Adopting environmentally-friendly certifications: Transaction cost and capabilities perspectives within the Italian wine supply chain

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Abstract

Purpose – Environmentally-friendly certifications have increased over the past decade within food supply chains. Although a large body of literature has explored the drivers leading firms to adopt such certifications, it has not closely examined the strategic motivations associated with their adoption. This paper aims to investigate an environmentally-friendly certification, VIVA, examining its role as an alternative form of supply chain governance. The aim is to investigate the drivers affecting the adoption of VIVA and to assess managerial perceptions related to transaction-related characteristics and the firm's internal resources and capabilities.

Design/methodology/approach – This study draws upon both an extended transaction cost economics perspective, which is based on transaction risks and the resource-based view, which examines a firm's internal resources. A survey was conducted via a structured questionnaire sent to all of the wine producers in charge of the decision regarding whether to adopt VIVA certification. A Hierarchal Bayesian Model was applied to analyse questionnaire responses. Such a model allows us to specify the probabilistic relationship between questions and latent constructs and to carry over uncertainty across modelling levels.

Findings – The adoption of this environmentally-friendly certification is envisioned as a tool to curb internal risks, and thus to manage behavioural uncertainty within the supply chain. A high level of exposure to exogenous transaction risks discourages firms from adopting VIVA certification. The certification system is not perceived as a promoter of operational capabilities. Managers are more likely to implement the certification when they expect that its adoption will leverage their potential knowledge of the supply chain or prompt new and better collaborations with the suppliers. Therefore, the certification can become a resource that interacts with the capabilities of the firm, expressing complementarities that stimulate the formation of dynamic capabilities.

Research limitations/implications – The identification of drivers from the two theoretical perspectives offers insights into the attributes that are perceived as important by managers and which, therefore, could be leveraged to foster the adoption of the environmental certification. The external validity of the study could be improved by extending the sample to other certifications and supply chains.

Originality/value – The study offers a different perspective on environmental certification. It demonstrates that considering the certification as an alternative form of supply chain governance opens up a set of efficiency and strategic considerations that could be addressed to promote the effectiveness of an environmental strategy within a supply chain

Keywords Governance, Green supply chains, Transaction cost theory, Resource-based view

Paper type Research paper

1. Introduction

Growing concerns about environmental change and resource depletion are increasingly prominent on the world stage. For example, in food supply chains, many environmental concerns

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are related to agri-food activities such as the impacts of soil erosion, fertiliser excesses and animal handling practices (Jose and Shanmugam, 2019; Notarnicola *et al.*, 2012). Firms in various industries are increasingly shifting to greener supply chain practices (Stranieri *et al.*, 2019). In food supply chains, a number of green practices have gained ground over the past decade to manage existing environmental challenges and to satisfy increasing consumer demand for environmentally-friendly products (De Steur *et al.*, 2020).

Voluntary environmentally-friendly certifications are amongst the instruments used by firms to express their commitment to green strategies. To date, there exists a large variety of such instruments (Marette, 2016). They can be both public and private and they can be of an individual or collective nature (Hammoudi *et al.*, 2015). Moreover, they can be either sector-specific or not and they imply the certification of different product and process characteristics (Yokessa and Marette, 2019). Apart from their intent to improve the sustainability of production processes, environmentally-friendly certifications are considered effective instruments to reduce market failures related to information asymmetry between consumers and producers, to improve stakeholders' reputation on the market and to introduce liability and trust amongst agents within a supply chain. Moreover, these certifications are also used as marketing tools for product differentiation and producers' instruments to reach consumers with a high willingness to pay (Bonroy and Constantatos, 2015).

Current literature has highlighted several categories of drivers influencing the adoption of these certifications: firm-based drivers, institutional drivers and supply chain drivers (Chkanikova and Lehner, 2015; Lee *et al.*, 2013; Naidoo and Gasparatos, 2018). Firm-based drivers refer to an improvement on performance indicators related to cost-effectiveness, the achievement of competitive advantage and a good level of firm-internal knowledge and management involvement regarding environmentally-related topics (Hauschildt and Schulze-Ehlers, 2014; Pullman *et al.*, 2009; Vermeulen and Ras, 2006). Amongst institutional drivers, the pressure exerted by NGOs, civil society, regulatory agencies and consumer preferences has a positive effect on the adoption of green certifications (Ding *et al.*, 2019). Supply chain drivers relate mostly to increased transparency, which is due to an increase in the information exchanged amongst supply chain agents and improved supply chain monitoring activities, which are present because of the enhancement of standardised processes (Dodds *et al.*, 2013; Johnsen *et al.*, 2017; Mangla *et al.*, 2018). Within the supply chain context, environmentally-friendly certifications also act as tools to improve supply chain coordination. More precisely, they can be viewed as alternative forms of organisational governance that lead to an increase in supply chain efficiency due to more transparent transactions and more integrated activities (Ménard, 2017; Stranieri *et al.*, 2017). This improved vertical coordination is related to the introduction of specific agreements amongst supply chain agents for the implementation of such certifications and the centralisation of information flows within supply chains (Passuello *et al.*, 2015).

The decision to adopt an environmentally-friendly certification can be considered both as a solution to the coordination problems related to vertical exchanges (supply chain perspective) and as a solution to improve a firm's competitiveness (firm's perspective). From a supply chain perspective, adoption of the certification implies an improvement in transaction transparency and a better distribution of liability amongst supply chain agents. Moreover, the centralisation of supply chain activities leads to a reduction in transaction costs. From a firm's perspective, the certification requires the internalisation of activities and the improvement of vertical relationships, calling for a mobilisation of internal resources and competencies (Hart, 1995; Prajogo *et al.*, 2014; Treacy *et al.*, 2019). This requirement for the development of knowledge within a firm could stimulate dynamic capabilities fostering a sustained competitive advantage.

Despite its importance from a supply chain perspective, there is a limited amount of research on the role of environmentally-friendly certifications as alternative forms of organisational governance. Managerial motivations and expectations can be very different when choosing certain strategic paths. Understanding the drivers behind decisions relating to these certifications could foster improved design, effectiveness and increased adoption, improving both the management of the supply chain and its environmental impact. Therefore, the present paper aims to investigate the drivers affecting the adoption of these forms of transaction governance in terms of both the supply chain and the firm: i.e. taking into account both the relationships between the certification and transaction-related characteristics and between the certification and a firm's internal resources and capabilities.

To achieve our goal, we drew upon two theoretical frameworks: transaction cost economics (TCE) and the resource-based view (RBV). These two conceptual approaches are chosen as analytical frameworks because they allow us to explore the adoption of environmentally-friendly certifications from both supply chain- and firm-based perspectives. TCE regard the transaction as a basic unit of analysis, underscoring the role of transaction costs in determining efficient supply chain governance (Williamson, 1991). In contrast, RBV regard the firm as the basic unit of analysis (Barney, 2001), focussing on asset integration as a possible way to exploit resources (Argyres and Zenger, 2012) and enhance firm capabilities (Hart, 1995). Taken together, these two theoretical approaches provide a solid theoretical basis for the formulation of hypotheses regarding the strategic drivers behind the adoption of voluntary certification.

