ISO 9001 and Business Performance: A Quantitative Study in Portuguese Organizations

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Abstract

The effects of ISO 9001 quality certification process inside an organization may be considered on a wide range. This article places this phenomenon under a theoretical perspective and aims to analyze the impact of ISO 9001 quality standard on business performance according to the financial information data. More specifically, the impact of ISO 9001on productivity, business value and increase on sales is viewed through an econometric model of analysis concerning a panel data of Portuguese companies from the agro-food and to the construction sector. This analysis has presented interesting different results and in brief revealed that it may not be deterministically ascertained a direct connection between ISO 9001 certification and the improvement on business performance. Many other variables are committed to its success.

Keywords: *ISO 9001, business Performance, productivity, Portugal.*

JEL classification: M19, M21.

Introduction

Meta-standards such as ISO 9001 have been adopted by an increasing number of organizations across the world (Heras-Saizarbitoria & Boiral, 2013). Up to the end of December 2011, at least 1,111,698 certificates had been issued in 180 countries of the world. This is more than the double of the number of certificates issued by the end of the year 2000 when a new version of the standards was launched - reaching 457,834 certificates (ISO, 2012).

The effects of ISO 9001 certification on business performance has been widely debated in the academic literature (for a recent review see Heras-Saizarbitoria & Boiral, 2013). Some of these studies have used rather objective or factual measures (i.e. accounting data), while the majority of studies have used perceptual measures obtained by surveys (i.e. based on questionnaires) to analyse the impact of meta-standards on performance. Nevertheless, most of the research

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based on factual measures has been focused on the study of the impact of ISO 9001 on firm's financial performance. Although many methodological concerns can be established, such as reverse causality and endogenous relations (Dick, Heras and Casadesús, 2008) thus leading to different results, in a majority of studies, a significant positive relationship is found between the adoption of meta-standards and a company's financial performance. Surprisingly, the analysis of the relationship of ISO 9001 and other business performance issues such as Gross Added Value and productivity have not gathered much attention in the literature. This article tries to add more empirical information about this issue doing an empirical quantitative work on Portuguese companies. For that purpose, its structure is the following: the second section has a short literature review where from some hypotheses - that will be described and analyzed - were constructed; the third section will deal with the results of the empirical quantitative work and at last, in section four, after the discussion of results the conclusions will emerge .

1. Literature review

There is a large consensus in literature (Dick, Heras and Casadesús, 2008) about the fact that inside the organization, the effects of ISO 9001 quality certification may be rather important. As a consequence of this process the knowledge and the increased skill capacity will emerge. This way the internal processing cycles may be eventually reduced, increasing customer satisfaction (Ito, 1995; Yang, 2008). Thus an increase in the market share of the firm may happen (Grant, Shani and Krishnan, 1994). As stressed by Dick, Heras and Casadesús (2008) causal links can be extended as follows. An ISO 9001 certified quality management system can achieve an increased emphasis on quality, leading to less waste and to a reduction of effort. These combined factors lead to an improved profitability resulting from a combination of lower cost of production, lower sales expenses and scale economies got from greater sales volume. Indeed, as underlined by Dick, Heras and Casadesús (2008), even if not all the quality benefits can be materialized, the possession of the "Quality Badge" such as ISO 9001 could lead to increased sales opportunities and so, to improve profitability just through an increased sales volume. Therefore, many authors argue that the use of this ISO justifies the performance improvement that can and should be quantified (Pun and Lau, 2002; Hendricks and Singhal, 2000; Lin and Johnson, 2004; Sun, 2000; Rao and Ragunathan, 1997). Furthermore, many other works suggest that a good financial performance is usually a result of ISO 9001 (Weldeghiorgis, 2004; Zairi and Sinclair, 1996). As mentioned before, there have been many studies analyzing the impact of ISO 9001 on business performance. Most of them have focused on companies' financial performance (e.g. Häversjö, 2000; Heras, Dick and Casadesús, 2002; Wayhan, et al., 2002; Corbett, Montes-Sancho and Kirsch, 2005; Bener and Veloso, 2008; Dick, Heras and Casadesús, 2008; Martínez and Jimenes, 2008; Sampaio, Saraiva and Monteiro, 2012; Sitki-Ilkay and Aslan, 2012). As stressed by Sampaio, Saraiva and Monteiro (2012), despite all the studies carried

out in order to analyze the impact of ISO 9001 implementation on companies' financial performance, conclusions reached so far have a contradictory nature. Some works conclude that there is a positive relationship between ISO 9001 certification and companies' financial improvement, while others do not find this evidence. As far as we know there is a lack of studies aiming to analyze the impact of ISO 9001 on business or on operational performance aspects by means of factual measures. Most of the articles from literature about this issue have been focused on perceptual measures obtained by surveys based on questionnaires. This kind of self-reported information has very well known bias such as the social desirability of the respondents (Boiral, 2011). For instance, Feng, Terziovski and Samson (2008) in their paper went beyond the measurement of the impact of ISO 9001 on indicators such as sales growth, profitability and market share and tried to analyze the impact on the operational performance. To put it in other words, the performance related to organisations' internal operation, such as productivity, product quality and customer satisfaction. The authors based their evidences on perceptual measures obtained from 613 valid responses got from companies' managers of certified manufacturing and service organisations in Australia and New Zealand. Their conclusions showed that ISO 9001: 2000 had a positive and significant effect on operational performance. Therefore, following these studies, this investigation will try to contribute to the literature with an empirical study aiming to consider the impact of ISO 9001 on a broader definition of business performance.

