





RESEARCH ARTICLE

The impact of ISO 45001 on firms' performance: An empirical analysis

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Abstract

The aim of this study is to shed light on the relationship between ISO 45001 adoption and firm performance. To explore the issue, we conduct an event study and a weighted least squares regression on a dataset of 157 publicly listed companies – operating in various countries and sectors – that have given public announcement of the attainment of the ISO 45001 certification. The results show that, when compared to non-adopters, ISO 45001-certified companies display better performance in terms of productivity and profitability, while no significant differences emerge for sales. The effects of ISO 45001 adoption are significantly influenced by industry- and company-related contextual factors. The study contributes to the academic literature by developing the first large-scale empirical investigation on the performance implications of ISO 45001. Furthermore, it informs managers that by ensuring healthy and safe workplaces companies can also achieve higher financial performance.

KEYWORDS

International management standards, ISO 45001, management system standards, occupational health and safety, OH&S, OHSAS 18001

1 | INTRODUCTION

According to recent data provided by the International Labor Organization (ILO, 2021), 2.78 million people die every year for work-related causes, and 3.74 million are involved in non-fatal work accidents. In 2020, diseases, disorders, and injuries attributable to dangerous working conditions resulted in an economic loss of 4.94% of the global gross domestic product. Having recognized the importance of addressing this issue, organizations are devoting substantial efforts to identifying strategies and implementing policies that prioritize the enhancement of workers' health and well-being (Evangelinos et al., 2018; Marhavidis et al., 2022). One prominent tool for achieving this objective is ISO 45001 (Arias et al., 2022). Designed to replace the British standard OHSAS 18001, ISO 45001 draws on a process-oriented approach characterized by systematization and formalization (Nunhes et al., 2021; Para-González & Mascaraque-Ramírez, 2019). It

aims at promoting healthy and safe workplaces and preventing work-related injuries and illnesses. With approximately 300,000 certified companies and a growth trend of 55% between 2020 and 2021, ISO 45001 is the third most widely adopted ISO standard after ISO 9001 and ISO 14001 (ISO, 2022). It has been embraced by prominent companies in different industries such as Alstom, Nestlé, and Repsol (e.g., Alstom, 2018; Bureau Veritas, 2020; Jones, 2018).

Notwithstanding the high number of adherents, little is known about the impact of ISO 45001 on firms' performance. This is one of the most relevant topics in the stream of research on management system standards (e.g., Castka & Corbett, 2015); a lack of clarity about the outcomes of certifications adoption could indeed hinder the understanding of their opportunities and value, and even lead companies to abandon them (e.g., Cândido et al., 2016; Podrecca et al., 2021). Previous studies on ISO 45001 are characterized by scarce and sometimes conflicting findings. While some scholars agree

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that the standard could help companies to improve their occupational health and safety (OH&S) performance (e.g., Arias et al., 2022; Karkoszka, 2020), others highlight possible adverse effects: the required bureaucratic efforts could reduce the time devoted to the firm's core activities, with negative implications on business objectives (e.g., Heras-Saizarbitoria et al., 2020; Skład, 2019). Similarly, although the literature reports that companies may adopt ISO 45001 to meet customer requests, its impact on revenues and profitability is still controversial (e.g., Purwanto et al., 2020; Yang & Maresova, 2020). This lack of agreement may also be due to the reliance on survey-based approaches, which often suffer from the use of “perceptual measures”, and/or the focus on specific geographical contexts (e.g., Indonesia, China).

With this in mind, we pose the following research questions:

RQ1. What are the performance implications of ISO 45001 adoption?

RQ2. How do contextual factors influence the outcomes of the adoption?

In line with similar studies carried out on ISO 14001, SA8000, and ISO 9001 (e.g., Corbett et al., 2005; De Jong et al., 2014; Orzes et al., 2017), we considered sales, productivity, and profitability as target dimensions to address RQ1. As for RQ2, we explored the role of three contextual factors (associated to firm, industry, and country-related characteristics) potentially affecting the ISO 45001-performance link: prior adoption of OHSAS 18001, sustainability sensitivity of the sector, and level of development of the country. We drew upon Signaling Theory (ST) and Resource Based View (RBV) to elaborate our hypotheses, testing them through a long-term event study (RQ1) and a weighted least squares (WLS) regression (RQ2) using a sample of 157 publicly listed companies coming from different countries and operating in various industries.

The results show that ISO 45001 adopters experience increases in productivity and profitability, while no effects emerge as regards sales. Furthermore, the impact of ISO 45001 is lower for firms that have previously adopted OHSAS 18001 and for organizations operating in sustainability-sensitive sectors.

Our investigation provides several contributions. From a theoretical standpoint, by joining the debate on the performance implications of international management standards, we show that proactive investments aimed at safeguarding employees' health and safety pay off also from a financial perspective. Moreover, we highlight the role of some contextual factors in affecting the outcomes of ISO 45001 adoption. From a practical standpoint, the study can assist managers in addressing concerns regarding the influence of this standard on a company's performance.

The rest of the article is arranged as follows. The next section outlines the characteristics of ISO 45001 and summarizes extant research on the topic. Then, we introduce the research framework and the methodology (Section 3 and 4). Thereafter, we present (Section 5) and discuss (Section 6) the findings. To conclude, Section 7 outlines the contributions and limitations of the study.

2 | BACKGROUND

ISO 45001 dates back to 2018, when it was issued by the International Organization for Standardization (ISO) as an evolution of OHSAS 18001, previously developed in 1999 by the British Standards Institution (BSI). By building on a process-oriented risk-based thinking, ISO 45001 “specifies the requirements for an occupational health and safety management system, and gives guidance for its use, to enable organizations to provide safe and healthy workplaces by preventing work-related injury and ill health, as well as by proactively improving its OH&S performance” (ISO 45001:2018, p.1). The standard applies to all organizations, regardless of type, industry, or size. It also aligns with the United Nations Sustainable Development Goals (SDGs), particularly supporting Goal 3, which aims to ensure healthy lives and promote well-being for all at all ages, and Goal 8, which targets sustained, inclusive and sustainable economic growth, full and productive employment, and decent work for all (Global Goals, 2023). In this perspective, ISO 45001 adoption demonstrates an organization's commitment to these global objectives, reflecting a proactive stance on worker safety (BSI, 2023; Pauliková et al., 2022). When compared with OHSAS 18001, ISO 45001 is characterized by more clearly defined objectives, terms, and scope, an increased focus on the responsibilities of the top management (e.g., Campanelli et al., 2021), and a more central role of workers' needs/expectations. Moreover, it is based on the “high-level structure” Annex SL, a common format for ISO standards that makes it less complex for companies to adopt and maintain it (Glevitzky et al., 2019).

