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Critical Factors Affecting Trust in the Wine Supply Chain in Greece: A Grey DEMATEL Approach

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Abstract: *Background*: Although trust is a well-studied topic in supply chain management, the case of the wine supply chain has not been adequately investigated. *Methods*: A hybrid approach combining qualitative and quantitative data analysis was adopted. The research was divided into two phases: (i) identification of critical factors based on the literature, and (ii) analysis of eight experts' insights on those factors by employing the grey DEMATEL approach. *Results*: Fourteen factors that affect trust in the wine supply chain were identified based on the academic literature. From the analysis of the experts' views, with the use of the grey DEMATEL approach, the factors were classified into two groups. The first group (nine factors) concerns the factors that affect the rest and the second group (five factors) concerns those which are affected by the former factors. *Conclusions*: The study of trust in the supply chain can be further improved by monitoring the trends in the sector and by engaging a wider audience of stakeholders. This approach can be applied to various regions in order to examine whether the situation is different from country to country. Stakeholders will have the necessary information to support their decisions and prioritize their objectives, aiming at improving the whole supply chain.

Keywords: wine supply chain; trust; grey DEMATEL; Greece

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1. Introduction

In light of the strategic planning challenge, supply chain management (SCM) has garnered more attention and research engagement from scholars. Being one of the most well-known areas of study in the management sciences today, SCM has produced a plethora of novel ideas for maximizing supply chain performance across boundaries between and inside firms [1,2]. Organizations nowadays pay greater attention to and concentrate more during the supply chain process in order to maintain corporate development and intense competition.

To enhance the long-term success of businesses and their supply chains, SCM encompasses a range of strategies and procedures that efficiently connect manufacturers, distributors, suppliers, and customers. These practices provide organizations the chance to set themselves apart via outstanding performance in the areas of distribution, inventory management, demand forecasting, and product availability. As a result, companies who successfully apply SCM techniques have better supply chain outcomes. However, improved supply chain performance necessitates both external integration with suppliers or customers and internal cross-functional integration inside a company [3,4].

Supply chains function in a dynamic environment that is becoming more and more defined by globalization, fierce rivalry, and quickly shifting market conditions brought on by pandemics, warfare, and the consequences of climate change. Organizations must work together more closely and integratively to address these risks and difficulties. Supply chains are now the focus of competitive strategies due to the necessity to maintain

competitiveness in an ever-changing corporate environment. In light of the fact that supply networks offer competitive advantages over other resources, managers are now basing their competitive strategies on them [5,6]. Nearly all contemporary supply chain collaboration models can be traced back to the early 1990s developments that followed the widespread recognition of SCM as a discipline in the mid-1980s, helped along by the advent of the Internet as an enabler. Therefore, these advancements are essential to our comprehension of supply chain collaboration [7].

Supply chain networks are, by nature, complex adaptive networks, many of which form on their own without any deliberate process control [8]. A supply chain's ability to function effectively rests mostly on how well its participants coordinate their actions, and this potential is being realized via the use of information technology in coordination tasks [9].

A different way to think about SCM is as the management of a supplier–customer relationship with the goal of optimizing value added for the end user at the lowest possible cost of the supply chain as a whole. Establishing appropriate relationships in the supply chain is essential to its functioning [10,11]. Because supply networks are complex, efficient cooperation can only be achieved by sharing reliable, timely, accurate, and helpful information with all parties involved in the supply chain [6]. Effective communication of goals, strategies, and projections is the first step in collaborating closely with partners to develop productive product flows that reach final consumers. Open communication with other chain members in any collaborative endeavor entails a risk of exposure to another party's activities [12]. Integration is motivated by the realization of interdependency. In the past, when an organization was vertically integrated, several functional areas had to collaborate to achieve strategic organizational objectives. To efficiently deliver the products to the market, the organizations must integrate as much of their operations across the key partners and supply chain processes as possible throughout the portion of the product's value that is divided to the various entities outside of the organizations [1]. In order to improve supply chain performance and boost competitiveness, supply chain cooperation offers a comprehensive approach to supply chain optimization. Effective SCM requires long-term, close vertical links between upstream and downstream supply chain stakeholders, from suppliers to customers [13]. Moreover, companies benefit most from collaborative ties for risk sharing and access to complementary resources that boost financial performance and competitiveness [6]. By combining their diverse skill sets, participating members aim to build long-term collaborative benefits that will benefit all members. Establishing a collaborative connection might result in a new leadership with distinct talents and goals. Companies that become major participants in a supply chain network frequently exert significant influence on others to optimize supply chain processes and provide exceptional customer service. Additionally, they are adaptable enough to standardize value-added procedures that are more responsive and cost-effective [12].

Today's company supply chains are complex networks that must be managed collaboratively and optimized globally. Additionally, business is evolving swiftly worldwide. In volatile and competitive business contexts, organizations seek supply chain flexibility through information exchange. Since supply chain decisions require a variety of information, participants must offer and receive excellent information [6,14–16]. Supply chain experts understand that, in order to generate value across the organization, they need to refocus their efforts, from cost reduction to developing new procedures that make businesses more connected and flexible. Speed is essential in the Internet era because product life cycles are becoming shorter due to global manufacturing and distribution dispersal [17]. Consistency between strategic objectives, measures, and achievements is seen as alignment. Prior to all other business and organizational disciplines, such as strategy, management information systems, organizational behavior, and manufacturing strategy, alignment is a crucial component that greatly influences the success of companies. Therefore, supply chain alignment promotes improved firm performance by assisting businesses in achieving

organizational goals, structures, and practices both inside and among the many activities and participants of a supply chain [18–20].

In particular, the complexity of agri-food supply chains has increased with several stakeholders having an active role, and consumer concerns over food safety are rising. Because of this, people frequently rely too much on supply chain actors to guarantee the quality and the characteristics of the goods they consume [21–24]. The agri-food sector is highly specialized, full of informality, and susceptible to a wide range of crises, including supply, climatic, sanitary, and others. In this way, discovering new ways to enhance the efficiency of such systems requires a knowledge of how trust functions in agri-food supply chains [25–27].

In this paper, the role of trust in the supply chain is addressed. Although trust is a very important factor in the supply chain, very few studies have been conducted regarding trust in the case of the wine supply chain. Through trust it is possible to improve supply chain operations and performance and to foster partnerships among supply chain parties. Moreover, the supply chain, as a dynamic rather than a static system, is affected by many factors that involve trust in one way or another. Thus, the aim of this paper is to identify the factors affecting trust in the wine supply chain and to examine their relationships. Towards this end, the role of trust in SCM is discussed in Section 2 with a particular focus on agri-food supply chains. Then, a typical wine supply chain is presented in Section 3. In Section 4, we present the methodology we have followed, and in Section 5, the results of our research are presented. The paper ends with some concluding remarks.

