"Certification of Portuguese companies as an inducer of profitability: A panel data approach"

| AUTHORS | Anabela Santos (iD)
António Pedro Pinto (iD)
Ⓡ
Pedro Reis (iD)
Ⓡ
Elisabete Neves (iD)
Ⓡ |

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Anabela Santos, MSc. in Corporate
Finance, Department of Management,
Higher School of Technology and
Management, Polytechnic Institute of
Viseu, Portugal.

António Pedro Pinto, Ph.D. in
Corporate Finance, Teacher
Coordinator, Department of
Management, Higher School of
Technology and Management,
Polytechnic Institute of Viseu, Portugal;
CISeD – Research Centre in Digital
Services, Instituto Politécnico de Viseu,
Portugal. (Corresponding author)

Pedro Reis, Ph.D. in Corporate Finance,
Assistant Professor, Department
of Management, Higher School
of Technology and Management,
Polytechnic Institute of Viseu, Portugal;
CISeD – Research Centre in Digital
Services, Instituto Politécnico de Viseu,
Portugal.

Elisabete Neves, Ph.D. in Corporate
Finance, Teacher Coordinator,
Polytechnic of Coimbra, Coimbra
Business School Research Centre;
Researcher, CETRAD|UTAD, Portugal.

Anabela Santos (Portugal), **António Pedro Pinto** (Portugal), **Pedro Reis** (Portugal), **Elisabete Neves** (Portugal)

CERTIFICATION OF PORTUGUESE COMPANIES AS AN INDUCER OF PROFITABILITY: A PANEL DATA APPROACH

Abstract

With the globalization and internationalization of markets, companies need to be more competitive and offer high-quality guarantees to consumers, suppliers, banking institutions, and shareholders. Thus, the objective of this paper is to measure the impacts that these guarantees, analyzed through quality management, environmental management, and management of occupational health and safety standards, will have on the return on assets (ROA) of companies classified by sector of activity, considering each of the certifications individually and as a whole. The panel data approach methodology was used for 10 years in Portuguese-certified companies between 2010 and 2019. The Chow test, the Breusch-Pagan, and the Hausman test were applied to identify a more feasible model between the pooled OLS and the random or fixed effects model. Furthermore, the cluster-robust standard errors model was applied.

The results show the existence of synergies when adopting more than one certification to improve firm performance. Moreover, the single certification estimate by sector results are significant and can be positive drivers of profitability, but only for companies in the manufacturing industries related to natural resources. However, they trigger negative results in the accommodation, catering, and information and communication sectors.

Keywords	sustainability guarantees, quality, environmental, occupational health, safety management, ROA
JEL Classification	G32, L15, L21, M16

INTRODUCTION

The Sustainable Development Goals (SDGs), or Global Goals, adopted by the United Nations in 2015, call for everyone's action and commitment to eradicate poverty and discrimination, protect the planet, and ensure that by 2030 all people enjoy peace and prosperity. Thus, business development must allow or at least help to reinforce the balance of social, economic, and environmental sustainability.

Due to these new challenges of global markets, companies need to be increasingly competitive to survive in time, in a sustainable way, and with the capacity to expand to new international markets. Now, the certification of companies is an instrument that can help them guarantee greater visibility and commitment to sustainability objectives, allowing them to reduce information asymmetries and increase the reputation and credibility of the business, promoting its internal and external growth.

Portugal is a country that has yet to be studied in the literature on these topics. However, it is experiencing external solid pressure, namely from consumers, as the challenges of the sustainability objectives are proposed to be achieved by 2030.

Although the number of Portuguese companies certified in the ISO9001 QMS (quality management) is increasing, environmental sustainability and the scarcity of resources have generated increasing pressure for greater demand and consumer awareness.

Nevertheless, if environmental issues and management quality compliance with the SDGs are important, safety assurance is also vital. Following the OHSAS18001 (OHSAS) standard, occupational health management and safety certification will help reduce occupational injuries and risks and respond to a growing concern for working conditions and equal opportunities, which makes this standard more relevant than ever.

1. LITERATURE REVIEW AND HYPOTHESES

A considerable number of companies around the world have at their disposal a set of regulations (ISO, 2022) to improve their activity (Robson et al., 2007) and face the needs of stakeholders (Poltronieri et al., 2018). As a result, organizations are subject to increasing pressure to improve productivity (Yunus et al., 2020; Talbot et al., 2021), solve problems, and minimize risks (Pires, 2007). This study intends to shed some light on this issue. The empirical investigation focuses on a sample of Portuguese companies.

Although there are different quality management systems, ISO9001 (Quality Management System – QMS) was first published in 1987, becoming a standard for the certification of quality management systems recognized worldwide (Corbett et al., 2005). ISO9001 allows for managing processes and resources in an integrated manner (Boulter & Bendell, 2002). The ISO9001 standard incorporates the documentation of processes, procedures, and responsibilities to meet quality objectives, bearing in mind seven quality management principles: customer focus, leadership, people involvement, process approach, organizational context, continuous improvement, and fact-based decision-making (SGS Portugal, n.d.a).

In 1996, the ISO14001 standard (Environmental Management System, EMS) was published, dedicated to environmental issues (Zhu et al., 2013). ISO14001 aims to reduce the impact of organizational operations on the environment and facilitate sustainable development and international trade by introducing a globally recognized standard system. Companies are increasingly looking for ISO 14001 environmental accreditation (De Vries et al., 2012). Going green is being eco-friendly and having a business sense (Reyes-Rodriguez et al., 2016). The total quality environmental management (TQEM) system is a part of the global management system that seeks to control ecological aspects. It involves the entire organizational structure, all activities, equipment, products, and processes that may cause environmental damage, implementing proactive strategies of continuous improvement (Curkovic et al., 2008; Harrington et al., 2008). ISO14001 considers success factors: commitment at all levels and functions of the organization; leadership of top management; increasing opportunities to prevent or mitigate adverse impacts; increasing options for beneficial effects; effective treatment of risk and opportunities; alignment and integration with the strategy, business process and decision making (SGS Portugal, n.d.a).

