

Do multiple certifications leverage firm performance? A dynamic approach

Abstract

In a dynamic environment where organizations are continuously exposed to change, being robust, strong and competitive is a major managerial task. The aim of this article is to study the impacts of adopting multiple certifications on firm performance, by considering the dynamics involved in this process. A sample of 247 Portuguese firms that had adopted multiple certifications by 2015 encompassing the ISO 9001, ISO 14001 and OHSAS 18001 standards were studied by means of a longitudinal analysis. Their historical certification records were matched with their performance indicators to create a panel dataset from 2007 to 2015. The research into the causal effects of the certifications on firm performance was based on a panel dynamic approach, namely the system generalized method of moments. The following three combinations show consistent leverage on firm performance: ISO 9001, ISO 9001 + ISO 14001 and ISO 9001 + ISO 14001 + OHSAS 18001. Being ISO 9001 the common factor of these combinations and also the first standard adopted by most firms, results suggest that it might be a relevant driver towards improving firm performance. This research reveals new insights in this field by analyzing a changing environment where firms can be expected to certify dynamically according to the requirements of different standards.

Keywords: Management systems; Standards; Firm performance; Multiple certifications; Panel dynamic model

Paper type: Research paper

1. Introduction

Firms are continuously challenged to satisfy their wide range of stakeholders, with different visions and objectives, and many of them see certifications as a milestone of legitimacy (Boiral & Gendron, 2011). Firms first define a strategy to achieve such objectives managing the inter-related parts of their business, according to their function-specific Management Systems (MSs) (ISO, 2018a). Amongst the most implemented, firms adopt Quality (QMS), Environmental (EMS) and Occupational Health & Safety (OHSMS) MSs (Bernardo et al., 2009; Zeng et al., 2007; Domingues et al., 2017). Certifying them is supposed to assure the accomplishment of the procedures demanded by stakeholders through the periodical external auditing carried out by independent bodies (ISO, 2018b; Power, 1997).

ISO 9001 and ISO 14001 are the most popular QMS and EMS standards with presence in more than 190 countries (ISO, 2018c), and OHSAS 18001 is following similar diffusion patterns (Lo et al., 2014; Domingues et al., 2017). Therefore, it is not surprising to find an extensive literature analyzing different perspectives of MS standards, including their potential effects on firm performance (FP).

Notwithstanding the efforts to understand how certifications are related to firms' FP, there is a generalized lack of consensus regarding their effects –if any–, on the direction of the connections and whether a causal relationship actually exists (Nunhes et al., 2016; Heras-Saizarbitoria & Boiral, 2013; Bernardo et al., 2015; Sampaio et al., 2009; Robson et al., 2007). The existing literature is mostly focused on function-specific MS standards, but only a few have considered the dynamics involved in adopting multiple MS standards (Labodová, 2004; Karapetrovic & Casadesús, 2009; Bernardo et al., 2012; Ivanova et al., 2014) and its impacts on FP (Martí-Ballester & Simon, 2017; Ferrón-Vílchez & Darnall, 2016; Wang et al., 2016). Although firms are increasingly adopting multiple MS standards, managing more

complex certification structures can be challenging due to possible conflict of interests of several stakeholders, which might hinder firms' FP (Wiengarten et al., 2017).

Another concern is related to the high amount of studies relying on perceptual measurements (e.g., surveys). Although they play a dominant role in the existing literature (Heras-Saizarbitoria & Boiral, 2013; Sampaio et al., 2012), researchers have pointed out that it is preferred to rely on existing records to avoid over-valued or biased conclusions (Heras-Saizarbitoria & Boiral, 2013; Corbett et al., 2005; Häversjö, 2000; Sharma, 2005).

To the best of the authors' knowledge, scarce research has simultaneously considered both: i) the dynamics involved in the adoption of multiple certifications, and ii) its effects on FP, measured objectively with existing records. This study aims to contribute to this research gap with longitudinal empirical evidence of a country where firms are increasingly adopting multiple MSs standards.

2. Theoretical Framework

Table 1 summarizes the empirical research analyzing this complex relationship from the year 1999, when most literature relying on objective FP indicators emerged (Sharma, 2005; Simmons & White, 1999). Literature includes different dynamic and non-dynamic methodological approaches. Dynamic models, in contrast to non-dynamics, are longitudinal studies that control for endogeneity underlying lagged variables through an econometrical method such as instrumented variables that are uncorrelated with the effects (Arellano & Bover, 1995).

INSERT TABLE 1 ABOUT HERE

As evidenced on Table 1, the debate remains unsolved for all the analyzed certifications and regardless of the FP indicator, so further examination is required. To this end, this section is divided in two parts, the impact of i) single, and ii) multiple certifications on firms' FP.

2.1. The relationship between single certification and firm performance

Focusing on ISO 9001, Simmons & White (1999) were one of the first to rely on existing records, concluding that certified companies are more profitable than non-certified. Nonetheless, they found non-significant effects in terms of operational performance and foreign sales. The cross-sectional nature of their analysis was insufficient to provide definitive conclusions. Later, Häversjö (2000) found that the positive relationship between the ISO 9001 certification and FP were attributable to the innovative management rather than the certification itself. Heras et al. (2002) pointed out that, although there are signs of positive links between the certification and FP, it was not possible to claim for a causal relationship. However, Sharma (2005) was critical about the methods adopted by Heras et al. (2002) and, although he improved the models by accurately controlling for the pre-certification performance, the paper does not present explicitly any control for the dynamics involved in the certification process. The study concluded that ISO 9001 is positively related to FP, especially due to the improvements achieved in the business processes, which gives credibility to the self-rated benefits of this standard.