2. The Role of Trust in Supply Chain Management

2.1. Conceptualization of Trust

There is now an extensive range of literature on trust, spanning from specialized applications to broad concepts. But as several experts in the area have pointed out, the definition of trust as it is understood by different researchers varies throughout the body of published research [28]. Scholars from a variety of fields, including operations management, psychology, sociology, and economics, have studied the idea of trust [2,29]. The concept of trust is challenging. It is a complex and varied communication issue, and different academic fields have offered distinct definitions of trust as analyzed in the reviews of [28,30,31].

Belief, attitude, or anticipation about an exchange partner that stems from the companion's knowledge, dependability, and intentionality, or from the relationship's honesty and kindness, constitutes trust as a multifaceted construct [32,33]. One can distinguish between two types of trust that promote cooperation: interorganizational and interpersonal. Interpersonal trust acknowledges individual interdependence while relying on conduct. However, expectations are more important to interorganizational trust than commitments and agreements made in commercial dealings with the intention of lowering risk [34]. Numerous elements influence trust, including the competence, skill, and reputation of trustees, and the emotions, experience, and cognition of trustors [35]. Relationships between individuals, reputation, honesty, and cooperation with shared ideals all contribute to the maintenance of trust. Information asymmetry and disparities in relationships are the causes of trust imbalance [36].

Trust is a crucial managerial concept that fosters an environment in which businesses work to go above and beyond the minimum requirements of a relationship in order to maximize the likelihood of mutual benefits. Trust has also been identified as the cornerstone of strategic partnerships and as a prerequisite for fostering long-lasting relationships and fostering the involvement of exchange partners. Trust has also been thought of as a governance mechanism at times and as a mechanism to reduce opportunism in strategic networks [37,38]. In and of itself, trust does not generate value or offer a foundation for long-term business collaborations. The foundation of trust is a shared commitment on the part of both parties to carry out the terms of understandings and agreements in the most practical and efficient ways possible in order to maximize value for each of them [17].

The foundation of a collaborative creative capability is trust. Building and maintaining successful partnerships is impossible without an underlying basis of trust [33]. Uncertainty and trust are becoming increasingly relevant in tandem. To put it another way, trust is fundamentally based on uncertainty. Expectations that positively impact social actors are the foundation of trust, and they are developed in the face of uncertainty. We can discuss trust when one actor has reasonable grounds to believe that the other would behave in accordance with his or her own expectations, but neither actor knows what the other will do [28].

Eventually, although trust is acknowledged as an element that enhances collaboration, little is known about this complicated phenomenon that is impacted by a wide range of influencing variables [5].

2.2. Trust in Supply Chain Management

In all kinds of alliances, trust is crucial, particularly because it acts as a facilitator to foster the kinds of environments that result in improved performance. In fact, proponents of organizational theory contend that trust serves as an organizing principle rather than just a contributing aspect. Almost all business transactions involve some degree of trust [1,2,32,39]. Therefore, we also stress the significance of trust in assessing the performance of supply chains.

Trust is a significant subject in SCM, where relational business competitiveness is emphasized and rewarded. Many researchers emphasized trust as a key factor in supply chain partnerships. Supply chain actors have long understood the value of trust in business-to-business and business-to-customer relationships. Customers consider trust, risk, and reputation when making a supply chain purchase, and when supply chain connections fail, many firms blame trust [36,40]. As an informal relationship construct, trust along with commitment can support the three market orientation constructs: responsiveness (by encouraging actors to invest time, energy, and resources in the value chain), intelligence generation (through their contribution to relationship quality and related information exchange), and intelligence communication (by enhancing actors' willingness to share information) [41]. Since it is difficult to measure, particularly in complex and challenging supply chains, trust is an elusive, multifaceted term with no consensus on what exactly makes it up. This makes the meaning of trust in the context of SCM even more unclear [42].

SCM governance relies on trust, hence recent research has focused on understanding and conceptualizing trust. However, the definition of trust is still debated. SCM's inter-organizational trust context has been researched from several angles. Due to its numerous facets, trust, especially inter-organizational trust, is difficult to understand. Every discipline perceives trust through its own lens, without understanding or appreciating others' ideas [29,33,42]. As a governance system, trust is essential to business partners' information exchange. It is important to remember that one of the primary drivers of SCM is information, which serves as the foundation for choices on the other drivers of the supply chain. It serves as the link between each task and procedure in a supply chain [9].

Three categories of results are identified by the classification of trust's influence [43]: relational, indirect, and direct economic results. The longevity of the partnership, the expectation of continuation, the company's financial performance, and the ambition to make more purchases are all direct results of trust. The indirect economic effects of trust also include innovation, interdependence, investment in relation-specific assets, cooperative action, cooperative problem solving, cooperative responsibility, knowledge transfer, loyalty, perceived risk, and decreased purchase costs.

The classification of trust proposed by Sako [44], who made a distinction between contractual, competence, and goodwill trust, has been widely embraced by supply chain experts. When partners anticipate that their counterparts will follow contractual provisions, contractual trust arises. When partners think their counterparts are capable of carrying out particular responsibilities, competence trust develops. When partners pledge freely to take initiative for their mutual benefit while abstaining from unfairly taking advantage of one

another, goodwill trust is created. The strongest type of trust is goodwill trust, which is built via consistent interactions in committed partnerships. Maybe the work by Fawcett et al. [33] provides the necessary background and tools to analyze trust in the context of SCM. They introduced the trust capability–commitment matrix as a tool to assist companies in assessing the expected trust level as they develop certain performance and commitment capabilities. Then, they suggested the trust maturity framework, which includes four trust stages, namely limited trust, transactional trust, relational trust, and collaborative trust. Companies' potential for collaborative innovation grows as they have the ability to create mature levels of trust.

Apart from its crucial role in cultivating strategic partnerships in the supply chain, trust plays various additional enabling roles in inter-organizational interactions [45]. First, trust between suppliers and purchasers can curb opportunistic behavior, which leads to increased flexibility and lower governance costs from the standpoint of transaction costs. Second, trust is closely related to social capital theory, which has provided a more sophisticated framework for comprehending supply chain connections than transaction cost theory does. In supply chains, social capital is crucial because it may help partners evaluate each other's current and future resources. Additionally, data in the context of business-to-business supply networks indicates that social capital will affect delivery, flexibility, quality, and cost. In addition, mutual trust would motivate participants in the supply chain to mitigate their risks. Throughout the partnership, they acknowledge the possible cost savings that come with it and cooperate to make this happen [12,46].

