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Exploring the Link between Environmental Practices and Financial Performance: An Empirical Study

ABSTRACT

Ongoing environmental deterioration has led governments and other institutions to pay closer attention to pollution problems as pollutant emissions can significantly influence and constrain economic growth. Most countries on the American continent use the ISO 14001 standard and the number of new certifications grows year by year. This work empirically explores the influence of environmental management system based on ISO 14001 certifications upon the financial performance of Colombian companies, 133 ISO 14001 certified and 5,036 non-certified firms. A panel data analysis over three years was the data analysis method. This work studied the financial performance of the companies implementing EMS compared to those that did not in one of the most important Latin American economies (Colombia). It was found that a positive relationship exists between the ISO standard and financial performance measured through the companies' Return on Assets (ROA).

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INTRODUCTION

Growing environmental impacts generated by industrial production has given rise to a concern within organizations for addressing environmental management actions through voluntary practices including environmental management systems. Changes in societal values, beliefs and norms have given corporations a different understanding of their role in society. Stakeholders are pressuring companies to earn the trust of the public that demands environmental measures and actions. For instance, society, customers and non-governmental organizations (NGOs)- as stakeholders- place special emphasis on the social purpose of corporations. These groups demand socially responsible behavior from corporations, such as the introduction of eco-efficient products and attention to ethical and environmental concerns for legitimation before stakeholders (*Shrivastava and Guimarães-Costa 2017*).

In recent decades, pressure on companies from different stakeholders, including investors, consumers, and environmental regulations has intensified, making environmental impact concerns a priority for companies. Environmental practices have become a relevant competitive factor, since customers demand eco-efficient processes as criteria for consumption (*Lucato etal. 2017*). Ongoing environmental deterioration has encouraged governments and other institutions to pay closer attention to pollution problems as pollutant emissions significantly influence and constrain economic growth (*Jiao et al. 2014*). Thus, managers have begun developing strategies and social-economic measures to adopt more sustainable practices (*Hikichi et al. 2017*). With regards to this, *Kawata* (*2011*) found that the most efficient environmental policies are those that consider population preferences and opportunity costs. According to *Kawata* (*2011*), people's preference will be greater as their understanding of the need for environmental conservation improves and it is easy to control. *Kawata* (*2011*) suggested that adjustments in preferences will be the key to environmental conservation.

Technologies and processes that do not prevent pollution should be replaced by sustainable production processes and environmental management systems that help reduce negative environmental impacts. Therefore, not only is compliance with environmental regulations in specific contexts important, including taxes on industrial wastewater discharges or environmental licenses for a specific project, but also other actions including voluntary practices that improve company performance and

environmental management. Only in recent years have countries like Colombia, Ecuador, Chile and Peru, on the American continent, shown greater interest in certification. For example, Colombian companies have been at the forefront of the International Organization for Standardization (ISO) 14001 standard over the last ten years. With 3,453 certifications in 2014, Colombia ranked second only to the United States in the number of companies with certifications in the continent (*Hikichi et al. 2017*).

One of the most widely used environmental practices among companies is the implementation of an environmental management system through certification under the ISO 14001 standard (*Heras Saizarbitoria and Arana Landín 2011*), and the number of organizations that have adopted this certification has grown over the years (*Hikichi et al. 2017*).

The case of Colombia is especially notable due to the rapid expansion of the ISO 14001 standard among companies in the country. In 2000 it had 21 certified companies and had reached around 3,000 in 2016, with an annual average growth of 25%, the highest in the region for the 2000-2016 period. It is therefore evident that there has been great interest in obtaining ISO 14001 certification in Columbia (*ISO 2015a*) (**Figure 1**).

The five sectors with the highest number of ISO 14001 certifications throughout the American continent in 2014 were basic metal and manufactured metal products, construction, chemicals, chemical products and fibers, transport, storage, and communications, electrical and optical equipment, all of which are sectors with an important environmental impact (*Hikichi et al. 2017*).