In 1999, the BSI (British Standards Institution) published OSHAS18001 (Occupational Health and Safety Management Systems), becoming the most used standard to assess organizations' health and safety management processes. Implementing and certifying an organizational management system under OHSAS18001 makes it possible to improve the image, evaluate risks, guarantee employees' health, reduce accidents, and positively affect company performance and profitability (Arocena & Núñez, 2010). According to SGS Portugal (n.d.b), the certification addresses the following topics: HACCP, legal requirements, resources, roles of responsibility and authority, competence, training, awareness raising, communication, participation and consultation, operational control, emergency preparedness and response, measurement, monitoring, and performance improvement.

1.1. Quality management system and company performance

There is a wide range of studies focusing on this topic in the literature; however, it has been difficult to fully agree on what kind of impact certification, alone or in combination with other factors, can have on business profitability. Many studies (Nicolau & Sellers, 2002; Furtado, 2003; Corbet et al., 2005; Mokhtar & Muda, 2012; Ullah et al., 2014; Cândido et al., 2016; Hernandez-Vivanco et al., 2019; Siougle & Dimelis, 2021) refer to a positive relationship between quality management system (QMS) certification and business profitability.

Among the authors who defend a positive causal relationship between certification in quality management (ISO9001) and company performance, the work of Furtado (2003) is one of the most relevant. The study assesses performance through financial autonomy, sales profitability, and stock rotation. As a result, it was found that companies, particularly in the manufacturing industry, after certification, show a better commercial and financial situation, as well as an increase in the volume of exports, an improvement in the projected image at an international level. Along the same line, Siougle and Dimelis (2021) assess the impact of ISO9000 certification on the financial performance of one hundred and sixty-three companies listed on the Athens stock exchange (1992–2012). The results indicate that certified companies have significantly higher financial performance than non-certified companies. Moreover, the effect on the financial performance of ISO9000 certification persists for many years after certification.

In addition, Corbet et al. (2005) compared companies in the same sector of activity with equivalent size and ROA before certification. After being certified, the study concluded that companies show significant performance improvements (ROA), although the timings and magnitude of the effects vary according to the specifications of the control group. However, they question the causal relationship, stating that certification may cause better financial performance, but this effect occurs in companies with better management. Confirming the positive relation between certification and performance, Mokhtar and Muda (2012) concluded that certified companies with successful implementation

processes perform better, are younger, have higher performance, have a higher growth rate, and have a lower level of indebtedness. Their study compared the performance and characteristics of eighty-one uncertified companies with the same number of certified (ISO9001) companies listed on the Malaysian Kuala Lumpur Stock Exchange. In turn, Heras et al. (2002) mentioned a positive relationship between certification and financial performance; however, they do not attribute this to accreditation.

Ullah et al. (2014) showed that certification positively relates to size and age and that exporting companies are more prone to accreditation. They address a study with twenty-one thousand eight hundred and fifty-two companies in Latin America and the Caribbean, concluding that certified companies have significantly lower levels of financial constraints, higher labor productivity, and lower cost of sales than non-certified companies.

However, Simmons and White (1999), Heras et al. (2002), and Martínez-Costa and Martínez-Lorente (2007) refer to the negative impact of certification on profitability. For example, Martínez-Costa and Martínez-Lorente (2007) suggest that ISO9000 positively affects quality and market perception but negatively impacts company performance, as the results do not offset the effects of adopting the standard and maintaining it. Similarly, Heras et al. (2002) studied the impact of certification on sales and profitability (ROA), comparing four hundred certified and four hundred non-certified companies for five years. The study concluded that although certified companies have bigger returns, this is not a consequence of certification and that companies with higher ROA seek certification more actively. Moreover, an inverse relationship translated by companies with higher performance is the ones that most seek certification was found by Simmons and White (1999) and Heras et al. (2002).

Finally, Corbett et al. (2005), Feng et al. (2008), Demming (1986), Mokhtar and Muda (2012), and Cândido et al. (2016) have not proven a significant impact of quality management certification on business performance. Demming (1986) and Feng et al. (2008) refer that the weak positive relationship between ISO9000 certification and financial performance indicates that certification by this standard alone does not affect performance. The studies con-

clude that certification can increase organizational performance if well planned and implemented, with organizational commitment, employee training, corrective actions, and periodic audits. Accordingly, Cândido et al. (2016) assess how the loss of ISO9001 certification affects the financial performance of certified companies for a sample of one hundred and forty-three Portuguese companies, comparing them with a group of matched companies. The study concluded that there are no statistically significant differences between the performance of companies that lost ISO9001 certification and their counterparts. After losing certification, companies do not present superior or inferior performance in operational terms compared to their peers that were not subject to the same event.

1.2. Environmental management system and company performance

Regarding the impact of certification of environmental management systems (ISO14001) on business performance, Darnall et al. (2008) seek to identify the motivations for accreditation in the international context. Based on a sample of industrial companies from Canada, Germany, Hungary, and the United States with more than fifty employees, the study referred to pressure from legislation, the market, shareholders, and the social context as inducers of certification. They also mentioned that certification enhances performance, companies with more resources are more motivated and committed, and those that export the most will perform better. In the American market between 1996–2010, Lee et al. (2017) found that ISO14001 benefits companies in the long term in terms of profitability. Furthermore, the intensity of investment in environmental issues positively affects proactive ecological management in the initial moment, according to López-Gamero et al. (2009). They also mentioned that company resources and competitive advantages mediate a positive relationship between environmental protection and financial performance.

In turn, Link and Naveh (2006) have not found any positive impact of environmental certification on financial performance. In a study of nine hundred sixty-seven Chinese companies, Lee et al. (2017) concluded that the adoption of ISO14001 has min-

imal impact on the performance of Chinese companies. They also mentioned that despite insignificant financial gains, the adoption of ISO14001 offers implicit non-financial benefits: for example, it promotes exports and alleviates the mandatory environmental inspections of government institutions.