Executives from all sectors agree that the key to effective supply chain operations is sustaining and fostering trust in connections inside the chain [47]. Global supply chains have begun implementing technology-based, trust-building solutions, such as blockchain technology, to solve this issue [18,42,48]. Because blockchain may improve information authenticity and transparency, it is seen to have a promising potential to drastically shift the paradigm of supply chain trading and create a reliable exchange environment.

It is important to note that the possible lack of trust in the interactions that occur within the supply chain may lead suppliers and customers to boycott the firm [6]. This means that the firm will have to raise buffer inventories and increase marketing costs. In addition, the lack of confidence in the interactions that take place within the supply chain may lead to production delays and shortages, which in turn may result in underperformance, increased production costs, and increased production time.

2.3. Insights from Trust in the Agri-Food Sector

Agri-food supply chains are more difficult to manage because of a variety of factors, including the perishability of the product and the promptness of responses, which ultimately dictate how much trust a supply chain member should be willing to place in other chain members [49,50]. The research on the agri-food sector indicates that building trust is a key factor in enhancing sustainability performance as well as the efficacy of partnerships. Accordingly, comprehending the mechanisms behind trust in agri-food supply chains is crucial to identifying more effective ways to enhance the efficiency of those systems [51–53]. In agri-food supply chains, trust is sometimes based on the people who handle food production, processing, control, and commercialization rather than on particular products. In-person connections and social contact facilitate and support the development of profound trust [54].

However, it is critical to comprehend the degree of trust attributed to chain participants, as this will allow individual chains to formulate the best approaches for bolstering customer assurance about food safety [21]. Supply chain managers are becoming more aware of the need for trust as a vital component of supply chain performance due to the rapid changes in the agri-food supply chains brought about by globalization, food quality, and food safety concerns and requirements [55].

Lately, alternative food networks such as short agri-food supply chains (SAFSCs), have gained increased attention [56,57]. Because farmers/producers and consumers engage

directly with SAFSCs, trust is a critical component. The proximity of these parties in SAFSCs can improve transparency and strengthen their connection, both of which are critical for establishing trust. In SAFSCs, customers frequently look for assurance on the food's origin, quality, and safety and rely on that information to guide their purchases [58]. In addition, shorter distances are intended to provide both economic benefits and social and cultural objectives, such as environmental and health preservation, as well as to fortify cultural ties through a sociable and communal consumption behavior [59].

3. Methodological Concerns

3.1. The Subject: The Wine Supply Chain

The wine supply chain is a complex network with various levels and activities. A typical wine supply chain can be divided into three tiers as presented in the sequel [24,60,61].

Grape and wine producers, as well as wineries, are the key actors in the first tier. From cultivation to production, grape producers are vital in the early phases of the supply chain. They are involved in the cultivation and harvesting of grapes, which are necessary for the creation of wine. This covers tasks including creating vineyard planning, producing crops, and managing postharvest treatments. Then wine producers are in charge of all aspects of the winemaking process, which includes fermenting, processing, storing, bottling, labeling, and marketing/selling the finished product. In order to ensure optimal production operations, producers must manage basic inputs including equipment, insecticides, fertilizers, and other resources. This involves making certain that resources are used effectively throughout the grape production and the winemaking process. In addition, producers interact with various stakeholders such as suppliers, distributors, logistics providers, intermediaries, and cooperatives/associations. Developing and preserving ties with these parties is essential to the wine supply chain's seamless functioning.

Wholesale distributors make up the second tier. They buy wine from producers, sell it to retailers, and transport it. Wholesalers and distributors work as intermediaries in the supply chain. After buying wine, they sell it and transport it to stores. Wholesalers' supply chain operations include a number of crucial tasks. To guarantee a consistent supply of wine for retailers, distributors are in charge of buying wine from producers and controlling inventories. Demand forecasting, buying, and inventory management are all part of this. Distributors are in charge of processing, storing, and shipping wine products. Distributors and third-party logistics (3PL) companies may offer value-added services such order fulfillment, handling, and storage. Because of their skill and strategic placement, 3PL partners are the ones to whom these operations are being outsourced. Distributors establish and preserve connections with manufacturers and retailers. They buy wine from producers, serve as intermediaries, and then sell and distribute it to retailers. Distributors are responsible for making sure that all laws pertaining to the sale, transportation, and storage of alcoholic drinks are followed.

Liquor stores, supermarkets, restaurants, and other companies that sell wine to final customers are included in the third tier. Retailers buy wine from wholesalers and distribute it to customers via a variety of outlets. Retailers are in charge of maintaining inventories to satisfy customer demand and acquiring wine from wholesalers. To guarantee product availability, forecasting, purchasing, and inventory control are required. Retailers market and sell wine products to consumers by taking part in a variety of sales and marketing initiatives. This covers customer relationship management, advertising, and product placement. For retailers, offering top-notch customer service is essential. This includes answering questions, helping consumers choose products, and making sure they are satisfied all around. Retailers are subject to laws governing the distribution and sale of alcoholic drinks. This includes licensing, age verification, and adherence to alcohol regulations. Retailers oversee product marketing to draw customers and boost sales, as well as the logistics of shipping and storing wine supplies.

It is important to note that the boundaries between the above tiers are sometimes blurred due to vertical integration possibilities experienced in the sector. In addition,

there are occasions where the second tier is made redundant and win producers have the opportunity to sale their products directly to consumers.

The wine supply chain has certain unique traits that differentiate them from other agri-food products. These include the following aspects:

Seasonality in production—The seasonality of the grape harvest has a big impact on the wine business. The harvest's quality and quantity might differ greatly from year to year depending on the climate, pests, and illnesses. This unpredictability may result in variations in wine availability and output, which may have an effect on the supply chain, especially with regard to planning and inventory control [62].

Geographical indication—Wine is frequently connected to certain places, which raises the product's value. Given that rigorous control and traceability are necessary to guarantee the authenticity of the wine's origin, this geographic indicator may have an impact on the supply chain. Due to the intricacy of the wine supply chain, which sometimes involves several stakeholders in several nations, this can be difficult [63].

International markets—Wines are imported and exported all over the world, and the wine business is a worldwide enterprise. The supply chain may become more complex in this global market because of the many laws, regulations, customs processes, and logistics of transportation. Additionally, it exposes the sector to changes and trends in the global market, which may have an effect on prices and demand [64].

Complex laws and regulations—Laws and regulations include everything from import and export laws to production and labeling guidelines. The supply chain is made more difficult by the wide variations in these laws between nations or regions. Adherence to these standards is crucial in order to avert legal complications and preserve the brand's image [65].