By that time, authors like Corbett et al. (2005) and Sampaio et al. (2011) pointed out some of the limitations of relying on self-reported data, such as the lack of independence and biases in the responses, so they emphasized the need of using existing and objective FP measures. Although surveys are still the most adopted research tool, most studies report different and still inconclusive outcomes (Heras-Saizarbitoria & Boiral, 2013; Sampaio et al.,

2012). For instance, Singels et al. (2001) found no evidence of a direct effect of the ISO 9001 certification by itself. Instead, the relationship is significant only to firms adopting it with the aim of improving their organizational processes. Later, Naveh and Marcus (2007) concluded that ISO 9001 provides firms the necessary support to improve their operational performance. This in turn, would allow them to be more profitable and certify if not certified yet. Conversely, Chatzoglou et al. (2015) concluded that implementing ISO 9001 is directly associated with significant improvements in FP as well as quality awareness.

Another trend of analysis is based on event-studies in which Corbett et al. (2005) is one of the most influential. The authors found evidence of ‘abnormal’ improvements in FP after implementing ISO 9001. Although in the short term the timing and magnitude of such effects vary according to different factors (size, industry, FP before the certification), the effects in the long-term are always strongly significant. The authors also stress the need of implementing the ISO 9001 certification in a rigorous and comprehensive manner to boost such benefits. Although this technique allows to detect changes in FP after the certification, it might not be enough to state a causal relationship (McGuire & Dilts, 2008). In this line, Cândido et al. (2016) concluded that after de-certification, firms continue to be as profitable as those that maintained it. Although such outcomes are certainly revealing, it is not clear whether their conclusions would maintain in the long-run beyond the two-year span analyzed. Thus, in the short term, firms that lost their certification seem to maintain their quality-related practices, leading them to be as competitive as certified firms.

Based on case studies Sampaio et al. (2012) studied six Portuguese firms, concluding that firms that adopt ISO 9001 with the aim of improving their performance increased their FP more than those that implemented it due to external pressures. Although in most cases there was an increased FP after the certification, they concluded that it is not clear whether firms would have been less profitable if they were not certified.

More recently, Lo & Yeung (2018) reported that when ISO 9001 becomes increasingly institutionalized, firms that hold this certification experience a steady increase of their FP in terms of sales revenue and their CEOs are able to upgrade their cash compensation (i.e., salaries and bonuses). However, they also report that such benefits occur in detriment of firms' organizational efficiency. The authors suggest that, in order to make management standards less susceptible to institutional forces, firms might adopt a fact-based, result-oriented approach in the implementation of this standard.

Even if there is a still latent lack of agreement among scholars, a positive association between the adoption of the ISO 9001 standard and FP is less arguable, which might suggest a possible causality. To this end, firms must be committed in the long-term to the underlying principles of ISO 9001 related to the philosophy of continuous improvement (Singels et al., 2001; Corbett et al., 2005; Sampaio et al., 2012; Chatzoglou et al., 2015). Firms should also analyze their industry contexts to implement this standard in the seek for operational excellence (Lo et al., 2013) with a strong focus on facts and results (Lo & Yeung, 2018). When firms succeed to maintain this focus in the long term, a positive association with their performance might be boosted by the inherent improvements of the newer versions of ISO 9001 in the long-run (Siougle et al., 2018). Thus, H1 is developed as follows:

H1: ISO 9001 positively impacts firm performance.

The lack of agreement is similar for studies focused on ISO 14001. Based on surveys, Darnall et al. (2008) found that firms applying its framework, regardless of being certified or not, obtained better FP scores. Therefore, committed is critical to success rather than just gaining external recognition. Later, Agan et al. (2013) concluded that firms implementing an EMS based on ISO 14001 achieve long-term economic benefits due to their improved image, increasing market share and gaining competitive advantage. According to Amores-Salvadó et

al. (2015) the positive relationship is mainly due to the creation of environmental innovations. The previous results are not in line with He et al. (2015), who found that ISO 14001 has non-significant effects on FP, since firms adopt it due to external pressures and gains in their image rather than in pursuit of financial benefits. Similarly, Lisi (2015) concluded that the improved environmental performance increased FP rather than the certification.

Based on event-studies, Heras-Saizarbitoria et al. (2011) researched into firms' FP before and after the certification considering two independent models. They concluded that firms with better FP are more likely to certify, but there is no evidence to state that the improvements in performance could be entirely attributed to the certification. Concurrently, de Jong et al. (2014) did not find evidence for consistent FP improvements immediately after following the ISO 14001 guidelines or certification. They also detected minor FP improvements in the short-term and significant effects in the long-run, so they finally conclude that environmental management indeed pays off.