More specifically, concerning the variables used in the research, one must associate them to its theoretical perspective based on the dynamic capability – Teece, et al. (1994) that Dirickx and Cool (1989) named as new specific knowledge. In this sense, ISO 9001 implementation might contribute to better worker productivity (Dirickx and Cool, 1989). Consequently an embodiment of the improvement in production processes can translate an increase in business value translated by EVA - Economic Value Added (Stern and Shiely, 2001). It is convenient to remember that this improvement stems from several factors already considered in this study, which vary from the management culture (Lagrosen and Lagrosen, 2003) to the best practices established in the organization (Chenhall, 2003). Although literature reveals the indicator EVA - economic value added (Stern and Shiely, 2001) as recommended, this study will use the Gross Added Value (defined by the sum up of Sales and Services minus the Cost of the goods sold/ consumed less the costs of the supply of External Services and less the other Operating Costs). This option for the GAV has to do with the fact that the available database – *The 500 Biggest and Best Companies* (Expresso Publishing) just considers it.

So, as to the hypotheses, the first (H1) will consider the implementation of ISO 9001,in the internal process of the organizations, as being able to provide an increased productivity and added value to the business, and will be defined through GAV. To test this hypothesis, GAV is defined as a proxy and the model analysis - AE1 – is addressed. On the other hand, as stressed by Keogh (1994), ISO 9001

might contribute to an increase on sales and a consequent increase on the market share. There are also many authors who claim that a better definition of strategies can allow greater external visibility (e.g. Schein, 1992; Argyris and Schon, 1996) favouring the image in the market. Hence, taking into account literature ideas about this issue (e.g. Häversjö, 2000; Heras, Dick and Casadesús, 2002; Dick, Heras and Casadesús, 2008) the hypothesis concerning the increase of the organization sales as an effect of ISO arises. It is a complementary hypothesis to the previous one, once it is also associated to ISO 9001 (H2). To validate this hypothesis H2 which intends to analyze the impact of ISO 9001 on the market a variable proxy was defined as the *volume of sales* and the model of analysis (AE2) was created to address it. Therefore, in terms of synthesis of hypotheses and associated models we posit the following:

H1: The adoption and certification of ISO 9001 can contribute to higher productivity and increased business value defined in terms of GAV – Model AE1

H2: The adoption and certification of ISO 9001 can be associated with the increase on sales occurred in certified organizations – Model AE2

2. Methodology

The sample to be analyzed was selected in order to grant reliability and comparability of data (Quivy and Campenhoudt, 2008; Yin, 2009) reason why a single statistical source was used. In this sense, the source of information was a database periodically published in Exame Magazine (nowadays Expresso Publishing). This database is quite well disseminated around Portuguese financial experts and comprehends the compiling of financial indicators for all the 500 Biggest and Best Business guide (this was published on 2009). Information included national companies from which the following indicators were taken: Global sales (internal and external), results - operating and net staff costs, Assets, Gross Value Added, personnel attached. The information was gathered per sector analysis. Within these sectors of activities companies that owned (or not) ISO 9001 quality certification for the period 2002 to 2009 were identified.

To get this information, many specialty magazines were considered and often, the identification of certified companies and the respective data issue, was got through some direct phone calls to companies were made. For all the considered sectors of activity the number of certified companies and respective size were taken into account. Data was obtained during the period 2002 to 2009[2], and was limited to the sectors of Construction and the Agricultural - food (agro-food) industry. It must be registered that in the field of agro-food industry there are representations from both agro industry and food distribution. These sectors were added because they are interrelated. Together they form a critical mass with a representative assessment of the large food area. This sector shows a high level of certification, reaching 52% in 2002 and 71% in 2009. The construction sector

[2] Guia de empresas certificadas. Edição (2009) Cem Palavras.

shows a significant growth in recent years, representing about 85% in 2009, a value well above the average ones recorded in Europe.

For the descriptive analysis two outcome variables were also included corresponding to alternative proxies: one for financial performance and another for non-financial performance (productivity). In the context of estimating the impact of certification on performance it was defined a model that based on a regression of Gross Value Added (as a proxy of the non-financial performance) and Sales (as a proxy of financial performance).

The variables of the sample were defined according to the assumptions and the ones belonging to the econometric model were summarized in the below table.