In Colombia, the sectors with the most ISO 14001 certifications were construction, transport, storage, and communication and engineering services (*Hikichi et al. 2017*). Overall, the ISO 14001 standard is used in most countries throughout the Americas, and the number of new certifications is increasing year by year (*Hikichi et al. 2017*). Moreover, "ISO 14001 is widely recognized to be a vital part of the international environmental management movement and an important index for gauging the international competitiveness of enterprises" (*Lin and Liu 2011*). This work empirically explored how Environmental Management Systems (EMS) based on ISO 14001 influence the financial performance of Colombian companies. Environmental management systems are defined as "soft environmental policy instruments in contrast to less flexible instruments. These are regulations that represents an organizational

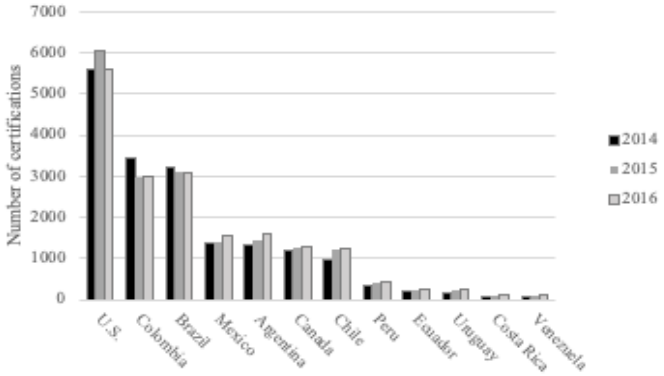

Figure 1. Number of companies certified under ISO 14001 in South America (Source: *ISO 2015a*).

change and a self-regulation effort on the part of businesses that consist of defining a set of formal environmental policies, goals, strategies and administrative procedures aimed at improving the environmental performance of the organization" (*Amores-Salvadó et al. 2015*).

Theoretical Background and Hypothesis Development

An increasing number of studies have tried to evaluate the relationship between environmental management and business performance in companies from an empirical point of view; however, the results obtained have been generally inconclusive (*Heras Saizarbitoria and Arana Landín 2011*). *Lucato et al.* (*2017*) studied this relationship in micro, small and medium Brazilian textile companies and recognized that there is a lack of unanimity reported in the literature, with which their own work is aligned. Along these same lines, *Bartolacci et al.* (*2018b*) found a positive relationship between separate waste collection and financial performance in 880 Italian waste management companies, but this relationship can be negatively affected by municipal territorial extension and logistics costs.

Enterprise performance is defined as "the degree to which the enterprise has satisfied its objective(s), and the resource use situation facing the enterprise, which respectively indicates enterprise effectiveness and efficiency" (*Lin and Liu 2011*). Other authors consider that financial performance evaluation indicators aredirectly related to corporate financial goals such as debt ratio and return on assets (*Vatavu 2015*). Financial performance is defined as "a construct emphasizing the profitability and growth of the firm" (*Judge and Douglas 1998*). The Return on Assets (ROA), Return on Equity (ROE), and Return on Investment (ROI) ratios are used for measuring financial performance (*Santis et al. 2016*).

The ISO 14001 environmental management system

standard detects the environmental aspects of activities, products or services of different types of organizations, reducing the environmental impact of their main outputs including products, activities, or services (*Lin and Liu 2011*). Therefore, an effective environmental management system enables developing conditions to achieve overall continuous improvement of the management system (*Hikichi et al. 2017*). ISO 14001:2015 seeks to reinforce the link between the company's internal strategies and environmental protections, and incorporates a product or service life-cycle perspective (*ISO 2015*) into a voluntary scheme. ISO 14001 is used to help organizations or companies to establish their own management systems and is not focused on obliging them to comply with regulations to reach specific objectives (*Lin and Liu 2011*).

From the theory, an environmental management system and other voluntary practices are related to the resource-based theory, which supports proactive environmental strategies, as mentioned by *Cañón de Francia and Garcés Ayerbe* (*2006*). For instance, *Sharma and Vredemburg* (*1998*) state that the greater the degree to which a company adopts proactive strategies, the greater the likelihood that specific company capabilities will be created, and the higher their degree of development, and the greater the probability of benefit associated with such capabilities. For example, an effective waste management system could drive production of "secondary raw materials" which can improve corporate finances (*Bartolacci et al. 2018a*)

With 154,000 certificates issued worldwide by the end of 2007, and close to 50% growth between 2004 and 2007 (*ISO 2008*). Studies have been performed analyzing the positive results of ISO 14001 implementation, however, others have criticized the implementation of this standard, specifically when it does not translate into important improvements in an organization's environmental performance (*Ferrón Vílchez 2017*). Moreover, while *Lin and Liu* (*2011*) state there is no clear relationship between environmental management systems and corporate financial performance; other scholars argue that a positive relationship exists, while others state that it is inconclusive. Thus, this work attempts to analyze a potential relationship between implementation of the ISO 14001 standard and the financial performance of companies in Colombia. Based on these arguments, the following hypothesis was established: There is a positive relationship between the ISO 14001 certification and its impact on the improved financial performance of companies.