With different methodological approaches, but still focused on secondary datasets, Wagner et al. (2002) based on longitudinal data and concluded that ISO 14001 affects negatively FP while simultaneously improving its environmental performance, so firms are challenged to find a profitable manner to manage such trade-off. Teng et al. (2014) tested a similar model but with a larger sample (975 firms). The authors concluded that although in the short-term the high maintenance costs of ISO 14001 would decrease FP, firms might be end-up with beneficial results in the long-term. Therefore, it seems that, after a period of adaptation, firms adopting ISO 14001 might improve their performance.

He et al. (2015) adopted a dynamic approach to control the effects of the previous years' FP and found no evidence of causality because firms adopt ISO 14001 for market-oriented reasons rather than to gain FP. Despite their contributions, two limitations should be

pointed out: i) the certifications' year was self-reported and, ii) the study does not evidence any control of whether firms had multiple certifications. Su et al. (2015) overcame both limitations and concluded that ISO 14001 positively affects FP, especially when they have prior experience with MSs.

Most research seems to agree that positive effects of ISO 14001 occur when firms aim to maintain it in the long-term through a strong commitment to its principles. Thus, H2 is stated as follows:

H2: ISO 14001 positively impacts firm performance.

Studies assessing empirically the effects of OHSAS 18001 on FP are limited (Robson et al., 2007), since it is usually implemented in combination with other certifications (Bernardo et al., 2012; Domingues et al., 2017). Bianchini et al. (2017) based on case studies, and concluded that investing in an OHSMS is profitable particularly for large firms. This might be due to the high costs associated to implementing and maintaining OHSMSs, which provoke unprofitable results in smaller firms. The authors attribute such perceptions to the lack of an effective implementation of the OHSMSs. Firms could enjoy the benefits of OHSMSs, which are mainly related to the assurance of exemption of responsibility –in case of accident– for employers (specially in smaller firms), together with an adequate return of investments.

Firms that successfully implement OHSAS 18001 across the organization and are committed to its principles can achieve higher levels of workforce productivity (Robson et al., 2007). Besides the enhancement of the safety conditions, its strategic value supports creating a competitive advantage and consolidate business operations (Abad et al., 2013). Additionally, its implementation positively impacts on FP through operational efficiency and

increase of sales, which occurs consistently for firms operating in environments with stringent safety regulations and with complex production systems (Lo et al., 2014).

The benefits of implementing OHSMSs can be reinforced when it covers broadly the whole organization in a proactive manner, and the certification legitimizes this through auditing (Mohammadfam et al., 2016). Thus, firms that strategically decide to implement and maintain OHSAS 18001 seem to obtain FP benefits, as stated in H3:

H3: OHSAS 18001 positively impacts firm performance.

2.2. Multiple certifications: do they leverage firm performance?

The strategies for adopting multiple certifications are well reported in literature (Labodová, 2004; Karapetrovic & Casadesús, 2009; Bernardo et al., 2012; Ivanova et al., 2014). According to it, firms can adopt different MSs dynamically; for instance, firms that are only certified by ISO 9001 in year t can adopt ISO 14001 in year $t+k$, and continue to certify subsequently (or simultaneously) by other MSs such as OHSAS 18001. The phenomenon related to multiple certifications becomes more complex as it involves changes that depend not only on the current certifications, but on firms' certifications strategy and FP (Corbett et al., 2005). The impacts of the different combinations of certifications have been scarcely studied and require further examination (Gianni et al., 2017).

According to Hillary (2004), most scholars agree that EMSs standards are positively related to firm economic and commercial performance. According to the author, EMSs have the potential to improve QMSs, so the synergies of both boost their joint benefits. This was empirically supported by Su et al. (2015), who found that ISO 14001 without the previous experience of ISO 9001 could be detrimental to FP, especially in more competitive environments.

Adopting ISO 14001 allows decreasing the consumption of resources (Melnyk et al., 2002) and to follow-up costs and savings (Llach et al., 2013). This mechanism is better achieved if firms integrate both quality and environmental perspectives (Deltas et al., 2014; Khanna et al., 2009). Goedhuys & Sleuwaegen (2013) considered the effects of both certifications on firms' FP at a global scale. The authors performed a massive global survey considering jointly the ISO 9001 and ISO 14001 certifications within a unified variable. They justified such approach arguing that the motives, benefits, and international diffusion patterns of both certifications are compatible worldwide. They concluded that through certifications, firms gain efficiency and quality signaling (i.e., 'signal' to external parties that the firm is a reliable supplier and partner).

Measuring QMSs and EMSs as different MSs, Ferrón-Vílchez and Darnall (2016) reported that adopting both is better than adopting only one. The authors argue that both MSs are complementary and, to some extent, symbiotic since each promotes the development of internal capabilities related to their function-specific objectives. This in turn, enables the adoption and daily operationalization of the other, while maintaining their individual goals. This mechanism would improve the firms' strategic value and FP. Therefore, ISO 9001 seem to support ISO 14001 in pursuit of economic and environmental sustainability (Siva et al., 2016). Moreover, the positive effects of the integrated procedures in firms that adopt both MSs overweight the negative ones related to their bureaucracy, giving as a result an improved FP (Martí-Ballester & Simon, 2017). Thus, H4 is developed as follows:

H4: Being simultaneously certified by ISO 9001 and ISO 14001 positively impacts firm performance.

