively correlated with corporate profitability.

Corporate Social Responsibility

Social development refers to the social dimensions of a firm, community, or region and can include measurements of education, equity, and access to social resources, health and well-being, quality of life, and social capital. The examples listed below are a small sample of potential variables: female labor force participation rate, median income, relative poverty, percentage of employees with a post-secondary degree or certificate, organizational learning capability, interorganizational knowledge sharing, CSR, and so forth.

In the traditional sense, CSR is the commitment of a company to contribute positively in terms of ethical behavior and economic development (Lindgreen & Swaen, 2010) and includes maximizing economic profit and addressing environmental issues, in addition to pursuing socially beneficial goals.

This study defines CSR slightly differently. It follows the work of Bansal (2005) in defining it as inter-societal equity that is carried over to each generation. This means focusing only on the social dimension—the well-being of employees and communities, interests of stakeholders, and promotion of connections within and outside society.

CSR can be divided into two components: stakeholder management and social-issues management (Hillman & Keim, 2001). Stakeholder management is the process of building good relationships with external or internal stakeholders and distributing more resources and value equitably to all relevant stakeholders. Social-issues management is the process of solving social problems (Bansal, 2005) and is described as a responsibility on a broader socio-ethical level. Specifically, this can be expressed in terms of promoting human rights, rule-following, and refraining from engaging in “sinful” industries (e.g., gambling, tobacco) (Hillman & Keim, 2001). In this line, Zhao (2023) for firms in the Yangtze River Delta of China shows that networks and socialization have a direct relationship with innovation and, specifically, with open innovation.

According to stakeholder theory, promoting connections and maintaining solid relationships with internal and external stakeholders can mitigate conflicts among different stakeholders (Cho et al., 2019) and will subject the organization to less government oversight (Burke & Logsdon, 1996). Ensuring an organization’s ethical level and social legitimacy on social issues can enable companies and stakeholders to achieve mutual benefits (Hörisch et al., 2014). Therefore, CSR and the stakeholder can contribute to corporate profitability and economic growth.

In the long run, more and better fulfillment of social responsibility by companies can, on the one hand, increase their employees' happiness and satisfaction (Bauman & Skitka, 2012) and help improve the efficiency of managers' decisions and employees' motivation. On the other hand, it can also significantly increase the social focus of companies and increase the goodwill and trust of the public, especially of potential customer groups (Martínez & Rodríguez del Bosque, 2013), which can lead to good financial performance and help improve the profitability of the company. Thus, the hypothesis is formulated:

H2: Corporate social responsibility is positively related with corporate profitability.

Corporate Profitability

Most economic sustainability measures focus on how profits are directly generated: i.e., based on the firm's financial performance. In this line, corporate governance must be a clear driver of investment and innovation in the company (Ezzi et al., 2023). In addition, Bansal (2005) proposes value creation: providing products or services to different stakeholders to increase the value of the company. Although these products or services may not generate good performance directly, they are concerned with achieving sustained competitiveness.

As mentioned earlier, the hierarchical relationships in the TBL framework are not equivalent (Griggs et al., 2013). Over time, an investment in social and environmental aspects may generate profits for a company, and the growing profits may gradually cover the costs of the investment in an invisible manner. To a large extent, economic sustainability is based on the stable development of society and the environment.

This study uses corporate profitability as the dependent variable to assess the economic sustainability of a company. The reasons environmental management and corporate social management can positively affect profitability are outlined above. Secondly, the main objective of SMEs is to achieve economic efficiency and make it sustainable. When a firm has good profitability, it has sufficient capital and autonomy to contribute more to sustainable development, for example by promoting new product development and investing more funds and resources in innovative projects.

Sustainable Product Innovation Performance

Sustainable product innovation is "the introduction of a new product or improvement to an existing product by a firm that has a significantly lower environmental impact over the product's life cycle than an existing product" (Varadarajan, 2017). In short, sustainable product innovation comprises a series of processes from product development to market entry, including product design, development, manufacturing, management, and commercial activities, with the aim of minimizing negative effects on the environment (Campo & Trio, 2022; Muñoz-Pascual et al., 2019).

New product development and improvement are subject to greater uncertainty; in particular, the high cost of sustainable innovation implies a high risk of investing significant resources in failed activities (Sivadas & Dwyer, 2000). Previous studies have analyzed the role of firm size, with larger firms being more successful at sustainable product innovation. Berrone et al. (2013) and Li (2014) found that firm resource commitment (e.g., knowledge resources, financial resources) and high levels of specific assets positively affect innovation performance, which means that firms that have sufficient resources can contribute to sustainable product innovation practices.

According to the NRBV, resources and capabilities for activities that promote sustainability can gain an organization competitive advantage (Hart, 1995). Profitability is often considered an excellent organizational outcome, but it is also an essential resource for future development. Implementing sustainable product innovation requires adequate resources, including financial resources, technology, and labor. A higher level of profitability can provide the resources needed to reduce the financial burden of the product-innovation process, which means that firms with sufficient resources can invest in sustainable product innovation (Ahmad & Zheng, 2023). Furthermore, the TBL approach argues that sustainability requires three fundamental pillars: environmental, social, and economic. For this reason, and as a result, sustainable product innovation is obtained thanks to the development of environmental and social practices and the economic growth of companies.

On the other hand, as mentioned, SMEs' main objective is to achieve economic efficiency and make it sustainable. Highly profitable businesses have a stronger need to transform present resources into future profits than do firms with low profitability (Maury, 2018), implying that they are more inclined to pursue long-term returns that are sustainable and risk-resistant rather than short-term gains.

Profitable companies also take into account the limitations of their current products and the effect of potential future competitive, social, and emerging issues on their products, so they make decisions in response to changes in the market environment. With the introduction of sustainability policies and the emphasis placed on sustainability by stakeholders like customers and investors, companies are more inclined to contribute to society and the environment and project a positive public image (Morrow & Rondinelli, 2002) by investing in sustainable product innovation. Taken together with the ability and willingness of profitable companies themselves, the hypothesis is proposed:

H3: Corporate profitability is positively related to sustainable product-innovation performance.

The current unexpected and severe Covid-19 epidemic has reminded people of the importance of balance among people, nature, and profits. Economic sustainability is based on the preservation of the natural environment and social harmony. In an ever-changing business environment, companies are taking steps to implement environmental management and social responsibility in order to reap long-term economic benefits. When organizations have sufficient capital, they tend to invest in product innovation projects to improve their corporate image as well as secure

a competitive advantage in the long run (Aliabadi et al., 2023; Nchofoung et al., 2023).

This paper proposes that environmental management practices and CSR are positively related to corporate profitability. The implementation of sustainable product innovation is influenced by corporate profitability, as shown in Fig. 1.