Table 1. Definition of the variables

Variable	Definition	Unit
$Sales_{it}$	Annual sales value i, year t	Million Euros
GAV_{it}	Gross Added Value i, year t	Euros
Current $profits_{it}$	Annual operational balance for company i, being the difference between operational income and expenses in period t.	Euros
Net $profits_{it}$	Net profit of company i, being the difference between income and expenses, including operational profits the financial charges and the extraordinary results, in year t.	Euros
Certification ISO_{it}	Binary variable identifying if company i, is certified (assuming value 1) or not (assuming value 0) in year t.	Certified company=1 Non certified company=0
$Asset_{it}$	Set upon f factors of the company i – able to generate financial inflows – year t	Euros
$Productivity_{it}$	Work apparent productivity: ratio between GAV and the number of employees	Euros

From the database and by means of a descriptive analysis elaborated by sector of activity a more detailed perspective was elaborated. After having identified the sectors of activity with a major relevance of ISO certification – a brief description of the sample will follow.

In the construction sector and considering the 52 (N) firms on the database referred to, only 16 (31%) held ISO certification in 2002. This number has evolved considerably in recent years, standing, in 2009, 44 companies (85%). The temporal analysis (T) is 8 years (2002-2009). This data set constituted a panel data that the sample size (N * T) would be 416 observations (52 * 8). However, the database used had some information gaps that forced resizing of the panel. Considering the dependent variables to be used in the model and the non existence of 123 observations for the variable sales, these observations were taken out in the econometric analysis. However, it was necessary to remove from the sample more 52 observations resulting from the unavailability of data for the year 2007 (missing in the database considered). Thus, the original panel data was reconfigured in an unbalanced panel with about 241 observations.

The sample concerning the sector of the agro-food industry includes a total of 38 companies with observations in the period 2002 to 2009, setting up a panel data with 304 observations. However, and similarly to what happened in the construction sector, the erroneous information in the database has eliminated 144 observations. Of those eliminated observations, 38 were a result of lack of data for all companies in the sample, for the year 2007. Thus, the unbalanced[3] panel data results in 157 valid observations included. In 2002, about 52% of the sample (n = 20) were certified, this proportion rising to 71% in 2009, with about 27 companies certified.

Both a descriptive and a correlation statistical analysis was carried out but it's not included in this article due to length restrictions and the analysis will focus on the econometric analysis that was carried out. For that purpose, it was possible to construct an unbalanced panel data with about 52 companies in the construction sector and 38 companies in the agro-industry for a period of eight years (in construction, the sample size will be approximately 52x8 = 416 and agro-industry sample size will be approximately 38x8 = 304). However, in some years the financial information was not available, and this fact reduced the size of the actual sample values shown in the tables of results and drew together an unbalanced[4] panel data. Therefore, in the research an unbalanced panel was used since it does not involve significant changes in the theoretical model[5]. Moreover, the software used (LIMDEP) allows to treat the absence of information as such and not as a zero. Thus, we believe that there was no reason to lose the value of information gathered while incomplete for the entire period. The fact of working with a panel of data allows the use of multivariate regression methods more complex than the simple OLS (Ordinary Least Squares Method) or the pooled OLS (Greene, 2003)[6]. In brief, we carried out the following:

a) Pool OLS

Pool OLS is an extension of the traditional method of least squares benefiting from the larger sample of data made possible by the panel. This extension has a positive impact on the accuracy of the estimators and the quality of statistical inference (Wooldridge, 2003). Given the assumptions for the empirical analysis and associated model (AE1 and AE2) the regression of the GAV and/or sales as a function of ISO certification and a set of control variables before mentioned was tried. The generic models will be, respectively, AE1 and AE2:

$$AE1: \quad GVA_{it} = Z_i^{'}\alpha + \beta_1 ISO_{it} + X_{it}'\theta + \nu_{it} \qquad (1)$$

$$AE2: \quad Sales_{it} = Z_i^{'}\alpha + \beta_1 ISO_{it} + X_{it}'\theta + \nu_{it} \qquad (2)$$

[4] Alternatively, we could have used a balanced panel. A panel of this kind implies that there is complete information for all the observations considered in this case would only be possible by eliminating some of the observations.

[5] For further details, check Greene (2003, pp. 289-290).

[6] As in this case, the non-availability of data over a long period discourages the use of methods of time series analysis as the GMM – Generalized Moment Method (Greene, 2003).

Where α is the vector of constants for each company, β1 the regression coefficient that reflects the estimated impact of ISO certification in the dependent variable and X a matrix of control variables that include, among other things, the assets. The composite error, only considering group effects are present, is given by

$$\varepsilon_{it} = a_i + \mu_{it} \qquad (3)$$

shows the error ε_{it} e associated with the estimated models, decomposing it into two parts: one component is not observed and is specific to each individual (i) and another has a perturbation stochastic character μ_{it}.

According to the hypotheses particular attention shall be granted to the analysis of the estimated coefficient $\hat{\beta}_1$:

$$\frac{\hat{\partial} Y}{\partial ISO} = \hat{\beta}_1 \qquad (4)$$

where it represents the estimated effect of ISO on company´s performance.