MATERIALS AND METHODS

Data Description

This empirical investigation used financial data for 2014, 2015, and 2016 found in the business process reengineering (BPR) Benchmark database. This information was obtained from Euromoney Institutional Investor (EMIS). The companies were from the agricultural, infrastructure and construction sectors in Colombia.

The interest of the selected sectors in ISO 14001 certification is described by *Christini et al.* (*2004*): "Construction firms are realizing that environmental management is a primary key to their success. These sectors understand that it is imperative to eliminate or minimize harmful environmental impacts from construction and ISO 14001 allows construction firms to determine what EMS level is right for their organization, so they can maintain an even balance between costs and benefits".

The random sample used included 5,169 companies from different regions around Columbia. The information on ISO 14001 certification was obtained through one of the main certification entities in Colombia. It should be mentioned that, in recent years in Colombia, 133 companies in the sample implemented ISO 14001 according to the Colombian Institute of Technical Standards and Certification (ICONTEC, in Spanish). This study used total assets to classify company size and the Colombian Law 905/2004 as an indicator to measure enterprise size and classify companies into sectors according to the information presented on the BPR Benchmark database. Thirty-four different sectors were considered for analysis, out of 65 sectors in the database. The sectors that did not have at least one company with ISO 14001 certification were discarded to ensure an efficient comparison between sectors. The sector with the highest number of companies was the engineering and civil works with 973 uncertified an28 ISO 14001 certified companies. Companies with missing or zeroed financial indicators were removed from the dataset to ensure data viability. Regarding measures of financial performance, the indicators used in this research were: Return on Assets (ROA), Total Assets, Current Assets, Asset Ratio, companies holding ISO 14001 certification and uncertified firms.

The panel data analysis method was used for analyzing the data over three years. The Ordinary Least Squares (OLS) and the Between Estimator and Random Effect models were used, which allow controlling for the

effects of the individual enterprises upon which these models were applied. Extensive financial information was obtained from the *BPR Benchmark* (*2017*) - EMIS Benchmark database for almost 28,246 Colombian companies for 2014, 2015 and 2016.

The original database contained 73 variables with the following information: The first 19 cells of information are set aside for the company description (name, tax identification number, activity description, address, etc.). The remaining 54 columns are divided into three large groups: Balance sheet information, Performance information and financial status: information such as ROA (Return on Assets), ROE (Return on Equity), and Results statement.

These data were filtered to adjust to theoretical requirements and to avoid biases in the estimates. First, the units of analysis were defined as companies operating in Colombia and located in its main geographical regions. Five regions were selected to limit the study's scope: Antioquia, Atlántico, Cundinamarca, Bogotá D.C, and Valle del Cauca (*DANE 2017*). Second, the companies included in the study either belongs to productive sectors such as agribusiness, construction, and manufacturing, or are highly related. Third, companies that did not provide complete information were eliminated. Given the nature of a large database, some companies were lacking information and this can cause bias.

To increase data reliability (liability) and avoid bias issues in the estimates, companies that had, for any of the three years, any variable with no value (value missing), or values that were exactly zero in variables where a value of zero should not appear (such as assets, sales or profits), were removed from the database (for all three years). The database classified companies into 64 sectors, 30 of which were filtered out because companies were not ISO-certified. Thus, this research ultimately considered 34 sectors. These 34 sectors were grouped into eight macro-sectors by economic affinity. Sample distribution was not uniform between sectors but resembles the distribution of the population as a whole.

Sector distribution is presented by *Hikichi et al.* (*2017*), where the main sectors with companies that are certified under ISO 14001 are Construction, Transport, Storage, and Communication and Engineering Services, based on data from 2014. In terms of size, ISO-certified companies have higher levels of absolute variables on average, including assets, equity, profits, taxes, etc. This bias is also consistent with the characteristics of the population, wherein ISO 14001 certified companies also tend to be the largest ones.