Previous studies on ISO 45001 were identified by conducting a systematic search in Elsevier's Scopus using the keywords “ISO 4500*” OR “ISO4500*”. To ensure the quality of the selected contributions (Centobelli et al., 2020), we focused on English-written, peer-reviewed journal articles; the search yielded 67 papers. After reading the full texts, we excluded 36 articles that only mentioned ISO 45001 without any analysis/discussion and/or referred to other occupational health and safety standards. On the 31 remaining papers, we performed a forward/backward citation analysis (Trevisan & Formentini, 2023), identifying four further relevant articles. Overall, we reviewed and analyzed 35 articles, whose overview is provided in Table A1 of the online Appendix. As the table shows, 40% of the articles are conceptual in nature and only three papers are grounded on established theoretical lenses. Yang and Maresova (2020) build on the dictates of the Institutional theory, Karanikas et al. (2022) rely on the Socio-Technical System theory, while Liu et al. (2023) integrate three different perspectives: the Institutional theory, the Resource-Based View, and the Stakeholder theory. In terms of content, the reviewed papers deal with four main different aspects of ISO 45001: *motivations, implementation process, outcomes* of the adoption, and *contextual factors*.

The first topic concerns the *motivations* for companies to adopt the standard, which include not only the desire to prevent accidents and injuries (Zhao et al., 2022), comply with legal requirements and regulations (e.g., Glevitzky et al., 2019; Nisipeanu et al., 2017), and improve internal processes/activities (e.g., Zhao & Jiang, 2020), but also the willingness to enhance corporate image, reach

international markets, and respond to business pressures and competitive dynamics (e.g., Arias et al., 2022; Hemphill & Kelley, 2016).

A second discussed aspect regards the criticalities of the ISO 45001 *implementation process*. According to the reviewed papers, a significant amount of time is required to carry out activities (Alarcon et al., 2022) and fill in documents (Heras-Saizarbitoria et al., 2020) associated with ISO 45001 adoption. Furthermore, the text of the norm is quite ambiguous (e.g., Pauliková et al., 2022), leading companies to incur relevant costs for hiring external experts and consultants (e.g., Grujić et al., 2023). Workers may also find it difficult to understand the relevance of the implemented processes and procedures, thus requiring specific (costly) training programs (Campanelli et al., 2021; Marhavilas et al., 2022).

The third theme explored in the literature relates to the *outcomes* of ISO 45001 adoption. Overall, contrasting results have emerged for almost all the investigated dimensions. Starting from efficiency-related aspects, the adoption of ISO 45001 has been linked to an easier identification and treatment of potential occupational illnesses and accidents (Arias et al., 2022; Karkoszka, 2020), with a consequent reduction in time and money losses (e.g., downtime due to disruption of operations, legal costs related to incidents, insurance fees – Nisipeanu et al., 2017). Scholars have likewise highlighted that the agile circulation of information, which typically results from the adoption of ISO 45001, can promote internal dialog and lead to more timely decision-making. On the contrary, ISO 45001 has also been accused of causing excessive bureaucracy; this may discourage employees and negatively affect their participation in activities related to safety management, as well as reduce the time they devote to the company's core activities (Heras-Saizarbitoria et al., 2020; Skład, 2019).

Similarly, there is no clear understanding of the impact of ISO 45001 on the reputation dimension. Some scholars argue that ISO 45001 represents a significant signal vis-à-vis the competitors (e.g., Hemphill & Kelley, 2016) and can help companies to demonstrate their social responsibility efforts to key stakeholders (Arias et al., 2022; Zhao & Jiang, 2020). This should enhance the firm's standing and increase trust in the products and services offered (Castiblanco et al., 2020). Despite these arguments, previous research has pointed out that the effects of certification could be rather limited, and that ISO 45001 could also send the wrong signal due to its "lack of guarantee, legitimacy, and appropriateness to address OH&S issues" (Heras-Saizarbitoria et al., 2020, p. 414). According to Brocal et al. (2018), this happens because the effectiveness of the standard depends on a number of aspects, including the actual integration of the OH&S system into the daily processes/routines and compliance with the legal requirements of the context in which the company operates.

The last explored dimension relates to financial measures. In this regard, both positive (e.g., Fahmi et al., 2021; Purwanto et al., 2020) and negative (e.g., Yang & Maresova, 2020) effects of ISO 45001 have been identified. These differences are probably due to the distinct contexts under investigation (i.e., Indonesia vs. China), and the fact that some contributions (e.g., Fahmi et al., 2021) consider companies that have implemented an integrated management system (i.e., ISO 45001 along with ISO 9001

and ISO 14001). It is also worth highlighting that these studies are characterized by two main methodological limitations. First, some of them (e.g., Fahmi et al., 2021; Purwanto et al., 2020) are based on survey research which may suffer from issues related to the use of perceptual benchmarks and inflated claims (e.g., De Jong et al., 2014). Second, regardless of the adopted approach, the authors neither compared the performance of adopting and non-adopting firms nor controlled for a selection effect.

A limited number of studies have also investigated the *contextual factors* associated with ISO 45001 adoption and ongoing management. The contributions of Molina-Reyes et al. (2022) and Campanelli et al. (2021) highlight the relevant role of company size: large companies usually pay more attention to OH&S-related aspects and are therefore more likely to certify, as well as they have more resources to devote to the successful implementation of an OH&S policy. Similarly, Zhao and Jiang (2020) and Marhavilas et al. (2022) argue that ISO 45001 is generally more useful in the manufacturing sector, as these companies are usually characterized by "more unsafe working conditions" (Marhavilas et al., 2022, p. 19). Finally, Skład (2019) and Liu et al. (2023) testify that the adoption and effectiveness of ISO 45001 depends on aspects connected to leadership and managerial commitment; in particular, how the top management perceives occupational health and safety and communicates its relevance to the employees.

Summing up, extant research indicates that ISO 45001 is implemented not only to achieve higher levels of occupational health and safety but also with the expectation of process improvement and commercial benefits. Despite the significant amount of resources associated with the certification, our review provides evidence that the performance implications of ISO 45001 are inconsistent and mostly anecdotal. Unclear findings emerge, as well, by widening the scope to contributions focused on OHSAS 18001 (see Madsen et al., 2020 for an overview). Some of them show positive effects on both health and safety and financial performance measures such as sales and productivity (Abad et al., 2013; Lo et al., 2014). Others highlight that the certification is not associated with relevant performance benefits (e.g., Heras-Saizarbitoria et al., 2019), but rather could slow down a company's profitability (Fan & Lo, 2012) and favor decoupling and complex risks hiding (Gallagher et al., 2003; Hohnen & Hasle, 2011).

The controversy on the outcomes of ISO 45001 and OHSAS 18001 fits into the debate on the effectiveness of other certifications/management systems such as ISO 14001 (De Jong et al., 2014), SA8000 (Orzes et al., 2017), ISO/IEC 27001 (Podrecca et al., 2022), and ISO 9001 (Corbett et al., 2005). These contributions, which generally build on event studies performed on secondary data from firms' financial statements, are based on the assumption that a lack of clarity about the financial/operational impact of standards adoption would ultimately hamper the understanding of their opportunities and value. Accordingly, a prominent need exists to address the weaknesses of the previous literature on ISO 45001 and to examine the impact of the standard on firm performance as well as the role of some contextual factors in influencing such outcomes.



