Hindawi
Complexity
Volume 2022, Article ID 6024077, 17 pages
https://doi.org/10.1155/2022/6024077

Research Article

The Effect of Green Intellectual Capital on Green Performance in the Spanish Wine Industry: A Structural Equation Modeling Approach

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Received 17 May 2022; Revised 3 July 2022; Accepted 15 July 2022; Published 8 August 2022

Academic Editor: Zhi-Qiang Jiang

Global environmental problems, such as global warming, pollution, or deforestation, are critical issues that require a rapid and common response. In this context, companies play a decisive role in achieving environmental objectives through the ecological knowledge they can store and manage. In this context, the present research focuses its interest on analyzing how the set of green intangibles possessed by organizations, i.e., Green Intellectual Capital (GIC), affects their Green Performance (GP). Specifically, the study shows how GP is influenced by GIC through the mediating role of the Green Innovation (GI) variable. Therefore, the research questions to be answered by this study are as follows: Does GIC influence environmental performance? Does GI mediate the GIC-GP relationship? What actions can companies take to improve their GP? There are several reasons that have led us to carry out this research. First, there is little empirical evidence of the relationships proposed in this study. Second, to the best of our knowledge, there is no previous research that has contextualized the relationships raised in the wine industry, thus representing an advance in the comprehension of the constructs studied. Third, GIC represents an incipient field of study that needs to be developed and established within the literature linked to Intellectual Capital (IC). In order to achieve the proposed objectives, data from a survey of 202 wineries in Spain were used and a quantitative approach was followed using Structural Equation Modeling (PLS-SEM). The results of the research indicate that there is a positive and significant relationship between GIC and GP. In addition, GI partially mediates the relationship between these two variables, playing a key role in the environmental management of wineries. The theoretical and practical contributions of the study improve the understanding of the relationships raised, being a pioneering study due to its contextualization in the wine industry, as well as providing a series of guidelines for both environmental managers and winemakers to improve their GP.

1. Introduction

Global warming, pollution, and deforestation are the manifestations of the accelerated growth of the world economy experienced in the last century [1]. These global environmental problems are critical and, therefore, require rapid and common responses, which has led to an intense academic debate on the need to achieve environmental sustainability [2].

Traditionally, activities aimed at environmental protection have conflicted with those aimed at economic performance [3]. On the one hand, earlier research claimed that the sole mission of managers was to maximize shareholder wealth [4]. On the other hand, recent studies indicate that companies must assume social and environmental responsibilities beyond purely economic ones [5, 6]. However, despite the ongoing debate on whether companies should be green or not, the need to balance their economic needs with environmental ones has begun to be recognized. This can be reflected in the growing interest of scholars in the study of environmental topics, such as green human resource management [7], green supply chain [8], sustainable manufacturing [9], circular economy [10], green creativity [11], and organizational sustainability [12].

In this context, Green Innovation (GI) represents a win-win solution to the economic performance-environmental management conflict [13, 14]. Concern for the environment has created great opportunities for companies to improve the environmental characteristics of their products and processes in order to gain competitive advantages [15]. In fact, numerous studies demonstrate the positive relationship between the development of GIs and the improvement of the economic, social, and environmental performance of companies [16]. This type of innovation requires the integration of internal and external resources through the development of organizational capabilities and intangible resources [17]. Therefore, companies wishing to properly manage their GIs should prepare themselves by acquiring the necessary environmental capabilities and resources.

There are two main reasons why there is a growing interest in environmental management in organizations: (1) stringent environmental regulations [18]; and (2) increased customer awareness [19]. These factors require an added effort on the part of organizations to reduce the environmental impact of their products and processes by promoting GI such as packaging or eco-design [20], as well as to communicate the environmental practices developed within the organization in an appropriate way [21].

Despite the widespread tendency of organizations to develop sustainable business practices, it is still unclear what are the drivers of GI that, in turn, drive Green Performance (GP) [22, 23]. From the Natural Resource-based View (NRBV), intangibles such as knowledge, skills, and capabilities of the firm constitute essential elements for its environmental management and, as a consequence, for obtaining a competitive advantage, since, under the NRBV logic, competitive advantage is achieved from the sustainable activities of the organization. Therefore, intangible assets related to environmental protection can be considered antecedents of GI and GP. To accumulate and use intangible assets, companies can adopt different approaches framed under the three dimensions of Intellectual Capital (IC): human, structural, and relational capital [24]. However, the IC that incorporates sustainable concepts, i.e., Green Intellectual Capital (GIC), has emerged as an important field of study at present [25], being the construct currently used by scholars to understand the cause-effect relationships between such set of green intangible assets and other green variables.

The GIC brings together the research fields of IC and corporate sustainability, being understood as “the total stock of all kinds of intangible assets, knowledge, capabilities, and relationships, etc., on environmental protection or green innovation at the individual level and at the organizational level within a company” [18]. Therefore, GIC presents clear differences with IC, given that, while the IC approach understands sustainability as one of several intangible assets, GIC considers sustainability as the core of intangible assets, as well as the main driver for knowledge generation and management.

In this context, the present study aims to investigate the relationship between GIC-GP, as well as the mediating role of GI in this relationship. Three main reasons justify the need to carry out this study. First, there is little research that has provided empirical evidence on the relationships discussed above. Second, no previous research has been identified that addresses the relationships to be raised in the industry under analysis, i.e., the wine industry. Third, GIC is an incipient field of study that needs to be developed and established in the field of environmental management of organizations. To this end, as Chen [18] points out, there is a need for research on how GIC drives other variables, such as GP and GI. The research is of use for both academics and wine industry professionals, since, on the one hand, the research contributes to the academic literature by addressing the study of environmental intangibles and their relationship with GP, contextualizing the study in a sector where such relationships had not been previously addressed, and, on the other hand, the research is helpful for wine industry professionals by offering a series of recommendations for winemakers to improve their GIC and, as a consequence, their GP.

Thus, the present research aims to fill the existing gap in the literature through the study of GIC to advance the understanding of this construct, as well as its relationship with GP. In addition, GI is conceived as a mediating variable in this relationship. This study, therefore, aims to shed light on the ambiguity surrounding the GIC construct. It contributes to the existing debate in the environmental management literature, first, by analyzing the effect of GIC on GP in the wine industry and, second, by exploring the mediating role of the GI variable in clarifying this relationship. In particular, the research aims to answer the following two research questions: (1) Does GIC have a positive effect on GP? (2) Does GI mediate the GIC-GP relationship? (3) What actions can wineries take to improve their GP?