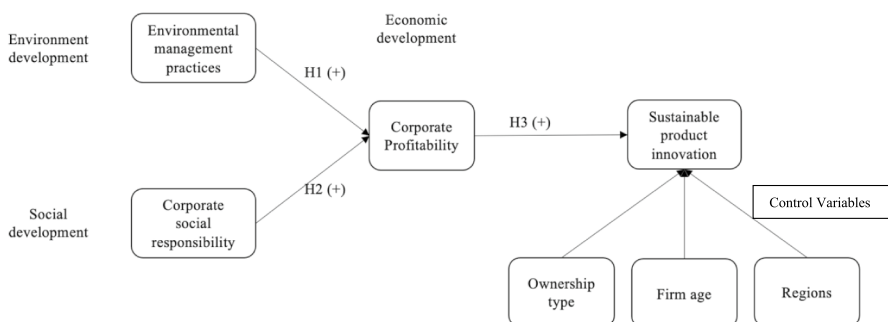
Research Methodology

Research Philosophy

Research as a way of knowing, interpreting, and transforming reality cannot ignore the constant demands of an increasingly unstable, complex, and diverse business world. Hence, for some authors (Oyemomi et al., 2016; Valaei et al., 2017), traditional research approaches fail in the resolution of problems and situations that require new perspectives. In this context, the application of complex methods approaches as the structural equation model is important, and it allows to exploit the strengths to achieve more complete understandings of economic, social, and environmental problems (Berkovich, 2018). SEM is a complex statistical technique for studying causal relationships between variables with direct and indirect effects. This study therefore provides a unique, complete, epistemological, and coherent understanding of sustainable development and sustainable product innovation. The quantitative methods approach can be defined as a kind of research that combines quantitative techniques, methods, approximations, concepts, and language in a holistic study (Creswell & Plano, 2007). This methodology leads to a complete and joint interpretation of the results.

Sample Frame Design

The empirical context of Chinese SMEs was selected for quantitative analysis in this study for several reasons. Firstly, with rapid industrialization, environmental pollution is becoming increasingly serious in China, but most Chinese companies are pursuing economic growth and remain at a relatively low level of sustainable

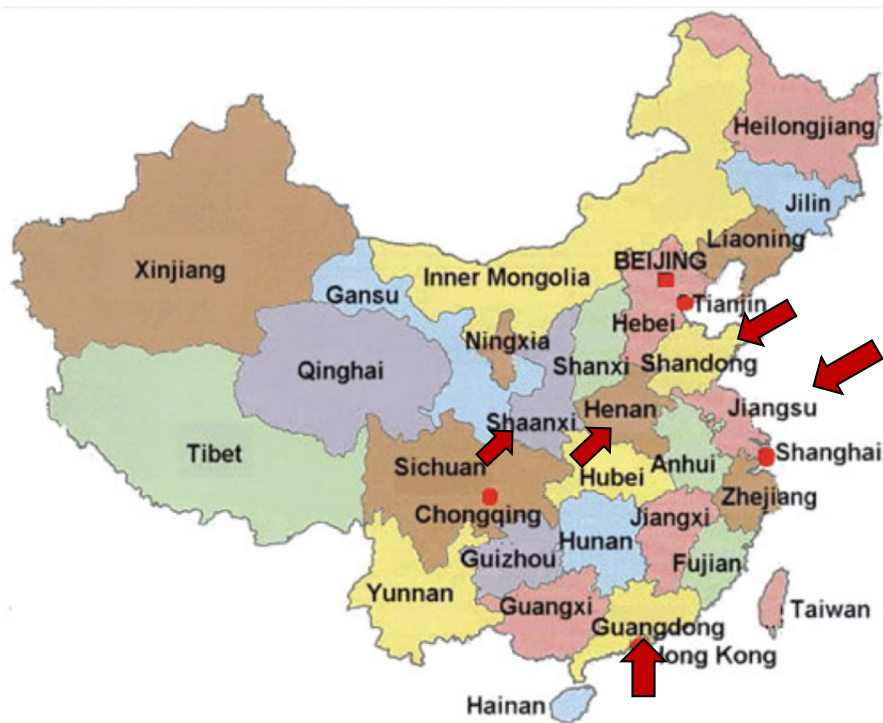


Source: Own elaboration

Fig. 1 Research model

innovation practices. In addition, there is less research on sustainability in Chinese companies than in western ones (Melander, 2017; Shi et al., 2019).

Secondly, China's vast size and geographical diversity are characterized by uneven economic development across its regions. To decrease geographical bias and make the sample more representative of the nation as a whole, five provinces—Jiangsu, Guangdong, Shandong, Henan, and Shaanxi—in different geographical regions in China were chosen (Zhao et al., 2018). Jiangsu and Guangdong are located in the east and south of China, respectively, and they are regions with high levels of economic development. Shandong is located in the Bohai Economic Zone, which reflects the average Chinese level of economic development. Henan and Shaanxi are located in the central and northwestern regions, respectively, and due to these regions' underdeveloped infrastructure, their economic development is relatively low, as shown in Fig. 2. The procedure for selecting the sample in the five provinces described was based on four specific selection criteria to try to study the sustainable product innovation: (a) selection of representative sectors in five provinces (technology, food, furniture and crafts, service, construction, manufacturing, mining, automotive, pharmaceutical, energy, and others); (b) ownership type (state-owned enterprise, private enterprise, foreign-invested enterprise, sino-foreign joint venture, and others); (c) age of company; and (d) size.



Source: Own elaboration

Fig. 2 Provincial level administrative divisions in China Source: own elaboration

Generally, the sample of enterprises from these regions is representative of Chinese enterprises.

Finally, SMEs play a vital role in China's economic growth. They contribute more than 60% of the country's GDP and account for more than 90% of the total number of firms (Jia et al., 2020), yet the survival conditions for SMEs are much more difficult than those of large enterprises. Therefore, SMEs in the Chinese context provide an interesting perspective on the subject.

Data Collection

Data were collected using a questionnaire survey to obtain accurate and reliable information on businesses relevant to this study. The questionnaire was based on scales previously validated by the literature (Chang, 2016; Chow & Chen, 2011; Severo et al., 2017; Yang et al., 2011). We adopted the broadest definition of SMEs as independent enterprises with fewer than 500 employees (Lu & Beamish, 2001). The respondents were top managers (CEOs, general managers, manufacturing department managers, R&D department managers, and HR managers). Both the decision-makers and executives drove the direction and implementation of the companies' strategy; as decision-makers, the CEOs had an overall vision of their companies' development. Similarly, as executives, the line managers had an in-depth understanding of the business-development process and could provide reliable and accurate information about their companies.

We selected an online questionnaire platform (www.WJX.cn) similar to Qualtrics, the largest academic survey platform in China, which is widely used by Chinese researchers (Chang et al., 2018). Through this platform, an email was sent to senior managers inviting them to complete the online questionnaire. Participants were informed of the purpose of the study in the first section of the questionnaire and were promised that all responses would be used for academic research only and not for other commercial purposes, that participation would be voluntary, and that the questionnaire questions would not involve personal information and would all be anonymous to ensure confidentiality. To minimize the probability of errors due to the interpretation of the language used, the survey was initially drafted in English, and the back-translation method was used for the survey items. Therefore, the questionnaire was originally written in English, translated into Chinese by a certified translator, and then back-translated into English. Before the survey's design, a pre-test was carried out with five prestigious scholars and managers who helped to draft the final survey. Finally, the firms were contacted by telephone to introduce the study, and mass mailings of the survey were then sent to them. The survey took 20 min to complete, and the respondents were the top managers within each firm. Top managers are responsible for making decisions, and they know all the information and tools required for economic, social, and environmental development and sustainable product innovation. In this sense, top managers have a realistic and broad vision, and they know the firm's situation for the development of sustainable product innovation.

The survey was conducted in July and August 2021. In total, 620 questionnaires were distributed, and responses were received from 151 SMEs. After excluding incomplete, incorrect, and invalid questionnaires, the final sample size was 128, and the response rate was 20.6%, comparable to the previous literature's response rate (Zhao et al., 2018).