The observations include information of the companies for the years 2014, 2015 and 2016. The test concludes that the average difference in Return on Assets (ROA) (financial performance metric, to be detailed in the next section) between certified companies and uncertified companies is both statistically different from zero and negative. This means that certified companies have a higher level of ROA on average than non-certified companies. In addition, the Wilcoxon-Whitney-Mann test (non-parametrical) concludes, similarly, that there are significant differences between the two groups.

Description of Variables

In this study, the Return on Assets is the endogenous variable, ISO 14001 certification is the exogenous variable, defined as a categorical variable, while the Asset Ratio is a control variable, and the sector is a categorical variable. These variables are further described below:

Return on Assets (ROA). The ROA is used in the literature as a common indicator of financial performance, together with other variables such as ROE (Return on Equity), ROI (Return on Investment) (*Santis et al. 2016*) and ROS (Return on Sales), among others. ROA is the most appropriate performance indicator for this field of analysis and is defined as:

$$\text{ROA}_{it} = \frac{\text{EBITDA}_{it}}{\text{Total Assets}_{it}} \quad (1)$$

Where EBITDA (Earnings Before Interest, Taxes, Depreciation and Amortization) represents the profits of the fiscal year before allocating expense items for interest, depreciation, amortization, and taxes. This ratio shows how much profit is obtained for each Colombian Peso (COP) employed in assets. Thus, it measures the company's efficiency for profit generation. The reason EBITDA is used and not Net Income (final results of the year), is that net profits are affected precisely by interest, taxes, amortizations and depreciations that are relatively external to a company's productive performance (*Ferron et al. 2012; Jewell and Mankin 2011*).

ISO 14001 certification (ISO). The ISO variable is defined as a categorical (dummy) variable as follows:

$$\text{ISO}_{it} = \begin{cases} 1, & \text{If company } i \text{ has ISO 14001 certification in year } t \\ 0, & \text{Otherwise} \end{cases}$$

The ISO variable has a value of 1 if the company has ISO 14001 certification in September 2017 and a value of 0 if the company did not have ISO 14001 certification.

Control variables

Asset Ratio (AR). The asset ratio (Asset Ratio) is calculated as the proportion of fixed assets over total assets (*Vatavu 2015; Lazăr 2016; Işık 2017; Nunes et al. 2009*):

$$\text{AR} = \frac{\text{Fixed Assets}}{\text{Total Assets}} \quad (2)$$

This variable allows controlling for company characteristics that affect financial performance, specifically the effect that arises from its structural composition. Additionally, this variable is important since it provides a lot of information related to a company's productive conditions. In the literature, the AR is used as an indicator of financial performance, and therefore is generally considered relevant for determining ROA.

According to results published by *Vatavu* (*2015*), *Lazăr* (*2016*), *Işık* (*2017*) and *Nunes et al.* (*2009*), an inverse relationship should be expected between the AR and the ROA, as companies that increase their proportion of fixed assets over total assets reduce their benefits in the short term to increase them in the long term.

Sector (SECTOR). The variable sector is a categorical variable with the following definition:

$$\text{SECTOR}_j = \begin{cases} 1, \text{ if company } i \text{ belongs to sector } j, j = 1, 2, 3, \ldots \\ 0, \text{ otherwise} \end{cases}$$

This study considers 34 sectors distributed into eight large categories as previously indicated. The base value for this set of dummy variables will be Engineering and Construction as it is the largest sector, and is expected to be one of the most relevant in terms of the relationship between financial performance and ISO 14001 standard implementation. Specifically, the coefficients resulting from a series of variables will show how the ROA of each sector j differs from the base value (**Table 1**).

This study aims to analyze the relationship between the Return on Assets and the ISO 14001 standard and, due to the fact that the database used contains three years of financial information on the Colombian companies, a panel data analysis is suitable for this estimation.

RESULTS AND DISCUSSION

Exploratory Data Analysis

The average of the ROA variable is 0.11 (11.23%), which shows that most of the companies in the sample have relatively good financial performance (**Table 3**).