Molina-Azorín et al. (2009) referred to an extensive list of authors who evidence this non-consensual relationship between adopting standards (ISO9001 and ISO14001) and financial performance. For example, Castro et al. (2016) also emphasized the conflicting effects of environmental certification on performance.

1.3. Occupational health and safety management and company performance

As for the impact of OHSAS180001 certification on profitability, Bianchini et al. (2017) concluded that certification could positively impact profitability, particularly in larger companies, since the excessive costs associated with implementing and maintaining this type of certification harm the results of smaller companies. In addition, companies that successfully implement the full OHSAS18001 and are committed to its principles will achieve greater productivity (Robson et al., 2007).

1.4. Multiple certification and company performance

Ferrón Vílchez and Darnall (2016), Ionaşcu et al. (2017), and Hernandez-Vivanco et al. (2019) assessed the impact of multiple certifications (QMS, EMS, and OHSAS) on business performance (ROA, ROE, ROS, EBIT, and sales). The studies concluded that companies that adopt QMS, SGA, and OHSAS certifications tend to perform better than those that are only certified by a certification system or are not certified. Therefore, there is some complementarity between the two certification systems.

Ionaşcu et al. (2017) assessed the impact of multiple certifications (ISO9001, ISO14001, and OHSAS18001) on the financial performance of sixty-seven companies listed on the Romanian Stock Exchange for three years (2013 to 215). They

concluded that in 2015, approximately 75% of the multiple certified companies obtained their ISO9001 certification system and adopted other management systems (ISO14001 or OHSAS18001, or both) along the way. The study also showed that the financial performance (in terms of ROA) is superior for Romanian-listed companies that have adopted various certification systems (QMS, EMS, and OHSAS) and is directly proportional to the complexity of the implemented certification systems.

The impacts of adopting multiple certifications on company performance for a sample of two hundred and forty-seven Portuguese companies that adopted different certification systems (ISO9001, ISO14001, and OHSAS18001) between 2007 and 2015 was assessed by Hernandez-Vivanco et al. (2019). Three combinations (ISO9001, ISO9001 + ISO14001, and ISO9001 + ISO14001 + OHSAS18001) were evaluated using panel data analysis. The study concluded that ISO9001 certification is a common factor in the three combinations and can therefore be considered the most critical driver to improve company performance (ROA, ROS, and ROCE). It was also the first standard adopted and implemented by most companies. Companies certified with ISO9001, ISO9001 + ISO14001 and ISO9001 + ISO14001 + OHSAS18001 show improved performance across all dimensions, while companies that adopted ISO9001 + OHSAS 18001 certification only felt an impact on ROA. The study also mentioned that managers should consider that certification alone does not lead to better business performance. On the contrary, companies should seek certification as a long-term strategic objective in their quest for excellence.

Table A1 summarizes the major empirical studies conducted to assess the relationship between certification systems and business performance.

1.5. Hypotheses

As can be seen from the analysis carried out in the literature review, differentiated impacts on the performance of companies persist, arising either from the individual or combined use of the various certification systems. Thus, it is pertinent to develop additional efforts to clarify for a small economy that it proposes to conquer and be competitive in international markets through a business structure strongly focused on micro and small companies.

Since the studies carried out show diverging opinions about the impact of certification on performance, this paper formulates the following hypotheses:

H1: *ISO9001 certification affects profitability (ROA).*

H2: *ISO14001 certification affects profitability (ROA).*

H3: *OHSAS18001 certification affects profitability (ROA).*

H4: *ISO9001 and ISO14001 certifications affect profitability (ROA).*

H5: *ISO9001 and OHSAS18001 certifications affect profitability (ROA).*

H6: *ISO14001 and OHSAS18001 certifications affect profitability (ROA).*

H7: *ISO9001, ISO14001, and OHSAS18001 certifications affect profitability (ROA).*

Thus, this study aims to understand whether certifications per se or together positively affect companies' operating performance before any financing or tax policy. Moreover, it estimates whether this impact varies depending on the sector of business activity.

2. METHODOLOGY

In line with the methodology used by Mokhtar and Muda (2012), this investigation focuses on the universe formed by the companies that are certified to the three standards in force in Portugal and that fall under the different CAE (01-63) sectors of activity according to the information provided by IPAC (Portuguese Accreditation Institute). This information had to be cross-checked with the accounting elements taken from the Iberian Balance Sheet Analysis System (SABI) using the

company name. All the elements collected from SABI focused on the two databases for ten years (2010–2019). The sample of certified and non-certified companies obeyed several criteria. Namely, it included companies that have been active for ten years (2010–2019), belonging to the different CAE (Portuguese economic sector classification) activity sectors (01 to 63), having a total of assets and operating income equal to or greater than 2,000 euros, and presenting a minimum of 5 employees for the ten years under analysis. Once the selection criteria were implemented, the database was left with 36,101 companies. 8,892 of those companies had been certified to at least one of the standards (ISO9001, ISO14001, OHSAS18001) for at least one year.

Table 1 includes the absolute number of companies that were part of the sample and were certified to the three management systems during the period under investigation. The first half of Table 1 shows the number of companies certified to only one of the management systems, while the second half shows companies with multiple certifications. The evidence clearly showed that Portugal follows the trend observed in other countries where ISO9001 certification stands out compared to ISO14001 and OHSAS18001 certifications. However, the number of certifications to these two standards has been growing steadily over the last decade. Conversely, the number of ISO9001 certifications decreased in 2019 compared to 2010. The year 2017 was the best year for certification in Portugal. The following years witnessed a decrease in certification to the three standards, both in Portugal and other EU countries (Domingues et al., 2017).

Table 2 summarizes the sectors of activity of the certified and non-certified Portuguese companies included in the sample for the period ended in 2019.