The sample companies were mainly from the manufacturing (26.6%), construction (17.2%) and energy or chemical (11.7%) sectors, among others, within the mentioned five provinces. The types of company ownership included private enterprises (44.5%), state-owned enterprises (35.9%), foreign-invested enterprises (14.1%), and joint ventures (3.9%). The largest percentage (32%) of the companies had been established more than 14 years prior. Of the respondents, most were male (57%), with an age between 31 and 40 years (60.2%), and the largest group was department managers (26.6% in manufacturing, 25% in R&D and 10.9% in HR), with an average 6–10 years of experience (43.8%). For a detailed descriptive analysis of the respondents, see Table 3.

To check for possible nonresponse bias, a time–trend extrapolation test to compare late and early respondents was used. The late respondents are those whose responses were received after the first round of mailing, that is, after the follow-up. These respondents are very similar to nonrespondents, given that they would have fallen into that category without the follow-up efforts (Armstrong & Overton, 1977). A one-way analysis of variance (ANOVA) showed no significant difference between the early and late responses in terms of measures such as the firm's size (numbers of employees) and age. Thus, the sample was representative of the population.

Variables and Measurement

To ensure the reliability and validity of the measurement scales, the scales involved were referenced to mature scales. Without changing the actual meaning of the scale, some questions were adjusted appropriately so that respondents could easily answer. All these items were measured on a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). The details of the questionnaire items can be found in Table 4.

Environmental management practices were measured using a 5-item scale from Chow and Chen (2011) and Severo et al. (2017). A six-item scale from Chow and Chen (2011) was used to measure CSR. Corporate profitability was measured by comparison with the firms' main competitors and financial performance over the past three years using Yang et al.'s (2011) four-item scale ranging from 1 (much worse) to 5 (much better). Sustainable product innovation was measured using a seven-item scale from Chang (2016).

The potential effect of external factors on the model was considered, controlling for firm ownership type, firm age, and region. Existing research suggests that different ownership types in China affect sustainable innovation (Bai et al., 2015; Zhang et al., 2023), with state-owned enterprises (SOEs) in particular having stronger ethical values, as they are required to take on more social and environmental responsibility, influencing sustainable innovation behavior. Although,

Table 3 Respondents' descriptive statistical information

		Frequency	Percent
Province	Guangdong Province	28	21.9%
	Henan Province	12	9.4%
	Jiangsu Province	45	35.2%
	Shaanxi Province	18	14.1%
	Shandong Province	25	19.5%
Sex	Male	73	57.0%
	Female	55	43.0%
Age	26 to 30 years	24	18.8%
	31 to 40 years	77	60.2%
	41 to 50 years	27	21.1%
Ownership type	State-owned enterprise	46	35.9%
	Private enterprise	57	44.5%
	Foreign-invested enterprise	18	14.1%
	Sino-foreign joint venture	5	3.9%
	Other	2	1.6%
Age of company	1 to 3 years	8	6.3%
	4 to 6 years	21	16.4%
	7 to 9 years	27	21.1%
	10 to 13 years	31	24.2%
	More than 14 years	41	32.0%
Size (Number of employees)	Less than 50	21	16.4%
	51 to 100	32	25.0%
	101 to 200	35	27.3%
	201 to 500	40	31.3%
Industry	Information technology	4	3.1%
	Food	7	5.5%
	Furniture and crafts	5	3.9%
	Service	11	8.6%
	Construction	22	17.2%
	Manufacturing	34	26.6%
	Mining	3	2.3%
	Automotive	14	10.9%
	Pharmaceutical	10	7.8%
	Energy or chemical	15	11.7%
Job title	Other	3	2.3%
	CEO	18	14.1%
	General manager	30	23.4%
	Manufacturing department manager	34	26.6%
	R&D manager	32	25.0%
	Human resource manager	14	10.9%
Experience (Years of work)	Less than 2 years	2	1.6%
	2 to 5 years	39	30.5%
	6 to 10 years	56	43.8%
	11 to 15 years	29	22.7%
	More than 15 years	2	1.6%
Total		128	100%

Source: own elaboration

Table 4 Questionnaire scale items

Environmental management practices (Chow & Chen, 2011; Severo et al., 2017)	
EMP1	Our firm reduces energy and water consumption
EMP2	Our firm reduces wastes and emissions from operations
EMP3	Our firm reduces the risk of environmental accidents, spills, and releases
EMP4	Our firm reduces purchases of non-renewable materials, chemicals, and components
EMP5	Our firm reduces the use of traditional fuels by substituting some less polluting energy sources
Corporate social responsibility (Chow & Chen, 2011)	
CSR1	Our firm improves employee or community health and safety
CSR2	Our firm recognizes and acted on the need to fund local community initiatives
CSR3	Our firm protects claims and rights of aboriginal peoples or local community
CSR4	Our firm shows concern for the visual aspects of the firm's facilities and operations
CSR5	Our firm considers the interests of stakeholders in investment decisions by creating a formal dialog
Corporate Profitability (1 = much worse; 5 = much better) (Yang et al., 2011)	
CP1	Relative to our competitor(s), our firm's return on sales (ROS)
CP2	Relative to our competitor(s), our firm's return on investment (ROI)
CP3	Relative to 3 years ago, our firm's return on sales (ROS)
CP4	Relative to 3 years ago, our firm's return on investment (ROI)
Sustainable product innovation (Chang, 2016)	
SPI1	Our firm chooses the materials of the product that produce the least amount of pollution for conducting the product development or design
SPI2	Our firm chooses the materials of the product that consume the least amount of energy and resources for conducting the product development or design
SPI3	Our firm uses the smallest amount of materials to comprise the product for conducting the product development or design
SPI4	Our firm deliberates whether its products are easy to recycle, reuse, and decompose when conducting the product development or design

Source: own elaboration

on the contrary, it can be considered that a private company can allocate more investment to activities that will once again benefit it, such as innovation activities and, in this case, sustainable innovation. Public companies must be accountable to the state, and this can be a limitation when investing in certain activities. Therefore, controlling for the type of ownership distinguishes SOEs from other types of enterprises.

Also the age of the company, as a reflection of the experience and knowledge accumulated throughout its history, can influence innovation (Huergo & Jaumeandreu, 2004; Kuemmerle, 1998; Kumar & Saqib, 1996). Some authors confirm a positive relationship between the age of the entity and the probability of

carrying out basic and applied research, as well as the amount invested in innovation activities. Kumar and Saqib (1996) also find a positive relationship between company experience, measured through age, and innovation. Therefore, the time the company has been operating in the market positively influences the level of resources invested in innovation in the case of medium-sized companies. On the contrary, other works show that recently created companies are the most active in dedicating resources to innovation. Huergo and Jaumeandreu (2004) indicate that the probability of innovating decreases with the age of companies, so young companies are more likely to innovate, while older companies are less innovative. Furthermore, Weng et al.'s (2015) work suggests that more mature firms may lose their willingness to innovate over time, hence controlling for firm age using the number of years a firm has existed.