The distribution of ROA values is relatively concentrated as shown by the percentiles. The variable has values between -3.5293 and 2.7269, however 50% of the sample is concentrated between 0.04 and 0.17. In other words, 50% of the sample is concentrated in 2.04% of the range occupied by the variable.

On average, 39.62% of the companies' total assets are fixed assets. In other words, these assets cannot become liquid in less than a year. The variable has a relatively normal degree of concentration. The ISO variable is already defined as a categorical variable with values between zero and one. The mean represents the proportion of values of "1" over *t* companies implement ISO 14001. Of the 133 certified companies, Engineering and Civil Works is the sector with the highest proportion (28 companies) followed by Special Businesses (10 companies) and Chemicals and Derivatives (9 companies).

Sectoral Distribution of Companies Certified under ISO 14001

It can be seen that this distribution has some differences compared to the overall sample distribution. Certified companies are in general, have the greatest potential to affect the environment because of their field of operations. The main sectors were: Engineering and Civil Works with 28, Special Businesses with 10, Chemicals and Derivatives with nine and Metal-mechanical with eight. Some sectors stood out for not being as certified as they should be. This is the case of both Basic Mining and Oil Exploration and Exploitation where only 1 company in each sector has been certified. In these particular cases, it is important to remember that this ISO standard is voluntary and is not designed for high impact sectors, as is the case of the latter two. High impact sectors usually fall under mandatory compliance standards, including environmental regulations (**Table 4**).

Correlation

Due to the heterogeneity of the sample, high levels of correlation between the variables were not expected (**Table 5**). However, according to the literature studied (*Vatavu 2015; Lazăr 2016; Işık 2017; Nunes et al. 2009*), some signs of correlation are consistent with expectations. Specifically, an inverse relationship was expected between the Return on Assets and Asset Ratio variables.

Table 1. Sample distribution of dataset of companies by sector from 2014-2017 in Columbia.

Aggregate Sectors	Companies	Percentage	Specific Sectors	Companies	Percentage
Agroindustry	500	9.67	Processed foods	239	4.62
			Sugar	159	3.08
			Fats and oils	40	0.77
			Dairy products	62	1.20
Construction	1650	31.92	Engineering and Civil Works	1001	19.37
			Cement and Concrete	62	1.20
			Construction and Building	559	10.81
			Brick, Veneers and Floors	28	0.54
Automotive industry	114	2.21	Auto parts and spare parts	24	0.46
			Bodyworks and Autoparts	38	0.74
			Automotive Assembly	52	1.01
Light industry	864	16.72	Rubbers and Derivatives	38	0.74
			Apparel	128	2.48
Mining and energy industry	225	4.35	Exploration and Oil Exploitation	63	1.22
			Basic Mining	78	1.51
			Oil services	84	1.63
			Iron and Steel	47	0.91
			Specific sectors	**Companies**	**Percentage**
Heavy industry	724	14.01	Special Manufactures	255	4.93
			Machinery and equipment	83	1.61
			Materials and Equipment	84	1.63
			Metal-mechanic industry	255	4.93
Chemical industry	269	5.20	Pharmaceutical laboratories	112	2.17
			Chemicals and Derivatives	157	3.04
Environmental sanitation	18	0.35	Environmental Sanitation	18	0.35
Services	805	15.57	Special Business	805	15.57
Overall				5169	100

Table 2. Difference of means Return on Assets by ISO, all sectors from 2014-2016 in Columbia.

ISO	Observations	Mean	Standard Error	Standard Deviation	Confidence Interval	
0	15108	0.111864	0.0012181	0.1497271	0.1094765	0.1142519
1	399	0.129933	0.0051102	0.1020768	0.1198866	0.1399794
Combined	15507	0.1123291	0.0011943	0.1487178	0.1099882	0.11467
Difference	-0.0180689			0.0075417	-0.0328515	-0.0032862
Dif. = mean group (0) – mean group (1)	Ho: Difference = 0					
Ha: Difference < 0	Ha: Difference not equal to 0				Ha: Difference > 0	
Pr(T < t) = 0.0083	Pr(|T| > |t|) = 0.0166				Pr(T > t) = 0.9917	

Table 3. Descriptive statistics of variables, all sectors in 2014-2016 in Columbia.