To answer the research questions, the article is structured as follows: First, after this introduction, Section 2 reviews the literature on the GIC effect on GP and GI, formulating, in turn, the hypotheses of the model proposed. Section 3 describes the methodology followed to achieve the research objectives, highlighting aspects related to data collection, measurements, and the statistical technique used. Section 4 examines the theoretical hypotheses put forward by discussing the results. Finally, Section 5 presents the most important theoretical and practical implications of the research, as well as the limitations and future lines of research.

2. Literature Review and Hypothesis Development

The widespread trend of organizations towards the development of more environmentally friendly business practices, as well as towards the generation of intangible assets and sustainable capabilities, such as GIC or GI, can be understood under the premises of the NRBV. The intellectual background of this approach has its origin in the seminal article written by Hart [26], who proposed this new vision under the logic of the Resource-based View (RBV), postulating that the strategy and competitive advantage of organizations in the coming years would be based on capabilities that facilitate sustainable economic activity.

The NRBV represented a milestone in the environmental management literature by relating for the first time organizational intangibles, such as tacit knowledge or capabilities, to the environmental management of companies, offering, in addition, a new perspective focused on studying the interaction between the company and its natural environment, given that, under the principles of the theory formulated, the natural environment could act as an entry barrier for companies to generate sustainable competitive advantages [27]. Therefore, under this approach, environmental management is considered an essential element in business strategy.

As a consequence of the above, the role of intangible assets and capabilities has attracted the interest of several authors specialized in environmental management. Thus, while Russo and Fouts [28] stressed the importance of organizational routines and capabilities for developing organizational policies to prevent pollution, Aragón-Correa and Sharma [29] emphasized that the implementation of a successful environmental strategy depended, in large part, on the development of a series of organizational capabilities in which accumulated knowledge, the vision shared among the members of the organization and learning processes played a fundamental role. More recently, authors such as Yusoff et al. [30] and Yong et al. [31] have focused on analyzing the influence of existing green intangible assets in the organization on the development and sustainable performance of organizations.

IC is the theoretical construct in which organizational intangible assets aimed at economic, social, and environmental improvement best fit. This concept refers to the set of intangible resources (human, structural, and relational) that allow a company to obtain a sustainable competitive advantage over time [32], and its study has been developed under the Intellectual Capital-based View (ICBV) [33]. According to RBV, a firm's intangible resources are more likely to contribute to achieving and maintaining superior performance when they are combined or integrated [34]. However, the two main criticisms of such a view revolve around: (1) the lack of specificity and (2) the lack of a clear explanation for achieving competitive advantage [35, 36]. ICBV aims to overcome the limitations of RBV with regard to the measurement and evaluation of intangible assets by having a greater explanatory capacity to address the relationship between organizational intangibles and their performance/competitive advantage [37, 38].

Although IC has been widely studied under the ICBV, recently some authors have attempted to integrate such an approach into the environmental discourse through the GIC construct [25, 30, 31, 39–42]. ICBV enables organizations to implement stringent international regulations, comply with the growing environmental awareness of consumers, and create value for the organization [43]. For this reason, its role is fundamental to ensuring the success of the Sustainable Development Goals (SDGs) promoted by the United Nations [44].

Definitions of GIC are scarce in the environmental management literature. On the one hand, Chen [18], in his pioneering work, defined it as the total set of intangible assets, knowledge, and capabilities related to environmental protection or green innovation at the individual and organizational levels within an organization. Chen [45], on the other hand, defined it as the integration of green and environmental knowledge sources into the organization to enhance its competitive advantage. Similarly, Liu [46] conceived it as the sum of all organizational knowledge that enables the organization to improve environmental management to gain a competitive advantage. López-Gamero et al. [47], on the other hand, conceptualized it as "the total stock of all kinds of intangible assets, knowledge, capabilities, relationships, etc., on environmental protection at the individual and organizational levels of the firm". Along the same lines, Huang and Kung [43] stated that "green intellectual capital represents a company's intangible assets, including knowledge wisdom, capabilities, experience, and innovation in the field of environmental protection".

It should also be noted that, as suggested by Hart [26], the GIC consists of three dimensions: Green Human Capital (GHC), Green Structural Capital (GSC), and Green Relational Capital (GRC). On the one hand, GHC is defined as the set of knowledge, skills, abilities, capabilities, experiences, and commitments of employees about environmental protection that is embedded in employees and not in organizations [18], allowing an organization to recognize its intangible assets related to the environment and helping to implement green strategies in a given competitive environment. On the other hand, GSC is conceived as the set of organizational assets that show concern for environmental protection within the company [48]. Thus, Jardon and Dasilva [49] suggest that the organization's concern for environmental aspects is not modified only by human capital, since the support of organizational culture and systems is required to increase the level of environmental awareness in the organization. Finally, GRC refers to the set of intangible assets based on the existing relationships between the organization and suppliers, customers, network members, and partners to improve the environmental management of the company and thus achieve a competitive advantage. Therefore, GRC plays a key role in building strong and lasting relationships between the organization and its customers and suppliers.

In addition, GIC provides a better understanding of the background of GI. The ability to innovate is becoming increasingly important for companies in a dynamic global environment, with more and more companies willing to devote their resources to the development of GI [50]. The development of GI is a win-win solution for all stakeholders, overcoming the conflict between economic development and environmental protection. The "green" label is an incentive for continuous innovation, as it creates new market opportunities for companies to meet new consumer demands and, as a consequence, improve their performance. GI encompasses innovation in energy-saving technologies, pollution prevention, waste recycling, eco-friendly product design, and environmental management of companies [51].

There are two types of GI: green product innovation and green process innovation. On the one hand, green product innovation aims to modify product designs by using nontoxic compounds or biodegradable materials during the production process to reduce the impact of disposal on the environment and improve energy efficiency [52]. This includes improvements in the durability or recyclability of products, reduction of raw materials, selection of more environmentally appropriate raw materials, and elimination of hazardous substances [53]. For its part, green process innovation aims to reduce energy consumption during the production process or during the process that converts waste into a valuable item [54]. In particular, green process innovation includes reducing air emissions, reducing water consumption, improving resource and energy efficiency, and switching from fossil fuels to bioenergy [53]. Thus, companies that pioneer green innovation strategies can achieve and maintain various competitive advantages [55], gaining not only cost efficiency, but also economic profitability [16].