Five provinces with different levels of economic development were selected to make the survey more representative of China generally, controlling for each region and exploring whether differences in levels of economic development affect sustainable innovation. It is important to evaluate the level of development because those provinces with a higher level of development, companies may have greater incentives for innovation to be able to compete and differentiate themselves as well as obtain synergies and cooperation from other innovative companies. On the contrary, since these companies are already in developed provinces, the incentives to improve and innovate may be lower because customers will also purchase their products as they have high purchasing power. On the other hand, companies located in provinces with a lower level of development may have great incentives to innovate for their own survival, although being located in these provinces, innovation activities related to networks and contacts may be greatly diminished by the own circumstances of the province.

Therefore, the selection of variables and their measurements are the best reflection of how Chinese companies are doing in developing sustainable products using the triple bottom line approach. Therefore, to evaluate environmental development, we focus on environmental management practices; to evaluate social development, we focus on the company's corporate social responsibility; and finally, to evaluate the company's economic development, we focus on economic benefit. In this way, we can evaluate and measure the impact that all this has on the innovation of sustainable products with measures such as materials used in production, those consumed or the recycling practices that the company has, among others.

Common Method Bias

Given that the data in this paper are derived from responses provided by the same respondents, common method bias (CMB) may arise in this case due to issues with the origin of the explanatory variables (Podsakoff & Organ, 1986). Therefore, a Harman single-factor test (Podsakoff & Organ, 1986) was conducted on all variable items involved in the model. The presence of a single or multiple factors explaining most of the variance variables indicated the presence of CMB.

This test was conducted using SPSS 26 statistical software. The principal component method of factor extraction was used, and the pivoting method used was maximum orthogonal rotation. The results showed that four factors were extracted in this instance, with 70.12% of the cumulative variance explained, with the first factor—CSR—accounting for 18.24% of the total variance. This demonstrates that the CMB in this study is not serious.

Therefore, the research design is consistent and logical because model, data collection, measurement, and analysis ensuring successfully solve the research topic.

Empirical Model

The variables involved in this study are corporate environmental management practices, CSR, corporate profitability, and sustainable product innovation. These are latent variables, meaning that they are difficult to measure directly and accurately, so indirect measures of observable indicators have been used.

Empirical studies of the relationships among latent variables have traditionally used *covariance-based structural equation modeling* (CB–SEM; Hair et al., 2019), which, as the name suggests, is a statistical method of analyzing the relationships between variables based on a matrix of variable covariances. Unlike regression analysis, structural equation methods allow for the presence of errors in the dependent and independent variables and error terms. Furthermore, the relationship between the factors and the structure of the factors themselves can be calculated simultaneously. The second estimation method is the *partial least squares structural equation model* (PLS–SEM), an iterative estimation method combining principal components analysis with ordinary least squares regression and a causal modeling method.

The sample size for this study was small ($n = 128$), and Reinartz et al. (2009) indicate that using PLS–SEM is a valid approach for those with fewer than 250 observations. (For CB–SEM, it is necessary to operate with larger sample sizes.) Secondly, PLS makes less stringent assumptions about the data distribution (Hair et al., 2019) and allows for causal predictive analysis of complex relationships between variables.

SEM-PLS is appropriate to identify the predictor essence of complex variables using small samples (Chin, 1998; Purwanto & Sugargini, 2021). It maximizes the explained variance of dependent variables, acting as a suitable alternative to covariance-based structural equation models (Hair, 2009). Unlike covariance-based models, SEM-PLS models offer robust predictive estimators of the structural pathways in circumstances where the more demanding assumptions for covariance-based models are not met (Hair, 2009; Hair et al., 2019). Furthermore, the SEM-PLS analysis is equally suitable for circumstances where research design accommodates complex variables (e.g., measurement of environmental development or social development) using small databases (Chin, 1998; Purwanto & Sugargini, 2021) or research designs that require multilevel analysis (Snijders & Bosker, 2012). Following the best practices (Hair et al., 2019), the choice of SEM-PLS for hypotheses testing is equally supported by the consistency of its use in sustainable development and the exploratory nature of our research. The usage of SEM-PLS is also supported by the

flexibility nature of the analysis measurement it allows (Hair et al., 2019). The symmetrical take place after two formal analyses (Hair, 2009; 2019). The first is through the measurement of the research model. The second is by testing the significance of the relationships in the structural model. The structural model assessment analyzes the significance of the relationships in the structural model, providing insight into the research hypotheses.

In summary, a partial least squares structural model was used to analyze the data with Smart PLS 3 software to verify the factors that lead firms toward sustainable product innovation and to obtain correlation coefficients between the latent variables in the model and their observed variables, as well as the individual latent variables.

Based on the hypotheses presented in the research model, the following equation model is proposed:

Model 1:

$$CP = \beta_1 + \beta_2 EMP + \varepsilon$$

$$CP = \beta_1 + \beta_2 CSR + \varepsilon$$

$$CP = \beta_1 + \beta_2 EMP + \beta_3 CSR + \varepsilon$$

Model 2:

$$SPI = \beta_1 + \beta_2 CP + \varepsilon$$

$$SPI = \beta_1 + \beta_2 SOE + \varepsilon$$

$$SPI = \beta_1 + \beta_2 AGE + \varepsilon$$

$$SPI = \beta_1 + \beta_2 REG + \varepsilon$$

$$SPI = \beta_1 + \beta_2 CP + \beta_3 SOE + \beta_4 AGE + \beta_5 REG + \varepsilon$$

EMP =environment management practice; CSR =corporate social responsibility; CP =corporate profitability; SPI =sustainable product innovation; SOE =state-owned enterprises; REG =regions.

Results

Reliability and Validity Test

The analysis of reliability and validity is the basis for conducting empirical studies to test the credibility of the scale, which must be analyzed to demonstrate the scientific validity of the scale design and use before empirical analyses can be conducted. The following sections were implemented primarily through SPSS26 and Smart PLS 3 statistical software. Table 5 reports Cronbach's alpha coefficient, loading factor, average variance extracted (AVE), composite reliability (CR), and variance inflation factor (VIF).

Reliability analysis is the process of understanding the reliability of a questionnaire scale, usually using Cronbach's alpha coefficient test, which tests whether the

Table 5 Construct Cronbach's alpha, composite reliability, average variance extracted, loading factor, and variance inflation factor

	Cronbach's alpha	Loading factor	AVE	CR	VIF
EMP	0.840		0.611	0.887	
EMP1		0.758			1.580
EMP2		0.836			2.182
EMP3		0.772			1.720
EMP4		0.804			2.053
EMP5		0.733			1.573
CSR	0.861		0.643	0.900	
CSR1		0.827			2.324
CSR2		0.822			2.128
CSR3		0.836			2.496
CSR4		0.778			1.719
CSR5		0.742			1.674
CP	0.824		0.654	0.883	
CP1		0.799			1.862
CP2		0.795			1.914
CP3		0.817			2.286
CP4		0.824			2.279
SPI	0.802		0.632	0.872	
SPI1		0.836			2.017
SPI2		0.845			2.144
SPI3		0.867			1.261
SPI4		0.820			1.807

Source: own elaboration

EMP environment management practice, *CSR* corporate social responsibility, *CP* corporate profitability, *SPI* sustainable product innovation, *CR* composite reliability, *AVE* average variances extracted, *VIF* variance inflation factor

items measured are identical or have similar characteristics. The results of the test indicate that each item corresponds to a reliability value greater than 0.8 (0.840, 0.861, 0.824, and 0.802, respectively), indicating that the items on the scale are good (Fornell & Larcker, 1981).