Variable	Observation	Mean	Std. Dev.	Min	25th Percent	50th Percent	75th Percent	Max
Return on Assets	15507	0.1123	0.1487	-3.5293	0.0408	0.0989	0.1745	2.7269
Assets Ratio	15507	0.3962	0.2710	0.0000	0.1638	0.3676	0.5990	0.9999
ISO	15507	0.0257	-	0	-	-	-	1

Model

This study considered the following functional form:

$$\mathrm{ROA}_{it} = f(\mathrm{ISO}_{it}, \mathrm{RA}_{it}, u_{it}) \quad (3)$$

That is, the ROA value for a given company is the product of a series of determinant variables (controls), unobservable effects (u_it) and ISO application.

The model to be estimated is a one-way error

Table 4. Number of ISO-certified companies per sector in Colombia, 2014-2016.

Sector	No.	Percentage	Sector	N	Percentage
Processed foods	4	3.01	Iron and steel	3	2.26
Auto parts and spare parts	2	1.50	Engineering and civil works	28	21.05
Sugar	4	3.01	Pharmaceutical laboratories	2	1.50
Bodyworks and autoparts	2	1.50	Dairy products	1	0.75
Rubbers and derivatives	2	1.50	Brick, veneers and floors	1	0.75
Cement and concrete	5	3.76	Wood and furniture	3	2.26
Apparel	1	0.75	Special manufactures	4	3.01
Construction and building	3	2.26	Machinery and equipment	1	0.75
Leather, tannery and leather goods	1	0.75	Materials and equipment	3	2.26
Home appliances	1	0.75	Metal-mechanic industry	8	6.02
Special business	10	7.52	Basic mining	2	1.50
Automotive assembly	4	3.01	Paper, cardboard and packaging	3	2.26
Hydraulic and electrical equipment	3	2.26	Plastics and packaging	7	5.26
Oil exploration and exploitation	1	0.75	Chemicals and derivatives	9	6.77
Soft drinks, beers and alcoholic beverages	1	0.75	Environmental sanitation	3	2.26
Generation and distribution of energy	3	2.26	Oil services	4	3.01
Fats and oils	2	1.50	Glass	2	1.50

Table 5. Correlation of numerical variables, all sectors 2014 - 2016 in Columbia.

	ISO	ROA	AR
ISO	1		
Return on Assets	0.0192	1	
Assets Ratio	-0.0097	-0.0207	1

component model:

$$\mathrm{ROA}_{it} = \beta_0 + \beta_1 \mathrm{ISO}_{it} + \beta_2 \mathrm{RA}_{it} + \sum_j \beta_{j+2} \mathrm{SECTOR}_{ji} + u_{it} \quad (4)$$

The unobserved effects term (u_{it}) is made up of two components: first, the company-specific unobservable factors (α_i) that affect the ROA. This has an identical effect for observations of the same company, meaning this factor controls a company's unobservable features. Second, the unobserved factors effect (ε_{it}) for company i and moment *t* (observation) affecting the ROA:

$$u_{it} = \alpha_i + \varepsilon_{it} \quad (5)$$

where:

$$\varepsilon_{it} \sim \mathrm{IID}\ (0, \sigma_\varepsilon^2) \quad (6)$$

The random effects estimation presents the variance of the two components of the error term, and each error term is a random variable with a mean of zero and variance σ_α^2 and σ_ε^2.

The summation of the functional form represents the sum of the 33 categorical Sector variables.

The model presented was estimated using different Panel Data methodologies:

a. Pooled Model or Ordinary Least Squares Model: Simple Ordinary Least Squares (OLS) model. Under this model, α_i=0, or, in other words, there are no individual characteristics to control.
b. Random Effects Model: This model assumes that differences between individuals are random and unrelated to the exogenous variables. Assumptions of the model: α_i is a random variable, Corr(α_i,X)=0
c. Between Estimator Model, or regression toward the mean: This model performs a cross-sectional regression with OLS on the average observations of each company, for both the dependent and independent variables.

The three models showed a direct relationship between the implementation of ISO 14001 and ROA, which represents financial performance. The three estimates coincide on the value of the coefficient, but differed regarding the significance of the coefficient. The OLS regression assigns the maximum significance while the estimates using the Random Effects and Between Estimator Models still assign significance, but to a lesser degree.