Need for specialized handling at every stage of the supply chain—To preserve its quality, wine has to be specially handled at every stage of the supply chain. This entails cautious transportation to prevent breakage and appropriate storage conditions to prevent spoiling and damage. The necessity for specialized tools and skilled labor is common, which raises the supply chain's price and complexity [66].

Different product categories, ranging from premium to bulk—There are several different product categories within the wine industry, ranging from bulk wines to premium and specialty wines. Every category has unique supply chain needs and difficulties. Premium wines, for instance, could need more cautious handling and storage in addition to more advanced marketing and distribution plans [67].

Wine aging—One special feature of the wine supply chain is the aging process. Certain wines are matured for many years prior to being marketed, necessitating appropriate storage conditions and prolonging stock holding. This may have an effect on cash flow and profitability in addition to supply chain planning and management [68].

3.2. Research Methodology

This study attempts to identify and analyze the critical factors affecting trust in the wine supply chain. Therefore, the following research questions are addressed:

Q1: What are the main critical factors affecting trust in the wine supply chain?

Q2: What are the relationships among the above factors?

To explore the subject examined both theoretically and empirically, a hybrid approach combining qualitative and quantitative data analysis was adopted. The research was divided into two phases.

During the first phase, which took place in November 2021, the Scopus database was used to identify the literature about trust in SCM. The search produced about 1600 results of journal articles written in English, which constituted a very large body of literature. Notably, performing the same search in December 2023 produced about 2200 results. This sharp increase can be attributed to the renewed interest in trust which has been fostered by blockchain technology. In any case, the topic of trust has been analyzed from various perspectives and in various sectors. The results were filtered based on their titles and

then based on their abstracts. Through content analysis, the authors ended up with a list of critical factors affecting trust in the wine supply chain. These factors are presented in Section 5.

During the second phase, quantitative research was conducted in February 2022. The empirical investigation was addressed to stakeholders of the sector with important professional experience and strong academic backgrounds. They are all from Greece and were selected based on their experience ($\geq$4 years) and their acknowledged presence in the sector. An invitation to participate was initially sent to 11 persons. After a first round of communication, three persons decided not to participate in the survey. Eventually, eight persons engaged in the wine supply chain in Greece participated in the survey. Expert 1 belongs to the University community with a PhD in Oenology with more than 30 years of experience. Experts 2 and 3 also belong to the University community with more than 5 years of experience and knowledge in oenology. Experts 1–3 offer consulting services to grape and wine producers. Expert 4 is a winery owner in Corinthia, Greece, with a master's degree, working with more than 300 wholesale customers and with more than 10 years of work experience. Experts 5 and 6 have been working for the last 5 years in wineries in Corinthia and all have a PhD in Oenology. The wineries where they work deal with more than 100 wholesale customers, while the wineries employ 20 and 30 people, respectively. In addition, Expert 7 is also a winery owner with 12 years of experience working in the winery, with more than 50 wholesale customers and 15 winery employees. Finally, Expert 8 is a manager in a company that supplies raw materials to wineries, with 4 years of experience in this position and 65 wholesale partners.

Prior to each participant filling out the questionnaire, a semi-structured interview was held in order to better understand the opposing viewpoints and incorporate any additional, more pertinent, or helpful material that was left out of the questionnaire. The purpose and context of the study were explained to each participant. They were reassured regarding their personal confidentiality as well as the protection of critical information by their organization. Each one of them gave their consent to participate and was free to end the survey at any time if the questions or the format were uncomfortable for them.

In-person conversations with experts were used to discuss the identified critical factors and get their opinions on how significant they were regarding the subject of the study. A grey DEMATEL technique was used to analyze the data, and a customized questionnaire was developed to evaluate the key elements that affect trust in the wine supply chain. Between 1972 and 1976, the Battelle Memorial Institute in Geneva developed the DEMATEL technique, which aims to solve complex problems by determining the essential parts that need to be examined, together with their causal relationships. Applying a structural modeling approach helps to uncover the link between independent variables and investigate their interconnectedness. Seven to twenty-one participants is the suggested range for employing this method [69]. It should be noted that the grey DEMATEL technique is not used to measure to what extent the critical factors affect trust. The focal point of the technique is to explore the complex relationships among these critical factors.

One major problem of using the DEMATEL approach alone is that it might be challenging to analyze unclear events and scenarios when there is disagreement among participants owing to a lack of information. Grey system theory is helpful in such situations because it facilitates the analysis of ambiguities resulting from uncertainties, ignorance, or insufficient human activity [70,71]. In this paper, the procedure for grey DEMATEL followed in [72] is used.

A linguistic scale is established, which is used to evaluate the relationships among the factors, as shown in Table 1.

The evaluation of factors $c = \{ci|i = 1, 2, \ldots, n\}$ by H experts is used to form the initial direct relationship matrix. Therefore, H different matrices are created: $Z^1, Z^2, \ldots, Z^H$, containing the elements "$\otimes z_{ij}^k$". Next, grey numbers are converted to crisp numbers using the following equations:

The calculation of the normalized values $\underline{\otimes} n_{ij}^k$ and $\overline{\otimes} n_{ij}^k$ is performed as follows:

$$\underline{\otimes} n_{ij}^k = (\underline{\otimes} z_{ij}^k - \min_j \underline{\otimes} z_{ij}^k) / \Delta_{min}^{max} \quad (1)$$

$$\overline{\otimes} n_{ij}^k = (\overline{\otimes} z_{ij}^k - \min_j \underline{\otimes} z_{ij}^k) / \Delta_{min}^{max}, \quad (2)$$

where

$$\Delta_{min}^{max} = \max_j \overline{\otimes} z_{ij}^k - \min_j \underline{\otimes} z_{ij}^k. \quad (3)$$

Table 1. Linguistic scale and the corresponding grey numbers.