3 | RESEARCH HYPOTHESES

In this section, we develop a series of research hypotheses on the impact of ISO 45001 on firms' performance (RQ1) and the contextual factors that influence such relationship (RQ2).

Starting with RQ1, in line with previous contributions on management standards and initiatives (e.g., ISO 14001, ISO 9001, United Nations Global Compact, SA8000 – De Jong et al., 2014; Corbett et al., 2005; Orzes et al., 2017, 2020), we selected these three indicators: sales, productivity, and profitability. To develop our hypotheses, we relied on the underpinnings of ST and RBV. These theories, besides being particularly effective in explaining the performance impacts of ISO 45001, are among the most used lenses to investigate issues connected to management system standards implementation and outcomes (e.g., Cantele et al., 2023; Marcuzzi et al., 2023).

The dictates of the ST can be used to frame the research hypothesis related to the effect of ISO 45001 on sales. As explained by Spence (1973) and Connelly et al. (2011), the interactions between two parties of an exchange (e.g., sellers and buyers) are often characterized by imperfect and incomplete information, which could result in inefficient agreements and suboptimal decision-making. To reduce information asymmetry and facilitate win-win relationships, firms whose products or behaviors are characterized by desirable attributes send signals, namely perform some actions that convey relevant details (Akerlof, 1970). The ISO 45001 certification can be viewed as a practical tool to signal that the organization adopts a structured approach to OH&S, thus informing potential customers of the firm's sensitivity to the topic. We expect that this signaling approach can lead to a growth in sales for at least two reasons. First, obtaining certification from a well-known and respected regulatory body, such as ISO, can allow firms to differentiate themselves in the market (Santos et al., 2018; Terlaak & King, 2006) and serve as an entry barrier that prevents less socially responsible firms from competing (Starke et al., 2012). Second, attention to employee health and safety can enhance a firm's reputation, providing a superior commercial position to certified companies (Arias et al., 2022; Hemphill & Kelley, 2016). Overall, the improved brand image resulting from socially responsible behavior can attract new customers and create new commercial opportunities (Taoketao et al., 2018). Therefore, we formulate the following hypothesis:

H1. The adoption of ISO 45001 leads to improved firm sales.

RBV posits that the competitive advantage of organizations comes from possessing resources and competencies that are valuable, rare, difficult to imitate, and non-substitutable (Barney, 1991). According to extant research (e.g., Cândido et al., 2016), the structured approach underpinning management system standards could become one of such resources. It enables companies to build internal practices and capabilities that can result in cost reduction and productivity rise (Podrecca et al., 2022). This seems to be the case for ISO 45001 for at least three reasons. First, ISO 45001 promotes a culture of continuous improvement within organizations: it encourages regular assessment, measurement,

and monitoring of health and safety performance (e.g., Nunhes et al., 2021). By identifying areas where to prioritize efforts and implement corrective actions, organizations can optimize their processes and enhance overall operational efficiency (e.g., Marhaviilas et al., 2022). Second, the standard could reduce workplace accidents, injuries, and illnesses, thus decreasing downtime (e.g., Zhao & Jiang, 2020). Third, ISO 45001 requires organizations to establish effective training and competency development programs; well-trained employees are more likely to make informed decisions, adapt to different working conditions, and perform their tasks efficiently (e.g., Arias et al., 2022). In sum, ISO 45001 could promote the introduction of effective routines and organizational competencies that can provide a strong competitive advantage to the related company. Hence, we hypothesize that:

H2. The adoption of ISO 45001 leads to improved firm productivity.

Even if the adoption of ISO 45001 may require substantial expenditures and internal efforts, we expect that the higher revenue generated by the additional sales and the lower operational cost due to the increased productivity can result in an enhanced profitability performance. Additional arguments to support the positive impact of ISO 45001 on profitability can be derived from both ST and RBV. Following Starke et al. (2012), the provision of signals through the attainment of an ISO certification can allow firms to set higher prices for their products, without experiencing a concurrent decrease in demand. Companies perceived as responsible, reliable, and credible can indeed benefit from increased customer loyalty, which positively affects firm performance (Taoketao et al., 2018). We may thus expect that firms certifying their OH&S management systems improve their profit margin and experience higher profitability. Moreover, from an RBV perspective, ISO 45001 could be considered a valuable resource that embraces both intangible (e.g., competencies and knowledge) and tangible elements (e.g., targeted and dedicated tools and devices) (e.g., Arias et al., 2022). As argued above, the standard could not only provide specific guidance at the various organizational tiers but also disseminate OH&S knowledge throughout the organization, thus preventing accidents. As a result, companies can mitigate financial losses associated with business disruptions, legal expenses, and compensatory measures (e.g., Nisipeanu et al., 2017). Moreover, although some studies argue that the costs (and burdens) of certification may outweigh its positive aspects (e.g., Heras-Saizarbitoria et al., 2020), ISO 45001 demands companies to design the OH&S management system in accordance with their characteristics and needs; the flexibility inherent in ISO 45001 dictates allows organizations to avoid unnecessary operating expenses and OH&S investments by focusing on what is actually necessary (e.g., Castiblanco et al., 2020). We thus posit that:

H3. The adoption of ISO 45001 leads to improved firm profitability.

Regarding RQ2, previous studies on other management systems, standards, and initiatives suggested that the certification-performance

link might be influenced by firm, industry, and country-related aspects (Orzes et al., 2017, 2020; Podrecca et al., 2021, 2022). The literature on ISO 45001 acknowledged the presence of contextual factors as well; their role has been examined mainly for aspects connected to ISO 45001 implementation (e.g., Campanelli et al., 2021; Liu et al., 2023; Molina-Reyes et al., 2022). Hence, we propose that the internal and external organizational settings significantly affect the performance impacts of ISO 45001. Furthermore, since profitability can be considered the overall impact associated with the implementation of a management system standard depending, above all, on factors such as sales and productivity (e.g., Corbett et al., 2005; Jacobs et al., 2015; Lo et al., 2014), we limited the contingent analysis to this performance outcome. This decision follows the approach already adopted by extant research on ISO 9001 (Lo et al., 2013), SA 8000 (Orzes et al., 2017), OHSAS 18001 (Lo et al., 2014; Yang et al., 2021), and ISO/IEC 27001 (Podrecca et al., 2022).