Validity analysis refers to the intrinsic relationship between the research concepts and measurement indicators. It is generally divided into *content validity*—the representativeness of the items in the questionnaire design—and *structural validity*, which reflects the degree of validity of the measurement. The items in this study were mainly drawn from existing literature, and these scales are widely used to ensure the content validity of this questionnaire effectively.

Construct validity refers to the extent to which the scale measures the theoretical structure and attributes and is generally tested using factor analysis, where correlations between indicators on the scale are tested with the loading coefficients of each question item. The results are shown in Table 4, where the factor loadings are

Table 6 Constructs of mean, standard deviation, and correlation

	Mean	Sd	EMP	CSR	CP
EMP	4.030	0.616			
CSR	4.102	0.608	0.835**		
CP	4.010	0.747	0.733**	0.742**	
SPI	3.990	0.619	0.771**	0.831**	0.802**

Source: own elaboration

EMP environment management practice, *CSR* corporate social responsibility, *CP* corporate profitability, *SPI* sustainable product innovation

**Correlation is significant at the 0.01 level (2-tailed)

all greater than 0.5 (Hulland, 1999), satisfying the structural validity requirement (Bagozzi et al., 1991; Hair, 2009).

In addition to the above validation that the items used have good content and structural validity, convergent and discriminant validity analyses were conducted to analyze the factors under the scale in depth.

Convergent validity emphasizes those measures that fall under the same factor and fall within the same factor when measured and is usually analyzed using the extracted mean–variance (AVE) and composite reliability (CR). As shown in Table 5, the results indicate good convergent validity for the scale used if the AVE is greater than 0.5 and the CR is greater than 0.7. At the same time, the corresponding factor loading coefficient for each measure is greater than 0.7.

Discriminant validity demonstrates that there is no correlation or very low correlation between measures of unrelated constructs. Therefore, discriminant validity focuses on differences, while convergent validity focuses on similarities. The degree of correlation is measured by the Pearson correlation coefficient. The value of the correlation coefficient always ranges between 1 and -1 , and it serves as an indication of the strength and the direction of the relationship between variables ($r = 1$ there is perfect positive correlation; $r = 0$ there is no correlation at all; $r = -1$ there is perfect negative correlation). As shown in Table 6, the results indicate good discriminant validity for these types of studies because all coefficients are less than 0.85.

In summary, it can be concluded that the constructs of environmental management, CSR, corporate profitability, and sustainable product innovation performance are valid in this study.

Correlation Analysis and Multicollinearity

Table 6 reports the means, standard deviations, and correlations of the data. The variables were analyzed for correlation through the Pearson correlation coefficient, representing the data's degree of association between the factors and reflecting the correlation's strength.

Table 6 shows a significant positive correlation between the latent variables. The correlation coefficients for corporate profitability and environmental management

practices and CSR were 0.733 and 0.742, respectively, showing a 0.01 level of significance, thus indicating a significant positive correlation between corporate profitability and environmental management practices and CSR. Similarly, there is a significant positive correlation between corporate profitability and sustainable product innovation, with a correlation coefficient value of 0.802, which is significant at the 0.01 level.

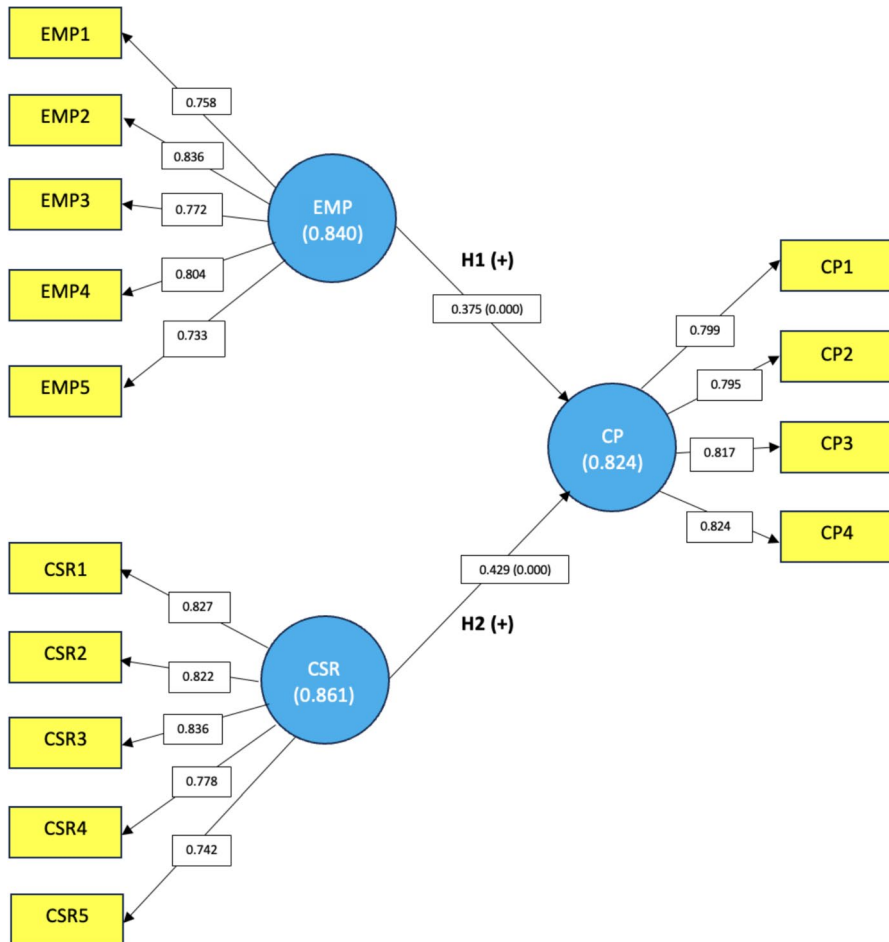
The high and significant correlation coefficients between the variables may generate a multicollinearity problem (Diamantopoulos & Siguaw, 2006) and lead to inaccurate model estimation. The variance inflation factor (VIF) was therefore calculated. The results obtained indicated that the VIF value was well below the threshold value of 5 and provided no evidence of problematic multicollinearity.

Therefore, the relationships between the variables proposed in this model have the strength and veracity to be studied in detail. Since the correlation coefficients themselves in all cases are showing us this, but also by calculating VIF, it is guaranteeing us that despite the relationship and strength between the variables, there are no multicollinearity problems in the presented model.

Findings and Discussions

The PLS emphasizes the ability of the structural model's formative and reactive indicators. The model's explanatory power is expressed as R^2 for the ability of the observed indicators to explain the latent variables, and the path coefficients are estimated as standardized β -values. Smart PLS tests the significance of the path coefficients by the Bootstrap method, expressed as p -values. The assumed path coefficients and p -values are reported in Fig. 3 (Structural Model 1 diagram using Smart PLS 3), Fig. 4 (Structural Model 2 diagram using Smart PLS 3), and Table 7.