The choice of method pooled OLS is appropriate where the vector is actually a scalar, i.e., only contains a constant term common to all observations in the sample. However, it corresponds to a vector including non-observable components and specific individual. Thus, there is the disturbance term correlation with the explanatory variables which would have as consequence that the estimators obtained using pool OLS method would be inconsistent. This fact would be due to the violation of the classical hypothesis of correct specification model (the effect is not observed and it is not captured by the pool OLS method, constituting a problem of omission of relevant explanatory variables). In addition, pool OLS (as illustrated in the above graphic) ignores the evolution of the causal relationship estimating it over time. In other words, the method estimates pool OLS data panel, without considering the temporal evolution of the estimation.

Thus, the estimation through pool OLS, will be the best if the relationship between the variable explained and at least some of the variables, keep constant over time. It is also hoped that there are no features "individual - specific" that influence this relationship, or which due to the idiosyncratic nature, are not captured by any of the explanatory variables but only for a battery of dummy variables identifiable for each element of the sample (Wooldridge, 2003). Thus, instead of adding the information of the individual over time (and hold it in the estimation of the model) it is considered each observation in time as a different individual, returning an overall average.

b) Fixed Effects Model (FEM)

The fixed effects model (Anglo-Saxon terminology) instead of ignoring the temporal evolution of the relationship in each individual, tries to capture the idiosyncratic differences in the constant term. Thus, a sub set of regressions, that allow the estimation of a model that incorporates the average overall temporal evolution of the relationship between individual works and the information panel

data, is estimated. The implementation of fixed effects model assumes that there is an observation that no component is specific to each individual. To solve the violation of classical hypothesis already mentioned, the fixed effects model implemented in a similar manner to the technique of first differences in order to remove and replace the classical hypotheses, ensures consistency of the estimators. This process involves estimating a model transformed (as set out below) as an original generic:

$$AE1: \quad GAV_{it} = Z_i^{'}\alpha + \beta_1 ISO_{it} + X_{it}{'}\theta + \nu_{it} \qquad (1)$$

$$AE2: \quad Sales_{it} = Z_i^{'}\alpha + \beta_1 ISO_{it} + X_{it}{'}\theta + \nu_{it} \qquad (2)$$

Since the term a_i does not vary over time, its average coincides with the very term and the transformation nulls it.

$$AE1: \quad GAV_{it} - \overline{GAV_{it}} = Z_i^{'}\alpha - \overline{Z_i^{'}\alpha} + \beta_1\left(ISO_{it} - \overline{ISO_{it}}\right) + \left(X_{it} - \overline{X_{it}}\right)\theta + \left(a_i + \mu_{it} - (a_i + \overline{\mu_{it}})\right) \qquad (1')$$

$$AE2: \quad Sales_{it} - \overline{Sales_{it}} = Z_i^{'}\alpha - \overline{Z_i^{'}\alpha} + \beta_1\left(ISO_{it} - \overline{ISO_{it}}\right) + \left(X_{it} - \overline{X_{it}}\right)\theta + \left(a_i + \mu_{it} - (a_i + \overline{\mu_{it}})\right) \qquad (2')$$

Where the variables identified with the bar represent the average. Thus, the model turned the unobserved component eliminated. The transformed variables

$(\dot{VAB}_{it}, \dot{ISO}_{it}, \dot{\mathbf{X}}_{it})$ and respective model result in:

$$AE1: \quad \dot{GAV}_{it} = \beta_1\left(\dot{ISO}_{it}\right) + \left(\dot{X}_{it}\right)'\theta + \left(\mu_{it}\right) \qquad (1'')$$

$$AE1: \quad \dot{Sales}_{it} = \beta_1\left(\dot{ISO}_{it}\right) + \left(\dot{X}_{it}\right)'\theta + \left(\mu_{it}\right) \qquad (2'')$$

FEM seeks to eliminate the component not observed (a_i) included in the composite error v_{it} or u_{it},, re-establishing the classical assumptions necessary for OLS estimation. In particular, this procedure eliminates the term a_i which captures a set of omitted variables in the model and that could lead to the biased and inconsistent estimators, if there was any correlation between a_i and any of the explanatory variables used.

To prevent this and to get a certain consistency, the method of fixed effects transforms the model through the first differences found eliminating a_i, from the regression model.

In summary, FEM is preferable to pool OLS as an estimation of data panel because it considers the variation of each variable stratified by individual (company) and it leads to estimators that are always consistent. Compared with the standard random effects REM which is next described, the fixed effects model has the advantage that in addition to the consistency it enables statistical inference too. However, they may be less efficient if there is no correlation between the unobserved term and any of the explanatory variables.

c) Random Effects Model (REM)

The random effects model, is based on the assumption that the term non-observed which is individual-specific, is not related to any of the independent variables used. If this starting hypothesis is true, then the estimation by FEM (fixed effects model), although consistent, is not efficient. In contrast, REM estimators (random effects model) are consistent and efficient (Wooldridge, 2002, 2003).The advantage of using REM goes through this efficiency gain, but it is a risk, in the sense that if the initial hypothesis is violated, the estimators REM are not consistent. In contrast, the estimators FEM are always consistent. The higher efficiency results from this hypothesis underlying the model REM imports a significant reduction in the number of parameters to estimate when compared to the FEM method.