A first aspect that could affect the outcomes of ISO 45001 adoption is the fact that some companies might have already certified with **OHSAS 18001**. On the one hand, organizations transitioning from OHSAS 18001 to ISO 45001 may experience a smoother implementation process as they already have a foundation in place (Darabont et al., 2018). They can build upon their existing occupational health and safety management systems and improve them based on the enhanced requirements of ISO 45001 (Skřad, 2019). On the other hand, firms that have not previously joined OHSAS 18001 may experience more significant effects from ISO 45001. These companies may need to establish and implement occupational health and safety management systems from scratch, leading to transformative changes in their safety practices and performance (Alarcon et al., 2022). Overall, the former organizations may benefit from the reduced cost and effort of adapting their activities and routines to ISO certification, while the latter might exploit the potential for greater improvement in their internal processes. Hence, we assume that:

H4. The effect of ISO 45001 certification on profitability is influenced by the previous adoption of OHSAS 18001.

The second aspect that may influence the outcomes of ISO 45001 adoption is the **sustainability sensitivity** of the industry. Sustainability-sensitive industries usually involve high-risk work environments and therefore have established and routinized security practices and regulations (Al-Shaer & Zaman, 2019). The implementation of ISO 45001 in such industries may act as a reinforcement, leading to incremental improvements rather than profound changes in the internal processes and practices. At the same time, it should be noted that sustainability-sensitive industries face higher public scrutiny, which increases the pressure to effectively comply with ISO 45001 dictates (Podrecca et al., 2021). Moving to non-sustainability-sensitive industries, firms operating in such contexts might have a lower prioritization of safety (Zaiane & Ellouze, 2023); by introducing new security protocols and practices, ISO 45001 could thus have a more noticeable impact. Moreover, non-sustainability-sensitive industries may adopt the standard based on internal initiatives and organizational values

rather than to comply with stakeholder pressures (Solikhah, 2016). Overall, the different levels of safety performance, regulatory pressures, and existing practices could contribute to the different effects of ISO 45001 between sensitive and non-sensitive industries. Therefore, the following hypothesis is posed:

H5. The effect of ISO 45001 certification on profitability is influenced by the sustainability sensitivity of the sector.

Finally, given that working conditions differ between developing and developed countries (Sartor et al., 2016), it is likely that the outcomes of ISO 45001 implementation will vary with the **level of development** of the country where the ISO 45001 is implemented. Developing countries are characterized by a higher risk of fatal occupational injuries, poor law enforcement, and weak legal systems (Parmigiani & Rivera-Santos, 2015). Furthermore, in this context, information asymmetry tends to be more prominent, making it difficult for stakeholders to access sustainability-related information (Hou et al., 2016). We can thus expect that the introduction of OH&S systems will be particularly promising for accidents reduction and reputation improvement, consequently affecting firm profitability. At the same time, firms located in developed countries typically have greater financial resources to invest in health and safety systems, which may result in a better assimilation of the practices and procedures foreseen by ISO 45001 (Ali et al., 2017). Competence and knowledge gained through training and development programs can become valuable resources that are difficult to replicate by competitors. Therefore, considering the different logics that can characterize the two contexts, we propose the following hypothesis:

H6. The effect of ISO 45001 certification on profitability is influenced by the level of development of the firm's country of origin.

Figure 1 Provides an overview of the research hypotheses.

4 | METHODOLOGY

In line with extant research investigating the performance effects associated with the adoption of international management standards (e.g., ISO 14001 – De Jong et al., 2014; ISO/IEC 27001 – Podrecca et al., 2022; SA 8000 – Orzes et al., 2017; OHSAS 18001 – Lo et al., 2014; Yang et al., 2021), we answered **RQ1** using a long-term event study and **RQ2** running a weighted least squares regression.

Long-term event studies are a very effective and widely acknowledged approach for examining the impact of managerial choices like the introduction of new practices (e.g., Hill et al., 2018; Shou et al., 2021) and standards (Orzes et al., 2020; Yang et al., 2021). They are designed to mitigate major sources of endogeneity that are typically encountered in shedding light on the performance implications of a firm's strategic decisions (e.g., Corbett et al., 2005; Lo et al., 2014). In fact, it might be the case that companies with specific

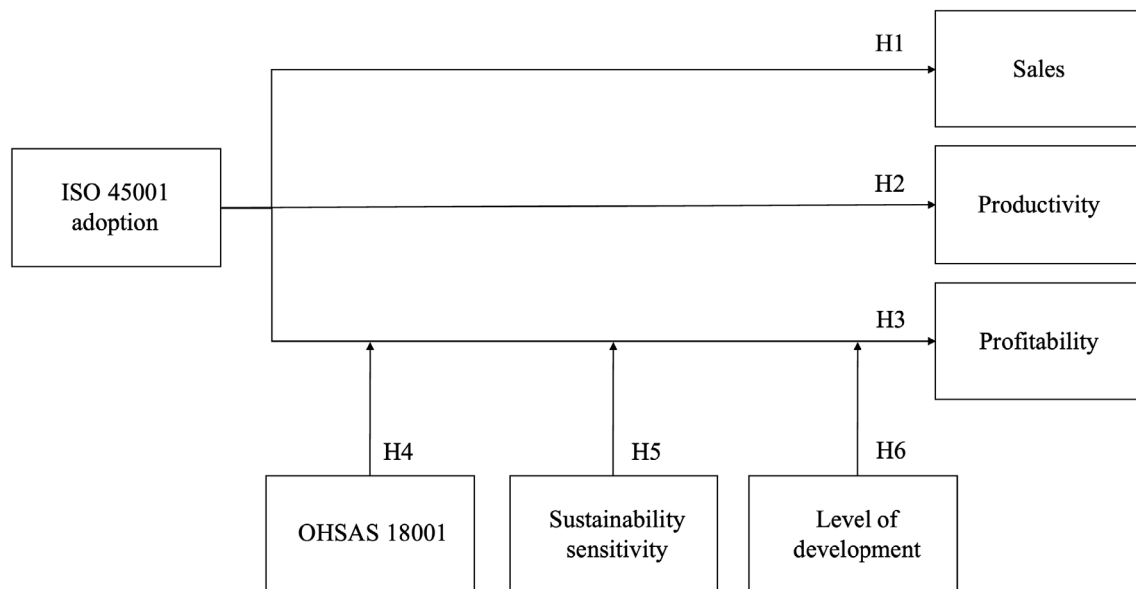


FIGURE 1 Research framework.

characteristics are more inclined to make certain actions (i.e., in our case, to adopt ISO 45001). This tendency leads to an inherent non-random self-selection process (Boyd et al., 2019). By comparing ISO 45001 adopters with a control group of similar non-adopting companies, the event study allows to test the effects of standard implementation while avoiding issues related to selection biases and the presence of prior trends (e.g., Barber & Lyon, 1996; Corbett et al., 2005; Lo et al., 2014).