Therefore, both GIC and GI can lead to improved GP, understood as the positive consequences of green initiatives on the natural environment inside and outside the company [18]. The present research attempts to link both the NRBV and the ICBV to understand the relationships posed in the study between the variables GIC, GI, and GP. The following sections set out the hypotheses put forward in the research.

2.1. Green Intellectual Capital and Green Performance. Companies cannot ignore the increasing environmental concerns of customers and the pressures of international environmental regulations [25]. In this context, companies must consider the negative externalities generated by their activities on the environment through GIC management, which can not only reduce production waste and increase productivity but also increase the GP of the organization. This can be understood as the degree to which the activities carried out by the organization are environmentally friendly [56, 57].

GHC refers to the set of intangibles that are strongly rooted in employees' skills, being owned by the members of the organization and not by the employees. Therefore, this set of intangible assets represents a solid basis for obtaining a competitive advantage, given the difficulty for competitors to imitate these resources [58]. Thus, the GHC not only allows obtaining a sustainable competitive advantage, but also improves the GP of the organization, given that by acquiring greater environmental skills, the GHC will be higher and, as a consequence, the GP will also increase [59].

Thus, if the green knowledge stock of the workers, i.e., the GHC, is higher, the GP of the organization will also be higher [60]. The GHC represents a key piece, therefore, for the success of the GP of organizations, since the knowledge and skills of employees are essential to address the environmental challenges faced by the organization [61]. If a company develops a strong GHC, employees will have the necessary green knowledge to address environmental challenges. In fact, in the environmental management literature, a qualified GHC is considered to increase the organization's chances of gaining a sustainable advantage over time, since a more environmentally aware workforce will have better skills to address such organizational challenges and, therefore, contribute to a greater extent to the generation of sustained performance over time [62, 63].

Furthermore, the interaction between companies can significantly increase their ability to address their environmental challenges [64], as close and intense linkages between companies can be an effective means for them to collaborate in reducing the negative externalities generated by their activities. Frequent interaction between external partners can encourage the organization to exchange resources and capabilities, as well as establish stronger relationships [65], and can generate positive externalities that improve GP [61]. Therefore, the GRC can improve the GP by matching the environmental interests of the main stakeholders with those of the organization [66]. In addition, trust between companies and their stakeholders plays a fundamental role in the acquisition of green knowledge, which is subsequently translated into improved GP [67]. Likewise, it should be noted that although organizations may have environmental objectives among their priorities [68], they need to crystallize their environmental management through their corporate objectives, culture, strategies, and organizational structure [69]. The GSC is thus understood as an internal resource that can improve the achievement of environmental objectives [70, 71], by representing a set of green intangibles owned by the organization that allows it to improve its GP.

The GIC can improve GP in different ways. First, it allows for minimizing environmental costs. Second, it promotes green knowledge and awareness among employees. Third, it enables the company's adherence to the demanding standards and expectations present in governmental environmental regulations. According to Chuang and Huang [72], GP is rooted in the organization's ability to accumulate knowledge and resources related to environmental protection. Therefore, based on the above arguments, we put forward the following hypothesis:

H1. GIC has a positive effect on GP.

2.2. Green Intellectual Capital and Green Innovation. Numerous studies claim that a company's IC positively influences its capacity for innovation [73–76]. Similarly, companies that properly manage their GIC have several intangibles that favor GI, enabling the company to adapt to new challenges related to sustainable development [76, 77].

Human capital is an essential resource for developing organizational innovations since the knowledge possessed by employees represents the key intangible resource for developing innovations to compete in the current turbulent environment [78, 79]. Therefore, GI will be higher as the green knowledge stock of employees is higher [60]. GHC thus acts as a catalyst for GI, enabling organizations to stimulate their green product and process innovations [30]. This set of environmental intangibles provides a competitive advantage to the firm through improved eco-innovation capability [51]. GHC improves environmental practices at the firm level [25], so firms with higher GHC tend to adopt more environmental innovations. Such a set of environmental intangibles have become a necessity to achieve environmental success for organizations [80], as companies wishing to develop GI need employees with high environmental knowledge. Also, GHC can generate an organizational climate in which risk, failure, and uncertainty are tolerated, thus facilitating the generation of creative ideas to develop GI. Therefore, if companies want to generate new green products and processes, they will need to develop their GHC.

Close relationships between employees and institutions facilitate innovation processes due to the faster flow of knowledge and its better utilization [81, 82]. In fact, numerous researchers claim that the relational capital of organizations, which is deployed through the exchange of ideas and knowledge between them, has a positive effect on organizational innovations [83–85]. From an environmental point of view, the tacit knowledge of employees [86], their social relationships [71], as well as inter-organizational relationships [8], serve to develop new technologies, ideas, products, and/or processes focused on preventing pollution caused by organizations, which can materialize in environmental product and process innovations. Therefore, the formation of a collaborative network between organizations to achieve environmental objectives, crystallized through the GRC, can foster the development of GI [87]. Therefore, as Huang and Kung [43] point out, GRC improves a company's cooperation and engagement with its customers, suppliers, and other stakeholders on environmental sustainability issues, which can translate into improved GI.

Despite developing GHC and GRC, if an organization does not have management systems and an adequate environmental culture, GI will be impossible to achieve. The elements of GSC, such as organizational structure, organizational culture, databases, and internal capabilities, directly increase the efficiency of GI, leading to higher firm profitability [88]. Moreover, organizational structure, culture, and policies lead to the improvement of innovation [89], so the integration of environmental knowledge in the organization can favor the development of GI. Thus, a company with a strong environmental culture fosters the acquisition of new green knowledge by employees, which is subsequently translated into GI [90]. Similarly, when such knowledge for the protection of the environment is codified, it can become systematically disseminated within the organization, to subsequently be used to develop GI [91]. Based on the above arguments, we propose the following hypothesis.

H2. GIC has a positive effect on GI.

2.3. Green Innovation and Green Performance. GI can not only increase the financial and social performance of companies but can also reduce the negative environmental impact generated by their activity [92], given that it is associated with the environmental management objectives of the organization [51, 93, 94]. Thus, GI is an essential capability for the successful environmental management of organizations, since it enables them to develop environmentally friendly products and processes.

