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Climate Change and Financial Performance in Times of Crisis

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ABSTRACT

Over the past years there has been a debate on the relationship between the environmental and financial performance of businesses, but researchers have not reached any agreement. This research attempts to explore this relationship, especially as in recent years there has been controversy about how this relationship has been affected by the global economic crisis. Taking into account that successfully limiting global climate change to safe levels in the long term is likely to require connecting climate change policies to sustainable development strategies, this paper focuses on the performance of environmental policies. We used a sample of 855 international companies in sectors of intensive greenhouse gas/CO_2 emissions. Specifically, we used data from the Forbes Global 2000 Index and Carbon Disclosure Project data from 2006 to 2009. The data analysis was performed using panel data methodology. The results obtained show that in times of economic crisis, the synergy between environmental and financial performance is higher, meaning that companies must continue to invest in sustainable projects in order to enhance relations with their stakeholders, leading to higher economic profits. Copyright © 2013 John Wiley & Sons, Ltd and ERP Environment

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Introduction

In recent years, multinational companies have been making significant efforts in all matters relating to corporate social responsibility (CSR), especially in regard to one of its pillars, the environment (Baumgartner and Ebner, 2010). This concern is a result of the immense social interest in the issue, combined with the economic, ecological and ethical reasons for preserving the planet (Freeman, 1984; Donaldson and Preston, 1995; Phillips *et al.*, 2003; Velayos, 2008). In this regard, the behavior of organizations is aimed more specifically at protecting the ozone layer, preventing climate change and fostering the advantageous use of water and energy, among other things.

In this research we will focus on climate change, because according to the latest publication by the Intergovernmental Panel on Climate Change (IPCC), the average quantity of greenhouse gases in the atmosphere has increased significantly in recent years due to the large release of CO_2 and other gases into the atmosphere (IPCC, 2007). This increase has caused changes in climate, rises in sea level, earlier and longer springs, melting of Arctic ice, changes in precipitation, ocean salinity and so on. All this is despite the fact that the Kyoto Protocol to the Convention of the

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United Nations Framework on Climate Change (UNFCCC), signed in 1997 by almost all countries around the globe, was aimed at reducing emissions of greenhouse gases by controlling the emissions of each country and the distribution of costs associated with climate change.

This situation has now become exacerbated because the proposals and commitments made at the last Conference of the Parties to the United Nations Framework Convention on Climate Change, COP-16, organized by the UN in Mexico, were aimed at deferring both the implementation of measures and their costs due to the effect that the economic crisis that began in 2008 is having on large companies (Karaibrahimoglu, 2010).

However, other researchers say that in times of economic crisis, investment in CSR should be supported, since it has a positive influence on consumer behavior (Mohr *et al.*, 2001). They also note that CSR is strongly associated with good corporate governance, consequently inviting greater investor confidence in those enterprises that value it (OECD, 2004).

The objective of this paper is thus to analyze the effect that the economic crisis has had on business performance and in turn how both factors have impacted on the behavior or environmental performance of large international companies. With this goal in mind, 855 multinational companies belonging to Forbes Global 2000 Index were analyzed. The information on greenhouse gas emissions was voluntarily provided in the Carbon Disclosure Project during the period 2006 to 2009. Thus, we will apply a panel data study as our research method.

The explanatory variables used to test the hypotheses are: the size of the company, return on assets, the economic crisis, intensive sector gas emissions, the Kyoto Protocol and the rate of gas emission recorded in the Carbon Disclosure Project. Thus, this research provides a bidirectional focus between an environmental performance study and financial analysis and also considers fundamental aspects such as where the world economy is going right now and what factors are directly affecting businesses, such as the economic crisis.

The results obtained show that in times of economic crisis, the synergy between environmental and financial performance is higher, validating the hypothesis of this study.

This paper is divided into the following sections: following this introduction the next section is a review of the most relevant international literature on the relationship between environmental and financial performance. Given the great importance of the economic crisis at this time we then go on to analyze how the crisis is affecting environmental social responsibility. Then we describe the population and sample, the variables used in the research and the methodology employed. A discussion of the results of the investigation follows, and we end with the conclusions, limitations and future research possibilities.