This study focusses on the Italian wine supply chain. Specifically, we study the drivers of adoption of the public voluntary certification "VIVA". Data were collected through a survey based on a structured questionnaire sent to all VIVA-certified firms and firms that were considering the implementation of VIVA certification but did not adopt it. We use a Hierarchal Bayesian Model (HMB) to analyse questionnaire responses and shed light on which drivers influence the adoption of the environmental certification.

The present analysis contributes both to theory and practice. From a theoretical perspective, we shed light on how different kinds of transaction uncertainties and related risks can influence the decision to adopt alternative forms of governance such as environmentally-friendly certifications, within supply chains. Results reveal that behavioural uncertainty-related risks influence positively their adoption, while environmental-related risks will act negatively on it. Moreover, using RBV, we help to clarify the role of environmentally-friendly certifications as potential resources for a firm. Differently from other studies, we do not look at certification adoption only as the result of the

exploitation of existing capabilities, but we formulate hypotheses testing their role in developing dynamic ones. Results indicate that such certifications are not considered as a strategic resource *per se*, but as instruments able to leverage a firm's dynamic capabilities related to supply chain coordination skills. From a practical perspective, the theoretical setting allows featuring some key aspects in the design and promotion of an environmentally-friendly certification. For example, TCE arguments highlight how the optimal design of certification is challenged by the trade-off between efficient coordination of the supply chain and the need for flexibility a firm has when perceiving high external risks. Differently, hypotheses from RBV highlight how a long-run environmental strategy could be fostered by a certification able to stimulate sustainable competitive advantage throughout potential complementarities between the implemented standardised procedures and firm internal resources.

The paper is organised as follows. Section 2 presents the theoretical frameworks, proposing a number of hypotheses formulated based on the TCE and RBV frameworks. Section 3 describes the VIVA certification, the study data, the measures and the empirical model. Section 4 presents the results, which are discussed in Section 5. Finally, Section 6 concludes the paper and outlines limitations and suggestions for future research.

2. Theoretical framework and hypotheses

2.1 Transaction cost economics and transaction risks

Following TCE, high transaction costs lead to the need for adopting transaction governance forms with a high level of vertical coordination. Higher transaction costs result from the variation of transaction-related characteristics, especially the degree of asset specificity and the degree of transaction uncertainty (Williamson, 1985). The positive variation of one or both such attributes leads to the risk that economic agents act opportunistically. The present study makes large use of TCE theory. Specifically, we refer to an extended perspective that addresses the role of transaction risks in shaping the organisation of supply chains by considering, not only the risk of opportunistic behaviour but also the risks surrounding the transaction which do not hinge on economic agents' behaviour (Stranieri *et al.*, 2017; Wever *et al.*, 2012). Indeed, besides transaction-related risks during vertical exchanges, there are additional types of risks that do not influence transaction characteristics directly but can affect the success of transaction execution (Kaplan and Mikes, 2012). Consequently, forms of transaction governance can be viewed as tools that not only minimise transaction costs but also manage all the risks surrounding vertical exchanges (Wever *et al.*, 2012).

According to Williamson (1985), transaction uncertainty depends on both behavioural uncertainty and environmental uncertainty. The higher the level of behavioural uncertainty, the higher the risk of a transaction failure due to non-compliance with the conditions set up within agreements (Williamson, 1991). This kind of transaction risk is defined as "internal" because it can be managed within the transaction, through the adoption of a form of governance that reduces behavioural uncertainty through improved transaction transparency. In general, the higher a transaction's internal risks, the greater the probability that a firm will adopt forms of transaction governance with a high level of vertical coordination (Fernández-Olmos *et al.*, 2009; Stranieri *et al.*, 2017). As noted above, environmentally-friendly certifications can be considered alternative organisational governance forms that improve transaction transparency and foster coordination amongst supply chain partners. Indeed, these instruments imply the adoption of agreements that set out specific activities and rules that supply chain agents need to follow. Such agreements can establish standard procedures, guidelines for the operation of certified activities and the distribution of specific responsibilities to economic agents. Information flows are, thus, centralised, implying that the firm receiving the certification acts as the leader of the supply chain and stimulates its partner to implement and monitor the standards. Such a firm usually coordinates the implementation of certified activities within the supply chain, also internalising monitoring activities related to the correct execution of certified procedures throughout the supply chain.

According to the transaction cost perspective, the adoption of such certifications may be linked to the presence of internal risks surrounding transactions within the supply chain. Thus, we hypothesise:

TCE-H1. The higher the firm's perception of transaction-internal risks, the higher the probability that it will adopt an environmentally-friendly certification.

Environmental uncertainty is not caused by the behaviour of supply chain agents in the accomplishment of vertical exchanges. Instead, it depends on unpredictable changes in the economic environment that may lead to an increased risk of maladaptation amongst supply chain agents (Williamson, 1985). Environmental uncertainty and transaction-related risks lead to increased difficulty in the arrangement of agreements (Gurcaylilar-Yenidogan and Windsperger, 2014). Such risks are defined as "transaction-external" risks, as they are exogenous to the behaviour of transacting parties and have a strong influence on the management of conditions set up in the agreements (Sydow *et al.*, 2013; Wever *et al.*, 2012). Different types of transaction-external risks have been found to influence transaction execution within food supply chains. Variations in agricultural raw material and product prices, the complexity related to frequent changes in legislative frameworks and the changing quality preferences of consumers affect the ease of accomplishing transaction conditions and achieving transaction efficiency. For example, Hau (2006) stresses the positive relationship between transaction costs and financial volatility, while Huchet-Bourdon (2011) analyses agricultural commodity price volatility, highlighting that high price events have characterised agri-food system exchange dynamics for the past 50 years. Moreover, Farber *et al.* (2011), Kvalvik *et al.* (2011) and Grimm *et al.* (2014) discuss how changing agricultural policies on food safety and climate change play an important role in a firm's adaptive capacity and on sustainable supply chain relationships. Beske *et al.* (2014) discuss the challenges that food supply agents face in adapting to constant changes in consumer preferences.

The debate surrounding the influence of external risks on the governance of vertical relationships is still inconclusive, especially concerning hybrid (intermediate) forms of transaction governance (Ménard, 2017; Romme, 1990; Sydow *et al.*, 2013). Transaction

cost theory assumes that supply chain agents will adopt hierarchical forms of transaction governance when external transaction risk is high (Williamson, 1985). However, current empirical evidence highlights a negative relationship between the level of transaction-external risks and the level of vertical coordination (Das and Teng, 2001; Olmos, 2010). Regarding public certifications, for example, the collective nature of such instruments means that suppliers are substitutable with competitors. Therefore, external transaction risks could lead to a higher risk that certified firms will be substituted for other certified firms in cases of delayed adaptation to the changing economic environment (Hartmann *et al.*, 2010). In this situation, the transaction costs deriving from external risks cannot be mitigated by tighter coordination throughout the adoption of the certification (Schulze *et al.*, 2007). For these reasons, supply chain agents could decide to remain flexible and adapt to environmental changes through more flexible forms of transaction coordination (Perrow, 1986).

Based on the above discussion regarding the role of transaction-external risks in affecting vertical coordination and the role of different public certifications within food supply chains, we propose the following hypothesis:

TCE-H2. The higher the firm's perception of transaction-external risks, the lower the probability that it will adopt an environmentally-friendly certification.