Model 1 results suggest that environmental management practices ($\beta = 0.375$, $p < 0.01$) and CSR ($\beta = 0.429$, $p < 0.001$) have a positive effect on firm profitability, supporting H1 and H2. This demonstrates that enterprises that contribute to the environment and society will lead to increased economic benefits during Covid-19. In relation to H1, we can highlight that companies, during Covid-19, managed to implement and maintain environmental management practices such as saving energy, water, emissions, waste, and leaks and are also able to make a good purchasing forecast in their materials will achieve optimal corporate profitability (Chow & Chen, 2011; Severo et al., 2017). Therefore, those companies that have been concerned about these issues during Covid-19 will experience an economic return that they can use and allocate to other types of activities that may involve a greater economic effort (Montabon et al., 2007; Song et al., 2017), such as sustainable product innovation. However, Li (2014) and Yang et al. (2011) demonstrate that this relationship is negative due to the fact that implementing environmental management requires a significant investment of resources and additional costs, thereby reducing profitability. Claver et al. (2007) and Tsai et al. (2020) have suggested a dynamic perspective of the relationship over time for various environmental changes.

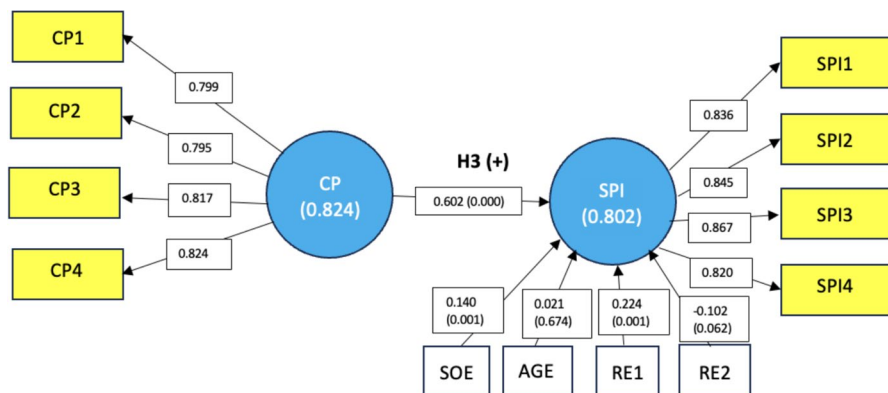


Source: Own elaboration

Notes: EMP = Environment Management Practice; CSR = Corporate Social Responsibility; CP = Corporate Profitability

Fig. 3 Structural model 1 diagram using Smart PLS 3

In relation to H2, we can highlight that companies that during Covid-19 were concerned about the health and safety of their employees and environmental stakeholders and established formal and informal ties of trust and relationships with other agents can more easily achieve corporate profitability (Chow & Chen, 2011). Therefore, those companies that during Covid-19 were concerned about social responsibility issues will have cared for people and the environment and will experience an economic return, as the results show (Hörisch et al., 2014; Lindgreen & Swaen, 2010). However, although CSR may be seen as an expense, it is undoubtedly a long-term investment not only for the internal well-being of the organization but also for sustainable economic growth over the long run (Bauman & Skitka, 2012).



Source: Own elaboration

Notes: CP = Corporate Profitability; SPI = Sustainable Product Innovation; SOE = State-Owned Enterprises; AGE = Firm Age; RE1 = Jiangsu (higher levels of economic development); RE2 = Henan (lower levels of economic development)

Fig. 4 Structural model 2 diagram using Smart PLS 3

Table 7 Structural model test results

	Model 1		Model 2		
	$R^2 = 0.594$		$R^2 = 0.714$		
Relationships	Path coefficient	<i>p</i> -value	Path coefficient	<i>p</i> -value	Results
H1: EMP → CP	0.375	0.000			Support
H2: CSR → CP	0.429	0.000			Support
H3: CP → SPI			0.602	0.000	Support
SOE → SPI			0.140	0.001	
Age → SPI			0.021	0.674	
Jiangsu → SPI			0.224	0.001	
Henan → SPI			−0.102	0.062	

Source: own elaboration

EMP environment management practice, CSR corporate social responsibility, CP corporate profitability, SPI sustainable product innovation, SOE state-owned enterprises

Model 2 examines the effect of corporate profitability on sustainable product innovation. The result demonstrates a significant positive relationship between firm profitability and sustainable product innovation ($\beta = 0.602$, $p < 0.001$), supporting H3. This implies that corporations with strong profitability are more likely to invest in sustainable product innovation during Covid-19 (Ahmad & Zheng, 2023). In relation to H3, we can highlight that companies that, during Covid-19, have been concerned about the return on their sales and their investment with respect to their competitors and themselves for 3 years have more easily achieved the development of sustainable product innovation (Yang et al., 2011). This means that companies with good corporate profitability may be more willing to choose materials for their product production that do not pollute or may reevaluate the product's design so they

can ultimately bring a new product to the market that meets the three Rs (recycle, reuse, and reduce) (Maury, 2018). Companies with good corporate profitability can influence this type of activities in their production processes because they are less concerned about their margins and adjustments in production costs. Furthermore, as previous results have shown (H1 and H2), if the company also implements other environmental management and social responsibility practices, it is easier to achieve long-term corporate profitability during periods of serious social or health crisis, and thus, the company will be able to be in the spiral of sustainable innovation that not only generates economic benefits but also universal social and environmental benefits (Chang, 2016). However, it has traditionally been shown that innovation, in this case sustainable innovation, can increase economic benefits. Now it is also being demonstrated that economic benefits will lead to investments and interest in new sustainable innovations (Aliabadi et al., 2023; Nchofoung et al., 2023).

All three hypotheses proposed in this study were supported. For the three control variables, state-owned enterprises had a positive effect on sustainable product innovation ($\beta = 0.140$, $p < 0.1$). Secondly, regions with different levels of economic development were examined separately, and the region with higher levels, Jiangsu, showed a significant positive association with sustainable product innovation ($\beta = 0.224$, $p < 0.1$); conversely, the region with lower levels, Henan, showed a negative association ($\beta = -0.102$, $p > 0.1$). This study, however, did not capture the control effect of firm age on sustainable product innovation ($\beta = 0.021$, $p > 0.1$). As the literature review itself has shown, there are studies suggesting, depending on the context, the age of a company may have either a positive or negative effect on innovation activities (Molero & Buesa, 1996). In this case, it can be argued that age is not a relevant issue when a company engages in sustainable product innovation activities. This may be because, within the Chinese context, as demonstrated, there are other more relevant variables and factors, such as the type of ownership or the level of development, that can influence a company's innovation activities. The present work would contribute a relevant aspect to the existing literature on age as a control variable in innovation activities, which is that it depends on the context (Chinese) and, in this case, also on the temporal space (stage of the Covid-19 pandemic).

Therefore, the results of the study provide very relevant findings by reporting how social and environmental development are directly linked to economic development. This finding reveals that companies that rely on the support and implementation of corporate social responsibility and environmental management practices are capable of obtaining a long-term economic profitability even in long periods of pandemic such as Covid-19. These results give a complete vision to the companies since it helps them to conduct future investments. Furthermore, both social and environmental development practices can have a double effect on economic development. On the one hand, they guarantee long-term economic efficiency but, on the other, they also guarantee an ethical, social, responsible vision with society as a whole and with humanity, serving companies as a powerful promotional and marketing tool for its main stakeholders (customers, suppliers, institutions, governments, etc.) in the short and long terms.

In addition, the results obtained in model 2 show that when companies have a good economic and financial situation, they are more predisposed to research and

develop sustainable products that are so necessary in the current world. This finding reveals that a good economic situation gives the firms a broader, more humane, sustainable vision and helps them develop more sustainable products. Therefore, if necessary, investing in more sophisticated materials or techniques to achieve sustainable product innovation will be easier, giving new value to a firm vision based on long-term values and quality. This finding is once again accentuated with the results when showing how companies located within the most economically developed provinces have a strong predisposition toward investing in sustainable product innovation.