Relationship Between Environmental and Financial Performance

In recent years, several authors have attempted to analyze the relationship between environmental and financial performance in order to see if there is a competitive advantage for firms in preserving the environment (Schmidheiny, 1992; Elkington, 1994; Porter and van der Linde, 1995a; Hart, 1995; Shrivastava, 1995; Wagner *et al.*, 2002). At the same time, several authors using the resource-based view of the firm provide good reasons why companies should not consider financial performance alone, as companies rely on both the internal and external environments to remain and survive in the market (Barney, 1991; Conner, 1991; Grant, 1991; Hart, 1995).

Thus, several research studies have been conducted in various fields in order to verify the relationship between environmental and economic financial performance. Among the study areas measuring financial performance and its relationship to the environment, we can point to several works conducted in the fields of management, marketing, operational management, costs, investment, accounting and strategic direction, although in this research we focus on the use of accounting data.

A review of the literature finds several studies that show opposing results. On the one hand, certain empirical studies using accounting data claim to show a positive relationship between financial and environmental performance (Klassen and McLaughlin, 1996; Russo and Fouts, 1997; Judge and Douglas, 1998; King and Lenox, 2002; Melnyk *et al.*, 2003; Nakao *et al.*, 2007; Griffin and Mahon, 1997; Waddock and Graves, 1997; Preston and O´Bannon, 1997; Simpson and Kohers, 2002; Hillman and Keim, 2001; Orlitzky *et al.*, 2003; López *et al.*, 2007; Prado-Lorenzo *et al.*, 2008; Nishitani, 2011). These works consider that the costs of environmental actions are lower

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than the benefits they provide and that environmental actions can attract the most qualified employees, reduce costs and increase operational efficiency, thereby increasing market opportunities, improving the relationship with stakeholders and avoiding conflicts with them.

On the other hand, there have also been many studies that found no positive relationship between environmental and financial performance (Cordeiro and Sarkis, 1997; Bromiley and Marcus, 1989; Newton and Harte, 1997; Gilley *et al.*, 2000; Wagner *et al.*, 2001; Link and Naveh, 2006; Hibiki and Managi, 2010). Some authors argue that there is no relationship between these variables, but if there is it is too complex to be identified (Margolis and Walsh, 2003; Ulmann, 1985).

Studies like the one by Porter and van der Linde (1995b) analyze environmental performance from a strategic view as an opportunity for the company to gain a competitive advantage, arguing that compliance with certain environmental regulations reduces costs. The same position is clear from the work of Shrivastava (1995), which states that environmental policies can bring benefits, differentiation strategies and cost reduction. However, in the opposite direction, Palmer *et al.* (1995) consider that regulation will only help to increase costs and result in a consequent loss of competitiveness.

From the standpoint of management, firms that adopt proactive environmental strategies may benefit from a special price and sales will increase because of market legitimacy and greater social recognition, therefore giving the company greater economic output and products differentiated from those of its competitors (Rivera, 2002; Molina-Azorín *et al.*, 2009). Ambec and Lanoie (2008) point out that there are several ways to reduce costs: risk management and relationships with external actors, the cost of materials, energy and services and their capital and labor costs, and three cost opportunities to increase revenue, improve access to markets of certain differentiated products and pollution control technology sales.

The research work of Gonzalez-Benito and Gonzalez-Benito (2005), using an operational analysis, shows a relationship between the environment and economic performance by changing the interpretation of environmental performance to one of environmental proactivity, in the understanding that not all environmental variables affect the business world. They also analyzed company performance through three different dimensions: operational, marketing and financial performance. As regards the operational area, the work of Jiménez and Lorente (2001) seeks to approach the role of operations in environmental sustainability.

Another study by Bagaeva (2008) for companies from Russia found a positive relationship between environmental performance and financial results, arguing that other studies have limited their data to sectors, such as pulp and paper (Jaggi and Freedman, 1992), mining (Magness, 2006) or a single measure of environmental impact, for example air pollution (Hughes, 2000). In short, businesses that ignore environmental issues will have greater future costs and the lack of action can affect the stability of the company (Li *et al.*, 1997).