On a practical way, the implementation of this method assumes the continuation of a series of steps similar to those pre-estimation as a method FEM, with the nuance behind the hypothesis concerning a_i.

$$AE1: \quad GAV_{it} = Z_i^{'}\alpha + \beta_1 ISO_{it} + X'\theta + \nu_{it} \quad (1)$$

$$AE2: \quad Sales_{it} = Z_i^{'}\alpha + \beta_1 ISO_{it} + X_{it}'\theta + \nu_{it} \quad (2)$$

As a_i is a component of the composite error in each time period and there is a correlation over time, the REM method assumes that the estimation is done using the method of Generalized Least Squares (GLS) or the Method of the minimum least square – Feasible Generalized Least Squares (FGLS) if the variance is unknown (Park, 2006)[7]. Similarly to that performed in the previous case, the use of the method of random effects assumes the prior transformation of the model in order to eliminate the disorder in terms of correlation (Wooldridge, 2003). Thus, this transformation imports the following steps[8]:

$$AE1: \quad GAV_{it} - \lambda\overline{GAV_{it}} = Z_i^{'}\alpha - \overline{\lambda Z_i^{'}\alpha} + \beta_1\left(ISO_{it} - \lambda\overline{ISO_{it}}\right) + \left(X_{it} - \overline{\lambda X_{it}}\right)\theta + \left(a_i + \mu_{it} - \lambda(a_i + \overline{\mu_{it}})\right) \quad (1''')$$

$$AE2: \quad Sales_{it} - \lambda\overline{Sales_{it}} = Z_i^{'}\alpha - \overline{\lambda Z_i^{'}\alpha} + \beta_1\left(ISO_{it} - \overline{\lambda ISO_{it}}\right) + \left(X_{it} - \lambda\overline{X}_{it}\right)'\theta + \left(a_i + \mu_{it} - \lambda(a_i + \overline{\mu_{it}})\right) \quad (2''')$$

This transformation leads to a multivariate linear regression model in which the problem of correlation is eliminated, allowing an efficient estimate by OLS.

d) Pool OLS, FEM, REM – which to adopt?

As before mentioned, OLS pool method in practice results from the application of the application of this method to a sample juxtaposed for various

[7] This problem can be solved using the GLS. However, these aspects go beyond the necessarily limited range of this thesis and a more detailed analysis can be found in Wooldridge (2003, pp. 470-473).

[8] $\lambda = 1 - \left[\sigma_u^{\,2} / \left(\sigma_u^{\,2} + \sigma_a^{\,2}\right)\right]^{0,5}$

periods. The methods FEM and REM (which in their estimation consider the temporal evolution of the causal relationship in each individual) conduct, if there are indeed effects of group that capture the idiosyncratic characteristics, to more efficient estimates.

In the case of this research, considering the defined specifications, it is expected that there is no correlation between the observed and intrinsic component of the company and any of the explanatory variables. The ultimate performance of an organization reflects, in addition to structural features, idiosyncratic aspects that sometimes are not perfectly grasped by the chosen variables created to explain them. According to this, the fixed effect models will be used. There are a set of statistical procedures and tests that contribute to a greater security in the decision making and that, as shall be seen in the results part, will confirm this option. Thus, the first test of statistical analysis implemented in this practice is the F-test or global significance. This test seeks to infer the statistical significance of the artificially set of dummies created to capture the individual-specific effects in panel data. The null hypothesis assumes that these dummies are zero and, as such, there would be no statistically significant idiosyncratic characteristics that should be taken into account in the estimation process. In case of rejection of this null hypothesis, this implies that there are indeed effects of group and thus FEM outlays more efficient estimators. In addition one might consider also the test of the Lagrange Multiplier (LM). Analogously to the F test, this test considers the analysis of the significance of the dummy model compared to the method underlying the REM (where there is no correlation between the individual-specific component and the independent variables which leads to an estimated transformed model different from the FEM). Finally, to test if whether a_{ir} or w_t are correlate or not, with the explanatory variables and thus opt for the method FEM or REM method, the Hausman test was performed. The Hausman test compares the fixed effects model with the random effects model, assuming as a null hypothesis that the component is not observed and specific to each individual and did not correlate with the regressors of the model (Hausman, 1978; Park, 2006). If there is evidence of correlation, the null hypothesis is rejected and one should opt for the fixed effects model because the random effects model would produce inconsistent estimators. If the null hypothesis is not rejected, then it is preferable to adopt the random-effects model because it leads to consistent estimators and more efficient than the ones obtained by the method of fixed effects (Greene, 2003). In this analysis there are theoretical reasons that support the choice of the fixed effects model - statistical tests. The relationship between quality performance does not translate a clearly defined role in the theory, so that one might say that all structural parameters that contribute to it are fully consolidated. Accordingly, and given the restrictions imposed by the available data, it is not possible to model a complete listing that captures all of these structural effects. Usually idiosyncratic aspects are captured by the effects of group, something that allows to identify individual characteristics of each company and which favor the choice of FEM or REM.