Traditionally, it was believed that the opposite occurred; that is, first we must achieve corporate profitability and then determine what practices to apply for achieving innovation. The review of traditional literature examines the direct relationship between corporate profitability and innovation, generally considering technological innovation as the focus of study (Cló et al., 2022). This work advances beyond traditional literature by exploring the relationships inversely, demonstrating that the selection of sustainability and corporate social responsibility practices leads us to corporate profitability and can also propel us toward a specific type of innovation, such as sustainable product innovation.

Therefore, this study opens a new path that enables companies to attain more sustainable development based on the triple bottom line, allowing them to better confront its effects during economic, environmental, humanitarian, health, and social crises, both current and future, since the implementation of these practices will lead them to sustainable product design in time, space, and form.

Conclusion

Researchers are increasingly applying research on sustainable innovation to business models (Bocken et al., 2014), but there is little research based on the TBL approach in the context of emerging economies (Longoni & Cagliano, 2018; Muñoz-Pascual et al., 2019).

The aim of this study is to address the following questions: (1) What interrelationships may exist between the triple pillars? (2) What are the factors that lead firms to implement sustainable product innovation? (3) Can sustainable development contribute to the current Covid-19 crisis or possible future crises?

This study, which combines sustainable innovation and a triple bottom line approach, establishes the relationship between the environmental dimension (corporate environmental management practices), the social dimension (CSR), the economic dimension (corporate profitability), and the implementation of sustainable product innovation, based on an NRBV and stakeholder theory.

A partial least squares structural model was used to conduct an empirical study on SMEs in China. The results indicate that environmental management practices and CSR are significantly and positively related to corporate profitability; this finding contradicts previous studies (Li, 2014; Yang et al., 2011). This may be due to the large number of resources required upfront for environmental and social development. This study set the time to measure corporate profitability at three years and

obtained positive results, indicating that investment in environmental and social development is a long-term investment, which means that a decline in profitability may occur at the beginning of the investment, but the company's profitability may improve when it is on a long-term time scale. This is in line with previous studies in different contexts (Montabon et al., 2007; H. Song et al., 2017). This should be due to the fact that environmental management practices and CSR will positively affect environmental and social development, building a good corporate image, while a good reputation will attract strong investors, leading to improved corporate profitability.

Secondly, consistent with our predictions, the findings show a significant and positive relationship between profitability and sustainable product innovation, with results consistent with previous studies in different contexts (Li et al., 2017). Sustainable product innovation is a process that comes with high costs and risks, for which firms can compensate with good profitability. Achieving superior financial returns is many companies' primary goal, and pursuing sustainable profitability can help them achieve it. In a fast-changing market, this type of business is likely to sacrifice short-term profits in order to enhance its reputation and competitive advantage. Thus, it tends to contribute to environmental and social issues and promote the implementation of sustainable product innovation.

Finally, the control variables are firm ownership type, firm age, and geographical areas with different levels of economic development. The results show that state-owned enterprises and regions with higher levels of economic development positively affect sustainable product innovation. This may be explained by the fact that state-owned enterprises have more resources due to the economic support provided by the state treasury. They are also required to take more social and environmental responsibility and therefore invest in sustainable product innovation. Regions with higher economic levels are also more conducive to sustainable product innovation than other levels because of the higher risk tolerance that comes with a better economic base.

Thus, this study offers a clear advance to research in three directions.

- (a) On the one hand, and answering to the first research question, companies that are engaged in environmental and social development will also reach economic development. A priori, it seems that the three pillars are reinforced and even some are a consequence of others. Therefore, in order to carry out a complete study of sustainable product innovation, the three pillars of sustainable development must be interrelated. Studies that only focus on one or some of them will give a reduced insight.
- (b) On the other hand, and answering the second research question, this study presents the factors that companies can identify as environmental, social, and financial profitability so that they can achieve sustainable innovation products. Therefore, companies that invest in the reduction of energy, water, and emissions; care about employees and stakeholders; and achieve good three-year financial indicators, among others, have a high probability of introducing sustainable innovation products on the market.

- (c) Lastly, and answering to the third research question, given that this study is carried out in a context of health crisis, the results show that those companies that have relied on a triple bottom line approach exacerbated the result for those companies that are more economically and financially developed, either by the company itself or by the province itself, manage to innovate sustainably. To talk about innovation in the middle of a crisis or post-crisis is to talk about a broad sense of development, and even more so if a new product at the same time contributes to recycling, reusing, and maintaining. In short, the use of a triple bottom line approach can help to save in crisis situations.

Theoretical Implications

The analysis of the relationship between the TBL and sustainable product innovation contributes to the field in the following ways. First, a new framework is introduced in which the interactions among the economy, society, and the environment are analyzed. Previous studies have focused solely on single-dimensional relationships and in specific sectors (Dixon-Fowler et al., 2012; Endrikat et al., 2014; Wang et al., 2015). The results of this study suggest that environmental and social sustainability lead to economic profitability for firms. Second, combining sustainable product innovation with the TBL provides a new perspective on the subject. Profitability is often seen as an organizational outcome, but research confirms that it can also be a driver of sustainable product innovation. These findings further deepen the understanding of the TBL.

From the significant positive correlations among the environmental, social, and economic dimensions derived from this study, it is clear that firms should now focus on social welfare and environmental sustainability issues. The significant increase in unemployment and firm closures in the broader social environment during the time of Covid-19 shows that the majority of SMEs and even some large enterprises are less able to withstand risks and have less innovative models. By comparison, most enterprises that actively carry out business innovation and promote digital transformation have been growing during the pandemic (Lee & Trimi, 2021).

Therefore, it is more important to respond to the crisis by expanding methods of corporate innovation, enhancing enterprises' organizational capacity, promoting team cohesion and learning ability, and continuously exploring sustainable products. The main factors leading to Covid-19 remain unknown, but from the responses of countries to the epidemic, the economy is based on the sustainability of human society and natural resources. The three interact in what appears to be a positive feedback loop; in the short term, this effect is predictable.

At the same time, with countries shutting down their societies and economies to mitigate the pandemic, the Covid-19 crisis has created opportunities, leading to a decline in greenhouse gas emissions, including China, whose emissions were down 25% from their peak. Disruptions in global trade supply chains and reduced industrial activity have led to a decline in fossil energy use (Muhammad et al., 2020). This means that effective sustainability measures are necessary and can mitigate the environmental crisis.

Sustainable policies are essential and will change how people consume and live and how companies operate and manage. Finding a sustainable course of development that suits a company as soon as possible will better protect the global environment and help the company improve its own ability to resist risks.

This research broadens the knowledge base by ensuring that a cyclical approach to TBL guarantees sustainable innovation even in periods of social, economic, humanitarian, and environmental crises. Contrary to what has been thought for a long time, if companies carry in their DNA the investment and implementation of factors that improve the environment but are also concerned about social norms and values (inside and outside the company) they will guarantee financial development. *A priori*, different actions aimed at improving the environment and social aspects can be costly, but it has been shown that in the long term and in adverse situations they are a guarantee not only of economic growth but also of progress and innovation. Historically, innovation has been taken as a variable that leads to the economic and financial result, but up to now, it has not been studied how. Thanks to this economic and financial result, one can contribute to more careful, respectful, and responsible innovations for society as a whole.