2.2 The resource-based view

In its initial stages, the RBV considered a firm as a unique bundle of resources that, if adequately used, bring sustained competitive advantage and greater value to the firm (Barney, 1986; Wernerfelt, 1984). In subsequent literature, this view was extended to distinguish resources and capabilities: resources include the tangible and intangible assets available to a firm for the production process such as equipment, skills, processes or finance (Barney, 2001; Grant, 1991); capabilities refer to the capacity to deploy a subset of resources to perform an activity with the desired goal (Amit and Schoemaker, 1993).

Resources are assumed to be heterogeneous and not perfectly transferable across firms (Barney, 1986; Wernerfelt, 1984). When these resources are valuable, rare, inimitable and non-substitutable (VRIN) (Wernerfelt, 1989), they can give rise to competitive advantage. Firms tend to integrate those assets and activities that have a unique complementarity with existing ones (Argyres and Zenger, 2012). According to the RBV, assets should be integrated when bundled with those already present within the firm, they bring unique and higher added value as compared to other firms. An environmentally-friendly certification is essentially an asset that, if integrated into the firm, plays the role of an organisational resource that coordinates various activities within the firm and the supply chain. Consequently, it can be considered a form of governance that improves vertical coordination. Such a certification is collective in nature, as it includes replicable practices by all firms adopting it (Treacy *et al.*, 2019). However, it can also possess characteristics that are unique to a firm, depending on its complementarities when bundled with existing assets. This assessment pertains to the views of the company's managers. Therefore, the decision to adopt (integrate) the certification can depend on their perception of the VRIN characteristics. Hence, we can propose the following hypothesis:

RBV-H3. The higher the firm's perception that an environmentally-friendly certification has VRIN characteristics, the higher the probability of its adoption.

Competitive advantage depends not only on resources but also on the way that they can be leveraged through a firm's capabilities. Capabilities can be considered a distinctive source of competitive advantage, as they cannot easily be copied, unlike the underlying resources (Collis and Montgomery, 1995). Several studies in the review by Argyres and Zenger (2012) postulate that firms tend to integrate an asset when they have higher prior capabilities for performing related existing activities than upstream or downstream actors. These higher capabilities predict the better performance of the firm in those specific activities. Environmental certifications can improve the efficiency of internal operations because of the scrutiny and constant monitoring of processes. This can be associated with an increase in internal operational capabilities (Darnall and Edwards, 2006). Additionally, the training of employees necessary for the implementation of certification and the resulting enhancement of interpersonal relationships can increase operational capabilities and improve the production process and labour productivity (Delmas and Pekovic, 2013; Lo *et al.*, 2014). Better internal coordination practices and control of costs also lead to higher efficiency in production planning, with lower production costs (Treacy *et al.*, 2019) and a better focus on value-adding production processes (Lo *et al.*, 2009). Supply chain coordination is also involved: the adoption and diffusion of an environmentally-friendly certification within a company can improve the procurement of inputs, as well as the adoption of green practices along the supply chain (Prajogo *et al.*, 2014). Finally, focussing on wine, Annunziata *et al.* (2018) show a positive relationship between proactive socio-environmental practices and cost advantages related to the operational dimension of the firm. Therefore, managers can expect increased efficiency due to the development of higher operational capabilities. Based on the above, the following hypothesis can be formulated:

RBV-H4. The higher the firm's perception that an environmentally-friendly certification promotes the coordination of operational capability, the higher the probability of its adoption.

To produce a sustained competitive advantage, integration choices also need to reflect market dynamism. In other words, they need to reflect complementarities with the supply chain environment (Nagano, 2020). When higher market dynamism is present, knowledge resources become important, as they can spur innovation and adaptation to new market conditions. Dynamic capabilities – the ability to manipulate firm and supply chain resources and gain competitive advantage – become central. This manipulation, which also includes entrepreneurship (Teece, 2009), allows for the development of new value-creating strategies (Santos and Eisenhardt, 2005). Capabilities only bring sustained competitive advantage when they are dynamic in nature as they "emphasise a firm's constant pursuit of the renewal, reconfiguration and re-creation of resources" (Wang and Ahmed, 2007, p. 36).

Gavronski *et al.* (2011) show that the adoption of certain routines such as those linked to green manufacturing processes and ISO 14001, provides the basis for the formation of new and dynamic capabilities. Within the wine sector, Annunziata *et al.* (2018) show that two types of organisational capabilities are associated with the adoption of proactive socio-environmental practices: the capacity for collaboration with partners and suppliers and the capacity for product innovation.

Collaboration with suppliers and more generally with stakeholders is suggested in the literature as one of the necessary prior capabilities favouring the adoption of environmental management practices (Hofmann *et al.*, 2012). At the same time, an environmental certification can promote the development of these capabilities because of the integration of practices with supply chain partners and suppliers. Under the coordinating role of the certification, firms can gain better knowledge about products, suppliers and supply chain characteristics and can start new partnerships exploiting their potential knowledge (Ghozzi *et al.*, 2016). This, in turn, could improve the firm's capacity to coordinate supply chain and stakeholders, fostering a long-run environmental strategy (Hart, 1995). Therefore, assuming market dynamism, we can formulate the following hypothesis:

RBV-H5. The higher the firm's perception that an environmentally-friendly certification promotes the development of a firm's supply chain coordination capacity, the higher the probability of its adoption.

As stated by Annunziata *et al.* (2018), the product innovation process leads to the development of internal knowledge, the acquisition of external knowledge and a general learning process within the firm (Cassiman and Veugelers, 2006; Jiménez-Jiménez and Sanz-Valle, 2011). When innovation is of a sustainable nature, it "increases organisational maturity and provides strategic and economic viable novelty and competencies that can foster actions to address the challenge of corporate sustainability" (Annunziata *et al.*, 2018, p. 1302). An environmentally-friendly certification can favour the innovation process, allowing access to new and more advanced procedures and improved introduction and tracking of new practices, which, in turn, stimulate the introduction of new ideas for the production processes. To have this effect, the certification needs to be embedded in daily routines and leverage capabilities across various functions of the firm. For example, Prajogo *et al.* (2014) show that with greater internalisation (diffusion) of a green management system such as certification, within the different functions of a firm, more green product practices (such as new product designs) are adopted. Hence, still assuming market dynamism, we can propose that:

RBV-H6. The higher the firm's perception that an environmentally-friendly certification promotes the development of innovation capacity, the higher the probability of its adoption.

3. Data and empirical model

3.1 The VIVA certification

As introduced above, the present analysis refers to VIVA, a sustainability-related certification used in the Italian wine sector. The motivations related to this choice are three-fold.

Firstly, the wine context is particularly interesting as it currently confronts multiple threats from the natural world such as water scarcity, climate change and volatile energy prices (Gilinsky *et al.*, 2016). Moreover, wine is one of the main crops for most of the terrestrial agroecosystems in Europe and in the temperate climate zones worldwide. Increased consumer interest in sustainable viticulture and the potentials for technical improvements in vineyards have led wine companies to take a greener approach by adopting different voluntary codes (De Steur *et al.*, 2020; Jourjon *et al.*, 2016).

Secondly, Italy has consistently been a worldwide wine production leader. In 2018, wine performed best across national agricultural products, with a production value of €10.2bn [Italian National Institute of Statistics (ISTAT), 2019]. According to the latest publicly available data, in 2014 over 500 Italian wineries were directly involved in sustainable development networks. Those companies accounted for at least one-third of the total wine production value, with an estimated turnover of about €3.1bn [Forum per la sostenibilità del vino (FSV), 2014].