Based on these results, there is evidence that companies with ISO 14001 certification have higher EBITDA in relation to their assets. The ISO 14001 standard corroborates whether a company is meeting certain environmental requirements. These requirements include designing measures for reducing negative environmental impacts, creating reporting system for

environmental achievements, and implementing environmental policies, among many others. By meeting these requirements, a company can generate internal learning dynamics, or endogenous learning (learning-by-doing) (*Arrow 1962*), to increase its productive efficiency (*Cañón de Francia and Garcés Ayerbe 2006*).

Thus, *Cañón de Francia and Garcés Ayerbe* (*2006*) mentioned that ISO 14001 certification may favor the creation of a set of resources and capacities that will generate the expectation of competitive advantages. For instance, in this aspect *Blanco Silva et al.* (*2013*) analyzed cost and energy consumption (and by extension, CO_2 emissions) reductions related to

Table 6. Regression of models across all sectors and years.

	OLS Model	Random Effect	Between Mean
Return on Assets			
Assets Ratio	-0.089***	-0.088***	-0.089***
ISO certification	0.021***	0.021*	0.021*
Sector			
Processed foods	0.009	0.009	0.01
Auto parts and spare parts	-0.012	-0.012	-0.012
Sugar	-0.044***	-0.044***	-0.043***
Bodyworks and autoparts	-0.036***	-0.037*	-0.036*
Rubbers and derivatives	-0.013	-0.013	-0.013
Cement and concrete	-0.023**	-0.023	-0.023
Apparel	-0.021***	-0.021*	-0.021*
Construction and building	-0.057***	-0.057***	-0.057***
Leather, tannery and leather goods	-0.041**	-0.041	-0.041
Home appliances	-0.076***	-0.076***	-0.076**
Special business	0.004	0.004	0.004
Automotive assembly	0.003	0.003	0.003
Hydraulic and electrical equipment	-0.042***	-0.042***	-0.042**
Oil exploration and exploitation	0.058***	0.057***	0.058***
Soft drinks, beers and alcoholic beverages	-0.012	-0.013	-0.012
Generation and distribution of energy	0.034**	0.034	0.034
Fats and oils	-0.033**	-0.033	-0.033
Iron and steel	-0.031**	-0.031	-0.031
Pharmaceutical laboratories	0.065***	0.065***	0.065***
Dairy products	0.011	0.011	0.011
Brick, veneers and floors	-0.036**	-0.037	-0.036
Wood and furniture	-0.03***	-0.03***	-0.03***
Special manufactures	0.002	0.002	0.002
Machinery and equipment	-0.023**	-0.023	-0.023
Materials and equipment	-0.036***	-0.036***	-0.037**
Metal-mechanic industry	-0.004	-0.004	-0.004
Basic mining	-0.042***	-0.042***	-0.042***
Paper, cardboard and packaging	-0.026**	-0.027	-0.026
Plastics and packaging	0.004	-0.001	-0.008
Chemicals and derivatives	-0.007	-0.007	-0.007
Environmental sanitation	0.023	0.023	0.023
Oil services	-0.009	-0.009	-0.009
Glass	-0.009	-0.009	-0.009
Constant	0.157***	0.157***	0.157***
Estimation tests			
F - Test (chi)	26.12***	441.71(W)***	11.26***
R – Squared	0.0558	-	0.0558
R - Squared (Adj)	0.0537	-	-
Number of observations	15507	15507	15507
Number of groups	-	5169	5169
Sigma epsilon square	-	0.0876	-
Sigma alpha square (idiosincratic)		0.1154	

efficient technical resource organization. Additionally, ISO 14001 implementation has an effect on the company's public image. This effect is small if the company is a relatively low pollutant (*Cañón de Francia and Garcés Ayerbe 2006*), but is strong if the company belongs to a sector with a high environmental impact, or if the company is widely known for its environmental impact. Generally, this is an important incentive for the adoption of proactive environmental measures even among higher education institutions. As public universities, although financial issues are not the main focus of their organizations, should not neglect the importance of strengthening environmental proactivity as an integral part of their environmental planning strategies (*Delgado-Márquez et al. 2013*).