Linguistic Term	Notation	Grey Number
No influence	0	[0, 0]
Very low influence	1	[0, 1]
Low influence	2	[1, 2]
High influence	3	[2, 3]
Very high influence	4	[3, 4]

The calculation of the normalized crisp values b_{ij}^k that formulate the matrix B^k is performed as follows:

$$b_{ij}^k = \frac{[\underline{\otimes} n_{ij}^k \cdot \left(1 - \underline{\otimes} n_{ij}^k\right)] + (\overline{\otimes} n_{ij}^k \times \overline{\otimes} n_{ij}^k)}{(1 - \underline{\otimes} n_{ij}^k + \overline{\otimes} n_{ij}^k)}. \quad (4)$$

The calculation of the final crisp values y_{ij}^k that formulate the matrix $\mathrm{Y^k}$ is performed as follows:

$$y_{ij}^k = \min_j \underline{\otimes} z_{ij}^k + b_{ij}^k \cdot \Delta_{min}^{max}. \quad (5)$$

The calculation of the matrix A, which contains the values a_{ij} is performed as follows:

$$A = \frac{\sum_{k=1}^{H} \left[Z^k\right]}{H}. \quad (6)$$

The classical approach of DEMATEL is applied in matrix A. With Equation (7), the normalization factor F is calculated, and with Equation (8), the normalized direct-relation matrix X is formed.

$$F = \frac{1}{\max\limits_{1 \le i \le n} \sum_{j=1}^{n} a_{ij}} \; i, j = 1, 2, 3 \ldots n \quad (7)$$

$$X = F \cdot A. \quad (8)$$

The calculation of the total relation matrix T, which contains the values t_{ij}, is conducted as follows (where I is the identity matrix):

$$T = X \times (I - X)^{-1}. \quad (9)$$

The causal relationships are identified using Equations (10) and (11).

$$R = \left[\sum_{j=1}^{n} t_{ij}\right]_{n \times 1} \quad (10)$$

$$C = \left[\sum_{j=1}^{n} t_{ij}\right]_{1 \times n}^{T}. \quad (11)$$

The values R_i indicate the direct and indirect influence of the factors i over the other factors, whereas the values C_j indicate the influence imposed on factors j by the other factors. The matrices P and E are formulated with Equations (12) and (13), which indicate the prominence and the net cause/effect of the factors, respectively.

$$P = R + C \tag{12}$$

$$E = R - C. \tag{13}$$

In cases where the number of factors to be addressed is large, decision makers may choose to use a threshold value θ to depict the most important relationships between the factors. In the case discussed in this paper, the threshold is defined by the mean value μ of the values t_{ij} and their standard deviation σ as follows:

$$\theta = \mu + \sigma. \tag{14}$$

4. Results

4.1. Identification of Critical Factors Affecting Trust in the Wine Supply Chain

In Table 2, a selection of critical factors affecting trust in the wine supply chain is presented. It should be noted that we focused on the literature around agri-food supply chains, since the literature in wine supply chains is very limited. As an agri-food product, wine shares many common features and challenges with similar products. In this sense, we have elaborated the critical factors and we have provided relevant supporting references. This does not necessarily mean that they have a focal role in the corresponding articles, but they are explicitly or implicitly connected with the concept of trust.

Table 2. List of critical factors.

Coding	Critical Factor	Description	Relevant Supporting References
K1	Traceability	Grape growers and wine producers produce, harvest, supply, and blend wine goods, ensuring traceability and quality assurance. Consumer information and product differentiation require wine authenticity. Traceability helps consumers trust wine by revealing its provenance and authenticity. Traceability increases supply chain transparency by providing customers and intermediaries with accurate batch, origin, and handling information. Due to its secure, tamper-proof data record, traceability may expedite company processes and reduce counterfeiting and fraud.	[73–81]
K2	Legislation and regulations	In order to prevent wine fraud, control labeling procedures, and guarantee the quality and authenticity of wine, rules and regulations pertaining to wine are essential. Customers' and industry players' trust in the products and supply chain is subsequently impacted by this. Legislation controls the use of protected indications of origin, labeling standards, and the use of additives and techniques in viticulture and winemaking. Legislation can also affect other economic issues, such as manufacturing costs and supply chain interruptions, which can then affect trust in the supply chain. As a result, the legislatively constituted regulatory framework plays a critical role in determining the degree of confidence and trust that the wine supply chain enjoys.	[3,82–88]
K3	Safety	Because there are so many dangers and hazards involved in the wine production process, safety is a vital aspect that affects confidence in the supply chain. Operational, reputational, and environmental risks are present in the wine supply chain and can have major effects on the end product's quality and safety. Constrained areas, controlling temperature, and overexertion are common risks in vineyards that can result in serious problems. Maintaining the quality and integrity of the wine production process, safeguarding employees, averting mishaps, and upholding the supply chain's safety are all critical to building consumer confidence in the finished product.	[54,78–81,89–91]

Table 2. *Cont.*

Coding	Critical Factor	Description	Relevant Supporting References
K4	Sustainability	Sustainability is crucial to wine supply chain trust for various reasons. As it includes social, environmental, and economic factors, business stakeholders and customers tend to favor businesses that practice ethical employment, environmental responsibility, and social inclusion. The wine industry's sluggish adoption of sustainable techniques has degraded land, water, and vegetation, alarming stakeholders and scholars. Global supply chain concerns including labor shortages and production and shipping interruptions have shown the wine industry's susceptibility, making sustainability even more important for trust and long-term resilience.	[52,77–81,92,93]
K5	Market requirements	The wine supply chain's trust depends on market requirements, which affect many elements of the sector. The worldwide wine market is expected to rise due to rising demand from emerging nations and premiumization. Market factors, such as customer preferences, quality standards, and distribution channels affect wine production and distribution, impacting supply chain trust. Market dynamics including rising consumer spending and global economic recovery have caused supply chain bottlenecks and delays in wine production and delivery. Consumer preferences and readiness to pay more for high-quality and premium wines have major ramifications for the business and supply chain trust. Market demands change distribution routes, regulatory norms, and wine availability due to globalization, influencing supply chain trust.	[45,84,94–100]
K6	Customer satisfaction	For a number of reasons, customer satisfaction is a crucial component that influences trust in the wine supply chain. In the wine business, satisfied customers encourage word-of-mouth marketing, client retention, and brand loyalty. Higher customer satisfaction promotes returning customers, client retention, and positive word-of-mouth, all of which boost an organization's performance. Furthermore, wine businesses must keep their customers by constant quality, tailored experiences, engagement, and communication. Wine companies may foster trust by putting the needs of their customers first, which will eventually help the wine supply chain as a whole.	[3,101–105]
K7	Exchange of information	It is possible to ensure the quality of wine to customers through the exchange of information, which also increases the traceability and authenticity of wine goods, decreases instances of fraud and counterfeiting, and improves the efficiency of supply chain operations. In order to guarantee that customers receive wine of a given quality, it is essential for all supply chain actors to share information with one another. The use of GS1 standards has the potential to enhance the effectiveness of the recording and interchange of information between the various players in the supply chain.	[9,21,45,61,106–114]
K8	Personal relations	Because trust-based connections between supply chain actors are complicated and iterative, personal ties play a significant role in shaping trust throughout the wine supply chain. Reputation, honesty, and cooperation preserve trust in the wine supply chain and provide advantages to all parties. Personal relationships not only help participants gain trust in one another, but they also affect customer behavior in the wine business. When making purchases, consumers frequently rely on first-hand recommendations from friends, influencers, and wine specialists. Via personal interactions, wine makers and customers may also affect each other's purchasing decisions by imparting knowledge about winemaking techniques, tasting notes, and food pairings.	[28,115–120]
K9	Reliability and solvency of the parties involved	The wine supply chain's trust is heavily influenced by characteristics such as reliability and solvency, which are crucial for timely product delivery, brand reputation preservation, and successful sales. The wine business has been impacted by global supply chain problems including delays and shortages, which highlights how crucial a dependable supply chain is. In addition, trust-building and seamless operations depend on the financial soundness of supply chain participants. For this reason, the stability and solvency of the companies in the wine supply chain are essential to preserving stakeholders' confidence, guaranteeing prompt product delivery, building brand equity, and generating revenue.	[3,52,84,86,88,102,121–125]