Table 2. Sectors of activity

SECTOR (2019)	ISO 9001	ISO 14001	ISO 18001
A	35	9	5
B	27	5	5
C	425	125	43
C1	684	230	119
C2	898	186	118
C3	452	120	74
D	22	21	14
E	127	99	59
F	541	140	143
G	1029	150	83
H	87	37	15
I	185	36	18
J	12	0	0

As for certification by sector of activity, wholesale and retail trade (G) is the sector that most certified companies include in their quality management. This fact concerns how a company wants to be perceived, not only by its domestic customers but also by external markets. On the other hand, companies that are part of the natural resource transformation sector (C1) are among those that most seek environmental management certification in an attempt to make better use of resources, mitigate the potential adverse effects of environmental conditions, and implement the legal regulations associated with the environment. Finally, OHSAS18001 certification is mainly sought by companies in the construction sector (F), an industry where occupational accidents are more likely to occur. Certification to this standard can reduce work accidents, manage risks, and improve operational performance.

Return on Operational Assets (ROA) was the dependent variable that indicates the ability of companies' assets to generate operating results. This indicator appears in a significant number of studies (Simmons & White, 1999; Lima et al., 2000; Corbet et al., 2005; Cândido et al., 2016;

Table 1. Dynamics of certified companies (2010–2019)

Single/Multiple	Standard	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	TOTAL
Single Certification	ISO9001	4221	4227	4494	4114	4061	3958	3693	4132	3811	3431	40142
	ISO14001	80	80	73	73	62	83	115	153	122	110	951
	OHSAS18001	12	12	8	15	7	13	14	25	26	40	172
Multiple Certifications	ISO9001+ISO14001	322	322	381	393	385	446	427	620	587	547	4430
	ISO9001+OHSAS18001	117	118	138	100	101	82	79	167	159	142	1203
	ISO14001+OHSAS18001	22	22	28	25	22	22	60	88	70	74	433
	ISO9001+ISO14001+OHSAS18001	324	324	417	462	452	505	417	518	433	450	4302

Siougle & Dimelis, 2021; Ionaşcu et al., 2017; Hernandez-Vivanco et al., 2019) conducted on this topic.

The model's main explanatory variables are the ISO9001, ISO14001, and OHSAS18001 certifications and their different combinations, according to the studies by Hernandez-Vivanco et al. (2019) and Ionaşcu et al. (2017). Company age is another explanatory variable (Hudson & Orviska, 2013), as the sector of activity, based on the Portuguese classification of economic activities (CAE rev.3). As shown in Table 2, companies that form the sample are grouped into 12 different sectors of activity. The unemployment, inflation, and GDP rates act as control variables since these macroeconomic factors can influence corporate profitability (Beck et al., 2005).

Table 3 gathers all model variables, with a maximum of 361,010 observations (year/company) that correspond to the total number of companies (36,101) for a period of 10 years (2010–2019). 272,080 observations correspond to non-certified companies and 88,930 to certified companies. Single certification occurred in 40,142 (ISO9001), 951 (ISO14001), and 172 (OHSAS18001) certified companies. Double certification was also observed: ISO9001+ISO14001 represented 4.98%, ISO9001+OHSAS18001 represented 1.35%, and ISO14001+OHSAS18001 represented 0.49% of the observations. 4,300 observations were related to triple certification, representing 4.84% of all the observations.

The correlation matrix shown in Table 4 makes it possible to assess the relationship between the variables. There is a statistically significant nega-

Table 3. Summary of dependent and independent variables

Dependent Variable			
	No (thousand)	Average	Standard deviation
ROA	345.09	0.01	9.34
Explanatory Variables			
	Freq .(thousand)		Percentage
Not certified	272.08		75.37
Certificate	88,93		24.63
Single certified ISO9001	40.14		45.14
Single certified ISO14001	0.95		1.07
Single certified OHSAS18001	0.17		0.19
ISO9001+ISO14001	4.43		4.98
ISO9001+OHSAS18001	1.20		1.35
ISO14001+OHSAS18001	0.43		0.49
ISO9001+ISO14001+OHSAS18001	4.30		4.84
Sector			
A	9.78		2.71
B	2.17		0.6
Ç	43.07		11.93
C1	34.45		9.54
C2	33.77		9.35
C3	21.19		5.87
D	850		0.24
E	3.21		0.89
F	49.29		13.65
G	117.27		32.48
I	35.94		9.95
J	8.87		2.46
Control variables			
	No. (thousand)	Average	Standard deviation
AGE	360.94	22.23	15.02
TXPIB	361.01	0.83	2.23
TXINFL	361.01	1.17	1.17
TXDES	361.01	11.5	3.14
Period		2010–2019	

Table 4. Correlation coefficients

	ROA	ISO9001	ISO14001	OHSAS18001	AGE	SECTOR	TXDES	TXINFL	TXPIB
ROA	1,0000								
ISO9001	−0.0069*	1,0000							
ISO14001	0.0013	0.3559*	1,0000						
OHSAS18001	0.0012	0.2894*	0.5939*	1,0000					
AGE	−0.0003	0.0730*	0.0532*	0.0345*	1,0000				
SECTOR	0.0007	−0.0766*	−0.0530*	−0.0266*	−0.0449*	1,0000			
TXDES	−0.0037*	0.0083*	−0.0200*	−0.0105*	−0.1357*	−0.0000	1,0000		
TXINFL	0.0008	0.0090*	−0.0123*	−0.0072*	−0.0966*	0.0000	0.1613*	1,0000	
TXPIB	0.0029	−0.0077*	0.0208*	0.0104*	0.1249*	−0.0000	−0.7740*	−0.5700*	1,0000

Note: * – Data for a significance level of 5%.

tive relationship between ROA and ISO9001 and the unemployment rate. Data also show a positive and statistically significant correlation between ISO9001, ISO14001, and OHSAS18001; these findings suggest that a certain degree of complementarity exists in multiple certifications, a conclusion confirmed with the statistical modeling that will be presented later on.

Using a linear regression OLS model for panel data, this study aims to assess whether certification to one of the three management systems or the three of them simultaneously influences companies' operating profitability.