Thirdly, although a number of environmentally related certifications have been proposed in the Italian territory (Borra *et al.*, 2016), in 2020 only five programmes are active. Of these, VIVA is the only certification promoted by a public institution, the Italian Ministry for the Environment, Land and Sea [1]. VIVA started as a pilot project in 2010 and within 10 years had successfully built a network of 79 certified firms, with 64 different types of wine bottles certified. We choose to focus on such certification as it refers to specific sustainability indicators that are directly measurable and not only declared. This allows concentrating on firms that fully embraced the certification in their sustainability strategy. The performance analysis to obtain the certification is conducted using four indicators: air, water, vineyard and territory. The first three indicators are more related to agronomic management, thus strongly emphasising the environmental facet of sustainability. The fourth indicator embraces the social sustainability aspect, linking wine to its territory and community. The project is open not only to wineries and processing firms but also to bottlers and a company can choose whether to certify the whole organisation, one product or several products. As a final characteristic, VIVA includes the issuance of a label and a QR code on the bottle. The label increases transparency and makes the certification visible to the consumer, thus making the environmentally-friendly attribute clearer [2].

3.2 Data

To test the six hypotheses proposed in the previous section, we collected data through questionnaires consisting of 21 statements evaluated on a seven-point Likert scale (where 1 indicated very strong disagreement and 7 represented very strong agreement). Each statement addressed one of six latent characteristics that might lead wine companies to implement (or not implement) the VIVA certification. These unobservable features relate directly to the previously discussed theoretical predictions. For example, hypotheses *TCE-H1* and *TCE-H2* can be reformulated as functional relationships between firms' exposure to internal and external risk, respectively, and the probability of adopting the certification. As there is no way to directly quantify the degree of internal and external risk

incurred by companies, these measures are said to be latent. Then, from a regression perspective, our problem consists of studying the expected change in the (log-) odds of getting the certification when comparing firms differing by one unit of the hidden attribute. The same conceptual framework applies to hypotheses *RBV-H3* to *RBV-H6*, only this time the unobserved features of interest concern the perceived benefits (or lack thereof) of implementing the environmentally-friendly certification. Table 1 briefly introduces the relationship between our 21 statements and the six latent characteristics they aim to approximate. In the next section, we discuss how we extracted latent characteristics from Likert-valued statements through a simple Bayesian multilevel model.

To improve internal validity, data collection was conducted using a two-stage approach where, for each respondent, an interview was performed before the survey. In the interview phase, we first contacted the companies by email explaining the purpose of the study and anticipating our phone call. The questionnaires were attached to the email for a preview. The initial submission involved 148 Italian wine producers that had recently shown interest in the VIVA certification. The list of such firms was provided by the Catholic University Sustainability Research Centre, which was directly involved by the Italian Ministry for the Environment in the creation and development of the certification. These companies had contacted the Centre to investigate and obtain more detailed information about the VIVA certification. Of these firms, 46 had already implemented the VIVA certification at the time of the interview (Group A), while 102 had not implemented the certification at the time of the interview (Group B).

Then, we contacted the contact persons via telephone. The purpose of the interview was to assure the data quality. It allowed establishing whether:

- the interviewees matched our preferred employee profile;
- the firms in Group B had seriously considered the VIVA certification or if it was just a spurious contact; and,
- the respondent was willing to complete the survey.

To ensure data trustworthiness, we decided to interview only those actors who were directly involved in the decision-making process regarding VIVA certification within the firm, i.e. firm owners, quality assurance managers and technical directors. If all these three conditions were met, we proceeded briefly to illustrate the scope and the content of the questionnaire. The interview closed with an appointment for a *vis-à-vis* meeting or,

Table 1 Structure of questionnaires and overview of responses

Latent characteristics	Statements	Rating distribution* ≤3	Rating distribution* >4
TCE-related variables			
Internal risk (TCE-H1)	All of the transactions with suppliers ended unsuccessfully	18	74
	The conditions laid down with suppliers were not respected	13	79
	It is not possible to predict in advance the exact quantity of raw material sourcing	21	71
External risk (TCE-H2)	Variations in agricultural raw material prices are a risk for the company	33	59
	The complexities embedded in the legislative framework are a risk for the company	26	66
	Qualitative variations in consumer's preferences are a risk for the company	30	62
	Variations in wine prices could be a risk for the company	29	63
RBV-related variables			
VRIN characteristics of the resource (RBV-H3)	The environmentally-friendly certification can be a source of competitive advantage	9	83
	My competitors have not already implemented an environmentally-friendly certification	52	40
	It is hard to implement an environmentally-friendly certification	61	31
	It is hard to switch from one certification system to another	48	44
Operational capabilities (RBV-H4)	Through the implementation of the certification, my firm can gain more certainty concerning costs along the chain	33	59
	The environmentally-friendly certification can be a tool to optimise production and logistics processes	27	65
	The environmentally-friendly certification could allow my company to focus on its most important activities	20	72
Dynamic capabilities related to the supply chain (RBV-H5)	I think that new competencies can emerge exploiting internal or external synergies created through the certification implementation	12	80
	I think that the environmentally-friendly certification could allow my company to broaden its knowledge of product characteristics, the supply chain and suppliers	11	81
	I think that the environmentally-friendly certification could offer the possibility of adopting new commercial relationships along the supply chain that could be hard to engage in other ways	19	73
Dynamic capabilities related to innovation (RBV-H6)	The environmentally-friendly certification can be a stimulus for generating new ideas for production processes	7	85
	I think that the environmentally-friendly certification could allow my company to access new and more advanced procedures	9	83
	I think that the environmentally-friendly certification could allow my company to keep track of new practices	9	83
	I think that the environmentally-friendly certification could allow my company to introduce new practices	9	83

Note: *Number of answers providing scores ≤3 or >4 in the 1–7 Likert scale

when not possible, for another telephone call where we could move to the survey phase.

Administering the survey *vis-à-vis* or by phone allowed to ascertain that the replies coherently reflected the goals of the questionnaire. Further, compiling the survey in this form allowed us to elicit the degree of understanding of the topics discussed, thus providing the opportunity to clarify misunderstandings about any specific statement or measurement. The latter is a key aspect for the reliability (Yin, 2017) of our research: as assessing 21 statements can be challenging and, as some concepts might not be immediately clear to the respondent, active guidance cannot be easily separated from the survey.

Amongst the 46 certified firms, 36 agreed to participate in the survey (78% response rate), while another 56 responses came from the group of 102 uncertified wine producers (55% response rate). On average, interviewees had been working in the wine industry for roughly 17 years and had been used by their current company for nearly 13 years. On average, most respondents had been in the same job position for 15 years.

The questionnaires administered to groups A and B shared the same structure and content, except that the interviewer was instructed to read Group A one additional introductory sentence. That is, the Group A survey started with the phrase: "When you decided to adopt the sustainability certification [. . .]." and progressed by clarifying that replies should reflect the respondents' opinions at the time the certification was implemented. The Group B questionnaire did not have an introductory sentence, so wine producers were asked to express their beliefs in terms of the company structure at the time of the interview.