Considering the eventual inefficiency of the model, the probability of correlation between the non stochastic component of the error and any of the independent variables, would result in the non-validity of the statistical inference.

Thus a more conservative and safe approach was undertaken, selecting a method that cannot produce more efficient estimators and therefore allow statistical inference. Moreover, as already mentioned, the statistical means intended to assist in this choice, mainly Hausman – test, have a high overall statistical test, indicating that for significance levels usually taken as a reference, the fixed effects model is in fact preferable and shall be used in the estimates of the models in this research.

e) The theoretical hypotheses

It is recalled that in the present investigation the influence of ISO 9001 on the performance of the organization is to be evaluated. A model of regression considering GAV (as a proxy of management performance and non-financial performance) and Sales (as a proxy of financial performance) was defined. Thus, the generic models presented - (1) and (2) – are respectively

$$AE1: \quad GAV_{it} = Z_i^{'}\alpha + \beta_1 ISO_{it} + X_{it}'\theta + \nu_{it} \qquad (1)$$

$$AE2: \quad Sales_{it} = Z_i^{'}\alpha + \beta_1 ISO_{it} + X_{it}'\theta + \nu_{it} \qquad (2)$$

Based on the models above described several sub-models were estimated, using alternative control variables, in order to disguise the possible overestimation of the impact of ISO and a further evidence as to the robustness of the results. To evaluate the non-financial performance of ISO 9001, a regression was made on three versions of model (1) trying to capture the impact of certification on Gross Value Added (GAV) and / or productivity (GAV / Workers), controlling the scale of operation of enterprises measured by the assets.

$$AE1-Mod.1: \quad VAB_{it} = \beta_0 + \beta_1 ISO_{it} \qquad (1.1)$$

$$AE1-Mod.2: \quad VAB_{it} = \beta_0 + \beta_1 ISO_{it} + \beta_2 Activo \qquad (1.2)$$

$$AE1-Mod.3: \quad \Pr odutividade_{it} = \beta_0 + \beta_1 ISO_{it} + \beta_2 Activo + \beta_3 Vendas \qquad (1.3)$$

Theoretically, it is expected that the impact of ISO 9001 is positive, whether as to GAV or as to productivity. It is also expected that GAV and productivity are higher in large scale organizations because they have size to be more productive. That is, it is expected that the assets has a positive impact on the GAV and productivity due to a larger scale of operation which would enable greater economies of scale and thus greater ability to create value. Similarly, to assess the financial performance of ISO 9001, a regression on three versions of the model (2) was considered. Its objective is to capture the impact of certification on the volume of sales and assets controlled by the company's productivity. It is expected that companies with a larger scale of operation and, consequently, greater production capacity, have larger sales volume, as well as productivity should have a positive impact on the company's competitiveness and, consequently, in its sales volume.

In order to estimate the effects of ISO 9001 certification on the performance of an organization, other regression models were considered:

$$AE2-Mod\,1: \quad Sales_{it} = \beta_0 + \beta_1 ISO_{it} \tag{2.1}$$

$$AE2-Mod\,2: \quad Sales_{it} = \beta_0 + \beta_1 ISO_{it} + \beta_2 Assets \tag{2.2}$$

$$AE2-Mod\,3: \quad Sales_{it} = \beta_0 + \beta_1 ISO_{it} + \beta_2 Assts_{it} + \beta_3 \Pr oductivity_{it} \tag{2.3}$$

As concerns testing hypotheses, it is well known from literature that certification should influence positively the market and it is expected that the estimate for β1 is positive for both sectors.

In model 2.3 it was included in addition to the assets, the productivity which means a way of evaluating the efficiency of enterprises and the extent to which the assets could induce workers' productivity. It has been tested as well whether this could also influence the volume of sales reflecting a higher added value.

Using the two samples (sectors of activity) as a source, the method of fixed effects selected on the basis of the taken theoretical assumptions and on the results of the achieved statistical tests (Hausman, LM, and F), the templates 1.1, 1.2, 1.3, 2.1, 2.2 and 2.3 were estimated for each sector, thus presenting the inherent results.

f) Results of the estimation.

4. Results

4.1. Results for the construction sector

Table 2[9] presents the estimation results for the construction sector. The model 2.1, containing one only explanatory variable - ISO certification, shows an impact estimated in more 28 million Euros than non certified companies. This impact decreases slightly when the control variable through the firm size, the combination of ISO and assets is effected (model 2.2).

As to the effect of ISO certification, it is estimated that certified companies observe an average turnover of more than 25 million Euros as to the companies that are not certified. This value is statistically significant at 5% of the estimation; it is similar also, in model 2.3, where the introduction of variable productivity proved to be not statistically significant.