NRBV advocates that pollution prevention, product stewardship, and sustainable development are key environmental strategies to improve GP and, as a consequence, gain competitive advantages [26, 27]. Therefore, organizations that are pioneers in the development of GI can achieve sustainable competitive advantages over time, since this type of innovation promotes the responsible and efficient use of raw materials in the production process, resulting in lower organizational costs [95], as well as improving product differentiation, which translates into higher consumer demand [96]. In this sense, it should be noted that GI allows for improving the ecological image of companies and, as a consequence, their GP [97], since they can incorporate ecological concepts in the design and packaging of their products [51]. In fact, the academic literature summarizes these two advantages under two dimensions: competitive advantage and GP. On the one hand, several studies affirm that GI, both in product and process, favors the achievement of competitive advantages [5, 70, 76]. On the other hand, scholars of the subject claim the existence of a positive relationship between GI and GP [91, 98, 99].

The implementation by organizations of GIs benefits organizations by enabling increased cost savings, improved environmental efficiency, and improved productivity, which directly contributes to competitive advantage [100]. In addition, the adoption of GIs potentially reduces pollution, hazardous toxic waste, and the cost of hazardous waste, while competently addressing external environmental pressures from other stakeholders with respect to environmental regulations [13, 100].

GP represents a major concern among managers since its improvement can imply compliance with strict environmental regulations and improve public perception of the products and services offered by the organization [101]. GI thus makes it possible to respond to the environmental needs of different stakeholders and to improve waste optimization. This is why companies that invest large resources to develop GI can: (1) reduce waste from their production, (2) increase their productivity, (3) comply with current regulations around environmental protection, (4) avoid sanctions from government agencies, (5) meet the environmental needs of stakeholders and (6) improve the differentiation of the organization. Therefore, in practice, the application of such type of innovation has the potential to improve the GP of organizations, with several researchers have demonstrated improved performance in terms of competitive advantage, green image, and GP [10, 12, 51, 102]. Thus, green products and process innovation are positively related to GP [100, 103, 104]. Based on the above arguments, we put forward the following hypothesis:

H3. GI has a positive effect on GP.

2.4. GI as a Mediating Variable in the GIC-GP Relationship. GHC refers to the set of knowledge, skills, and abilities possessed by employees in order to improve the environmental management of the company [10], favoring a climate conducive to tolerating failure and risk involved in the development of GI [12]. Thus, companies use the green knowledge of employees to develop GI to improve their GP [8]. Likewise, companies operating under strict environmental legislation understand the importance of GHC, given that this set of intangibles based on employees' skills, knowledge and creativity enables compliance with environmental regulations and encourages the adoption of strategies based on GI that, in turn, derive higher GP [55]. Thus, GHC allows a company to recognize its intangible green assets, facilitating the development and implementation of GIs to improve GP [61].

GRC, on the other hand, fosters GI development by reducing transaction and information search costs. Thus, when companies promote GRC in their environmental operations, they can better develop GI to minimize environmental impact and attract environmentally conscious customers. GRC is therefore a key resource for achieving the company's environmental goals from its relationships with suppliers, customers, and institutions [105]. Organizations should strive to integrate the green knowledge generated from the GRC, as GI is partly derived from this knowledge [106]. Therefore, GRC can increasingly increase GP through GI.

The GSC encompasses the existing codified environmental knowledge within an organization. This stock of organizational knowledge can favor GI, since the production of new products and the development of new processes often involve the application of this knowledge [107], positively influencing the GP of the organization [108]. Organizational structures and policies can positively influence innovations aimed at preserving the environment, and such innovations, in turn, can positively influence the GP of firms [109]. The codification of the environmental knowledge generated in the organization influences the GP of the organization, increasing the chances of successfully developing GIs [61]. Therefore, GSC, understood as the codified green knowledge possessed by the firm positively influences the GP of organizations by facilitating GI. Recently, Wang and Juo [61] demonstrated the mediating effect of GI on the GIC-GP relationship. However, there is little academic literature that has addressed such a mediating effect and, therefore, there is no certainty of such a relationship. Therefore, one of the main objectives of this study is to examine whether GI acts as a mediating variable in the GIC-GP relationship. Based on the above arguments, we propose the following hypothesis:

H4. GI mediates the relationship between GIC and GP.

Figure 1 shows the theoretical model proposed with the hypotheses to be tested.

3. Methodology

The methodological section of this research is divided into three blocks: (1) sample and population, (2) research questionnaire, and (3) analysis technique. Each of these blocks is described in detail below.

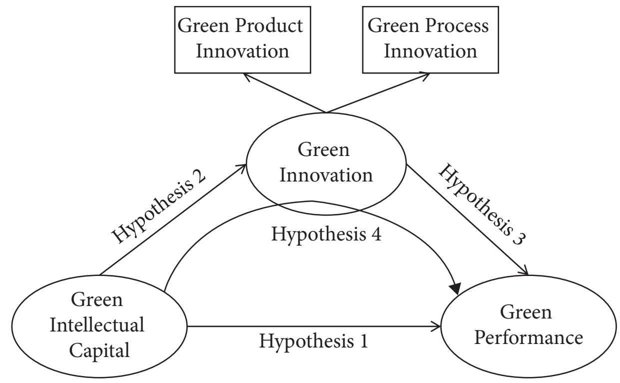

Figure 1: Proposed theoretical model. Source: own elaboration.

3.1. Sample and Population. Our research is contextualized in the Spanish wine industry for three main reasons. First, the Spanish wine industry has been selected as the unit of analysis given its importance for the economic and social development of Spain. Thus, according to the latest data provided by the International Organization of Vine and Wine (OIV), Spain stands out for its preferential position in the global wine industry, being the country with the largest vineyard surface area in the world and the largest exporter in volume. Second, in recent years various studies have emphasized the importance of knowledge as a key strategic factor in the modern wine industry [110–112]. Thus, while in the classic industrial approach, the wine sector was oriented to obtaining high yields per hectare as a formula for generating higher income, today, wineries are characterized by the intensive use of knowledge to reduce yields, prevent pests, enhance the expression of local varieties or take care of winemaking and aging in detail. Therefore, we consider it necessary to analyze green intangibles and their relationship with other constructs, being an increasingly knowledge-intensive industry. Third, no previous research has analyzed the relationships of the theoretical model proposed in the wine industry, which represents an opportunity to advance knowledge and understanding of the constructs under study.