The estimation with panel data is widely used in economics and finance as it simultaneously allows for the integration of the variations of the variables over time (T) and between different individuals (N). Panel data thus aggregate temporal (time-series) and sectional (cross-section) data in the same model. Marques (2000) mentioned some of the advantages of this methodology, such as the control of individual heterogeneity, the possibility of handling a high volume of information, less collinearity between variables, and greater efficiency in the estimation. The econometric software adopted to estimate the empirical model was STATA/IC 16.1 (Stata, 2019).

In the case under study, this paper deals with short, balanced panel data, i.e., the N> T (the number of individuals is greater than the number of time series). According to Wooldridge (2002), the regression model with panel data allows the estimation from three models: the pooled aggregate model, the model with fixed effects, and the model with random effects.

For the selection of the efficient model, this investigation proceeds as follows. The performance of the F and the Chow tests made it possible to assess whether the pooled least squares model is more suitable for panel analysis than the fixed effects model. The pooled model is the most suitable, and the null hypothesis is not rejected when there is homogeneity in the constant, that is, when the p-value is greater than 5%. If this is not the case, the null hypothesis is rejected, and the most appropriate model is the fixed effects model.

The Breusch-Pagan test aims to assess whether the random effects model is more suitable for panel analysis than the pooled OLS model. The Random Effects Model assumes that there is heterogeneity between individuals. That is, there is random variability from individual to individual. By rejecting H0, there is evidence of random differences between individuals, which supports the application of a random effects model. If the null hypothesis is not rejected, applying a model that considers individual random heterogeneity is no reason. In this case, the pooled OLS is an option. The objective of carrying out this test is to verify whether, for the panel under study, the random effects model is more appropriate than the fixed effects model.

Thus, the Hausman test evaluates the assumption of non-correlation between the ui-errors and the explanatory variables, testing the null hypothesis that the two estimators provide identical results. If the assumption in question fails, it is expected that the two estimators will not produce identical results (since one is consistent and the other is not), and the null hypothesis should be rejected. If the H0 is not rejected, the random effects model is chosen since the estimators are consistent and efficient, that is,

472

when the p-value is greater than 5%. Otherwise, the fixed effects model is chosen since the estimators are inconsistent.

Statistical inference problems can occur with panel data, as they involve temporal and transversal dimensions. The problem of serial correlation stems from the time series, and heteroscedasticity stems from the cross-section of the data.

To test multicollinearity, that is, the independence of explanatory variables, one of the tests indicated for panel data is the VIF (Variance Inflation Factor) by Montgomery et al. (2021), which indicates a collinearity problem when the result is greater than 10.

The model deals with contemporary correlation when there is a correlation between the errors of two equations in the same temporal space, which can result from the omission of variables, and serial correlation/autocorrelation when the errors of each individual are correlated in time. Wooldridge (2002) developed a flexible test for panel data based on minimal assumptions that can be performed in Stata, which allows for diagnosing the existence of a serial correlation between errors. The null hypothesis of this test is that there is no serial correlation, of course, if it is rejected, it can be concluded that there is.

When the variance of errors for each individual is not constant, the model presents heteroscedasticity problems. One of the tests that can be performed is the Breusch and Pagan Lagrange multiplier, or others, which assume the normality of errors. Wald's modified heteroscedasticity test works when this assumption is violated, where the null hypothesis points to homoscedastic errors and the alternative hypothesis to heteroscedastic errors.

This paper faces the presence of a short panel $T < N$, and as such, for the correction of heteroscedasticity and the existence of serial correlation of errors, the cluster-robust standard errors model, according to Arellano (1987), must be used.

3. RESULTS

The first estimate intends to investigate the validity of H1, i.e., whether ISO9001 (QMS) certification affects companies' operational profitability. All the

diagnostic tests were made, allowing the use of the fixed effects model after applying the Hausman test and rejecting the null hypothesis. The panel does not prove the existence of multicollinearity, and the Wooldridge (2002) test shows no autocorrelation between residuals. However, the Wald test shows the presence of heteroscedasticity. That way, the fixed effects model with cluster-robust standard errors will be used to calculate data panel regression, as it admits the existence of heteroscedasticity and accepts a less restrictive correlation structure between the errors. The model has the following specification:

$$ROA = \beta_0 + \beta_1 ISO9001 + \beta_2 TXDES + \\ + \beta_3 TXINF + \beta_4 TXPIB + \beta_5 AGE + e_{it}, \quad (1)$$

where OHSAS18001 = 0, ISO14001 = 0.

Table 5 shows the results of the estimate for the ISO9001 certification of the companies under study.

Table 5. Results of the ISO9001 regression model

ROA	Coef.	Robust Std. Err.	t	P>t
ISO9001	−.1092756	.105926	−1.03	0.302
TXDES	−.0074407	.0050722	−1.47	0.142
TXINFL	.0200797	.0197501	1.02	0.309
TXPIB	.0032773	.0079283	0.41	0.679
AGE	−.0056009+	.0032942	−1.70	0.089
_cons	.1990044	.1407414	1.41	0.157
F (5,35191) = 34.77 Prob > F = 0.0000				
R−sq: within = 0.0000				
Number of obs = 35,159				
Number of groups = 3,569				
sigma_u = 7.3232565				
sigma_e = 8.7553717				
rho = .41163157				

Note: * significant at a 5% significance level. + significant at a 10% significance level.

The second estimation was meant to examine H2, which stated that ISO14001 certification in EMS has a clear impact on the profitability of companies. The performance of different tests led to the fixed effects model with cluster-robust standard errors based on the following specification:

$$ROA = a_i + \beta_1 ISO14001 \cdot \beta_2 TXDES + \\ + \beta_3 TXINF + \beta_4 TXPIB + \beta_7 AGE + e_{it}, \quad (2)$$

where OHSAS18001 = 0, ISO9001 = 0; α_I captures the fixed specific effects.

Table 6 presents the estimation results for single ISO14001 certification.