To identify a sample of ISO 45001-certified organizations (ISO does not provide information on individual companies), a multi-step approach was adopted (e.g., Podrecca et al., 2022). First, we conducted a keyword search in the commercial news database Factiva with the words “ISO 45001”, “ISO 45000”, “ISO45001”, and “ISO45000”. The research covered the period from 2018 (i.e., the year of ISO 45001 enactment) to 2020. For each potential ISO 45001-certified firm, an additional screening was performed by conducting a supplemental news search in the Google and Factiva search engines and reviewing the firms' websites and annual reports to: (a) determine the actual certification status and identify the exact certification date; (b) ensure that there were no “confounding events” (McWilliams & Siegel, 1997) within the ISO 45001 certification time-frame that could affect the performance of the sampled firms. As a final step, the list of companies was matched with the Refinitiv Eikon database, which contains financial data for publicly traded organizations. Previous adoption of this database can be found, among others, in Molinaro, Orzes, et al. (2023), Ozkan et al. (2023), Kuo et al. (2021), and Shakil (2021).

The resulting dataset is composed of 157 companies (see Table 1 for the demographic data). To assess the representatives of our sample with respect to the overall population of ISO 45001-certified companies, we compared our data with the ISO survey data up to 2020 (i.e., the reference period for our analysis – ISO, 2021). It emerges that the composition of our dataset is consistent with the regional

TABLE 1 Sample distribution by adoption year, region, and industry.

Adoption year	Frequency	
2018	33	
2019	65	
2020	59	
Region	Frequency	
Asia	89	
Europe	50	
North America	13	
South America	3	
Africa	1	
Oceania	1	
Industry	NACE code	Frequency
Mining and quarrying	5–9	9
Manufacturing	10–33	103
Utilities	35–39	12
Construction	41–43	7
Wholesale and retail trade	45–47	12
Services and financial activities	49–93	14

distribution of ISO 45001 enacted certificates. In particular, Asian organizations represent 56.69% of the companies in our dataset, while this region accounts for 59.15% of the total amount of issued certificates. Similarly, European companies represent 31.85% of our sample and 33.65% of the total population. For the sake of transparency, it should, however, be noted that some differences emerge when data are considered at country level. For instance, Indian firms constitute 7.01% of our sample and 2.39% of the overall population; Italian companies account for 3.82% of the sample and 8.56% of the

population; and Swedish organizations represent 4.46% of the sample and 0.72% of the population. No comparison can be made in terms of industry, as ISO provides only limited information about the industries in which ISO 45001-certified companies operate.

4.1 | Event study

An event-study approach was adopted to verify whether the 157 ISO 45001-certified companies in our sample show significant abnormal *sales* (H1), *productivity* (H2), and *profitability* (H3) performance when compared with a control sample of similar non-certified organizations.

Occupational health and safety management systems usually require from 6 to 18 months to be fully implemented (Yang et al., 2021; Lo et al., 2014); the event period was therefore set as the certification year (t) and the year before ($t-1$). Year $t-2$ (i.e., the event-free year – Podrecca et al., 2022), was deemed as the base year and used to build the sample of control firms. Considering the methodological suggestions of Orzes et al. (2017) and Lo et al. (2014), year $t-3$ was also included in the analysis to verify the absence of endogeneity issues (i.e., ensure that performance effects were actually associated with ISO 45001 certification and there were no prior trends or selection effects).

The three performance dimensions under investigation were operationalized following the approach of previous event studies (e.g., De Jong et al., 2014; Liu et al., 2021; Lo et al., 2014); we resorted to year-over-year sales growth for *sales* (H1); the ratio between cost of goods sold and sales for *productivity* (H2); the return on asset (ROA) for *profitability* (H3); as said before, Refinitiv Eikon was used to collect the financial data used in the analysis. In line with Orzes et al. (2020) and Podrecca et al. (2022), a distinct portfolio of control firms was defined for each ISO 45001-certified company and each performance dimension under investigation. The three-criteria portfolio approach recommended by Barber and Lyon (1996) was adopted: industry (ISO 45001-certified companies and control firms should be characterized by the same 2-digit NACE code), size (control firms should have 50%–200% of ISO 45001-certified firms total assets in the base year), performance (the considered performance of the control firms – *sales*, *productivity*, *profitability* – should be comprised in the 90%–110% interval of the ISO 45001-certified firms performance in the base year). If no match was found, the industry criterion was then relaxed to the 1-digit NACE code and subsequently excluded (Barber & Lyon, 1996; Podrecca et al., 2022). On average each certified company matched with 9.470 control firms, a common ratio in event studies (e.g., Orzes et al., 2020).

The abnormal performance (AP) change of each ISO 45001 sampled firm was computed as follows:

$$AP_{(t+b)} = PS_{(t+b)} - EP_{(t+b)}$$

$$EP_{(t+b)} = PS_{(t+a)} + (PC_{(t+b)} - PC_{(t+a)})$$

where EP represents the expected performance, PS is the actual performance of the ISO 45001-certified firms, PC is the median

performance of the control firms, t is the year of ISO 45001 certification, a is the starting year of comparison ($-3, -2, -1, 0, 1$), and b is the ending year of comparison ($-2, -1, 0, 1, 2$).

As said in the previous section, our data present certain differences when compared with the overall population of ISO 45001-certified companies. To address the issue and make the country distribution of our sample equivalent to that of the whole population, the post-stratification weighting with inverse probability proposed by Kalton and Flores-Cervantes (2003) was adopted; the sample was weighted using weights equal to: $\frac{\% \text{ of certifications issued in the country}}{\% \text{ of cases of that country in the sample}}$. Previous adoption of this technique can be found, among others, in Orzes et al. (2020).

The Shapiro–Wilk tests indicated that our data did not follow a normal distribution. Therefore, we assessed whether the abnormal performance (AP) significantly differed from zero using non-parametric tests (Barber & Lyon, 1996; De Jong et al., 2014). In particular, the Wilcoxon signed-rank test (WSR) and the sign test were used, respectively, in case of symmetric and skewed distributions.

4.2 | Weighted least squares

To test H4, H5, and H6, we performed a weighted least squares regression on the abnormal ROA performance between $t-2$ and $t+2$. This technique allows to balance the distribution by country of our sample with that of the population, thus improving the generalizability of our results (e.g., Orzes et al., 2020; Siqueira et al., 2018). Similarly to the approach adopted for the event study, the weight of each observation is defined as $\frac{\% \text{ of certifications issued in the country}}{\% \text{ of cases of that country in the sample}}$.

As for the operationalization of the independent variables¹:

- To account for the previous adoption of OHSAS 18001 (H4), we added a dummy having value “1” for firms that were previously certified with OHSAS 18001 (Orzes et al., 2017).
- Following the industry categorization proposed by Al-Shaer and Zaman (2019), we included a dummy having value of “1” for firms operating in *sustainability sensitive* industries (H5): mining, oil and gas, metals, forest and paper products, tobacco, chemicals and pharmaceuticals, defense, alcohol, and utilities.
- In line with previous studies (e.g., Orzes et al., 2017, 2020), the *level of development* of a firm's country of origin (H6) was measured with Human development index (HDI) developed by the United Nations. This indicator provides an overall representation of each country development building on aspects, such as “*a long and healthy life, being knowledgeable, and having a decent standard of living*” (UNDP, 2023).