The study population, therefore, is made up of companies in the Spanish wine industry, specifically those included in the National Code of Economic Activities (CNAE, for its Spanish acronym) 1102. According to the Sistema de Análisis de Balances Ibéricos (SABI) database, this CNAE code has a total of 4,373 companies, more than 99% of which are micro-enterprises and SMEs. A structured questionnaire based on the literature review was used for data collection in order to achieve greater representativeness in the results. First, the content of the questionnaire was validated through a pretest in which environmental managers of wineries and winemakers participated to validate the clarity and validity of the items used. Subsequently, the survey was distributed online using the Qualtrics application during the last 4 months of 2021. After the data collection process, a total of 216 observations were initially obtained. However, after the data cleaning process, 202 questionnaires were considered valid, this being the final sample (94.3% of the total number of responses). This sample size is valid for obtaining robust data through structural equation modeling, since a minimum sample size of 100 is required for the relationships between variables to be analyzed [113]. Likewise, it can be seen that the Spanish autonomous communities most represented in our sample are Castile and Leon (14.36%), Catalonia (13.37%), Castile La-Mancha (10.89%), and La Rioja (9.90%), all communities being represented to a greater or lesser extent in our sample (see Figure 2). This order is in line with the population under study, given that, according to the data provided by the SABI database, the communities with the most wineries are Castilla and León (17.35%), Catalonia (15.64%), and Castilla La-Mancha (11.31%). Furthermore, with regard to the size of the companies, 99.56% of the wineries in our sample are Small and Medium-sized Enterprises (SMEs), coinciding with the size of the companies belonging to the population studied, given that, based on the data on workers provided by the SABI database, 98.76% of Spanish wineries are SMEs.

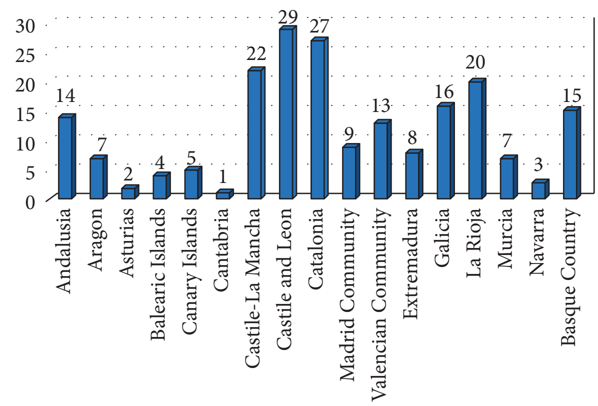

Figure 2: Distribution of the companies in the sample by the autonomous community. Source: own elaboration.

3.2. Research Questionnaire. To ensure consistency, reliability, and validity in the measurement of the variables, scales previously validated online in previous research were used (see Table 1). For the measurement of GIC, we used the scale employed by Zaragoza-Sáez et al. [96], which was measured by the authors using a 7-point Likert-type scale with seven items, taking as a reference the measures provided in the studies conducted by Chen [18], Huang and Kung [43], and Chang and Chen [48]. For the measurement of GI, the scale used by Chen [45] was used, conceiving the construct as the development of environmentally friendly products and processes that modify the design of an existing product and/or process to reduce any negative impact on the environment. On the one hand, green product innovation refers to the introduction of environmentally friendly materials, environmentally friendly packaging, product recovery and recycling, and eco-labeling [51]. On the other hand, green process innovation relates to a company's ability to improve existing processes, as well as to develop new ones that generate savings and avoid pollution, save energy, favor waste recycling, or decrease toxicity in processes [51]. In that sense, we followed Chen's approach [45] by considering GI as a second-order construct formed by green product innovation (4 items) and green process innovation (4 items) as first-order constructs. As with the GIC, the measurement scale used for this variable was Likert-type with seven response options (1–7). To measure GP, the 7-point Likert-type scale with 5 items by Paillé et al. [114] was used, which is based, in turn, on the five-item scale developed by Chow and Chen [115]. Finally, the size was introduced as a control variable, reporting the size of each organization according to the number of employees through the commonly known categorical classification that groups the different companies into microenterprises if they have up to 10 workers, small companies when they have 10 to 50 workers, medium-sized companies if they employ between 50 and 250 workers, and large companies when they have more than 250 workers [116].

3.3. Analysis Technique. The analysis technique used was partial least squares structural equation modeling (PLS-SEM), using the SmartPLS v. 3.3.3 software. This methodology makes it possible to analyze a network of theoretical relationships between variables, some of which may be latent, i.e., not observable. This makes PLS-SEM particularly useful for developing research in the field of social sciences since most of the concepts studied by the discipline are not directly observable [117]. In fact, the technique has experienced accelerated growth and acceptance in the field of social sciences during the last decade [118], particularly in the area of Management [119], the field in which our research is framed.

The choice of this technique for this study is based on several reasons. First, the minimum sample size for applying PLS-SEM is not very demanding [120], which is an advantage for the conduct of our study since the research sample ($n = 202$) is not very large. Thus, Reinartz et al. [121] consider that 100 observations should be the minimum sample size to give robustness to the results obtained in PLS-SEM. Second, our research establishes direct and indirect relationships between constructs, recommending the use of PLS-SEM in these cases as it can effectively handle these aspects [122]. Third, in our study, GI is a second-order construct, and this multidimensional variable can be effectively estimated in PLS [123]. Fourth, the PLS-SEM technique has been used previously to analyze the wine industry, so it is a valid research method for our investigation.

Likewise, it is important to note that there are several reasons to justify the use of the PLS-SEM technique as opposed to covariance-based structural equation modeling (CB-SEM). First, while CB-SEM is used when testing existing theory, PLS-SEM is appropriate in the exploratory phase for theory building and prediction [118]. Research addressing GIC, as well as its linkage to other constructs, is recent in the academic literature, so the field of study is still in the process of construction and consolidation. This justifies the preferential use of PLS-SEM over the CB-SEM approach in this study. Second, while for the use of the CB-SEM technique the properties of the normal distribution

Table 1: Measurement of the variables analyzed.