There are also studies such as the one by Hart and Ahuja (1996) which examines whether reducing greenhouse gas emissions affects financial performance. Thus we have papers that consider a single sector, such as Jaggi and Freedman (1992) and Cohen *et al.* (1995), multivariate studies such as Cormier *et al.* (1993) and Cormier and Magnan (1997), panel data studies, such as King and Lenox (2001), and even studies using simultaneous equations, such as the one by Al-Tuwaijri *et al.* (2004) to measure the relationship between environmental and financial performance.

Although most studies have focused on analyzing how environmental performance influences financial performance, other studies have focused on the reverse relationship, that is, they analyze how financial performance affects environmental performance. In this direction, McGuire *et al.* (1988) found a strong relationship when financial performance was considered as an independent variable. The results obtained by the previous authors have also been partially supported by Preston *et al.* (1991). Similarly, Bragdon and Marlin (1972) and Spicer (1978) obtained a positive influence of returns on environmental performance in companies within the stationery sector. Therefore, from these studies it appears that environmental and financial success seem to go together and complement each other.

However, some studies have not found a positive relationship between these two variables. For example, Rockness *et al.* (1986) analyzed two proxies of financial waste and 12 indicators representing firm economic performance and failed to find a statistical association between these variables, thus concluding that the financial result has no influence on environmental performance.

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As we have seen, there is great interest in this subject, and this has led to numerous studies that analyze both the effect of environmental performance on financial performance and vice versa, i.e. how financial results affect environmental performance.

From the work outlined above and in line with Gomez-García (2008), who synthesized a theoretical map of the research reviewed by Preston and O´Bannon (1997) on the relationship between CSR and financial performance, the causal sequence and signs of this relationship can be obtained, as shown in Table 1.

Table 1 indicates that the relationship has been divided into type of sign (positive, negative or neutral) and causal sequences (the use of CSR as an independent and dependent variable). Thus it can be concluded that it is possible to discern the following relationships between CSR and financial performance through the literature:

- The first relationship, social impact, is positive, and it follows that when the demands of stakeholders are met, the external reputation of the company improves and consequently its financial performance (Freeman, 1984). In the second, the availability of funds suggests that while companies may follow rules of conduct, good corporate citizenship will depend on the availability of resources (Waddock and Graves, 1997) and in the last positive relationship, positive synergy says that greater CSR leads to better financial performance.
- On the other hand, the negative sign of trade-off means that increases in CSR lead to higher costs and reduced financial performance. Another negative relationship, manager opportunism, or managers pursuing their own goals, leads to reduced investment in CSR so that managers can maximize their personal income in the short-term. Finally, negative synergy suggests the existence of a vicious circle between the trade-off theory and manager opportunism.
- Another relationship is that of moderating variables, which states that variables such as spending on research, development and innovation moderate the relationship between CSR and financial performance.

Considering all of the previous classifications and based upon empirical evidence, we put forward the following hypothesis:

H1: *There is a positive synergy between environmental and financial performance.*

Relationship Between Environmental Social Responsibility and the Economic Crisis

The hypothesis stated above assumes that businesses are considering other objectives beyond pure economic benefit as a result of incorporating in their business strategy the social environment in which they operate and with which they interact (Porter and Kramer, 2002). In recent years, however, this corporate behavior may have changed as a result of the global economic crisis (Fernández-Feijóo Souto, 2009; Njoroge, 2009).

In this context, according to Fernández-Feijóo Souto (2009) and Karaibrahimoglu (2010), companies are questioning their role in society because they are going through an internal crisis, reflected in the instability of their

	Type of relationship		
Causal sequence	Positive	Neutral	Negative
CSR → FP	Social impact hypothesis	Hypothesis of 'moderating' variables	Trade-off hypothesis
FP → CSR	Hypothesis on the availability of funds		Hypothesis of the opportunism of managers
CSR ↔ FP	Positive synergy		Negative synergy

Table 1. Relationship between CSR and financial performance (from Gómez-García 2008)
CSR, corporate social responsibility; FP, refers financial performance.

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environment. Thus, researchers, entrepreneurs and managers believe that in times of economic crisis a reduction in investment in social projects and environmental protection is required in order to reduce costs and, consequently, improve financial performance (Njoroge, 2009). For example, Carroll (1999) argues that the economic component of CSR is what the company does for itself, whereas the non-economic components are what it does for others, and in times of crisis, companies must look to their internal environment. In short, in times of crisis, organizational behavior becomes more conservative and defensive, such that companies stop investing in sustainable projects and do not change their methods of production (Cheney and McMillan, 1990).