As outlined in Table 2, nearly 90% of the interviewees are located in the north-eastern part of Italy (e.g. Trentino-Alto Adige/Sudtirol, Veneto, Friuli-Venezia Giulia and Emilia Romagna). In total, 42% of the firms market their products through the Ho.Re.Ca. distribution channel, while 33% sell through large-scale retailers. Small producers are almost equally represented, leaving medium producers as approximately 26% of the observations. The production level is not evenly distributed amongst certified and non-certified firms. Table 2 shows that 56% of the former produce less than 500,000 bottles per year, whereas 46% of the latter market over 1,000,000 bottles per year. Furthermore, our data set indicates that while most small and medium producers sell their product through the Ho.Re.Ca. the channel, large enterprises typically merchandise wine bottles via large-scale distributors. Finally, 80% of the companies interviewed already had a sustainability strategy in place, while 43% of them had already implemented other environmentally-oriented certifications (e.g. ISO14001, carbon footprint labels and/or organic certifications).

3.3 Empirical model

Given the six latent characteristics presented in Table 1, we need a probabilistic model linking these unobservable firm attributes to specific sets of Likert-valued inquiries designed to elicit the corresponding underlying feature. In this context, the advantage of using HMBs is twofold: firstly, one can fully specify the probabilistic relationship between questions and latent constructs using any suitable theoretical framework; secondly, HBMs allow for the carrying over of uncertainty

Table 2. Sample characteristics [a]

Characteristics	Group A (certified) (%)	Group B (not certified) (%)	Total (%)
Facility location [b]			
Northeast Italy	36	39	38
Northwest Italy	11	14	13
Central Italy	28	27	27
South Italy	11	13	12
Insular Italy	14	7	10
Production volume [c]			
Low	14	46	34
Medium	31	23	26
High	56	30	40
Distribution channel			
Ho.Re.Ca.	31	50	42
Large-scale retail	47	23	33
E-commerce	8	9	9
Wholesaler	11	11	10
Other	3	7	7
Existence of firm sustainability strategy			
No	17	21	20
Yes	83	79	80
Other environmental certifications/practices within firms			
No	34	59	57
Yes	47	41	43

Notes: [a]$n = 92$; [b]NUTS1 level in EU classification; [c]Low = <500,000; medium = 500,000 < bottles < 1,000,000, high = >1,000,000

across modelling levels, thus removing the need to correct nuisance parameters along the hierarchy.

The first part of our modelling approach consists of arranging individual respondents according to the hidden attributes discussed, thus, far. This empirical sorting is conditional on the rating scores obtained from the polytomous data collected through the surveys. Moreover, as scoring ordered data assuming fixed intervals between the categories can often be unrealistic, we let such distances adjust flexibly. When a latent characteristic is measured through multiple inquiries in a suitably structured questionnaire, item response theory (IRT) models provide a solid theoretical underpinning to link individual responses to unobserved features of the respondents. In particular, when participants are asked to respond to Likert-valued statements (assuming that the lowest/highest values always indicate strong disagreement/agreement), the rating scale model (RSM– Andrich, 1978) represents the simplest construct relating response scores to item-specific (i.e. statement-specific) and person-specific (latent) components, which are called "item difficulty" and "person-ability", respectively. In contrast to other IRT models such as the partial credit model (PCM – Rasch, 1961), the RSM constrains the distance between item difficulty values to be the same across all items. Clearly, this assumption is only reasonable when item responses are elicited using a fixed set of behavioural thresholds (i.e. Likert-type thresholds). In such cases, the RSM provides a more parsimonious alternative to the PCM (Andersen, 1997). Moreover, as all parameters in the RSM represent locations on an underlying variable, they specifically enable objective comparisons of persons and items (Rasch, 1977).

Mathematically, the RSM model can be formulated using the following category response function (Engelhard, 2014):

$$P_{ijx} = \frac{\exp\left[\sum_{m=0}^{x}(\theta_j - \alpha_i - \delta_m)\right]}{\sum_{r=0}^{S}\exp\left[\sum_{m=0}^{r}(\theta_j - \alpha_i - \delta_m)\right]} \quad (1)$$

where $i \in \{1,\ldots,N\}$ indicates the ith item, $j \in \{1,\ldots,M\}$ represents the jth person, $x \in \{1, 2,\ldots,S\}$ is the response given by person j to any item i, P_{ijx} indicates the probability that person j answers x to item i, α_i stands for the ith item's difficulty and θ_j refers to the jth person's ability. We will hereafter re-express equation (1) more compactly as:

$$x_{ij}|\theta_j,\alpha i,\boldsymbol{\delta} \sim \mathrm{RSM}(\theta_j,\alpha i,\boldsymbol{\delta}) \quad (2)$$

where $\boldsymbol{\delta}$ is an $S-1$ vector of thresholds.

Our implementation of the RSM is, however, conceptually different from its standard applications in psychrometric analysis. In fact, we are not interested in modelling respondents' abilities, nor do we want to explicitly correct for item difficulty. Rather, we borrow the above probabilistic constructs to map sets of Likert-valued statements onto continuous measures defined on a common support. Therefore, to make IRT terminology more suitable to our analytical framework, we will henceforth refer to the subscripts i, j as "statement" and "firm", respectively, instead of "item" and "person". Additionally, we will treat the ability parameters, θ, as firms' latent characteristics, while α will hereafter indicate statement-related random bias terms. Although most works focus on the estimation of α and δ to represent P_{ijx} as a function of θ, we are interested in estimating the latent characteristics themselves [3]. As discussed in Section 3, the TCE and RBV frameworks suggest that firms may choose the VIVA certification depending on six such unobservable attributes [4], thus requiring the extension of equation (2) to:

$$x_{cij}|\theta_{cj},\alpha_{ci},\boldsymbol{\delta} \sim \mathrm{RSM}(\theta_{cj},\alpha_{ci},\boldsymbol{\delta}) \quad (3)$$

where $c = 1,\ldots,6$ works as a placeholder for the aforementioned unobserved features. Moreover, the above statement also implies:

$$\mathrm{Cert}_j|_{\pi j} \sim \mathrm{Bernoulli}(\pi_j)$$

$$\mathrm{logit}(\pi_j) = \mu + \boldsymbol{\theta}_j'\boldsymbol{\gamma} + \mathbf{z}_j'\boldsymbol{\beta} \quad (4)$$

where Cert_j is a dummy variable taking on the value 1 when firm j adopts the certification, $\boldsymbol{\theta}_j = (\theta_{1j},\ldots\theta_{6j})$, $\mathbf{z}_j$ indicates a $D-$vector of controls and $\boldsymbol{\gamma}$, $\boldsymbol{\beta}$, respectively represent 6×1 and $D \times 1$ vectors of fixed effects. The variables in $\mathbf{z}_j$ include a set of binary controls accounting for:

- the presence of other sustainability certifications;
- the retail channel (wholesalers, HoReCa or e-commerce) used to merchandise the product; and
- how costly it was to implement the VIVA standards (we classify these costs as either "high" or "low").

The last element in $\mathbf{z}_j$ is continuous regressor capturing the total production volume, expressed in bottles per year.

Bayesian hierarchical modelling allows the estimation of parameters in equations (3) and (4) jointly, thus propagating the uncertainty in first-stage calculations to the second-stage regression. Except for trivial exercises with canonical and conjugate distributions, this framework requires two basic ingredients:

1. the full posterior distribution of the relevant coefficients; and
2. a sampling algorithm that efficiently explores the typical set of such a probability function (Betancourt and Girolami, 2015; Gelman *et al.*, 2013; Hoff, 2009; Kruschke, 2014).