Table 2. *Cont.*

Coding	Critical Factor	Description	Relevant Supporting References
K10	New technologies	New technologies may provide solutions to various wine supply chain challenges associated with trust. Blockchain technology has the potential to enhance wine product traceability, authenticity, customer confidence, and eliminate fraud. IoT may also improve supply chain operations and information exchange as it can be used to monitor supply chain operations by giving real-time temperature, humidity, and location data. This verifies the wine's authenticity and appropriate storage and shipping. RFID tags allow wine bottles to be tracked and identified throughout the supply chain. This prevents wine counterfeiting and boosts customer trust. Wine e-labels provide origin, production, and certification information. Drone technology and crop mapping are used to track vineyard health, production, and other metrics. This data can assist winemakers manage vineyards, improving wine quality and consumer trust.	[23,73,77–79,106,126–130]
K11	Stakeholder collaborations	Working together, stakeholders can overcome obstacles, improve operations, and make the best use of resources, all of which will increase the industry's competitiveness. Furthermore, by exchanging data on sales, stock levels, and customer demand, supply chain cooperation enables stakeholders to more effectively manage inventory levels. This lowers the risk of stockouts and overstocking by enabling more precise forecasting and replenishment. Collaborative traceability may also help the wine sector grow its supply chain, distinguish its offerings, prevent quality problems, and promote sustainability. Lastly, stakeholder cooperation is essential to the governance and effectiveness of wine cooperatives. Therefore, players in the wine supply chain may unleash enormous advantages, spur growth, and eventually increase supply chain trust by cooperating and utilizing innovative technology.	[49,52,73,86,93,122,131–134]
K12	Ethical practices	The industry's general responsibility, openness, and sustainability are all enhanced by ethical practices. Customers want more openness and responsibility from wineries as they become more conscious of their influence on social and environmental concerns. Organic and biodynamic viticulture are two examples of ethical wine production techniques that put the health of the land and the environment first. This ensures resource conservation and long-term sustainability. Because there are no artificial ingredients in the wine that is created, it is a healthier option for customers. Fair compensation, secure working conditions, and chances for career advancement are top priorities for moral wine producers. Consumers that respect environmental, social, and governance ideals are more likely to trust businesses that include these ideas into their company culture and mission. Smaller-scale and deeply ingrained in their local communities, ethical wineries frequently support the social and economic advancement of the areas they serve.	[3,23,52,84,94,135–137]
K13	Brand engagement	Brand engagement is crucial to wine supply chain credibility owing to evolving customer expectations. Modern consumers, especially wine drinkers, expect a story, a relationship, and a set of values from their companies. Brand interaction has become more important to create and sustain customer trust. Wine's origin, production, and brand values are increasingly important to consumers. They demand transparency, social responsibility, and a connection to the product and company. Brands that communicate with customers, tell their stories, and show quality and sustainability gain trust and loyalty. Brand involvement is essential in the wine sector, because the product is connected with heritage, craftsmanship, and place. Wineries may connect with consumers, tell their stories, and establish brand trust through social media, events, and direct communication. By actively interacting with consumers and fulfilling their changing expectations, wine supply chain businesses may build trust, loyalty, and long-term connections, boosting market success.	[3,84,86,88,89,102,138,139]
K14	Outsourcing	Because outsourcing affects labor conditions, supply chain dependability, and transparency, it has a major impact on trust in the wine supply chain. Concerns about fair pay, comfortable working conditions, and the longevity of the workforce emerge when outsourcing is chosen as a business option. This may have an impact on how the supply chain's ethical standards and social responsibilities are seen but also on the alignment and compatibility with other supply chain actors. Furthermore, outsourcing might exacerbate issues with the global supply chain, such as delays and shortages, which could cause supply chain interruptions and irregularities.	[87,92,99,125,140–142]

4.2. Application of a Grey DEMATEL Approach

Based on the steps outlined in Section 4 (Equations (1)–(9)), Table 3 displays the total relation matrix. The values in this table that exceed the threshold value θ are highlighted with bold text and grey cell coloring.

Table 3. Total relation matrix.

	K1	K2	K3	K4	K5	K6	K7	K8	K9	K10	K11	K12	K13	K14
K1	0.21	0.25	**0.33**	0.22	0.27	**0.34**	**0.31**	0.14	0.26	0.22	0.26	0.25	0.16	0.15
K2	0.28	0.15	**0.32**	0.26	0.27	**0.31**	0.26	0.11	0.22	0.20	0.19	0.24	0.14	0.13
K3	**0.34**	0.28	0.28	**0.30**	**0.37**	**0.41**	**0.34**	0.18	**0.32**	0.28	0.28	**0.30**	0.23	0.20
K4	0.20	0.17	0.25	0.16	0.27	0.27	0.20	0.11	0.19	0.20	0.18	0.24	0.16	0.12
K5	0.24	0.20	0.27	0.23	0.20	**0.31**	0.23	0.14	0.23	0.22	0.19	0.23	0.17	0.13
K6	0.23	0.19	0.28	0.21	**0.30**	0.24	0.25	0.13	0.25	0.21	0.21	0.24	0.19	0.14
K7	**0.30**	0.22	**0.32**	0.28	**0.32**	**0.38**	0.24	0.20	**0.31**	0.25	**0.29**	0.28	0.21	0.17
K8	0.14	0.11	0.15	0.14	0.17	0.21	0.19	0.08	0.22	0.12	0.19	0.17	0.12	0.12
K9	0.27	0.19	**0.30**	0.24	0.28	**0.34**	0.28	0.17	0.21	0.21	0.24	0.27	0.22	0.16
K10	0.28	0.20	**0.32**	0.28	**0.32**	**0.34**	0.28	0.13	0.22	0.17	0.21	0.24	0.19	0.15
K11	0.23	0.18	0.26	0.21	0.27	**0.31**	0.28	0.19	0.27	0.18	0.17	0.23	0.18	0.15
K12	0.26	0.21	**0.29**	0.26	**0.29**	**0.35**	0.27	0.18	**0.29**	0.19	0.27	0.20	0.20	0.17
K13	0.17	0.12	0.18	0.18	0.21	0.27	0.21	0.12	0.22	0.13	0.17	0.17	0.11	0.10
K14	0.19	0.16	0.23	0.20	0.23	0.28	0.24	0.14	0.21	0.19	0.22	0.20	0.15	0.10

The degree of prominence and the net cause/effect of the factors are presented in Table 4. Based on the results, the most prominent critical factors affecting trust in the wine supply chain are: K3 Safety and K6 Customer satisfaction, followed by K7 Exchange of information and K9 Reliability and solvency of the parties involved.