However, other authors advocate the opposite behavior because of the positive effect that CSR strategies have on economic performance, since it must not be forgotten that CSR has been considered as something positive to help minimize social inequality and thus contribute to sustainable development (Brilius, 2010). Branco and Rodrigues (2008) claim that the companies involved in sustainable projects create good relationships with their stakeholders, generating greater economic benefits through its resources and capabilities. In relation to this, Wilson (2008) suggests that it would be a strategic error not to participate in or to reduce expenditure on social projects because of the negative impact it would have on the process of overcoming the economic downturn, especially as social responsibility is most needed and demanded in times of economic crisis to build greater confidence in the business world (Air Human Rights, 2008).

In light of these recent arguments, we propose the second hypothesis:

H2: *In times of economic crisis, the positive synergy between environmental and financial performance will be higher.*

Methodology

Population and Sample

To conduct the research, data were gathered from the Forbes Global 2000 Index and Carbon Disclosure Project for the period 2006 to 2009. The first database corresponds to a population of 2000 companies from different countries and was very useful in measuring their economic performance. The second database, despite containing fewer companies in certain years, provided 4 years of study data obtained from 1619 multinational companies, and was very useful in measuring the environmental performance of companies through the information on total greenhouse gas emissions it supplied. Together, these two databases provided a sample of 855 multinational companies for the period 2006 to 2009.

Variables

Dependent Variables

Economic performance

Financial performance can be seen as an objective measure of the company's performance, as it shows the financial return the company receives in each year of operation. With regard to how to measure it, and considering the various studies that have analyzed the relation between environmental and economic performance, it can be seen that several variables have been used to measure a company's financial performance. Bradgon and Marlin (1972) used accounting measures, Spicer (1978) used both accounting and market measures and Al-Tuwaijri *et al.* (2004) measured the economic performance of the company using the industry's annual performance set. Accounting measures such as return on assets (ROA), return on equity (ROE) and return on sales (ROS) have been widely used in previous literature (Cohen *et al.*, 1995; Hart and Ahuja, 1996; Edwards, 1998; Wagner *et al.*, 2002; Nakao *et al.*, 2007; Kotabe *et al.*, 2002). Consequently, this research will use the accounting measure ROA as the measure of profitability, since this variable reflects an efficient and objective profitability.

DOI: 10.1002/bse

Environmental performance

Throughout the literature there has been much debate on two key issues related to environmental performance or results: one is how to define it and the other is how to establish the indicators to be used in measuring it.

Regarding its definition, Lober (1996, p. 184) considers environmental performance as the commitment of an organization to preserve and protect its natural environment with its multi-dimensional characteristics, such as maintaining the quality of water, air, soil, etc. Another definition states that environmental performance refers to the effects of business activities and products on the natural environment, such as resource consumption and waste generation and emissions (Klassen and Whybark, 1999). For his part, Epstein (1996, p. 27) lists several components of environmental performance, such as the minimization of pollutants, conserving resources, waste reduction, energy conservation, marketing of safe products and reporting potential risks, among others.

As to the measures of environmental performance, different indicators have been used throughout the literature, for example the ratio of recycled toxic waste to toxic waste generation, which includes three principles of good environmental performance: (i) to minimize polluting factors, to conserve resources and reduce waste, (ii) the Toxics Release Inventory (TRI) program, and (iii) the amount of toxic emissions divided by company revenue.

Along with the indicators, Hamilton (1995) and Hart and Ahuja (1996) used emissions of toxic chemicals to measure environmental performance and King and Lenox (2001) used total emissions (log of total emissions of the installations), relative emissions (emissions relative to other facilities of similar size and industry) and industrial emissions (emissions per employee in the sectors in which the company operates).

In the case of the emission of greenhouse gases, and specifically CO_2, we shall use a measure similar to the one that Patten (2002) used. This author used the amount of toxic emissions divided by company revenue. Thus, taking into consideration the previous literature, our environmental performance measure is expressed as the ratio of total greenhouse gas emissions (CO_2) divided by the volume of sales of each company.