Construct	Items	Measure	Source
Green intellectual capital (GIC)	*GIC 1.* Our employees care about the environment *GIC 2.* Our employees have the knowledge and skills to protect the environment *GIC 3.* Our employees cooperate in working groups to address environmental issues *GIC 4.* Our employees cooperate with our suppliers to protect the environment *GIC 5.* Our employees cooperate with our customers/distributors to protect the environment *GIC 6.* Our company implements innovations to protect the environment *GIC 7.* Our company invests in facilities to protect the environment	Likert scale (1 = strongly disagree; 7 = strongly agree)	Zaragoza-sáez et al. (2020)
Green product innovation (GPTI)	*GPTI 1.* The company chooses the product materials that produce the least amount of contamination to carry out product development or design *GPTI 2.* The company chooses the product materials that consume the least energy and resources to carry out product development or design *GPTI 3.* The company uses the least amount of materials to compose the product to carry out the development or design of the product *GPTI 4.* The company would deliberate with circumspection whether the product is easy to recycle, reuse and decompose to carry out product development or design	Likert scale (1 = strongly disagree; 7 = strongly agree)	Chen (2008)
Green process innovation (GPSI)	*GPSI 1.* The emission of hazardous substances or wastes is effectively reduced in the manufacturing process *GPSI 2.* In the manufacturing process, waste and emissions are recycled to enable their treatment and reuse *GPSI 3.* Water, electricity, coal, or oil consumption is reduced in the manufacturing process *GPSI 4.* In the manufacturing process, the use of raw materials is reduced		
Green performance (GP)	*GP 1.* Our company has reduced waste and emissions from operations compared to its competitors over the past 5 years *GP 2.* Our company has reduced the environmental impact of its products/services compared to its competitors over the last 5 years *GP 3.* Our company has reduced its environmental impact by establishing partnerships compared to its competitors over the past 5 years *GP 4.* Our company has reduced the risk of environmental accidents, spills, and emissions compared to its competitors over the last 5 years *GP 5.* Our company has reduced purchases of nonrenewable materials, chemicals, and components compared to its competitors over the past 5 years	Likert scale (1 = strongly disagree; 7 = strongly agree)	Paillé et al. (2014)

Source: own elaboration.

must be strictly complied with, for the PLS-SEM technique it is not necessary to assume a normal distribution of the data as it is a nonparametric method [119]. Therefore, as far as the properties of the data distribution are concerned, the PLS-SEM technique has greater flexibility compared to CB-SEM. Third, the PLS-SEM technique is preferable when there are second-order variables in the model to be tested [117]. Given the multidimensional nature of the GI variable, consisting of green process innovation and green product innovation, the PLS-SEM approach is more appropriate than CB-SEM. Fourth, the minimum sample size of the study could allow us to apply both the PLS-SEM and the CB-SEM approach, since while the minimum sample size to apply PLS-SEM is 100, to apply CB-SEM a minimum sample size of 200 is required [118]. In this regard, it has been decided to select the PLS-SEM approach since the sample size is clearly higher than the minimum required, which increases the precision of the model estimates. Fifth, several previous investigations addressing the relationships between GIC, GI, and GP constructs have used PLS-SEM, which confirms the suitability of the technique to test the relationships proposed.

4. Results

Given the multidimensional nature of the GI variable, we applied the two-stage model based on “latent variable scores” [124] to obtain the results. First, the aggregate scores of the first-order constructs were calculated. Second, these aggregate scores were used as indicators of the second-order construct. Next, based on the recommendations of Hair et al. [118], we present the results of the model in three blocks: (1) the evaluation of the global model, (2) the evaluation of the measurement model, and (3) the evaluation of the structural model.

4.1. Evaluation of the Global Model. The proposed model presents a standardized root mean square residual (SRMSR) of 0.047 < 0.08 [124], which means that the model has a good global fit. In addition, it also meets the more stringent requirement of Carmines and Zeller [125], who considers that SRMS must be less than 0.05 for there to be an adequate global fit of the model.

Once the SRMR fit criterion was checked, it was verified whether this indicator together with the unweighted least squares discrepancy (d_ULS) and the geodesic discrepancy d_G was within the confidence range after bootstrapping. As can be seen in Table 2, all values are below HI95 and HI99. Therefore, the results imply that this model cannot be rejected [118].

Table 2: Overall model fit.

	Value	HI95	HI99
SRMR	0.047	0.052	0.063
d_ULS	0.641	0.718	0.844
d_G	0.765	0.816	0.921

Source: compiled by authors.

Table 3 shows the mean, maximum and minimum values, as well as the standard deviation for each variable are analyzed. As can be seen, the minimum and maximum values of the constructs GIC, GI, and GP are 1 and 7 respectively. This is because these are the minimum and maximum values of the Likert scale used. Likewise, while the minimum size of the wineries is 1, referring to the number of workers, the maximum value of the size variable is 262, which is the maximum value of the number of workers that make up a winery among the companies in the sample. Similarly, there are 10 workers on average among the companies in the sample, with the average of the three remaining variables being around values close to 5. Of the four constructs analyzed, the GIC is the one with the greatest dispersion to the average (1.496), while the size is the one with the least dispersion (0.969).

Table 3: Values of the mean, minimum value, maximum value, and standard deviation of the variables analyzed.

	Mean	Min	Max	Standard deviation
GIC	4.944	1	7	1.496
GI	5.127	1	7	1.231
GP	4.873	1	7	1.343
Size	10.242	1	262	0.969

Source: compiled by authors.

4.2. Measurement Model. To analyze the quality of the measurement model, the following criteria set forth by Hair et al. [118] were followed: (1) and analyze the reliability of the individual indicators through their external loadings (λ), (2) assess the internal consistency reliability through Cronbach’s alpha and composite reliability, (3) check the convergent validity through the average variance extracted (AVE) and (4) to analyze the discriminant validity the Heterotrait-Monotrait criterion (HTMT).

First, as indicated in Table 4, all the indicators of the variables analyzed do meet the requirement of individual item reliability, since their loadings exceed the value of 0.707 [126]. It is, therefore, possible to state that the different indicators present sufficient levels of reliability at the individual level. Second, it is possible to state that all the constructs meet the reliability criterion of internal consistency since both Cronbach’s alpha and composite reliability (ρc) exceed the value of 0.8. Third, the constructs meet the requirement of convergent validity, since their AVE measures exceed the 0.5 level [127]. Therefore, each construct explains more than half of the variance of its indicators. Finally, Table 5 shows the discriminant validity test following the HTMT criterion. As can be seen, the values of the GIC, GI, and GP are clearly lower than 0.85 [128]. This means that each construct is unique and, therefore, captures phenomena not represented by other constructs in the model.

4.3. Structural Model. Once it has been confirmed that the measures of the constructs are reliable and valid, the next step is to address the assessment of the structural model. This assessment involves examining the predictive ability of the model and the relationships between constructs. Following the indications followed by Gilinsky et al. [129], to evaluate the structural model we analyzed the path coefficients, the R-Squared level, and the predictive relevance of Q2.