To ensure the robustness of our results, we added the following control variables related to country-, industry-, and firm-specific aspects that could affect the outcomes of ISO 45001 adoption¹:

¹Following extant research (e.g., Lo et al., 2014; Orzes et al., 2017; Podrecca et al., 2022), data refer to the base year (i.e., $t-2$).

- Regulatory quality (regulatory quality index – Iwanow & Kirkpatrick, 2007; World Bank, 2023a): firms operating in environments with stringent and effective regulations may experience limited opportunities for improvement (Parmigiani & Rivera-Santos, 2015).
- Economic openness (the ratio of a country's imports and exports to its gross domestic product – Knudsen, 2011; World Bank, 2023b): companies in open economies typically engage in commercial relations with a multitude of countries; thus, the “qualifying effect” of ISO standards is usually higher in these contexts (e.g., Para-González & Mascaraque-Ramírez, 2019).
- Average working hours (industry average weekly working hours by country – Lo et al., 2014; ILO, 2023): health and safety aspects are generally more relevant in contexts characterized by longer working hours (Spurgeon et al., 1997).
- Industry competition (1-Herfindahl index; industry defined at the 2-digit NACE code level – Jacobs et al., 2015): the effectiveness of international management standards tends to be lower in more competitive industries (Podrecca et al., 2021).
- Industry size (natural logarithm of the industry's total assets; industry defined at the 2-digit NACE code level – Lo et al., 2013): firms operating in large industries are usually subject to greater scrutiny and this could increase the effectiveness of management standard adoption (Terlaak & King, 2006).
- Industry efficiency (median ROA of the industry; industry defined at the 2-digit NACE code level – Podrecca et al., 2022): the benefits of standards adoption may be lower in contexts where processes are already optimized (Lo et al., 2013).
- Firm size (natural logarithm of the firm's total assets – Yang & Maresova, 2020): the impact of standards adoption is supposed to be different for small and large companies (Carvalho et al., 2020).
- Pre-certification ROA (ROA in year $t-2$ – Lo et al., 2014): the effects of the certification may be lower for companies with higher initial performance (Orzes et al., 2020).
- Firm age (years from company foundation when ISO 45001 was adopted – Podrecca et al., 2022): companies can attain greater benefits from certification by leveraging their accumulated experience (Wang & Zhao, 2020).
- Capital intensity (ratio of assets by revenues in the base year – Podrecca et al., 2022): the effects of management systems and standards may vary with business complexity (Su et al., 2015).
- Adoption year (year of ISO 45001 certification – Lo et al., 2014) to account for year specific aspects that could affect the outcomes (e.g., COVID-19) (Molinari, Romano, & Sperone, 2023).

Dummy variables related to the different regions and industries were also added to the model (Cantele & Zardini, 2020).

Table A2 and Table A3 in the online Appendix provide a summary of the included variables and the matrix with their correlations, respectively.

5 | RESULTS

5.1 | ISO 45001 performance implications

Table 2 shows the results of the event study conducted to investigate the effects of ISO 45001 certification on the performance of certified companies. For each considered performance dimension and period, the following information is reported: data characteristics (normality, skewness), number of observations (N), weighted mean and weighted median values of the abnormal performance (WAP mean, WAP median), and the results of the Wilcoxon signed rank (WSR) test (symmetric data) and the sign test (skewed data).

Starting with sales, mixed results emerged. On the one hand, a significant positive abnormal performance was found in $t-2$ to $t-1$ and $t+1$ to $t+2$. On the other hand, there was a negative and statistically significant abnormal performance from t to $t+1$. Moreover, none of the multi-year periods presented statistically significant values ($H1$ is not supported).

Regarding productivity, negative and statistically significant abnormal outcomes (indicating a better performance of ISO 45001 certified companies compared to their peers) occurred in $t-1$ to t and $t-2$ to $t+2$ ($H2$ is supported).

As for the profitability, the results showed a positive and statistically significant abnormal performance in these time intervals: $t-2$ to $t-1$, $t-1$ to t , $t-2$ to t , and $t-2$ to $t+2$ ($H3$ is supported).

Finally, to verify the absence of endogeneity issues (i.e., to ensure that the results were driven by the ISO 45001 certification and that there were no prior trends and/or selection effects), we also considered the period from $t-3$ to $t-2$ in our analyses (Orzes et al., 2017; Podrecca et al., 2022); no statistically significant performance changes appeared. Moreover, in all the considered performance dimensions, abnormal performance appeared only when companies started to implement ISO 45001 (i.e., from $t-2$ to $t-1$ – ROA, sales) or when companies achieved the certification (i.e., from $t-1$ to t – productivity). These two aspects confirmed the absence of prior trends and the robustness of our results.

5.2 | Contextual factors

From the results of the WLS regression (Table 3), it emerged that the effect of ISO 45001 certification on profitability is influenced by the previous adoption of OHSAS 18001 as well as by the *sustainability sensitivity* of the firms' sector ($H4$ and $H5$ are supported). In particular, firms that were previously certified with OHSAS 18001 and firms operating in sustainability sensitive industries receive less benefits from ISO 45001 adoption. On the contrary, no statistically significant effects were found for the *level of development* of the country ($H6$ is not supported). As for the control variables, more profitable firms (*Pre-certification ROA*) obtain fewer improvements.

We also calculated the variance inflation factors for our independent variables. The mean VIF is 3.255 and the values range from

TABLE 2 Event study results.

	Period	Normality	Skewness	N	WAP Mean	WAP Median	p-value (WSR)	p-value (sign test)
<i>Sales</i>								
Multi-year periods	t-2 to t (certification)	NO	S	153	12.64	9.80	0.090	0.491
	t to t+2 (post-certification)	NO		153	-5.23	-3.71	0.311	0.491
	t-2 to t+2 (full period)	NO	S	153	7.41	2.43	0.306	0.846
Single-year periods	t-3 to t-2	NO	S	150	-1.58	-9.19	0.960	0.491
	t-2 to t-1	NO	S	153	12.36	4.88	0.001**	0.000***
	t-1 to t	NO		153	0.28	4.56	0.960	0.491
	t to t+1	NO	S	153	-13.42	-12.90	0.016*	0.000***
	t+1 to t+2	NO		153	8.20	4.89	0.016*	0.449
<i>Productivity</i>								
Multi-year periods	t-2 to t (certification)	NO	S	148	-4.03	-4.05	0.094	0.633
	t to t+2 (post-certification)	NO		148	0.47	0.37	0.838	0.787
	t-2 to t+2 (full period)	NO		148	-3.56	-3.45	0.001***	0.000***
Single-year periods	t-3 to t-2	NO		147	0.13	-1.68	0.662	0.107
	t-2 to t-1	NO	S	148	-1.24	-1.97	0.662	0.633
	t-1 to t	NO	S	148	-2.80	-2.77	0.001***	0.000***
	t to t+1	NO	S	148	0.75	0.86	0.989	0.658
	t+1 to t+2	NO	S	148	-0.28	0.40	0.718	0.787
<i>Profitability</i>								
Multi-year periods	t-2 to t (certification)	NO		157	6.06	5.98	0.001***	0.000***
	t to t+2 (post-certification)	NO		156	1.68	-2.09	0.999	0.431
	t-2 to t+2 (full period)	NO		156	7.73	2.89	0.000***	0.000***
Single-year periods	t-3 to t-2	NO	S	152	-1.28	-1.48	0.315	0.431
	t-2 to t-1	NO		157	2.90	2.58	0.000***	0.000***
	t-1 to t	NO		157	3.15	2.65	0.013*	0.002**
	t to t+1	NO	S	157	-0.21	-0.22	0.999	0.854
	t+1 to t+2	NO	S	156	1.88	-2.17	0.999	0.431