Table 4. Degree of prominence and net cause/effect.

Factors	R	C	R + C	R − C	Classification
K1	3.37	3.33	6.70	0.03	Cause
K2	3.10	2.63	5.73	0.47	Cause
K3	4.11	3.80	7.91	0.31	Cause
K4	2.71	3.18	5.89	−0.47	Effect
K5	2.97	3.77	6.74	−0.80	Effect
K6	3.06	4.34	7.40	−1.28	Effect
K7	3.77	3.58	7.34	0.19	Cause
K8	2.14	2.02	4.16	0.12	Cause
K9	3.37	3.40	6.77	−0.03	Effect
K10	3.34	2.76	6.10	0.57	Cause
K11	3.11	3.09	6.20	0.02	Cause
K12	3.45	3.25	6.70	0.19	Cause
K13	2.35	2.44	4.79	−0.10	Effect
K14	2.74	1.98	4.72	0.77	Cause

There are nine factors that are classified as causes: K14 > K10 > K2 > K3 > K12 > K7 > K8 > K1 > K11. Notably, K14 Outsourcing and K10 New technologies are the most influential causes. Thus, changes in these factors are expected to significantly affect trust in the wine supply chain.

There are five factors that are classified as effects: K9 > K13 > K4 > K5 > K6. K6 Customer satisfaction and K5 Market requirements are the factors that are most susceptible

to other factors. In this regard, they mostly illustrate the implications of decisions that were made.

The overall prominence–causal graph is presented in Figure 1, which includes all the critical factors that were examined in this research. The calculation of the mean of $(R + C)$ values leads to the formation of four quadrants:

- The factors in the upper right quadrant are core factors (K3, K7, K12, K1) and are considered significant in affecting trust in the wine supply chain.
- The factors in the upper left quadrant are driving factors (K14, K10, K2, K8, K11) and should be given further attention following the previous group of factors is considered.
- The factors in the bottom left quadrant (K4, K13) are independent factors.
- The factors in the bottom right quadrant (K6, K5, K9) are prominent factors with poor relation being influenced by other factors.

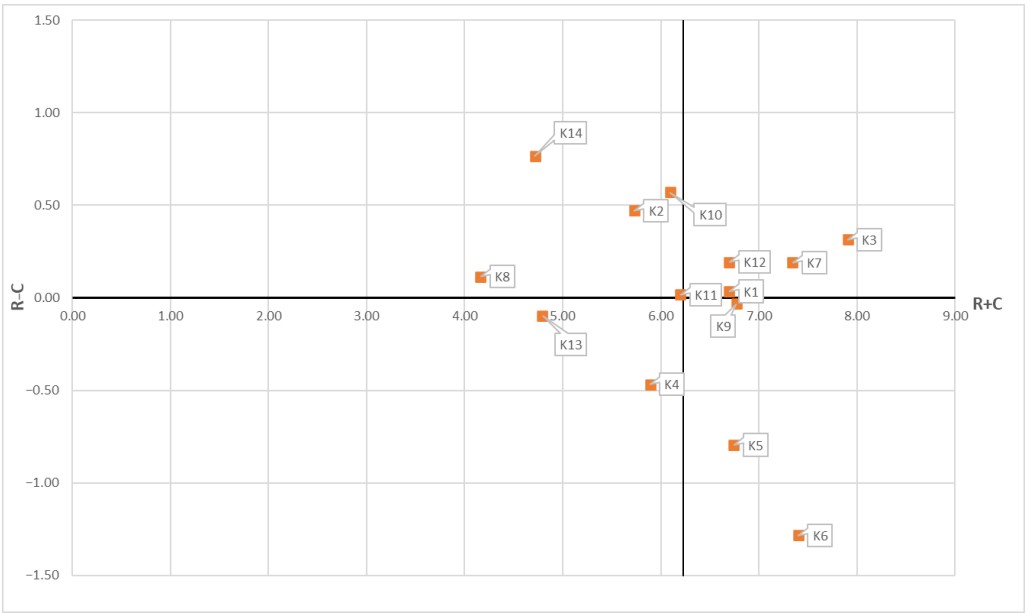

Figure 1. Overall DEMATEL prominence–causal graph.

4.3. Discussion and Implications

This article contributes to the literature on trust in supply chains by addressing a widely consumed product, which has its unique traits. Despite the fact that the notion of trust has been studied in various supply chains, our research has revealed that it has not been adequately addressed in the case of wine supply chains. Therefore, there are no similar studies which could be used for comparisons. Our quantitative analysis showed that there are four core factors which are significant in affecting trust in the wine supply chain. These factors (K3, K7, K12, K1) are further elaborated in the sequel.

Safety in the wine supply chain is more important than only preventing operational, reputational, and environmental hazards. In wineries and vineyards, employee health and safety are of utmost importance. The use of large machinery, contact with chemicals used in viticulture, and the strenuous physical labor involved in picking and processing grapes are just a few of the dangers that workers face. It is crucial to ensure worker safety by using safety equipment, safe work procedures, and appropriate training to avoid mishaps and injuries [143]. In addition to providing protection for employees, a secure workplace may boost morale and productivity, which can result in a supply chain that is more reliable and efficient. Ensuring the safety of wine products for consumption requires maintaining the quality and integrity of the winemaking process [144]. This entails monitoring for any unwanted derivatives, excessive residues, or possible pollutants during the whole winemaking process. Good sanitation and cleaning procedures are essential in wineries to prevent cross-contamination and reduce microbiological load, which can compromise

the safety and quality of the wine. Wineries may avoid product recalls and safeguard their brand's reputation by placing a high priority on integrity and quality assurance. Consumer trust and brand protection are directly related to the safety of the wine supply chain [145,146]. Wine fraud incidents, such the sale of tampered or counterfeit wine, can harm a company's reputation and erode customer confidence. Putting procedures in place, such tracking and tracing wine bottles, helps to guarantee the product's authenticity and shields customers from the health risks connected to fake wine. Wineries can sustain their market position and guarantee long-term success by protecting their brand and earning the confidence of their customers.