Regarding OHSMSs, Robson et al. (2007) pointed out that its adoption increases productivity and, when done voluntarily, firms experience decreases in disability-related

costs. As the OHSMS implementation is increased over time, such benefits might boost FP. The authors also discussed that, typically, the firms' commitment to QMSs is higher compared to that of OHSMSs. To deal with this issue, firms would prefer to integrate them and improve their results by giving both MSs equal priority and pursue common goals (Zeng et al., 2007).

Empirical research supports that firms with ISO 9001 could also achieve higher levels of safety, which might be attributed to the innovative management practices (Naveh & Marcus, 2007; Lim & Prakash, 2017). Thus, firms that correct the inefficiencies that jeopardize product quality, must also look after the enhancement of working conditions avoiding the labor costs associated to injury compensation, working days lost and training of replacement workers (Lim & Prakash, 2017). Therefore, firms attain FP improvements by addressing their internal safety concerns, and considering simultaneously the customers' requirements (Naveh & Marcus, 2007).

Additionally, both MSs complement each other with compatible objectives, and combining them promotes learning (Silva et al., 2017), continuous improvement and motivates employees (Pun & Hui, 2002). Thus, implementing both ISO 9001 and OHSAS 18001 might have positive effects on FP as indicated in H5:

H5: Being simultaneously certified by ISO 9001 and OHSAS 18001 positively impacts firms' performance.

The implementation of ISO 14001 and OHSAS 18001 is scarcely reported among firms that adopt multiple certifications (Bernardo et al., 2012; Karapetrovic & Casadesús, 2009; Domingues et al., 2017), so it is difficult to assess their FP effects. Labodová (2004) was one of the first to study the compatibilities between OHSMSs and EMSs. The author found that both standards are fully compatible. Thus, firms can integrate them i) by assessing

the current situation regarding risks and their technology and organizational reality, and ii) based on the PDCA-approach and saving resources.

Implementing OHSAS 18001 along with other MSs provides workforce and the organization of new learning capabilities to prevent further and future accidents, which occurs when reporting and analyzing an occurrence, and then communicating efficiently the outcomes throughout the organization (Silva et al., 2017). The management of the former mechanism requires exploring the synergies of having both certifications, which leads firms to perceive their benefits more efficiently (Karapetrovic, 2002). Therefore, firms might enhance their performance through the implementation of both ISO 14001 and OHSAS 18001 as hypothesized in H6:

H6: Being simultaneously certified by ISO 14001 and OHSAS 18001 positively impacts firm performance.

Regarding the triple certification, the existing literature is still scarce to determine its effects on FP. Wang et al. (2016) adopted an efficiency approach that gathered the economic, environmental and social results. The study concluded that firms with triple certifications had the highest performance while non-certified had the lowest. Moreover, the high costs associated to the certification in the first years were compensated with greater benefits in the long-term.

Although the empirical evidence is still limited, it seems that triple certifications can have beneficial effects in FP. In fact, firms that implement more certifications learn from the different perspectives (Silva et al., 2017). They also find innovative management practices that allow them to take advantage of the MSs common structure and optimize the use of resources through their integration (Bernardo et al., 2009; Zeng et al., 2007; Salomone, 2008). Hence, holding the three studied certifications seem to boost their FP, especially if

they are highly committed to them and intend to be certified in the long-term (Nunhes et al., 2017; Bernardo et al., 2009; Salomone, 2008). Thus, H7 is formulated as follows:

H7: Being simultaneously certified by ISO 9001, ISO 14001 and OHSAS 18001 positively impacts firm performance.

3. Methodology

3.1. Population and sample selection

The World State of Quality report (Saraiva et al., 2017) provides a rank of the ‘macro-quality’ level of 28 European countries. In 2016, Portugal was ranked among the top 10 in terms of the number of International Academy for Quality members, environmental wellbeing results, ecological footprint and ISO 9001 certified organizations. Therefore, Portuguese firms seem to be reckoning the potential of quality and environment as pillars to their development. Such orientation is evidenced by the evolution of certifications.

As shown in Figure 1, Portugal has increased the number of ISO 9001, ISO 14001 and OHSAS 18001 certifications (Domingues et al., 2017) during the last decade. The evolution of ISO certifications seem to be in a mature stage, similar to other European countries (To & Lee, 2014; Sampaio et al., 2011; Domingues et al., 2017). Furthermore, OHSAS 18001 certifications in Portugal maintain a persistent growth rate from 2007. Finally, the evolution of multiple certifications continuously increased until 2014, and since then it seems to be in a steady stage, which may be ascribed to maturity (Domingues et al., 2016). Therefore, Portugal represents an interesting environment for studying the dynamics of certifications.

INSERT FIGURE 1 ABOUT HERE

The sampling procedure consisted of four stages, as summarized in Figure 2. Firstly, 745 unique firms holding multiple certifications in 2015 were identified based on the Portuguese Accreditation Institute (IPAC, 2017). Then, their performance indicators were collected through the Amadeus records published by the Bureau Van Dijk (2017), which were matched with the previous dataset. The former procedure resulted in a gross match of 370 companies. After verifying manually their names, the final sample encompassed 247 companies.

INSERT FIGURE 2 ABOUT HERE

Then, the certifications' historical evolution of the sample was built using the IPAC past records, obtaining their complete certifications' dynamics from 2004. A manual crosscheck was performed to confirm that the fuzzy match was accurate based on the certificates published in the firms' websites. No further changes had to be done at this stage. Moreover, none de-certification case was detected so the sample solely considers firms that have continuously certified and maintained their certifications. Therefore, the panel consisted of 247 companies with the certifications' evolution from 2004 and with performance indicators from 2007 until 2015.