These samples are then used to construct summary statistics and posterior credible intervals for the (random) quantities of interest. Besides equations (3) and (4) – where the latter indicates the likelihood function – defining marginal posterior densities for $\theta, \alpha, \boldsymbol{\delta}, \boldsymbol{\gamma}$ and $\boldsymbol{\beta}$ require a full array of priors/hyperpriors distributions. In this work, we set [5]:

$$\boldsymbol{\alpha}_c|_{\sigma c,\alpha} \sim \mathrm{MVN}(0, \mathbf{I}_{N_c}\ \sigma_{c,\alpha})$$

$$\sigma_{c,\alpha} \sim \mathrm{Half}-\mathrm{Normal}(0,3)$$

$$\boldsymbol{\theta}_c|\sigma_{c,\theta} \sim \mathrm{MVN}(0, \mathbf{I}_M\ \sigma_{c,\theta})$$

$$\sigma_{c,\theta} = 0.5$$

$$\boldsymbol{\delta} \sim \mathrm{MVN}(0,\ \mathbf{I}_{s-1}\ \sigma_{\delta})$$

$$\sigma_{\delta} = 3 \quad (5a)$$

for the RSM and

$$\mu \sim \text{Normal}(0,\ 1.5)$$

$$\gamma_c \sim \text{Normal}(0,\ 2.5)$$

$$\beta_d \sim \text{Normal}(0,\ 2.5) \quad (5b)$$

for the logistic component (here $d \in \{1,\ldots,D\}$). In equation (5a), $\boldsymbol{\alpha}_c = (\alpha_{c1},\ldots,\ \alpha_{cN_c})$, $\boldsymbol{\theta}_c = (\theta_{c1},\ldots,\theta_{cM})$, while N_c indicates the number of items adapted to measure latent characteristic c.

The choice of modelling α and θ through normal distributions is standard in the literature on random-effects models and other Bayesian implementations of IRT (Bürkner, 2019; Gelman *et al.*, 2013; Luo and Jiao, 2018). Consistent with the growing body of literature discussing the shortcomings of using flat uninformative priors (Gelman *et al.*, 2008; Gelman *et al.*, 2017; Lemoine, 2019; McElreath, 2020), we give $\sigma_{c,\alpha}$ in equation (5a) a zero-centred, positive-valued weakly informative symmetric distribution [6] as suggested by Bürkner (2019), Luo and Jiao (2018) and Stan's reference manual (Stan Development Team, 2018). On the other hand, following the default distributional choices indicated by Furr (2017) and Gelman *et al.* (2008), we set the remaining hyperparameters $\sigma_{c,\theta}$ and σ_{δ} to 0.5 and 3, respectively [7]. By reflecting the scale of the data entering equation (4), $\sigma_{c,\theta} = 0.5$ allows us to properly set the corresponding regression parameters. In this respect, Gelman *et al.* (2008) present some technical guidelines for setting sensible weak priors on fixed effects in logistic regression. Provided that all variables in equation (4) have a mean of 0 and a standard deviation of 0.5 [8], these authors show that a 2.5-scaled Cauchy distribution represents a reasonable default choice for $\boldsymbol{\gamma}$ and $\boldsymbol{\beta}$. However, recent contributions have shown that this setup can be rather informative when – as in our application – information in the data is limited (Ghosh *et al.*, 2018). Therefore, common practice has now shifted to adopting t distributions with 3 or more degrees of freedom or zero-centred normals with standard deviations of up to 2.5 (our choice for the current work). Finally, μ indicates the average proportion of Cert when all other variables are set to zero (which, in this case, coincides with their mean). Because this coefficient enters an inverse-logit function, priors defined over a parameter range beyond 4 to −4 would produce posterior predictions either at 1 or 0. Consequently, any prior with a large probability mass beyond these two cut-offs would produce undesirable bimodal posteriors. Therefore, a sensible solution is to adopt a normal distribution with zero location and a 1.5 standard deviation. The inverse-logistic image of this parametrisation produces an approximately uniform density over the 0 – 1 interval, as desired. Further discussion of how modern Bayesian approaches deal with the choice of prior distributions is available in Gelman *et al.* (2017) and McElreath (2020).

4. Results

The joint posterior distribution obtained by combining equations (3), (4), (5a) and (5b) can be directly sampled using modern Markov Chain Monte Carlo (MCMC) algorithms [9].

One interesting feature of Bayesian estimation lies in the possibility of complementing the standard information provided by (first/second) moments and confidence intervals with other useful quantities such as posterior quantiles and probabilities. Table 3 reports the estimated posterior medians, 90% and 95% credible intervals (hereafter CIs) and probabilities $P(y > 0)$ and $P(y < 0)$, where † indicates any random variable of interest.

Our estimates support the first hypothesis (*TCE-H1*) presented in Section 2, as highlighted by the positively skewed CIs and the prominent proportion of positive γ_1 coefficients. Although the former also includes some negative values, the above-zero probability mass approaches 0.9. This indicates a low uncertainty when discussing the direction of the effect. However, the CI is very large, implying that the magnitude of γ_1 remains volatile. Moving to the effect of environmental uncertainty, hypothesis *TCE-H2* is strongly supported. As expected, we find that higher external risk reduces the odds of choosing to certify. The entire posterior distribution of the γ_2

Table 3 Estimated parameters for model (4)

Variable	Median	95% C.I.		90% C.I.		P(y>0)	P(y<0)
μ – intercept	−1.02	−2.06	−0.03	−1.89	−0.20	0.02	0.98
			Latent Characteristics				
γ_1– TCE: Internal risk	1.419	−0.93	4.08	−0.51	3.60	**0.890**	0.110
γ_2– TCE: External risk	**−4.60**	**−7.51**	**−2.43**	**−6.96**	**−2.74**	0	1
γ_3– RBV: VRIN	−0.36	−3.16	2.24	−2.62	1.85	0.40	0.60
γ_4– RBV: Operational capabilities	0.49	−2.06	3.23	−1.62	2.68	0.66	0.34
γ_5– RBV: Capabilities – supply chain	**2.54**	**0.38**	**5.45**	**0.71**	**4.86**	0.99	0.01
γ_6– RBV: Capabilities – innovation	1.10	−2.00	4.38	−1.44	3.81	0.76	0.24
			Control variables				
β_1– Ho. Re. Ca.	0.54	−1.45	2.42	−1.13	2.10	0.71	0.29
β_2– e-commerce	1.76	−1.28	4.86	−0.80	4.36	**0.87**	0.13
β_3– Large-scale retailer	**2.87**	**0.87**	**5.17**	**1.19**	**4.83**	1	0
β_4– Other certifications	0.11	−1.65	1.92	−1.35	1.60	0.56	0.44
β_5– Production volume	0.80	−1.01	3.25	−0.74	2.78	0.80	0.20
β_6– Certification costs	**−2.09**	**−3.91**	**−0.46**	**−3.61**	**−0.69**	0.01	0.99

parameter extends to the left of zero, indicating a rather strong consistency of the negative sign.