First, before evaluating these indicators, we examined the presence of problems related to collinearity in the structural model. This is due to the need to avoid the presence of multicollinearity between the antecedent variables of each of the endogenous constructs. According to Hair et al. [118], there are indications of collinearity when the variance inflation factor is greater than 5 (VIF > 5). Therefore, values greater than five of the endogenous constructs imply critical levels of collinearity. In this sense, the VIF values obtained in this work do not exceed the maximum value in any of the cases (see Table 6). In addition, there is no unobserved heterogeneity in the sample data.

Through Figure 3 it can be observed how the results regarding R-Squared and β are based on a bootstrap test with 5000 subsamples. The direct and indirect effects of GIC on GP of wineries have been tested, finding both positive and

Table 4: Measurement model: external loadings, construct reliability, and convergent validity.

Construct/items	Outer loadings	Rho (Pa)	Cronbach's alpha	Ave
Green intellectual capital (GIC)		0.883	0.883	0.589
GIC 1. Our employees care about the environment	0.759			
GIC 2. Our employees have the knowledge and skills to protect the environment	0.781			
GIC 3. Our employees cooperate in working groups to address environmental issues	0.719			
GIC 4. Our employees cooperate with our suppliers to protect the environment	0.833			
GIC 5. Our employees cooperate with our customers/distributors to protect the environment.	0.86			
GIC 6. Our company implements innovations to protect the environment	0.71			
GIC 7. Our company invests in facilities to protect the environment	0.724			
Green innovation (GI)		0.948	0.945	0.725
GPTI 1. The company chooses the product materials that produce the least amount of contamination to carry out product development or design	0.882			
GPTI 2. The company chooses the product materials that consume the least energy and resources to carry out product development or design	0.903			
GPTI 3. The company uses the least amount of materials to compose the product to carry out the development or design of the product	0.881			
GPTI 4. The company would deliberate with circumspection whether the product is easy to recycle, reuse and decompose to carry out product development or design	0.885			
GPSI 1. The emission of hazardous substances or wastes is effectively reduced in the manufacturing process	0.89			
GPSI 2. In the manufacturing process, waste and emissions are recycled to enable their treatment and reuse	0.801			
GPSI 3. Water, electricity, coal, or oil consumption is reduced in the manufacturing process	0.838			
GPSI 4. In the manufacturing process, the use of raw materials is reduced	0.713			
Green performance (GP)		0.936	0.928	0.78
GP 1. Our company has reduced waste and emissions from operations compared to its competitors over the past 5 years	0.906			
GP 2. Our company has reduced the environmental impact of its products/services compared to its competitors over the last 5 years	0.937			
GP 3. Our company has reduced its environmental impact by establishing partnerships compared to its competitors over the past 5 years	0.786			
GP 4. Our company has reduced the risk of environmental accidents, spills, and emissions compared to its competitors over the last 5 years	0.87			
GP 5. Our company has reduced purchases of nonrenewable materials, chemicals, and components compared to its competitors over the past 5 years	0.907			

Source: compiled by authors.

Table 5: Measurement model: discriminant validity.

	GIC	GI	GP	Size
GIC				
GI	0.725			
GP	0.486	0.553		
Size	0.170	0.107	0.224	

Source: compiled by authors.

Table 6: Analysis of collinearity in the model through VIF values.

	GIC	GP	GI	Size
GIC		1.778	1.000	
GP				
GI		1.779		
Size		1.013		

Source: compiled by authors.

statistically significant effects (see Table 7). This implies that the GI partially mediates the relationship between the GIC and GP, given the direct (0.169) and indirect (0.261) effects are positive and significant, with a strong total effect of GIC on GP of 0.430 ($p \leq\ = 0.01$). Therefore, all four hypotheses are supported. Table 8 also shows the effect sizes (f^2), i.e., the degree to which an exogenous construct contributes to explaining a given endogenous construct in terms of R^2 [130]. In this case, the most representative f^2 values correspond to the GIC for the GI construct (0.775) and GI for the GP construct (0.108). Finally, to analyze the quality of the model, Geisser's test (Q^2) was performed, which must have estimated values above 0 ($Q^2 > 0$). As can be seen in Table 9, an average predictive relevance of the model was observed because the Q^2 values are above 0.25 [111]. Regarding the control variables, the results show that the size of the wineries has a positive and significant impact on the GP.

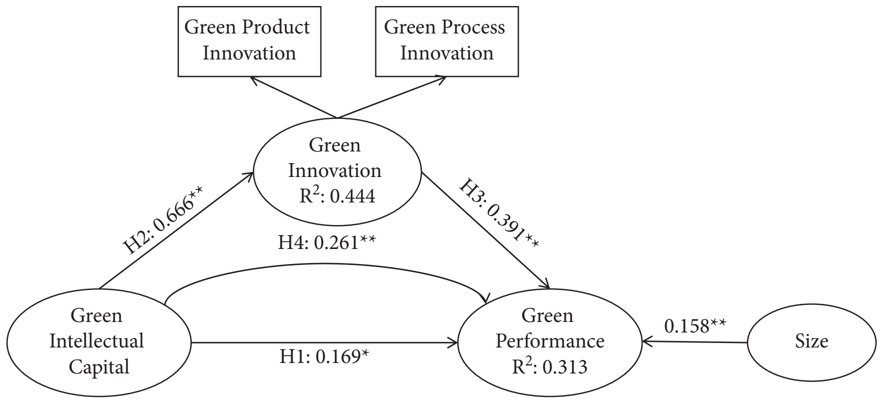

Figure 3: Theoretical model with R-squared, path coefficients (β), and significance. Source: own elaboration.

Table 7: Results of the structural model for the mediation model.

Direct effects	Path coefficient	t-value	p-value	95% BCCI	Hypothesis supported
GI - > GP	0.391	3.635	$\leq = 0.01^{**}$	[0.195; 0.551]	H3 supported
GIC - > GI	0.666	13.437	$\leq = 0.01^{**}$	[0.583; 0.748]	H2 supported
GIC - > GP	0.169	1.737	0.042^{*}	[0.069; 0.231]	H1 supported
Indirect effects	Path coefficient	t-value	p-value	95% BCCI	Hypothesis supported
GIC - > GI - > GP	0.261	3.572	$\leq = 0.01^{**}$	[0.134; 0.379]	H4 supported

Notes: BCCI: bias corrected confidence intervals; $^{*}p < 0.05$; $^{**}p < 0.001$. Source: compiled by authors.