3.2. Measurement of variables

3.2.1. *Dependent variables*

In this study, FP is measured in terms of Return on Sales (ROS), Return on Capital Employed (ROCE) and Return on Assets (ROA). These indicators reflect the organization's internal efficiency and have been commonly included in studies related to MSs (see e.g., Lisi, 2015; Martí-Ballester & Simon, 2017; He et al., 2015; Su et al., 2015; Corbett et al., 2005). Briefly, the following interpretations of the specific indicators are presented, based on Pendlebury and Groves (2004) and Reid and Myddelton (2005).

ROS measures the profitability that firms make out of their sales by maximizing revenues and minimizing costs, and it is measured as the ratio between the profits before tax and the revenues. ROCE refers to the efficiency of using capital and is measured as the ratio between the net income plus interests paid and the sum of the shareholder funds plus non-current liabilities. Finally, ROA indicates the efficiency in exploiting firms' assets to create profits, and it is measured as the ratio of the net profits and the total assets. Table 2, Panel A summarizes the descriptive statistics of the FP indicators.

INSERT TABLE 2 ABOUT HERE

3.2.2. *Explanatory and control variables*

The certifications held by a firm represent the main explanatory variable. The selected firms held two or three certifications by 2015; i.e. 'ISO9001+ISO14001', 'ISO9001+OHSAS18001', 'ISO14001+OHSAS18001' or 'ISO9001+ISO14001+OHSAS18001'. To this end, firms could adopt different strategies.

The seven different combinations of certifications identified in this sample are considered in the *CERT* categorical variable as summarized in Table 2, panel B. The ‘None’ certification level, that accounts for 26.39% of the observations, is considered the control category. Since all the analyzed certifications must be renewed at most each three years, until three-year lags were included (i.e. $CERT_{t-1}$, $CERT_{t-2}$ and $CERT_{t-3}$) (see e.g., Abad et al., 2013, Corbett et al., 2005, Heras-Saizarbitoria et al., 2011, Su et al., 2015).

Industry dummies are included to control potential differences in the levels of FP (see e.g., Heras-Saizarbitoria et al., 2011). The company size is also controlled (see e.g., Corbett et al., 2005). The size category provided by Amadeus (Bureau Van Dijk, 2017), which is based on the firms’ employees, revenues and assets is included directly. Firms are very large or large following these criteria. Very large firms report an operating revenue ≥ 100 million EUR, total assets ≥ 200 million EUR and more than 1000 employees. Large firms report an operating revenue ≥ 10 million EUR, total assets ≥ 20 million EUR and more than 150 employees. Finally, the year is also included. The descriptive statistics of these variables are summarized in Table 2, Panel B. Finally, Table 3 presents the correlation coefficients between all the included variables.

INSERT TABLE 3 ABOUT HERE

3.3. Model specification

The lagged FP_i (i.e., $FP_{i,t-1}$, referring to $ROS_{i,t-1}$, $ROCE_{i,t-1}$ and $ROA_{i,t-1}$) captures the effects of the omitted variables, such as the interdependencies between themselves, instead of

adding such effect to the variables of interest. The certifications are renewed at most every three years, so the effect of $CERT_i$ on FP_i is analyzed for $t-1$ and controlled for $t-2$ and $t-3$.

The two-step system Generalized-Method-of-Moments (system-GMM) panel estimators is the main research tool. A detailed description of this method is provided by Arellano and Bover (1995) and Blundell and Bond (1998). The following reasons justify the adoption of this technique. Firstly, FP_i and $CERT_i$ are not strictly exogenous but dependent on their own past observations. Moreover, this work aims to estimate the fixed individual effects of the certifications. The two-step system-GMM addresses the two previous situations by instrumenting i) the independent endogenous variables ($IND_{i,t}$, $Size_{i,t}$, $Year_{i,t}$), ii) the lagged independent variables ($CERT_{i,t-1}$, $CERT_{i,t-2}$, $CERT_{i,t-3}$), and iii) the lagged dependent variable ($FP_{i,t-1}$), with past observations uncorrelated with the fixed effects. Secondly, this method allows controlling the unobserved firm-specific effects correlated with the regressors, while controlling heteroskedasticity and autocorrelation within firms. Finally, this technique is well suited for a large sample compared with the size of the panel, so no specific distribution is assumed for its estimation (Greene, 2003, pp.201, 525–527, 555). The main models are represented in (1).

$$FP_{i,t} = \alpha_0 + \alpha_1 FP_{i,t-1} + \alpha_2 CERT_{i,t-m} + \alpha_3 IND_{i,t} + \alpha_4 Size_{i,t-1} + \alpha_5 Year_{i,t} + \mu_t + \nu_{i,t}$$

$$\nu_{i,t} = \varepsilon_i + \sigma_{i,t} \tag{1}$$

Where $FP_{i,t}$ denotes the three equations related to i) ROS, ii) ROCE and iii) ROA; $i=1, \dots, N$ and $t=1, \dots, T$ represent, respectively, the firms and time periods; $CERT_{i,t-m}$, stand for the combination of certifications held (according to Table 2, Panel B) by firm i in year $t-m$, $m=1,2,3$; μ_t is the time-specific effect and $\nu_{i,t}$ stands for the time-invariant error term. The latter depends on the firm-specific effect and controls unobservable heterogeneity (ε_i); $\nu_{i,t}$ also depends on the stochastic error term varying cross-time and cross-section ($\sigma_{i,t}$).