Turning to the next block of covariates, the VRIN latent regressor shows the centrality of the parameter, as highlighted by the roughly symmetric share of positive and negative parameter values. This means that the hypothesis *RBV-H3* is not supported by the results. Similarly, hypothesis *RBV-H4*, concerning operational capabilities, is also not supported. Differences in the probability of certifying are essentially undefined, given the relatively symmetric intervals that are centred around zero.

Results become much more clear-cut when the VIVA certification is envisioned as a tool to enhance dynamic capabilities related to the supply chain. In fact, hypothesis *RBV-H5* is strongly supported, as indicated by the positive CIs and by the 99% share of above-zero values for the corresponding γ parameter. On the other hand, the parameters' estimates are less conclusive when referring to dynamic capabilities related to innovation. In fact, for hypothesis *RBV-H6*, 76% of the sampled γ_5 parameters lie above zero and the CIs include both positive and negative values. Therefore, although the median value would suggest a positive relationship between trusting the certification's effectiveness in fostering innovation and the odds of certifying, this conclusion remains highly uncertain.

Finally, the control variables indicate that high certification costs decrease the odds that a firm will become certified, while the opposite is true for large-scale marketing channels (compared to wholesalers). Little can be concluded about the extent and direction of the marginal effect for the e-commerce/Ho.Re.Ca. distribution channels or for the presence of other green certifications. Aside from e-commerce, for which largely positive CIs support the positive location parameter, β_1, β_4 and β_5 have positive medians, but their posterior distributions encompass both positive and negative values to a greater extent.

5. Discussion

5.1 Implications for theory

The results presented in the previous section suggest that considering environmentally-friendly certifications as a form of governance can help to disentangle their role as organisational tools along the supply chain.

From a TCE point of view, our results seem to support both of the hypotheses proposed in Section 2.1. Firstly, there is evidence that the VIVA certification is envisioned as a tool to curb internal risks. In this respect, wine companies seem to believe in the certification's ability to improve transparency, routines and liability distribution, to the extent that these features increase the probability that a firm will adopt the certification. Clearly, this does not mean that there might not be other forms of vertical coordination. In fact, the risk is probably managed further through the different forms of transaction governance within the wine supply chain, which is characterised by hierarchical control mechanisms and the persistence of economic relationships amongst supply chain agents over time (Montaigne and Coelho, 2012). Next, the adoption of an environmentally-friendly certification can be also framed within the TCE conceptual framework in terms of external risk. This time, however, the exposure to exogenous threats discourages the implementation of the VIVA certification, as theory would recommend. Indeed, the procedures embedded in the VIVA system appear to negatively impact the probability that a firm will engage in an environmental certification when the external environment is more uncertain. This argument is in line with Stranieri *et al.* (2017), Wever *et al.* (2012) and the body of literature highlighting the importance of flexibility in a firm's vertical relationships (Olson and Wu, 2017; Shirmohammadi *et al.*, 2020; Tang and Tomlin, 2008). Other studies have highlighted the importance of risks related to the external environment for the adoption of certifications. However, they have been interpreted only as control variables rather than following a specific theoretical framework. For example, Demirel *et al.* (2018) used customer requests as a dummy variable to explain the adoption of environmental management systems amongst UK firms, while Graafland and Gerlagh (2019) used price competition amongst the control variables to study firms' environmental performance.

Switching focus to the firm level, the first hypothesis based on the RBV theory concerned the role of the environmental certification when integrated as a resource possessing VRIN characteristics. Our results demonstrate that these characteristics do not play a clear role in predicting the probability that a firm will adopt the VIVA certification. Most likely, even in those firms with higher scores, these characteristics are not sufficiently relevant to induce any detectable effect. This reinforces the argument that environmentally-friendly certifications, including the one, studied here, aim at standardising practices and these practices are generic and imitable across firms (Treacy *et al.*, 2019). Consequently, they are not perceived as an asset that alone could produce a competitive advantage.

As hypothesis *RBV-H4* suggests, the certification could leverage potential knowledge and be perceived as a promoter of operational capabilities. That is, the procedures required by the certification could enhance a firm's capabilities, thereby producing efficiencies at different levels of the production process, including input procurement, labour productivity and production costs (Delmas and Pekovic, 2013; Lo *et al.*, 2014; Prajogo *et al.*, 2014). However, our results do not appear to support this prediction, probably because managers were not interested in pursuing operational efficiency through the certification. As this study is not focussed on measuring performance, this does not mean that the certification cannot produce operational efficiencies – as found, for example, by Treacy *et al.* (2019) in the case of ISO14001 certification, by Lo *et al.* (2014) for the OHSAS 18001 certification, or, at a more general level, by Annunziata (2018) for proactive environmental practices in the Italian wine industry.

Finally, the adoption of certification may leverage dynamic capabilities that could promote a sustained competitive advantage over non-adopters. Hypotheses *RBV-H5* and *RBV-H6* investigate two of these capabilities, namely, those related to supply chain coordination skills and those related to the propensity for innovation. The evidence clearly supports the prediction in hypothesis *RBV-H5*. That is, managers are more likely to implement the certification when they expect that its adoption will improve their knowledge of the supply chain or prompt better and new collaborations with suppliers. As suggested by Hofmann *et al.* (2012), prior collaboration capabilities might play a role in

facilitating the adoption of certification or, more in general, of environmentally sustainable practice. However, our results say something different: managers expect the certification to create the basis to further develop collaborations along the supply chain. This concept is intrinsically dynamic and refers to the possibility of developing knowledge, that *ex-ante* might only be potential (Ghozzi *et al.*, 2016), with a certification that leverages dynamic capabilities as defined by Wang and Ahmed (2007). These results are also consistent with firms pursuing a sustainable development strategy. As defined by Hart (1995, p. 1007) in his "Natural-RBV of the Firm", this strategy "facilitates and accelerates capability development" in environmentally-friendly activities and "vice versa". In fact, green capabilities can also offer strategic support: according to Hart (1995), collaboration with other actors in the supply chain and more in general with stakeholders can bring substantial technological change. On a different ground, results do not support *RBV-H6* as there is no clear evidence of an association between the probability that a firm will adopt the VIVA certification and managerial expectations concerning innovation capacity. In other words, when the certification is envisioned as a tool fostering innovation, this has a very unclear impact on the choice to undergo certification. This result contrasts the empirical evidence provided by Prajogo *et al.* (2014) for green management systems.

To conclude, although from the results regarding *RBV-H4* the certification might not be considered a valuable, rare, inimitable or non-substitutable resource, it can interact with the capabilities of the firm, expressing complementarities that stimulate the formation of dynamic capabilities. These capabilities can be considered valuable from a managerial perspective, as they can lead to competitive advantage. This result supports the findings of Gavronski *et al.* (2011), which highlight how low-order standardised procedures from a certification like ISO14001 can be combined uniquely with the complex and higher-order capabilities of a firm, leading to better green supply management.

5.2 Implications for practice

From a TCE perspective, the results highlight how the decision to adopt the certification can be justified by the expectations of managers around more efficient management of vertical relationships and a reduction in behavioural uncertainty, while at the same time, in case of high environmental uncertainty, firms prefer to remain flexible and avoid the implementation of new standardised procedures. Using Santos and Eisenhardt's (2005, p. 498) terminology, in "high-velocity" environments, adaptability becomes central and boundary decisions become "path-breaking". Therefore, promoting the adoption of an environmental standard would require addressing the problem with firm flexibility. This could be achieved by shifting the focus, whereby the standardised procedures and consequent supply chain coordination move from an efficiency perspective to more strategic issues- and competence-based considerations.