In this regard, the ISO 14001 certification is relevant to companies' financial performance. Not only is it useful for eco-marketing or green industry purposes, it provides competitive advantages including preferential access to public sector contracts or licenses and when entering new international markets (*Cañón de Francia and Garcés Ayerbe 2006*).

The relationship between Return on Assets and Asset Ratio was expected to be negative due to the results returned by the correlation matrix. Companies with a higher proportion of fixed assets have lower profits as aproportion of total assets. There are several explanations for this phenomenon, which has been studied by different authors.

On the one hand, it is a potential proof of diminishing returns on capital, with fixed assets being generally expensive items with long lives that increase profits, but by an increasingly smaller proportion. In this regard, *Vatavu* (*2015*) states that companies that assume a greater proportion of fixed assets over total assets make long-term investment efforts, giving up short-term profits.

The control variables for each sector showed the average difference between the ROA for the specific sector and the ROA for engineering and civil works, which is used as the base value and is also the most numerous sector and one of those with the greatest expected environmental impact.

Additionally, this is one of the Colombian economy's most dynamic sectors. Thus, economic profitability comparisons will be made against this sector due to its optimal conditions within the Colombian economy. Based on the results, some sectors do not reveal significant differences in ROA value, including dairy products, metal-mechanic industry, etc. Regarding those sectors with statistically significant coefficients, pharmaceutical laboratories and oil exploration and exploitation were the sectors with the highest levels of average profitability, and both are key sectors of the Colombian economy.

On the other hand, home appliances, and Construction and Buildings, were the two sectors with the lowest differences in ROA values. It should be clarified that although the construction and building and engineering and civil works sectors are closely related, both are in very different areas. The latter had a higher level of specialization than the former, thus the result is not surprising. Given the diversity of models, some tests were used to obtain selection criteria. The Breusch-Pagan Multiplier Lagrangian test was applied as a criterion for choosing between the OLS and the Random Effects model (**Table 6**).

The test verified the existence of idiosyncratic variance or individual variance that corresponds to unobserved factors in the individual (or the companies) and is differentiated from the observational random term. The test rejected the null hypothesis that the individual variance is zero. Of the two models, the Random Effect model is evidently the best. There was no evidence found for heteroscedasticity using the Wald test.

CONCLUSIONS AND RECOMMENDATIONS

The literature in general was inconclusive and there was no consensus on the relationship between EMS and corporate financial performance. According to *Qi et al.* (*2014*), this debate remains unresolved, in part because the financial performance- environmental management relationship has proven to be more complex than expected. Along these lines, some work considered that ISO 14001 implementation has negative consequences to corporate finances, some considered it to have a neutral effect, while others consider it to have a positive effect.

This empirical work has allowed corroborating the existence of a positive relationship between companies that implement environmental management systems and companies with better financial performance in Colombia. There was sufficient evidence that companies that have obtained ISO 14001 certification have higher ROA values than the uncertified companies. In other words, certified companies receive more profits as a proportion of their assets than uncertified ones.

The work that coincides on the existence of the positive relationship between ROA and the ISO 14001 standard has considered the existence of two opposite

relationships. First, the conduct and performance changes promoted by the ISO 14001 standard within the company, in which can generate improved financial performance, either directly or indirectly. Second, companies with high financial performance decided to obtain certification for strategic business reasons.

This study has implications for firms considering the adoption of an EMS under the ISO 14001 standard, and for stakeholders aiming to promote these practices, especially those in developing countries. This study also helps companies from different sectors understand the current state of ISO 14001 implementation in Colombia. From an academic perspective. This study aimed to promote debate and research into economic-environmental trade-offs in a developing context like Colombia and other Latin American countries. These findings may be used as a basis for further research in different industries, regions, or markets to provide new knowledge that will lead to accurate policies. Additionally, policymakers can promote EMS practices and the ISO14001 standard to relieve burdens on resources and the environment and increase environmental policy effectiveness while reducing economic costs and promoting competitiveness internationally. Furthermore, the government can identify leading companies by sectors with higher levels of EMS implementation and could encourage pioneering companies to share their experience with other companies seeking environmental and productivity gains. Finally, for future studies, it is suggested that new data may be collected among the large number of certified companies in Colombia. It would also be interesting to explore the endogenous effects of ISO 14001 certification within companies specifically related to resources and dynamic capabilities.

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