Table 6. Results of the ISO14001 regression model

ROA	Coef.	Robust Std. Err.	t	P>t
ISO14001	−.0075407	.105926	−1.13	0.260
TXDES	.0030223	.0050722	0.90	0.367
TXINFL	−.000609	.0197501	−0.50	0.620
TXPIB	.0072573*	.0079283	3.38	0.001
AGE	.0004771	.0032942	0.69	0.489
_cons	.0181731	.1407414	0.53	0.595
F (5.33234) = 201.74, Prob > F = 0.0000				
R−sq: within = 0.0007				
Number of obs = 299,556				
Number of groups = 33,235				
sigma_u = .56546513				
sigma_e = .66902484				
rho = .41669757				

Note: * significant at a 5% significance level.

In order to assess H3, which stated that OHSAS18001 certification in OHSMS has a real impact on the profitability of companies, this paper carried forward different tests on the sample and the random-effects model with cluster-robust standard errors deviation led to the following model:

$$ROA = \beta_0 + \beta_1 OHSAS18001 +$$
$$\beta_2 TXDES + \beta_3 TXINF + \beta_4 TXPIB + \quad (3)$$
$$+ \beta_5 AGE + E_{(wit)},$$

where ISO14001 = 0, ISO9001 = 0; $E_{(wit)}$ the error term, captures the random effects.

Table 7 shows the estimation results for single OHSAS18001 certification.

Table 7. Results of the OHSAS18001 regression model

ROA	Coef.	Robust Std. Err.	t	P>t
OHSAS18001	.0020901	.0644969	−0.83	0.404
TXDES	−.0012485	.0026685	0.78	0.433
TXINFL	.0068516	.0009101	−1.37	0.170
TXPIB	−.0002907*	.0019603	3.50	0,000
AGE	.042011	.0003005	−0.97	0.333
_cons	0	.0189968	2.21	0.027
Wald chi2(5) = 634.82 , Prob > chi2 = 0.0000				
R−sq: within = 0.0000				
Number of obs = 298,868				
Number of groups = 33,142				
sigma_u = .50424218				
sigma_e = .67019642				
rho = .36146106				

Note: * significant at a 5% significance level.

None of the three hypotheses could be validated. Therefore, the next step is to group companies by sector and analyze the impact that single certification can have on the profitability of companies according to their sector of activity.

The diagnostic tests performed for each regression model align with the results obtained for the previous regressions: there is no evidence of multicollinearity and no autocorrelation between residuals. However, there is a higher prevalence of heteroscedasticity. Therefore, the paper used cluster-robust standard errors to calculate the panel regression in every model (Table 8).

The last estimation was performed to assess the impact of double or triple certification on Portuguese

Table 8. Results of the regression model by sector

Standard	ISO9001		ISO14001		OHSAS18001	
Sector	Coef.	P>|z|	Coef.	P>|z|	Coef.	P>|z|
A	−.0008293	0.939	.0206774	0.485	0 (omitted)	
B	−.0145	0.151	0 (omitted)		−.027621	0.584
Ç	−.1912552	0.382	.0047666	0.572	.0015619	0.911
C1	.0113598	0.100	.0193869	0.146	.0380194	0.005*
C2	−.6096522	0.296	.0072853	0.641	.0443873	0.548
C3	−.0014599	0.928	−.0105393	0,500	−2.702263	0.306
D	−.1973927	0.276	−.0465362	0.115	−.0091408	0.837
E	.0659553	0.243	−.0291225	0.345	.0201438	0.296
F	.0681687	0.174	−.0012434	0.963	−.0420941	0.171
G	−.3260017	0.368	.0094516	0.413	.0052701	0.827
I	−.0134179	0.546	−.0143984	0.722	−.1374705	0,000*
J	−.0061556	0.715	−.0093809	0.744	−.0129767	−.0282362*

Note: * significant at a 5% significance level.

companies' operational profitability. To this end, four hypotheses were formulated (H4 to H7).

The tests performed show that there is no multi-collinearity between the variables. Furthermore, the Wooldridge (2002) test demonstrates no auto-correlation between the residuals either. However, the results of the Wald test show the existence of heteroscedasticity. Accordingly, this investigation used the random-effects model with cluster-ro-bust standard errors that accept the possibility of heteroscedasticity and a less restrictive correlation structure between errors.

The regression model has the following specification:

$$ROA = \beta_0 + \beta_1 ISO9001 +$$
$$+ \beta_2 ISO14001 + \beta_3 OHSAS18001 +$$
$$+ \beta_{12} ISO9001 \cdot ISO14001 +$$
$$+ \beta_{13} ISO9001 \cdot OHSAS18001 + \quad (4)$$
$$+ \beta_{23} ISO14001 \cdot OHSAS18001 +$$
$$+ \beta_{123} ISO9001 \cdot ISO14001 \cdot OHSAS18001 +$$
$$+ \beta_4 TXDES + \beta_5 TXINF + \beta_6 TXPIB +$$
$$+ \beta_7 AGE + \beta_8 sector + E_{(wit)}.$$

Table 9 presents the estimation results for the multiple certifications of the companies under study.

Table 9. Results of the regression model for the multiple certifications

ROA	Coef.	Std. Err. (robust)	z P>z
ISO9001	−.219583+	.12605	1.74 0.082
ISO14001	−.0282026	.0371184	0.76 0.447
OHSAS18001	−.0391662	.0601834	0.65 0.515
ISO9001 + ISO14001	.2229468+	.1249164	1.78 0.074
ISO9001 + OHSAS018001	.2049228+	.1179621	1.74 0.082
ISO14001 + OHSAS018001	.1652143*	.0757649	2.18 0.029
ISO9001 + ISO14001 +OHSAS18001	−.1063159	.2267607	0.47 0.639
TXDES	−.0024936	.004449	0.56 0.575
TXINFL	.0279234	.0201938	1.38 0.167
TXPIB	.010252	.0089728	1.14 0.253
AGE	.0001548	.0014018	0.11 0.912
Sector			
A	.0143973	.0217328	0.66 0.508
B	−.0091004	.0180842	0.50 0.615
Ç	.0361863	.0231022	1.57 0.117
C1	−.2005008	.2389361	0.84 0.401

ROA	Coef.	Std. Err. (robust)	z P>z
C2	.0262073	.0267181	0.98 0.327
C3	.0106935	.0545074	0.20 0.844
D	−.0005615	.0516461	0.01 0.991
E	−.1172701	.1187757	0.99 0.323
F	.0023837	.0205259	0.12 0.908
G	−.0191656	.018593	1.03 0.303
I	.0485736*	.0235507	2.06 0.039
J	−.2586591*	.1312333	1.97 0.049
_cons	.0169804	.0890928	0.19 0.849
Prob > chi2 = 0.0000	sigma_u = 6.6797624		
R–sq: overall = 0.0001	sigma_e = 8.6644273		
Number of obs = 344,001	rho = 0.37278516		
Number of groups = 35,474			

Note: * significant at a significance level of 5%. + Significant at a 10% significance level.