The exchange of information is a determinant factor for trust in the wine supply chain. It makes it possible to save data on goods and procedures in an organized manner at every stage of the production process, from grape farmers to wine [147]. In order to combat counterfeit items in wine supply chains and fulfill growing customer expectations about the provenance and authenticity of the products they consume, greater traceability is vital [148]. Information sharing makes consumer and quality control information easier. It guarantees a strong quality assurance system that enables the tracking and management of all production system operations, including lighting, temperature, product recalls, marketing, distribution, and logistics. Additionally, it can lessen the effects of issues with supply chains that are often resolved, like the bullwhip effect [149]. In the wine supply chain, information sharing can also aid in preventing counterfeiting. Businesses may lessen the possibility of fraud and data manipulation by exchanging and archiving relevant information on safe platforms, guaranteeing the authenticity of their wines [150]. The exchange of information has the potential to advance environmentally friendly wine supply chain operations. Wineries may contribute to the general sustainability of the industry by raising customer knowledge and enjoyment of sustainable wines via providing information about their sustainable production processes [151].

Beyond the actual process of producing wine, ethical practices play a complex role in the wine supply chain. It includes fair trade, community impact, and sustainability, all of which help to foster trust with customers and other stakeholders. Regardless of their socioeconomic background or place of origin, small-scale producers and growers in the wine sector are guaranteed fair recompense for their harvests according to fair trade practices [152,153]. By leveling the playing field between small businesses and multinational enterprises, this fair strategy promotes a more competitive and diversified market. For consumers, fair trade certification is a reliable sign that the goods they buy are produced with consideration for the environment and the people who make them. Wineries that follow fair trade principles show their dedication to moral business conduct, which helps win over customers who are becoming more aware of the social and economic effects of their purchases and build trust and loyalty. Local communities' social and economic growth is sometimes greatly aided by ethical vineyards [24,154]. These wineries enhance the welfare and prosperity of their employees as well as the communities in which they operate by offering competitive pay, secure working conditions, and chances for professional growth. A winery's reputation can be improved by its dedication to social responsibility since customers are more willing to support companies that positively affect their communities. Furthermore, moral behavior can foster closer ties with neighborhood stakeholders, which is beneficial for the winery's long-term viability and sustainability. Sustainability is a fundamental element affected by ethical wine business operations. It entails putting into practice measures that support healthy soil, lessen erosion, and preserve grapevine health—all of which are critical to the land's long-term survival [155,156]. Imports of sustainable wine grapes, for instance, frequently originate from farms that hold certifications such as organic or biodynamic, which reassure customers of ecologically conscious production practices. Furthermore, the increasing demand from consumers for transparency and environmental stewardship is aligned with local sourcing and waste reduction initiatives across the supply chain. Wineries that put sustainability first not only safeguard the environment but also

establish themselves as industry leaders in a market where environmentally concerned customers are becoming more and more powerful.

In order to maintain the integrity of the wine supply chain and to build trust among stakeholders, traceability is a key factor. Various laws have been developed by regulatory agencies worldwide to guarantee the safety and authenticity of food and beverage goods, including wine. For example, wine must be traceable under EU Regulation 178/2002, which applies to all food items [151]. Wine manufacturers are required to monitor the flow of their goods from vine to glass along the supply chain. Because traceability systems provide a recorded trail of the wine's journey, they assist wine producers in adhering to these standards. In the case of a product recall, this documentation is essential because it enables prompt identification and removal of the impacted items from the market, reducing consumer risk and perhaps legal ramifications for manufacturers [103,157]. The capacity to respond quickly is crucial for safeguarding customers against any health risks. Furthermore, as was previously said, traceability solutions may aid in the fight against counterfeit wines, which represent a serious threat to consumer safety. Traceability solutions are more successful when cutting-edge technologies like blockchain and the Internet of Things are included in them. The implementation of blockchain technology results in an unchangeable ledger of every bottle's past movements, hence enhancing supply chain security and transparency [64]. To guarantee the qualities of the wine, IoT devices may collect real-time data on temperature, humidity, soil conditions, and insect control [147].

5. Conclusions

The main objective of this research was to study the issues of trust in the management of the wine supply chain, and to highlight the main factors that affect trust in the wine supply chain. In addition, the cause–effect relationships and the interactions between those factors were highlighted. The research was carried out with the input of eight experts from Greece with active roles in the wine supply chain with a strong academic background. The experts were selected based on their relevance to the subject of this research paper and also because of their experience in the wine supply chain.

Subsequently, fourteen factors that affect trust in the wine supply chain were identified based on the academic literature: traceability; legislation and regulations; safety; sustainability; market requirements; customer satisfaction; exchange of information; personal relations; reliability and solvency of the parties involved; new technologies; stakeholder collaborations; ethical practices; brand engagement; and outsourcing. All these factors were analyzed in the context of the wine supply chain.

The method used in this research is of great interest as it can highlight the relationships between the selected factors as well as their interdependence. However, to mitigate the errors associated with human judgment, the DEMATEL method was combined with Grey Theory. By applying Grey Theory, uncertainty can be limited, while errors due to human judgment can be minimized. By applying the grey DEMATEL approach, the fourteen factors were classified into two groups. The first group concerns the factors that affect the rest and the second group concerns those which are affected by the former factors. Nine of the fourteen factors belong to the first group and nine to the second group.

With the present research and data analysis through the multi-criteria decision-making method, wine industry enterprises can make decisions by considering many criteria. Furthermore, by improving one factor such as safety, other factors such as brand engagement, customer satisfaction, and the reliability and solvency of the parties involved can be immediately affected.

The study of trust in the supply chain can be further improved by monitoring the trends in the sector and by engaging a wider audience of stakeholders. Moreover, various business models that have recently gained wider acceptance, such as the SAFSCs, can be analyzed in this respect. In addition, this approach can be applied to various regions in order to examine whether the situation is different from country to country. Therefore, stakeholders will have the necessary information to support their decisions and prioritize

their objectives, aiming at improving the whole supply chain. The longitudinal study of trust in wine supply chains would also be an interesting research topic that would provide additional insights into the dynamics of the sector, especially in cases when significant disruptions occur. Such disruptions may refer to the emergence of new breakthrough technologies but also to unprecedented events such as the COVID-19 pandemic.

Finally, although trust is an important factor in SCM, further empirical evidence is necessary to comprehend the mechanisms that are formulated within individual firms and along supply chains.

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