Following the logic of competitive advantage, adopters expect to develop better capabilities through a certification that improves the management of the supply chain. However, the certification does not need to have VRIN characteristics. Competitiveness is perceived to emerge even from the standardised and replicable procedures included in a public or collective certification. The key is the complementarity of certification with internal resources that can exploit potential knowledge developments. Under market dynamism, the capabilities related to supply chain coordination are not only important as an antecedent for the adoption of environmental initiatives, as Annunziata *et al.* (2018) find for the wine industry, but are expected to directly feed dynamic capabilities exploiting their potential in a virtuous cycle. Therefore, the development and promotion of certification such as VIVA can represent a useful tool to promote a long-run environmental strategy within a supply chain. If the expectations of early adopters are confirmed, this perception could spread to late adopters and improve the overall management of the supply chain and its environmental impact. In the case of the wine industry, this could be an important message for industry associations or focal firms supporting these initiatives within their supply chain. It implies delivering a message where the success of certification is not simply related to its marketing and differentiation content, but to its ability to foster the development of procedures that can find synergies with firm resources and exploit the organisational capability potential within the sector.

On similar grounds, stakeholders in the wine industry should also consider the lack of a significant effect of expectations concerning operational efficiency as an interesting signal. As highlighted by Pomarici *et al.* (2015), winemakers have invested considerably in recent years in production efficiency as a response to sustainability challenges. Improvements in wine sustainability are expected as a continuous process in winemaking, while grape production is expected to improve substantially because of new varieties in the pipeline (Pomarici and Vecchio, 2019). This might induce a general perception that a plateau will be reached in terms of operational efficiency, at least for those benefits that certification could one allow foreseeing. This would also reinforce the standpoint of winemakers who culturally focus on the operational dimension of a certification, considering it a "cost" rather than an opportunity (Pomarici *et al.*, 2015). This suggests that, if an efficiency gain is the objective of certification, much more effort is needed to provide convincing evidence to supply chain agents regarding the operational benefits that certification could bring. This point is also reinforced when looking at the effect of the control variables included in the model. In fact, implementation costs have a negative impact on adoption, which highlights the care that entrepreneurs take regarding this aspect in their decision about whether to adopt.

Finally, the results presented here do not show significant evidence of an effect of winery size or for the presence of other environmentally-friendly certifications. Therefore, the potential targets for VIVA certification are independent of these characteristics. Interestingly, supply to a large-scale retailer strongly predicts the adoption of the certification. This result is in line with several findings in the literature (Chen *et al.*, 2015; Heyder *et al.*, 2012; Stranieri *et al.*, 2016) that empirically show how requests from retailers significantly affect a firm's decision to adopt a voluntary certification.

6. Concluding remarks

Environmentally-friendly certifications are gaining growing importance within food supply chains at the international level, even in the presence of heterogeneous formats that differ

substantially in terms of standards and amount of information labelled. In the wine sector, for instance, one can distinguish between voluntary public standards, i.e. organic certification at the European level and other national public standards, like the VIVA certification in Italy.

Although recent literature has explored the drivers leading firms to adopt such certifications, it has not closely examined the strategic motivations associated with their adoption. This paper investigated the VIVA certification, considering it an alternative form of supply chain governance. The aim was to investigate the drivers affecting the adoption of this certification by assessing managerial perceptions related to transaction-related characteristics and firm-internal resources and capabilities. Specifically, our research question was explored within the conceptual boundaries of TCE and RBV. A Hierarchal Bayesian Model was applied to survey data based on a structured questionnaire submitted to all wine producers in charge of the decision about whether or not to adopt the certification.

Overall, our results provide some interesting insights when comparing TCE and RBV postulates. The certification does seem to work as a coordination tool to curb behavioural uncertainty amongst supply chain actors. However, results also suggest that in cases of perceived high external risks, managers prioritise structural flexibility over vertical coordination mechanisms (such as environmental certifications). Extending the analysis to RBV, considerations linked to operational capabilities do not seem to be relevant drivers of adoption. However, the supply chain coordination activities implied by the certification are perceived as important from a strategic perspective. There is a higher probability that a firm will adopt a certification when managers perceive that their dynamic supply chain management capabilities can be leveraged by the certification.

The study is, however, not free of limitations. Firstly, our results are highly sector-specific, so extrapolation hinges on the structural characteristics of the wine sector and the features of the increasing demand for quality attributes of wine products. Moreover, the study does not model the possible interactions amongst different transaction risks and resource- and capability-related drivers in affecting the decision of whether to adopt the certification. The simultaneous consideration of such different strategic variables could play an important role in better conceptualising firms' behaviour towards environmentally-friendly certifications. From a methodological perspective, some results might be skewed by the limited number of items per latent attribute in the RSM component of the HBM.

Future work could improve the external validity of this study by investigating the consistency of our discussion across other food and non-food sectors. In this respect, it could be also beneficial to test these results against other environmentally-friendly certifications. The further empirical investigation should also address the interaction effect of different supply chains and firm organisational drivers to uncover multiple and possibly heterogeneous strategies for the adoption of voluntary certifications. Future surveys could also concentrate on longitudinal data to better represent and explain possible path dependencies in the strategic drivers behind the adoption of environmentally-friendly certifications.

Notes

1 The other certifications, all promoted by private institutions, are Gea Vite/Ita.ca, Vino Libero, Equalitas and Tergeo. The first two also issue a label.

2 More information can be retrieved from the certification website: www.viticolturasostenibile.org/

3 For example, consider statements 1 through 3 in Table 1: as indicated in the second column, we specifically designed these statements to quantify the degree to which firms are exposed to internal risks. Model (1) accommodates internal risk through the θ_j coefficient, which represents the firm-specific component of the RSM.

4 Following Table 1, we have: presence and severity of external risk and/or external risk, as well as attitude towards the potential benefits in terms of improved VRIN characteristics, efficiency, dynamic capabilities related to the innovation process and dynamic capabilities related to the supply chain.

5 MVN stands for Multivariate Normal Distribution, while the suffix "half-" indicates a zero-truncated distribution. Also, notice that we parametrise normal distributions in terms of their mean and standard deviation.

6 Replacing the $\text{half}-\text{Normal}(0,3)$ prior with $\text{half}-\text{Cauchy}(0,2)$ or $\text{Exponential}(0.1)$ distributions has no impact on the model's estimates.

7 A brief sensitivity analysis (available upon request) shows that our results are essentially invariant to higher values of σ_δ and σ_θ, provided a proper rescaling of $\boldsymbol{\theta}$ before it enters the likelihood function. Common options for estimating RSMs in standard psychrometric analysis involve setting $\sigma_\theta = 1$, $\sigma_\theta = 3$ or occasionally $\sigma_\theta \sim \text{Half}-\text{Normal}(0,3)$.

8 Given this requirement, we scale all the regressors in $\mathbf{z}$, dummy variables included. Specifically, we transform binary predictors following the procedure suggested in Gelman *et al.* (2008).

9 We briefly discuss such methods in a supporting material available upon request to the authors, where we also analyse their performance in terms of the reliability and model fit of the estimates.

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