4. DISCUSSION

According to Table 5, the single certification to IS09001 estimation, it can be verified that the regression is statistically significant; however, only the variable AGE proved to be significant for a significance level of 10%, which indicates that, on average, for one year of age, the company obtains 0.56% less profitability. Therefore, the model estimation result does not prove H1, which stated that the mono-certification in ISO9001 impacts the profitability (ROA) of companies; this result supports Reis (2021), Lima et al. (2000), and Heras et al. (2002).

The single certification to ISO14001 (Table 6) showed that the regression is statistically significant. However, only the gross domestic product (GDP) rate proved significant for a significance level of 5%, a unit of growth of the GDP rate that will, on average, produce a 0.72573% increase in companies' profitability. Therefore, the results of the estimation model were unable to prove H2, which claimed that single ISO14001 certification has a significant impact on companies' profitability (ROA). This result is, once again, in line with Reis (2021), He et al. (2015), Heras-Saizarbitor et al. (2011), and contrary to Ribeiro (2020), Ionaşcu et al. (2017), Hernandez-Vivanco et al. (2019), and Darnall et al. (2008).

The single certification to OHSAS18001 estimation (Table 7) shows that the regression is statistically significant. However, the gross domestic

product (GDP) is the only significant variable for a significance level of 5%, a unit of growth of the GDP rate that will represent, on average, a decrease of 0.02907% in the profitability of companies. The results of this regression cannot prove H3, which states that the single OHSAS18001 certification affects companies' operational profitability (ROA). The results are contrary to the ones found by Ribeiro (2020), Ionaşcu et al. (2017), and Hernandez-Vivanco et al. (2019) for other regions.

About the single certification by sector of activity (Table 8), the results show that companies belonging to sector C1 (manufacturing industries – natural resources) certified to OHSAS18001 are, on average, 3.80194% more profitable than companies that are not certified to this standard, for a significance level of 5%. On the other hand, companies in sector I (accommodation, catering, and similar) and sector J (information and communication activities) certified to OHSAS18001 standard are, on average, 13.4705% and 1.29767% less profitable, respectively, compared to those that are not certified.

The results suggest that companies that only seek certification for their image will hardly recover the investment made by improving their productivity and reducing their charges. This conclusion is in line with what Furtado (2003) advocates.

Considering the multiple certification regression (Table 9), this is statistically significant but has a relatively low coefficient of determination (r^2). This happens because the model does not include other relevant variables to explain operational profitability.

H4, H5, and H6 are validated as the results are statistically significant concerning double certification, for a significance level of 10% in the case of H4 and H5 and a significance level of 5% in the case of H6.

For H4, there is a positive relationship, i.e., companies certified in quality management and environmental management are, on average, 22.29468% more profitable than companies that are not certified or certified only in one management system. These results align with Ferrón Vílchez and Darnall (2016), who concluded that companies that adopt EMS and QMS certification tend to perform better than those that are only certified to a single management system or are not certified at all. In other words, the two certification systems are complementary.

Regarding H5, there is a positive relationship, i.e., companies certified in QMS and OHSMS are, on average, 20.49228% more profitable than companies not certified or certified in a single management system. Lo et al. (2014) conclude that OHSAS18001 certification significantly increases business performance, both in sales growth and profitability. According to Bianchini et al. (2017), ISO18001 certification can generate positive impacts, especially in larger companies supporting high certification costs. However, the study claim that more studies on this topic are required.

Considering H6, there is a positive relationship between certification and operational profitability. On average, companies with an EMS and OHSMS certification are 16.52143% more profitable. These results align with Ionaşcu et al. (2017) and Hernandez-Vivanco et al. (2019), who analyzed dual certification and multiple certifications and showed that synergies are created when companies adopt more than one management system certification.

H7 could not be proved by the regression model used and goes against several other studies (Ionaşcu et al., 2017; Hernandez-Vivanco et al., 2019) that triple certification leads to higher profitability in certified companies. As for multiple certifications according to the sector of activity, the accommodation, restaurant, and similar sector (I) and the communication information activities sector (J) represent relevant drivers of corporate profitability. In the case of sector I, there is a positive relationship between certification and profitability; in the case of sector J, that relationship is negative.

CONCLUSION

This study aimed to evaluate the impact of single and multiple certifications in Portuguese companies with ten years of certification between 2010 and 2019. This is the first time that all company population is used and that it is by sector of activity, conditions that make this study original and innovative.

The results indicate that ISO9001 certification peaked in Portugal in 2017, suggesting that quality system certification will no longer be a differentiating element. This type of certification is predominantly sought after by companies in the wholesale and retail sectors. This is probably because of the image they want to convey to the market and the proximity to a consumer, who has been exerting pressure in this type of industry for some time. Regarding the ISO14001 certification, it is the sector of transformation of natural resources that most seek. This result suggests that the most significant environmental concern will be transforming dirty energies into greener ones. Finally, the OHSAS18001 certification is applied in particular by companies in the construction sector, which is also understandable given the nature of the hard work and physical exposure of employees requiring rules that guarantee health and hygiene at work.

The results also highlight a negative relationship between ISO9001 certification and profitability when simultaneously considering the estimation based on ISO14001 and OHSAS18001 standards. It suggests that the cost-benefit trade-off of this type of certification is not worthwhile. Companies are more concerned with the outside image than with the impact that certification may have on their economic performance.