The development of the main model previously described took into account the analysis of different system-GMM dynamic alternatives, including the consideration of the year when certifications were implemented as shown in equation 2 (see e.g., He et al., 2015, Heras-Saizarbitoria et al., 2011).

$$\begin{aligned}
FP_{i,t} = & \beta_0 + \beta_1 FP_{i,t-1} + \beta_2 Certification_ISO9001_{i,t-1} + \beta_3 Certification_ISO9001_{i,t-2} \\
& + \beta_4 Certification_ISO9001_{i,t-3} + \beta_5 Certification_ISO14001_{i,t-1} \\
& + \beta_6 Certification_ISO14001_{i,t-2} + \beta_7 Certification_ISO14001_{i,t-3} \\
& + \beta_8 Certification_OHSAS18001_{i,t-1} + \beta_9 Certification_OHSAS18001_{i,t-2} \\
& + \beta_{10} Certification_OHSAS18001_{i,t-3} + \beta_{11} IND_{i,t} + \beta_{12} Size_{i,t} + \beta_{13} Year_{i,t} + \mu_i + v_{i,t} \\
v_{i,t} = & \varepsilon_i + \sigma_{i,t}
\end{aligned} \tag{2}$$

Where, the *Certification* variables are dummies coded as 1 since the year the company obtained the certification (of ISO 9001, ISO 14001 or OHSAS 18001) and 0 before being certified. Regarding *FP*, the control variables and the other variables related to the system-GMM, the notation remains the same as in the main model.

The two-step system-GMM represented in (1) and (2) were solved using Stata/SE 14.0 with the `xtabond2` command (Roodman, 2009). In order to control the downward bias usually produced in two-step results, the finite sample correction for asymptotic variance proposed by Windmeijer (2005) was applied. The option “collapse” (Roodman, 2009) was adopted to reduce instrument count for decreasing the average bias produced in two-step estimators (Windmeijer, 2005). Finally, years 2004-2006 were omitted due to lack of FP indicators during this period. Thus, the results of the alternative and the main models are discussed in the next subsection.

4. Results

As summarized in Figure 3, 68% (169 firms) of the sample did not hold any certification by 2004 and, at the beginning of the dynamic study, in 2007, this percentage was 38% (95 firms). Across the dynamic panel study, such firms were increasingly certifying by one, two or three MSs. By 2015, 53% (130 firms) were certified in accordance with the requirements of the three MSs, followed by 38% (95 firms) that adopted 'ISO9001+ISO14001'. The combinations 'ISO9001+OHSAS18001' and 'ISO14001+OHSAS18001' were a minority (9% of the sample). Although the sample considers only firms that by 2015 held at least two certifications, the aforementioned tendencies are representative of the country-level reality as previously shown (see Figure 1).

INSERT FIGURE 3 ABOUT HERE

Table 4 summarizes the different strategies adopted in this sample to obtain multiple certifications, adapting the methods described in Bernardo et al. (2012). According to the table, ISO 9001 is the first certification adopted by most firms (55%; strategies 1, 4 and 6), followed by the simultaneous implementation of the triple certification (30%; strategy 7) and the simultaneous implementation of ISO 9001 + ISO 14001 (14%; strategy 3). Hence, 88% of the sample included ISO 9001 as part of their first certified MS standards. Moreover, the percentage of firms implementing simultaneously more than one MS standard is remarkably around 35% of the sample, which would ease their integration, especially if the triple certifications are adopted simultaneously (Bernardo et al., 2012).

INSERT TABLE 4 ABOUT HERE

The results of the two-step system-GMM estimators are summarized on Table 5, Table 6 and Table 7 for ROS, ROCE and ROA, respectively. Then, first the validity of the models is assessed, followed by the estimated coefficients.

INSERT TABLE 5 ABOUT HERE

INSERT TABLE 6 ABOUT HERE

INSERT TABLE 7 ABOUT HERE

Both, the main (1) and the alternative (2) dynamic models for each FP indicator (ROS, ROCE and ROA) are valid according to the assumptions of the two-step system-GMM estimators. The Hansen (1982) *J* statistic for overidentifying restrictions is non-significant, suggesting the validity of the instruments exogeneity assumption. To test for autocorrelation

aside from the fixed effects, the Arellano-Bond test applied to the second-order correlation, AR(2), shows no evidence to invalidate instruments through autocorrelation, so there is no evidence of serial first-order correlation. The AR(1) is significant by construction, so its significance is uninformative in the validity assessment of this model. Finally, there are no major concerns regarding the instruments count, which is considerably smaller compared to the sample size in all cases.

In the main model (1), results suggest that not all the possible combinations of certifications have a positive impact on FP. Indeed, only 'ISO9001', 'ISO9001+ISO14001' and the triple certification consistently and positively affect all the analyzed indicators. Additionally, the 'ISO9001+OHSAS18001' certifications appear to improve ROA but neither ROCE nor ROS.