Table 8: Effect sizes (f^2) of the analyzed variables.

	GP	GI
GIC	0.036	0.775
GI	0.108	
Size	0.048	

Source: compiled by authors.

Table 9: Construct cross validated redundancy.

	SSO	SSE	Q^2 (=1-SSE/SSO)
GI	1616	1103.561	0.317
GIC	1414	1414	
GP	1010	771.32	0.256
Size	202	202	

Source: compiled by authors.

Therefore, it could be interesting to analyze the differences in environmental management between large winery groups and small wineries.

The results of this research suggest that the development of GIC in wineries can lead to higher GP. Moreover, these intangibles not only generate greater ecological performance but also favor the formation of key organizational capabilities, such as GI, thus strengthening the GIC-GP relationship. The positive and significant relationship between GIC on GIP is in line with the results obtained by Yusliza et al. [66] and Wang and Juo [61], which demonstrate such a relationship for Malaysian and Taiwanese manufacturing industries, respectively. In addition, GIC acts as a catalytic variable for GI. In this regard, Chen & Chang [20] demonstrate a positive and significant relationship between GHC and GI performance. In contrast, Chang [131] states that GHC does not directly affect GI, but indirectly through green adaptive capacity. Chen et al. [51] assert through their research that GIC has an indirect impact on GI through GSC. Ali et al. [119] show that GHC and GSC increase significantly with GI adoption. Jirakraisiri et al. [40], on the other hand, show that all three GIC dimensions positively and significantly influence the adoption of GI. In the present study, we analyzed the GIC construct in a unified way to understand the relationship of environmental intangibles to CG holistically. On the other hand, the mediating effect of GI on the GIC-GP relationship has been sparsely explored in the academic literature. However, through the joint understanding of the NRBV and ICV approaches, the mediating role that the GI variable can play in such a relationship has been corroborated.

5. Conclusions and Implications

The results presented in the present research are relevant for the academic community, as well as for companies and professionals in the wine industry, as they improve the knowledge about the relationship between GIC and GP in the wine industry.

Wineries are facing increasing pressures to improve their environmental sustainability [132], as the environment, the community, and the local economy can be negatively affected by their activity. The wine industry is facing several exogenous factors that threaten its survival, such as rising energy prices, water scarcity, increasing environmental awareness among stakeholders, and climate change [133].

These factors, together with the knowledge of winemakers and wineries, can drive the adoption of sustainable practices that subsequently culminate in product and process innovations to improve the GP of wineries [129]. For this reason, the analysis proposed in the present research becomes particularly relevant, since the high impact of GIC on wineries' GP has been empirically demonstrated. Moreover, as demonstrated in the research, this positive effect is partially mediated by GI. Therefore, wineries that promote their GHC, GSC, and GRC will be able to improve their GP, as well as their capacity to develop innovations aimed at protecting the environment.

There are several theoretical and practical implications derived from our research. Regarding the theoretical contributions, the results of the present research contribute to the environmental management and IC literature, providing practical evidence in the Spanish wine industry. In particular, the research empirically demonstrates the positive and significant effect of GIC development on wineries' GP, as well as the mediating effect of GI on this relationship. These results are consistent with recent empirical research such as that of Wang and Juo [61] contextualized in Taiwan's high-tech sector. However, further analysis of the constructs and their relationships should be pursued, as the academic literature addressing these relationships is very sparse. Therefore, we encourage environmental management researchers to continue to delve deeper into these relationships in future publications. The practical implications, therefore, allow us to answer the first two research questions, given that (1) there is a positive and significant relationship between GIC on GP, and (2) GI partially mediates this relationship. It is important to note that, to the best of our knowledge, no previous research has contextualized the relationships raised in the wine industry, which represents an advance in the understanding of the constructs studied, as well as in the comprehension of the environmental management of wineries.

Regarding the practical contribution of the study, the results presented in this research can play a key role in the environmental management decisions of environmental managers and winery winemakers. In this regard, from the GHC point of view, winery employees can develop codes of good environmental practices, organize training and environmental awareness sessions, as well as attend seminars and workshops to improve their green knowledge. As for the GSC, wineries can develop circular economy programs, computer systems to measure carbon and water footprint, eco-efficient facilities, a brand linked to sustainability, certifications that endorse their environmental commitment, a flat organizational structure through which green knowledge flows, an organizational culture built on the pillars of sustainability, as well as constant investments in R&D&i. As far as the GRC is concerned, the link between wineries and their stakeholders should be fostered, since such relationships can improve their green knowledge of the companies and, consequently, their environmental management. These organizational practices make it possible to accumulate a series of green intangibles that have a positive impact on the wineries' GP. Likewise, GI such as the development of organic wines, the technological improvement of agricultural soils, the valorization of waste, as well as the control of damages and climatic risks, can enhance the GIC-GP relationship. The practical implications provide an answer to the third research question, given that through actions aimed at improving employees' green knowledge (GHC), codifying the organization's environmental knowledge (GSC) and fostering relationships between different stakeholders (GRC), companies can improve their GP. The research can therefore be useful to winemakers who are thinking of improving their GP and/or their GIs, given that the actions proposed to improve the GHC, GSC, and GRC can lead to the improvement of the GP through the GI.

Despite the important contributions made in the article, it is important to highlight the existence of certain limitations. First, the relevance of the topic makes it necessary to extend this analysis to other wine-producing countries. In this sense, the effect of the GIC on the performance of wineries at the international level would be of great interest, and comparisons could be made between New World and Old World wine-producing countries. Second, there is a limitation inherent to cross-sectional studies, since they do not allow us to examine relationships over an extended period of time. Specifically, it would be interesting to know the evolution and temporal trajectory of the study carried out. For this reason, it seems relevant to us as a future line of research to analyze the companies that participated in the survey through longitudinal analysis. This implies that these companies should be willing to participate in the coming years in order to be able to investigate their evolution in an increasingly competitive, technological, and international business context. In addition, we could further investigate the role that winery size can play in GIC and GP. In fact, as a future line of research, we propose to carry out a multi-group analysis in which the differences in the model proposed according to the size of the wineries (SMEs or large companies) can be seen.

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The authors declare no conflicts of interest.

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