These estimates confirm the theoretical hypothesis of an effect of an external motive for certification. This process seems to enhance the visibility of the company through quality and the value assigned by customers relying on quality assurance (noting that this perception is progressively promoting the development and acquisition of certified companies in the sample).

[9] The table shows the test of statistics that explain the option for FEM.

In model 2.2 it was observed (by analyzing the results of the estimation) that the firm size/ scale of operation, being the assets a proxy, is also relevant, confirming that the scale of operations/firm size is associated with sales volume.

Table 2. Estimated results for the construction sector

		AE2			AE1	
	Model 1 Dep. Var.: Sales	**Model 2 Dep. Var.: Sales**	**Model 3 Dep. Var: Sales**	**Model 4 Dep.Var.: GAV**	**Model 5 Dep Var.: GAV**	**Model 6 Dep. Var.: Productivity**
Independent Variables						
Certification ISO	27.6524**	25.2837**	25.6922**	1.79947	1.47595	2940.911
Assets		0.25237***	0.24982***		0.05762***	0.000050
Productivity			192.658			
Sales						0.000032
Constant	103.479			24.2671***		
R^2 adjusted	0.83125	0.86788	0.86867	0.56603	0.59325	0.19234
Test F	496.390***	10.4120***	10.5440***	6.414***	2.693***	1.947***
Chi-square	21.349***	354.591***	353.703***	219.164***	150.554***	117.888***
LM – test	466.68***	119.06***	117.590***	210.49***	14.93***	6.62**
Baltagi-LI LM	240.14***	61.26***	63.41***	108.32***	7.68**	3.40
Hausman	1.0	10.11***	11.58***	0.2	8.85**	1.84
NT	241	241	241	241	241	241
Model	REM	FEM	FEM	REM	FEM	FEM

Notes: statistic significance *** a 1% ** 5% * 10%.

In model 2.3, the relationship of ISO 9001 with the variable sales, introducing as control variables the asset and the productivity, was recorded. As to these last items the estimated models did not point their statistical significance. As concerns the assets, the estimation results indicate that the relationship between firm size, measured by assets and sales, is positive. In this case, it is estimated that, under a caeteris paribus assumption, a company whose assets increases by 1 million Euros register sales increase by 0.25 million. In fact, the larger companies are the more interested in marking their presence in the most technologically advanced and demanding market segments.

As regards the estimation of the multivariate regression model created to assess the internal impact of ISO, it is observed that both in terms of GAV (models 4 and 5) and in terms of productivity (model 6) the estimation results indicate a non statistical significance of ISO 9001 at 10% significance level. This suggests that, at least in the context of the construction sector, where there are the largest companies, ISO is not a factor inducing greater productive efficiency. It is nevertheless important to clarify that this does not necessarily imply that ISO certification process has no positive impacts on productivity. The size of firms of the sample, the fact that some companies that are not quality certified possess technological skills and expertise in the fields of construction of high specialization, these are reasons that may contribute to distort the potential impact of certification. Regarding the control variables, in Model 5, it is registered that the Assets is statistically significant. As to the this variable, we observe a positive relationship between the size (through the value of Assets) and GAV estimated at about 6 cents for each additional euro of assets, indicating that there is a significant positive relationship between the scale of operation/size and the GVA which may possibly explain the exploitation of economies of scale.

As to the results of estimation of model 6, the use of productivity as an alternative dependent variable did not result in a better adjustment. On the contrary, this model 6 presents a low quality adjustment (also in the case of models 4 and 5 quality adjustment was not high) resulting in a lower adjusted (chi square) R2, enabling the ability group explanatory model and variables, individually, to be considered statistically insignificant.

In brief and according to the above estimates, one can conclude that ISO impact is more visible on the external side of the organization than on the internal one. The market seems to demand quality requiring it as a matter of assurance. Larger companies that operate in markets with higher levels of demand assume certification process as a requirement. Thus this process, in these companies, does not mean a big gain on efficiency (internal effect). Moreover, the model 6, after introducing the control variable sales whose high correlation with the independent variable assets makes it hard to get a consistency within the estimators.

4.2. Results for the sector of the Agro-food

Table 2 summarizes the results for the Agro-food industry. The results of the estimation done from the fixed effects model for this industry sector denote a good quality adjustment with a (chi square) R2 adjusted presenting high values in several models. As to ISO 9001 there is a significant positive relationship between the certification of companies in the food industry and its sales volume. Specifically, the model estimates that, under caeteris paribus assumptions, a certified company gets more 30.7 million Euros in sales than a company which is not certified. This is a higher absolute value than the one registered in the construction sector. The external visibility or assurance arising from a certification are highly valued in this particular market. Considering the assets, model 2 shows

that, the relationship between certification and sales remain relevant, and it is estimated that any certified company enables more 29.7 million in sales than a non certified company. Besides, companies with a greater scale of operations have higher sales volume, but the relevance of the assets as an explanatory variable assumes lower values than the verified in the construction sector.