The impacts on FP in year t are persistently related to the certifications that firms held during year $t-1$ (i.e., $CERT_{t-1}$), whereas the certifications held during the other years (i.e., $CERT_{t-2}$ nor $CERT_{t-3}$) show no significant effect on any FP indicator. Additionally, models that encompass all lagged certification variable at a time were analyzed, obtaining the same conclusions as in the main model. Therefore, it can be concluded that if firms: i) adopt more than one certification over time, and ii) are committed to maintain their certifications in the long term (this study analyses an eight-year-span), they enhance their performance in year t due to the certifications they held during the prior year ($t-1$), for any year t .

On the other hand, the results of the alternative models (2) suggest that if firms were certified of ISO 9001 on year $t-1$, they obtained ROCE benefits on t , while to gain ROA benefits, firms must have been certified on year $t-2$. The ISO 9001 certification is not significant in any other case. Concerning ISO 14001, there is no evidence of significant effects. Finally, OHSAS 18001 was only significant to ROS if firms certified on year $t-3$. Thus, there is some evidence that certifications might impact FP, but with this model it is not

yet clear whether such impacts are solely attributable to the individual certifications, or if the dynamics involved in multiple certifications might play a role, which is more clearly shown in the main model. Therefore, the results evidenced in (2) do not represent accurately the effects of the certifications since they are mixed (confused) with the dynamics of adopting multiple certifications (e.g., as in Goedhuys & Sleuwaegen, 2013 or He et al., 2015). The main model (1) surpasses such limitation and shows the effects of the different possibilities of holding different certifications.

Regarding control variables, FP_{t-1} is significant in all cases, meaning that persistence and inertia effects were detected and controlled in all models. Consequently, FP_{t-1} captures the effect of other variables that might not be included in this research and that consistently affect FP over time (Arellano & Bover, 1995; Blundell & Bond, 1998; Roodman, 2009). Moreover, the firms' size is significant and negative solely for ROCE in the main and alternative models (similarly to Lisi, 2015), meaning that Very Large companies in Portugal seem to be less efficient in their ability to transform their debts and shareholders' funds into profits, compared to their smaller peers. Finally, year and industry dummies were included as control variables.

5. Discussion and conclusions

The aim of this article is to research into the effects of multiple certifications considering: i) the dynamics involved in the adoption of multiple certifications, and ii) its impacts on firm performance relying on objective existing records rather than self-reported.

The most revealing finding lies on ISO 9001 being the common factor in all the certifications combinations that leverage FP, which is also the first standard adopted by most firms. According to the results, the positive relationship between ISO 9001 and FP is not only related to improvements in the first years of certification (Goedhuys & Sleuwaegen, 2013; Sharma, 2005), but it continuously and persistently occurs even when implementing other

certifications, thus confirming H1. This might be related to a proper implementation of this standard (Lo & Yeung, 2018) which leads to strong and lasting cumulative improvements over time (Corbett et al., 2005) in firms that adopt and hold ISO 9001 in the long term. Moreover, such benefits seem to be continuously updated through the inherent upgrades of the ISO 9001 versions (Siougle et al., 2018).

Regarding ISO 14001, H2 is rejected as its only adoption does not significantly impact FP. However, its effect is positive when combined with ISO 9001, in accordance with H4. This is in good agreement with Su et al. (2015), who reported that ISO 14001 provides additional performance benefits (especially in terms of ROS and ROA) only if firms had previous experience in ISO 9001, due to competitive advantage gained with it. Otherwise, firms would perform better without ISO 14001. The evidence that 'ISO9001+ISO14001' leads to FP improvements (especially in terms of ROS), suggests that profits might be boosted by the reputational motivations of implementing ISO 14001 (Heras-Saizarbitoria et al., 2011). This could move their adopters closer to effectively become a benchmark company, and consequently improve their ROS. 'ISO9001+ISO14001' also improves FP in terms of ROCE and ROA. This could be attributed to the optimization of resources attained through the implementation of ISO 14001 (Llach et al., 2013; Melnyk et al., 2002), and the quality support provided by ISO 9001 (Siva et al., 2016), which improves FP compared to adopting only ISO 14001 (Ferrón-Vílchez & Darnall, 2016).

Regarding OHSAS 18001, results show no evidence of significant changes in FP when held solely, so H3 is rejected. Moreover, there is no evidence of OHSAS affecting ROS or ROCE in any case, whereas its positive effect on ROA is significant, but only if it coexists with ISO 9001; thus, H5 is partially supported. This is in good agreement with Lo et al. (2014), which is complemented by the dynamic models used in this manuscript. Moreover, OHSAS 18001, among other benefits, could contribute to increasing labor productivity,

diminish the rate of accidents (Abad et al., 2013) and improve working conditions (Santos et al., 2013). Such benefits are combined with the increased operational performance achieved through ISO 9001, which might be the cause of the positive impact of 'ISO9001+OHSAS18001' on ROA. In addition, the high costs associated with OHSAS 18001 maintenance (Santos et al., 2013) seem to be compensated with the sales growth achieved through its certification (Lo et al., 2014), which might explain why ROS and ROCE are not affected. This can also explain the lack of significant effects of OHSAS 18001 (alone) on all FP indicators.