Note: To prevent type I errors, the false discovery rate methodology proposed by Benjamini and Hochberg (1995) has been applied.

*p < 0.05, **p < 0.01, ***p < 0.001.

1.243 to 7.046, lower than the normal threshold of 10 (Belsley et al., 2005): no multicollinearity issues were detected.

5.3 | Study extension

Since the level of development of the country was not significant (H6 is not supported), we argued that the outcomes of ISO 45001 implementation might depend on the cultural characteristics of each nation; scholars have highlighted that culture, people's mindset, and way of life are country-related factors that influence managerial practices (Hofstede et al., 2010) and thus the effectiveness of management standards adoption. Hence, we ran an additional regression where we added the 6 dimensions defined by Hofstede to "measure" the cultural characteristics of a country (Hofstede Insights, 2023): *Individualism*, *Power distance*, *Uncertainty avoidance*,

Long-term orientation, *Masculinity*, and *Indulgence* (see Hofstede et al., 2010 for a detailed description of each dimension). Previous adoption of this operationalization can be found, among others, in Orzes et al. (2017, 2020), Durach and Wiengarten (2017), and Wiengarten et al. (2011).

The results of this additional analysis (see Table A4 in the online Appendix) showed a negative association between *Long-term orientation* and *Indulgence* and the outcomes of ISO 45001 adoption.

6 | DISCUSSION

Building on a theory-based research framework and testing it through a long-term event study and a WLS regression performed on a sample of 157 certified companies, our study presents robust indications on the influence of ISO 45001 on the performance of certified

TABLE 3 WLS regression results.

Dependent variable = ROA (t-2 to t+2)	WLS (n = 156)		
	Estimated coefficients	Robust standard errors	Statistical significance
Explanatory variables			
OHSAS 18001	-0.113	0.046	0.015*
Sustainability sensitive industry	-0.124	0.049	0.012*
Level of development	-0.539	0.299	0.074
Control variables			
Regulatory quality	0.047	0.035	0.183
Economic openness	0.001	0.000	0.178
Average working hours	0.001	0.005	0.799
Industry competition	0.894	0.686	0.195
Industry size	-0.044	0.026	0.090
Industry efficiency	-0.523	1.098	0.635
Firm size	0.009	0.007	0.172
Pre-certification ROA	-0.832	0.242	0.001***
Firm age	0.000	0.000	0.231
Capital intensity	0.001	0.002	0.650
Adoption year	-0.018	0.017	0.281
Region dummies	Included		
Industry dummies	Included		
Adjusted R ²	46.52%		

Note: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

companies and on the role of some context-specific factors in affecting such influence.

As for **RQ1**, extant research has highlighted some downsides (e.g., Heras-Saizarbitoria et al., 2020; Skład, 2019) that might reduce the financial effects of ISO 45001 adoption. Our findings provide evidence that the advantages of ISO 45001 outperform these potential drawbacks. In particular, it emerges that ISO 45001 adopters experience significant increases in productivity (**H2**) and profitability (**H3**). These results are similar to those found for ISO/IEC 27001 and ISO 9001 (Corbett et al., 2005; Podrecca et al., 2022), but contrast to those concerning ISO 14001 and (partially) SA8000 (Orzes et al., 2017; Wang & Zhao, 2020). However, while in the case of ISO 9001 the effects on productivity are nearly immediate (Corbett et al., 2005), we find that substantial abnormal performance changes related to ISO 45001 occur mainly over the long term. This probably stems from the prolonged process required for the effective internalization of this standard (e.g., Zhao & Jiang, 2020).

Consistently with the RBV perspective, our results can be explained by considering ISO 45001 as a valuable resource that promotes a clearer identification and definition of roles and responsibilities while also enhancing employee capabilities and awareness (Arias et al., 2022). When employees are supported and cared for, they are more likely to be motivated and engaged, go the extra mile, and increase their productivity at work (Hur et al., 2022; Orzes et al., 2017). At the same time, the effects of ISO 45001 can be attributed to the adoption of a process-based approach, supported by a

continuous improvement logic. The impact of the certification, thus, does not only regard the production/operational areas – hence the outcomes for productivity – but spans across the whole company (profitability-related findings) for at least two reasons. First, regular meetings, audits, and enhanced communication assist organizations in reviewing and redefining their organizational practices, thereby improving the allocation of budget, resources, and personnel (Nunhes et al., 2021; Zhao et al., 2022). Second, by reducing work-related accidents, ISO 45001 helps companies to decrease legal costs and insurance fees (Nisipeanu et al., 2017).

Moving to the sales (**H1**), the effects of ISO 45001 appear rather limited. The explanation can be twofold. According to ST, the lack of relevant sales-related outcomes depends on the “strength of the signal” (Connelly et al., 2011; King et al., 2005): although the adoption of ISO 45001 is increasing, the substantial number of enacted certificates might have modified the role of the standard making it a mandatory requirement to operate in the market rather than a differentiating factor. Alternatively, it may also happen that ISO 45001 serves more as a relationship amplifier and not to attract new customers. In this sense, the attainment of such certification may be useful to increase customer loyalty and strengthen the existing relationships with the downstream network, but it may not lead to additional sales or market opportunities.

Regarding **RQ2**, we highlight that the financial effects of ISO 45001 are affected by previous adoption of OHSAS 18001 (**H4**) and the sustainability sensitivity of the industry (**H5**). On the one hand,

companies operating in sustainability-sensitive industries are in the spotlight (Post, 2013): as a prerequisite to conducting business, they are usually expected to pay particular attention to the labor conditions of their employees as well as to testify these efforts to several influential stakeholders (Egels-Zandén & Kallifatides, 2009). On the other hand, although ISO 45001 presents some differences when compared to OHSAS 18001, organizations that were already certified according to the previous version of the standard have already implemented the core OH&S practices and procedures (Darabont et al., 2018). Hence, in these two contexts, the adoption of ISO 45001 only leads to incremental improvements, resulting in lower benefits.