The single certification estimate by sector results are significant and can be positive drivers of profitability, but only for companies in sector C1 (manufacturing industries – natural resources) with OHSAS18001 certification. However, they trigger negative results in sector I (accommodation, catering, and similar) and sector J (information and communication activities). The cost-benefit trade-off of adopting this type of certification is only rewarding in sector C1, suggesting that pressure from stakeholders external to the organization is still incipient. In a country where the respect and rationalization of natural resources, the reduction and/or elimination of forms of pollution, the increase in the satisfaction of its customers, and globally, of its stakeholders are still factors that have to be developed, there is still a long way to go.

Finally, the results from the estimation of the double certification models are all significant, in line with the information provided by the literature review that clearly states synergies are created when different certification procedures are combined. Therefore, the commitment of companies, the experience they have acquired during their first certification, or the reduction of costs and optimization of resources can positively affect business performance.

The primary constraint of this study was the difficulty faced when was tried to match the existing social name in the IPAC (Portuguese Accreditation Institute) database with the one available in the SABI (Iberian Balance Sheet Analysis System) database. Other limitations, which may be addressed in future studies, can be pointed out as the absence of the effect of corporate size on profitability, a dynamic analysis considering different economic cycles, and a comparison with other institutional environments.

AUTHOR CONTRIBUTIONS

Conceptualization: Anabela Santos, António Pedro Pinto, Pedro Reis.
Data curation: Anabela Santos, António Pedro Pinto, Pedro Reis.
Formal analysis: Anabela Santos, António Pedro Pinto, Pedro Reis.
Funding acquisition: António Pedro Pinto, Pedro Reis.
Investigation: Anabela Santos.
Methodology: Anabela Santos.
Project administration: Anabela Santos, António Pedro Pinto, Pedro Reis, Elisabete Neves.
Resources: Anabela Santos.
Software: Anabela Santos, António Pedro Pinto, Pedro Reis.
Supervision: António Pedro Pinto, Pedro Reis, Elisabete Neves.

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APPENDIX A

Table A1. Empirical studies

Authors	Certifications	Origin	Sample: Certified Companies	Time Period Assessed	Methodology	Dependent Variables	Control Variables	Certification Impacts
Simmons and White (1999)	ISO9000	USA; Canada	165	1995	ANOVA	ROA; ROI	Size; Company; Sales/CP; Time of Certification	Certification has no impact
Lima et al. (2000)	ISO9000 ISO9001	Brazil	129	1992–1998	Signal Test	ROA; ROI; ROS	Sector; Active; Time elapsed since certification	Certification has no impact
Nicolau and Sellers (2002)	ISO9000	Spain	27	1993–1999		Share price return		Positive impact
Heras et al. (2002)	ISO9001	Spain	400	1994–1998	Longitudinal (before and after certification); Mean difference	Sales Revenue; ROA	Company size; Sector	Certification has no impact
Furtado (2003)	ISO9000	Portugal	929	1999	Questionnaire/survey	Financial autonomy; Fixed Asset Coverage; Gross Sales Profit; Stock Rotation	Time elapsed since Certification; Company Size; Sector	Positive impact
Corbet et al. (2005)	ISO9000	USA	554	1987–1997	Panel Data; Event study	ROA; ROS; Tobin's Q; Sales/Assets	ROA; Active; Sector	Certification has no impact
Ribeiro (2020)	ISO9000; ISO14001; OHSAS18001	Portugal	46	1999–2003	Questionnaire; Multivariate analysis	Company profitability		Positive impact
Feng et al. (2008)	ISO9000	Australia, New Zealand	631		Questionnaire	Operating performance, Financial performance	Company size	Certification has no impact
Darnall et al. (2008)	ISO14001	Canada; USA; Germany; Hungary	2108	2003	Questionnaire	ROA		Positive impact
Heras-Saizarbitor et al. (2011)	ISO14001	Spain	196	2000–2005	Study event; difference of mean average	Sales; ROA		Certification has no impact
Mokhtar and Muda (2012)	ISO9000	Malaysia	162	1998–2001	Test t	ROA; ROE; ROS; CF; EVE	Size; Capital Structure Growth; Age; Sector	Certification has no impact
Ullah et al. (2014)	ISO9001	Latin America and the Caribbean (31 countries)	21852	2006–2010	Logit analysis; Logit Matrix Correlation	Productivity; Financial Restrictions	Size; Age; Exporters; ISO; Property type	Positive impact
He et al. (2015)	ISO14001	China	967	2004–2007	Questionnaire; Data analysis	ROA; ROE; ROS Sales; Costs		Certification has no impact

Table A1 (cont.). Empirical studies

Authors	Certifications	Origin	Sample: Certified Companies	Time Period Assessed	Methodology	Dependent Variables	Control Variables	Certification Impacts
Ferrón Vílchez and Darnall (2016)	ISO9001; ISO14001	OECD	2619	AT	Heckman's Questionnaire and Regression	Perception of business performance; ROA; ROS; Sales	Market Concentration; Capital structure typology; property typology	Positive impact
Cândido et al. (2016)	ISO9001	Portugal	143	2007–2008	Event study	ROA; ROS; Sales	Size; Active	Certification has no impact
Ionașcu et al. (2017)	ISO9001; ISO14001; OHSAS18001	Romania	67	2013–2015	Diff-in-Diff; Regression Model	ROE; ROA; ACT	Size	Positive impact
Siougle and Dimelis (2021)	ISO9000	Greece	183	1992–2013	Longitudinal analyses; Diff-in -Diff panel data	ROS; ROCE; ROE; ACT; ROA	Size; Dummies Sector; Year Dummies	Positive impact
Hernandez-Vivanco et al. (2019)	ISO9001; ISO14001; OHSAS18001	Portugal	247	2007–2015	Longitudinal Analysis; panel data	ROS; ROCE; ROA	Size; Dummies Sector; Year Dummies	Positive impact