Firms simultaneously certified by 'ISO14001+OHSAS18001' do not perform significantly better, thus H6 cannot be confirmed. As expected, this combination is scarcely reported (Bernardo et al., 2012; Karapetrovic & Casadesús, 2009), which could be the main cause for the lack of noticeable effects on FP compared to other more adopted certification combinations. Besides, the impact of the first implemented standard, which is normally ISO 9001, is especially relevant not only towards FP but also because the following MSs are adapted to it (Bernardo et al., 2018). This might explain why ISO 14001 or QHSAS 18001 are significant only when combined with ISO 9001.

Results also imply that the triple certification is positively associated to improvements in all FP indicators, so H7 is confirmed. This finding complements the previous discussion, suggesting that it is possible to achieve a better FP even with a more complex certification structure. Wiengarten et al. (2017) argued that adopting more than two certifications might be challenging since conflicts of interest might arise when dealing with different stakeholders related to each certification. The evidence presented in this study suggests that firms can efficiently deal with such complexity and take advantage of it. In fact, firms seem to find the proper balance and synergy between MSs in pursuit of FP, for which ISO 9001 might have a major role according to the results (Siva et al., 2016).

Firms adopting multiple certifications can harness the existing synergies among them. One advantage of the three analyzed MSs is the same structure derived from the Plan-Do-Check-Act cycle, so firms can integrate various systems at different levels based on it (Bernardo et al., 2009; Zeng et al., 2007). Different taxonomic approaches have been proposed in literature and tested empirically, so the integration can be classified as full, partial or no integration, indicating the degree to which the different MSs have been assimilated to the firm as a single system (Salomone, 2008; Bernardo et al., 2009). Ribeiro et al. (2017) recently reported that 95% of Portuguese firms are at least partially integrated. This is also coherent with the expected behavior of firms adopting simultaneously more than one certification (Bernardo et al., 2009), which is the case of this sample (see Table 4). Among other benefits, integrating MSs fosters costs reduction, efficiency, cleaner production, increased productivity (Mustapha et al., 2017; Ribeiro et al., 2017; Bernardo et al., 2015) and increased FP (Martí-Ballester & Simon, 2017). Therefore, it could be expected that the multiple-certifications effects on FP might be attributed –at least partly– to their integration.

To summarize, results suggests that ISO 9001 could be the main driver in multiple certifications to leverage FP in terms of profiting from sales (ROS), assets (ROA) and using capital efficiently (ROCE). More specifically, firms that were certified by ISO9001, ISO9001 + ISO14001, and ISO9001 + ISO14001 + OHSAS18001 improved their performance in all the studied dimensions. The adoption of ISO 9001 + OHSAS 18001 was only significantly related to ROA improvements. The main implications to academia and practitioners, as well as the limitations and contributions of this paper are further developed in the next paragraphs.

This article has two main implications for academia. Firstly, researchers might consider dynamic models for researching into the effects of adopting multiple MSs. Firms operate in a dynamic environment, they have their own basal performance, and they can decide to adopt new certifications dynamically. Including these factors into the research leads

to a better understanding of the interactions; for instance, if each certification is analyzed as an independent factor, ISO 9001 had only a significant effect on ROCE and ROA. However, after implementing the dynamic approach with the different possible combinations of certifications (i.e., ISO 9001, ISO 9001 + ISO 14001 and so on), results unveiled the fixed effects of the certifications held by firms on FP. Secondly, the literature related to the integration of MSs might consider the role of ISO 9001 as a factor for further researching into the benefits of MSs integration.

This article has two main managerial implications. Firstly, practitioners should be aware that adopting a certification does not necessarily implicate improving their FP. Firms must see certifications as a strategic decision to maintain in the long term and pursue excellence by practicing and interiorizing the philosophy embedded in the standards. Secondly, managers could look at ISO 9001 as a driving MS in pursue of excellence. More specifically, this standard could act as the basis for incorporating other MSs, so that the benefits of a more efficient integrated management system could be a prevailing means to leverage FP.

The main limitation of this study lies in the sample itself. It is focused on Portuguese companies whose FP indicators were included in the secondary dataset, which did not specify if firms possessed multiple certifications for each standard. Thus, even if the strength and consistency of our findings reveal performance benefits of some multiple certifications, results may not be universal in scope and extension, especially for populations with less tradition of adopting multiple certifications. However, although the statistical generalization of the findings may be precluded there is no reason that prevents its analytical generalization. Another limitation lays on the relatively small sample of companies holding ISO 14001 and OHSAS 18001 alone, which seems to be an uncommon path in the strategies used by Portuguese firms to adopt multiple certifications. Finally, even if it can be assured that the

analyzed companies held their certifications continuously in time, it was not possible to identify the exact moment of renewal, but only the maximum time-span of renewal every three years.

Further research will focus on discerning the main attributes of multiple certifications that leverage FP. Some of them include the different versions of the standards, the industry context, the innovative performance, the internal and external motivations to adopt multiple certifications, and the integration strategy and methodology. It will consider the dynamics as well as the level and maturity of MSs integration. Further research will also consider other countries to extend the applicability of the conclusions.

Acknowledgements

This work was supported by an international mobility grant awarded by the University of Barcelona; the Portuguese Fundação para a Ciência e Tecnologia (FCT) post-doc Grant [SFRH/BPD/103322/2014]; and the Spanish project [ECO2013-48496-C4-2-R].

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