This study fully fills the initial gap in the literature. This research manages to value the need to study sustainable innovation from a TBL approach and not only from a single or at most two pillars as previous studies traditionally did, as shown in Table 1. In addition, this study addresses the problem that some industries and/or provinces may be more innovative than others due to their own activity and/or location. In this sense, the study fills the gap in the empirical literature by testing the research model in a comprehensive and broad context both in industries and provinces in China. Finally, new avenues are opened by studying economic development not as a final result variable, but as a variable that will drive the development of sustainable innovations as a final result for companies.

Practical Implications for Chinese SMEs During the Crisis and for the Future

The managerial implications of the study are several. On the one hand, managers can be sure that even investment in social and environmental practices will soon have an economic return, and they will make sure that in periods of instability with the Covid-19 or other crises (For example: fires in California (EEUU) or *dana* in Valencia (Spain)), that return is sustainable over time through their sustainable innovations. In addition, managers must be aware that practical social, environmental, and economic investments can be interrelated and must occur together and in a balanced way to achieve continued sustainable innovative success over time and better manage a situation of global instability. The study will also help managers to evaluate their economic financial situation (internal and external, of the company, of the sector, of the province and of the type of property and the influence to obtain financing) on a continuous basis as an important incentive to be able to innovate sustainably on the market.

Finally, the study offers three related implementation recommendations for SMEs:

Improve enterprises' environmental management practices:

- Minimize damage to natural resources in the production process.
- Reduce the use of harmful substances and non-renewable materials.
- Join environmental organizations in relevant industries.
- Encourage the launch of environmentally friendly products.
- Introduce recycling and responsible consumption practices.
- Introduce energy saving practices and responsible use of water.

Establish and implement a sense of CSR:

- Improve the well-being of employees and enrich their security system.
- Increase participation in social-welfare and charity activities.
- Join social non-profit organizations.
- Schedule networking activities and business exchanges with stakeholders.
- Schedule social activities in informal settings for employees and clients.
- Signing agreements and relationships with companies located in ethical industries.

Enhance profitability for sustainable innovation:

- Strengthen internal organizational learning and improve productivity.
- Improve the corporate organizational structure.
- Experiment with more promotional channels (e.g., new media).
- Detect business opportunities and new products.
- Detect new sources of financing.
- Detect new profitable investment opportunities.

Therefore, our results allow us to make some practical implications for Chinese SMEs during the crisis, but they also allow us to predict that these implications may be very valuable for post-crisis periods.

Firstly, if during a crisis you are an SME that makes and continues to maintain efforts to save energy, water, emissions, and waste, it is highly likely that all of this will help you achieve optimal corporate profitability (Severo et al., 2017). Therefore, we must always be very concerned about sustainability over time and in the long term. It may seem that during periods of crisis it is necessary to do without certain activities to the detriment of other more urgent ones imposed by the context itself and the short term, but the evidence shows that environmental practices must not be neglected.

Secondly, and very importantly, if during the crisis you are one of the Chinese SMEs that cared about the people in your company and its environment in every sense (health, safety, well-being, comfort, bonds of trust), the return on corporate profitability is guaranteed, and not only was it during the crisis, it will continue to be so (Chow & Chen, 2011).

Finally, the Chinese SMEs that, during the crisis, kept their corporate profitability very healthy are those that have been most concerned about launching and continuing

to update their portfolio of sustainable products with new materials and innovative compounds that make China and the world a better place environmentally. From all this, it follows that Chinese SMEs experienced the Covid-19 crisis deeply, but those that continued to delve into environmental and social practices achieved an economic return, and this has allowed them to continue innovating in very beneficial and innovative sustainable products in markets such as China, which is so crowded and competitive.

In addition, our study also allows us to give a relevant practical recommendation to Chinese SMEs during times of crisis, namely that the location and position of the company affect the ability to achieve greater corporate profitability. Therefore, it may be even more important to take care of environmental and social practices in Chinese regions where economic development is lower.

Therefore, the significant implication for industry as a result of the research is that not only does innovation lead to greater profits, but profits can help companies become more sustainable in the long term in turbulent times if they are directed toward the creation of new, sustainable innovative products. Furthermore, companies that enjoy strong financial health will be those that have invested in environmental and social practices within their organizations. It is also important to note that these findings may be influenced by the regional location and ownership of the company.

Limitations and Future Research

This study has several limitations. First, the survey was conducted in the context of an emerging economy—China—and, given its unique cultural context, caution is needed when applying the results to other contexts. The sample may bring with it biases related to the context, cultural and regional differences, or economic development itself. This may condition the generalization of the findings to other contexts, although they may also be emerging economies. The most appropriate thing would be to carry out the study directly. Second, testing hypotheses via questionnaire and a self-report may bias the obtained results. In addition, only cross-sectional data are provided. Furthermore, another limitation associated with the sample is that the data and information come from a single informant, and it is possible that in some cases there are certain limitations or a lack of information, for example, other collections of complementary information from other informants and over various time periods. Although some measurements avoid CMB, sustainability is a dynamic process, and therefore, future studies could consider conducting longitudinal studies or using objective data or other sources and even use a mixed methodology (quantitative and qualitative) to test the research model. As future lines, the model could be tested and the results obtained with fsQCA (Fuzzy Set Qualitative Comparative Analysis) could be compared (Bennat, 2022). The implementation of this new methodology can open paths to future research on which combinations of factors lead to the result and which do not, in this case, to sustainable innovation (beyond causal relationships). Furthermore, other possible factors may influence as mediators or moderators in the relationship between sustainable innovation and corporate performance (Aburumman et al., 2021; Bai et al., 2024; Ooi et al., 2025; Sari et al., 2023). For example, a continuation of the model could test research and development (R&D) as a previous

step between corporate performance and sustainable innovation, that is, as a mediating variable. If the organization manages to channel part of the corporate performance into R&D, it may lead to sustainable innovation. On the other hand, if corporate performance is invested in knowledge management practices, it is also possible that companies obtain sustainable innovation more easily and are aware of it (Muñoz-Pascual & Galende, 2017). All of this would lead to an even broader and more complete vision of the phenomenon and then would enhance the clarity and robustness of the theoretical framework.

In addition, future research could apply the model to check if the TBL approach adapts in a similar or different way to other types of innovations such as process innovation, radical innovation, and/or incremental innovation. It could even be possible to establish comparisons to detect for which type of innovation it is more convenient to follow a triple bottom line approach.

Although the present study already demonstrates how the implementation of sustainable development helps to face the negative effect of Covid-19 through the innovation of sustainable products, future studies can deepen into the changes and updates that the SDGs should undergo after a situation of uncertainty or pandemic such as Covid-19 to be more prepared for possible future crises.

Author Contribution All authors contributed to the study conception and design. Material preparation, data collection, and analysis were performed by Yilun Yan, Lucía Muñoz-Pascual, and Jesús Galende. The first draft of the manuscript was written by Yilun Yang, and all authors commented on previous versions of the manuscript.

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Data Availability The dataset associated with this research is available to readers upon reasonable request.

Declarations

Ethics Approval Ethical behaviors are adopted throughout the research.

Conflict of interest The authors declare no competing interests.

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