In model 3 it was introduced the variable productivity in order to analyze if the better efficiency of firms influences the volume of sales. It was found that not only it was not significant in this sector (as happened in the construction sector) as well as the model presents little interest as to its explanatory capacity. The estimation results of Model 3 reveal that certification is no longer significant, decreasing the explanatory power of the variable assets. The gains in (chi-square) - R2 are marginal and probably they do not reflect the best adjustment but, they mean, the statistical effect of the degrees of freedom reduction due to the introduction of an additional variable.

Table 2. Estimated results for the Food sector

		AE2			**AE1**	
	Model 1 **Dep. Var Sales**	**Model 2** **Dep. Var. Sales**	**Model 3** **Dep. Var. Sales**	**Model 4** **Dep. Var. GAV**	**Model 5** **Dep. Var. GAV**	**Model 6** **Dep. Var. Productivity**
Independent variables:						
Certification ISSO	30.705**	29.727**	10.5447	10.7968**	0.3745	-0.01092
Assets		1.09247***	0.72082***		0.18726***	0.000131***
Productivity			25.9504			
Sales						0.0000276
Constant				16.487***		62896.07***
R^2 adjusted	0.80321	0.925978	0.979268	0.870336	0.955900	0.959766
Test F	36.095***	51.851***	51.552***	25.666***	24.698***	95.94***
Chi-square	394.234***	448.442***	448.857***	345.795***	341.624***	542.153***
LM – test	266.68***	248.19***	247.64***	193.81***	200.71***	16.02***
Baltagi-LI LM	192.84***	179.77***	179.07***	140.15***	145.14***	11.58***
Hausman	1.52	9.76***	9.95**	2.26	9.85***	1.02
NT	157	157	157	157	157	157
Model	FEM	FEM	FEM	REM	FEM	REM

Notes: statistic significance: *** a 1% ** 5% * 10%.

As regards the estimation of the multivariate regression model to assess the internal impact of ISO 9001, it is observed that for all certified companies evidencing sales value close to the average or above the sector average, the impact of ISO on GAV is significant (model 4) considering a significance level of 5%. It is also estimated that ISO will have a positive impact on GAV of around 1 million Euros. In models 5 and 6 (the latter uses as an alternative the dependent variable productivity) ISO is not significant at a 10% level, though in this model 5 significance is reached for a level of 15%. Regarding the control variables, the assets working as proxy of company size, is statistically significant at 1%, and really estimated a significant positive relationship between assets and GAV. In model 6 it was introduced the control variable Sales but the high correlation of this variable with the variable Asset jeopardizes the consistency of the estimators. The choice of model of fixed effects and variable effects is due to the tests of Hausman and Lagrange, similarly as performed for the construction industry.

Conclusions

The estimation results above described show some differences across sectors. On one hand, it is observed that ISO 9001 has a positive external effect observed in the volume of sales in the Agro-food industry. Moreover, the tight control and hard regulation in force about this sector of activity make it somehow critical to this particular market, estimating an impact relatively larger, in absolute value, in this sector than in the construction one. However, along the period under review in the construction sector, one must refer the growing number of certified companies in the sample. Internally, the combination of the process of quality to performance in both sectors is less clear. In the construction sector as to quality certification, using as proxies the variable ISO 9001 and as consequent performance - GAV and productivity - it is observed that ISO is not statistically significant. In the agro-food sector, certification is relevant to a significance level of 10%, and just in model 3/ GAV/ISO 9001 (what does not happen in the construction sector).

In brief, in the case of the construction sector the econometric model evidenced a positive impact of certification on sales, therefore H2 was confirmed. On the contrary, the impact of ISO 9001 certification on performance – considering GAV and productivity – was not statistically relevant (H1 cannot be accepted). As to the Agro-Food sector it was evidenced that ISO 9001 certification has a significant effect on sales, confirming H2 and, similarly, it was evidenced that certification was also relevant at a significance level of 10%, but only as referred to GAV, then H1 was only confirmed in part.

In other words, it was confirmed that ISO 9001 certification has a positive effect on sales volume and it should be noted that in the Agro – food industry, this effect is more significant than in the construction one. As to the level of internal performance using GAV and productivity, it is observed that ISO 9001 is not statistically significant, GVA in the agro-food sector, where the certification is

relevant, but, at a significance level of 10%. Productivity is not statistically significant in both sectors. Along this study it was mentioned that it would be interesting to see if the increased sales motivated by ISO 9001 corresponded to increases in net profits of the organization. One must refer that this hypothesis has been tested by means of analysis of the selected database, but the results were inconsistent. So it seems that it may not be said from this empirical study, that ISO certification is directly related to the net profit of the organization. Therefore, this study revealed mixed results and in brief it evidences that it may not be deterministically ascertained, that there is a direct connection between ISO 9001 certification and the improvement of business performance. It depends on many other variables besides the ones mentioned along this research.

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