To conclude, the lack of effect of the country's level of development (H6) can be explained building on the findings of extant research on the performance implications of social standards: while in developing contexts the effects of the standard are supposed to be higher, the implementation and maintenance costs are also higher due to the relevant gaps to be addressed (Orzes et al., 2017). On the contrary, the findings are affected by the cultural characteristics of the country; companies adopting ISO 45001 in contexts less oriented to the future (Long-term orientation) and characterized by strict social norms (Indulgence) generally rely more on traditions and are more inclined toward upholding rights and values, thus posing higher attention to aspects such as social sustainability and employee well-being (Hofstede et al., 2010; Hofstede Insights, 2023; Orzes et al., 2020).

7 | CONCLUSIONS

7.1 | Contributions to the theory

Our study contributes to academic knowledge in some significant ways.

First, considering the increasing centrality of OH&S, we emphasize the importance of proactive investments aimed at safeguarding employee health and safety and show that systematic tools such as ISO 45001 pay off in financial terms. Previous studies present conflicting results, partly due to the use of subjective measures (survey-based research) and the neglect of potential selection bias. Against this background, we testify that the value of ISO 45001 is not related to satisfying customer demands and/or communicating to external stakeholders the attention paid to occupational health and safety, but rather results from its capability to guide companies in the definition of internal processes and practices. Overall, our findings are particularly relevant given the challenges in measuring the effectiveness of OH&S investments (Marhavilas et al., 2022) and the concerns about the potential financial drawbacks associated with ISO 45001 (e.g., Heras-Saizarbitoria et al., 2020; Skład, 2019).

Second, as highlighted in the literature review section, extant research on ISO 45001 lacks insights into the role of contextual factors. By showing that the effects of ISO 45001 might depend on country, industry, and firm characteristics, our investigation is a first attempt to close the gap. This expands the limited knowledge on the

topic and calls scholars to delve deeper into understanding the diverse contexts in which ISO 45001 is implemented.

Third, the study extends the literature on the performance implications of management systems standards and initiatives. By building on RBV and ST, we examine the impact of the most prominent OH&S standard on a sample of publicly listed companies, presenting robust evidence of the certification-performance relationship. The results show that, in contrast with "signaling oriented" (e.g., United Nations Global Compact – Orzes et al., 2020) and more general (e.g., ISO 9001 – Corbett et al., 2005) standards/initiatives which are characterized by significant implications for sales performance, the effects of ISO 45001 are mainly associated with improvements in the internal processes of the company.

7.2 | Contributions to practice

The decision of whether to adopt ISO 45001 holds strategic importance for managers and organizations, as it implies a comparison between the required investment and the potential impact on organizational performance. While the efforts associated with implementing ISO 45001 are well-known (and considerable), the effect on firm performance remains a subject of controversy. Existing empirical investigations on this topic are limited in scope, affected by methodological limitations, and characterized by conflicting results. Our study is one of the first attempts based on a large-scale, cross-country sample to provide clear evidence of the financial effects of ISO 45001. The findings can assist managers in addressing concerns regarding the influence of ISO 45001 on a company's performance and, in particular, could be used to justify to shareholders the costs associated with ISO 45001 adoption. Additionally, by considering the role of some contextual factors, we offer managers some dimensions to take into account when embracing the certification journey.

Second, as regards the ongoing management of ISO 45001, the study proposes two specific performance metrics (productivity and profitability) that managers can use to assess the effectiveness of the standard in their organizations. This would help to set (and monitor) realistic targets in the short and long-term.

Third, our research intersects with the global agenda for sustainable development. As highlighted in Section 2, the adoption of ISO 45001 represents a proactive step toward the achievement of some key SDGs (in particular SDG 3 and 8). The results are therefore relevant also for what concerns organizations' alignment with such Goals; an aspect that is particularly important in pursuing a future without problems related to workplace accidents and workers' well-being.

Fourth, the findings may be relevant for the regulatory body (ISO). The role played by country-, industry- and firm-specific aspects in affecting the outcomes of ISO 45001 adoption may suggest ISO to develop approaches aimed at supporting firms in adopting the standard in different settings.

Fifth, the implications of the study extend into the academic realm, particularly in the education and training of future managers



and professionals. Our findings highlight the importance of OH&S and advocate a change in the way companies view the topic: from mere compliance to a strategic lever for value creation. In this perspective, educational institutions can create awareness among the young generation about the role of OH&S standards as a key approach for enhancing firm performance. This can foster a culture of safety and sustainability in future leaders and equip them with the required knowledge and skills to effectively implement such standards. Moreover, our study can serve as a case example in academic discourse, encouraging students to consider the broader impact of operational decisions on employee well-being and financial outcomes. Incorporating these insights into academic programs will foster in future managers a mindset that prioritizes the integration of sustainability and safety into core business strategies.

In conclusion, by providing strong evidence of the financial effects associated with ISO 45001, our findings could promote the diffusion of the standard. This could contribute to a more sustainable society where companies prioritize the needs of their employees, ensuring the protection of their health and safety, alongside pursuing economic profit.

7.3 | Limitations and future research

The study is not exempt from limitations, which open up promising avenues for future research.

First, since we relied on secondary data, our analysis was limited to examining the financial dimensions of certified organizations rather than directly assessing the impact of ISO 45001 on their OH&S levels. This problem is difficult to overcome because firms and workers are usually reluctant to disclose occupational accidents (e.g., Petitta et al., 2017; Pransky et al., 1999). Moreover, our method does not allow us to consider the drivers leading firm to adopt ISO 45001 and how these might affect the identified outcomes. Surveys could effectively address this shortcoming.

Second, we considered only publicly listed companies. On the one hand, this approach allowed us to analyze reliable and comparable financial information. On the other hand, this choice limits the generalizability of our findings. Although the post-stratification with inverse probability weighting ensured that the country distribution of the companies was close to that of the total population, future research could verify the generalizability of our results by focusing on larger and more heterogeneous samples.

Third, as ISO 45001 was published only a few years ago, we were not able to consider its long-term effects. As time goes by, it will be possible to study the effects of ISO 45001 over a longer timeframe.

Fourth, in the modern business environment, competition is increasingly occurring at the supply chain level rather than just among individual firms (Antai & Olson, 2013; Moyano-Fuentes et al., 2019). Therefore, it would be interesting to broaden the investigation context and shed light on the effects of ISO 45001 considering the network structures in which individual organizations are embedded. This could provide a more holistic understanding of the standard's impact,

particularly as regards its effects on inter-company relationships, compliance, and the dynamics of secondary audits.

To conclude, we hope that by showing the significant effects associated with ISO 45001 adoption, our study will inspire future research on this certification framework. Particularly, we encourage investigations into how ISO 45001 adoption drivers, implementation challenges, and effectiveness vary across diverse contexts.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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