Independent and Control Variables

The economic crisis

To represent the temporary period of economic crisis we have defined a dummy variable, CRISIS, which takes the value 1 for 2008 and 2009 and the value 0 for the other periods tested. This variable is considered relevant to the present research because it examines a time period in which the markets reacted strongly to decreases in the value of companies. In this sense Raithel *et al.* (2010) considered that the value of the company was less dependent on intangible assets before the crisis, and that today companies are looking for confidence in the financial market and to improve their reputation in society. This variable has been also used to empirically test whether there is an economic value for companies with a good level of Corporate social performance (CSP) during an economic crisis (Ducassy, 2013).

To test our proposed hypothesis H2, we will interact this variable with the variables representing financial and environmental performance.

The Kyoto Protocol

Given that the sample of companies used in this investigation includes companies from different countries, a dummy variable has been included that identifies whether the company is registered in a country that has ratified the Kyoto Protocol or not. This variable has been considered in order to test empirically the effect of belonging or not to countries that have ratified the protocol.

This variable has already been considered in previous studies. Freedman and Jaggi (2005, p. 219) included this variable in their model, arguing that 'due to the costs incurred by companies to meet the requirements of the Kyoto Protocol it is important that they disclose details of their efforts and achievements in reducing greenhouse gas emissions to help investors make decisions about the balance between risk and profitability'.

The results of different studies point to a positive and statistically significant relationship between disclosure and the variable representing member companies or countries that have ratified the Kyoto Protocol. Thus, companies based in countries that have ratified the Kyoto Protocol provided more information on pollution, greenhouse gas emissions and global warming.

DOI: 10.1002/bse

Intensive sector

Activity sectors have also been considered as a control variable in this research, just as Freedman and Jaggi (2005) incorporated chemical, energy, gas, vehicles and insurance companies. The intensive sector in this context is a dummy variable that identifies whether the sector in which the company operates is intensive or not in the emission of greenhouse gases (CO_2).

Company size

Another variable that will be used as a control variable is the size of the company. The reason for choosing company size is because larger firms are in a position to invest more in sustainable environmental technologies and have greater financial resources to change processes and products in their manufacturing plants so that they do not harm the environment. In this research the firm size variable is represented by Total Assets. Company size has been also used to empirically test whether more diverse companies are more committed to the fight against climate change than less diverse companies (Ciocirlan and Pettersson, 2012).

Analytical Technique

To analytical technique selected to test the proposed hypotheses is a dependency model based on a linear regression for panel data. Specifically, this model has been estimated through fixed and random effects, testing for the validity of one model over another using the Hausman test.

The first effect can prevent information related to the fixed effects being correlated with latent variables in the model and ensures consistent estimators. The second is more appropriate when there is no correlation between the variables in the model and the fixed effects and allows more efficient estimators to be obtained by breaking down the various components of the residual variance. It also assumes that the variables are random and uncorrelated with the explanatory variables. The Hausman test of the null hypothesis of no correlation between individual effects and the independent variables, which should not be rejected, involves the selection of random effects to be more efficient.

In addition, in order to correct the problems of simultaneous causality between the variables representing environmental and financial performance, we used instrumental variables formed by their lag. Specifically, the expression of the estimated models is as follows:

$$\text{RTDO ECO}_{it} = \beta_0 + \beta_1 \text{RTDO M} - \text{A}_{it} + \beta_2 \text{SIZE}_{it} + \beta_3 \text{CRISIS}_{it} + \beta_4 \text{RTDO M} - \text{A} \times \text{CRISIS}_{it} + \varepsilon_{it} \quad (1)$$

$$\text{RTDO M} - \text{A}_{it} = \beta_0 + \beta_1 \text{RTDO ECO}_{it} + \beta_2 \text{SIZE}_{it} + \beta_3 \text{CRISIS}_{it} + \beta_4 \text{RTDO ECO} \times \text{CRISIS}_{it} + \beta_5 \text{KYOTO}_{it} + \beta_6 \text{SC.INTENSIVE}_{it} + \varepsilon_{it} \quad (2)$$

where i refers to the company and t is time and:

- RTDO ECO_{it} corresponds to the ROA and the ratio between net profit and total assets.
- RTDO M-A_{it} corresponds to the total CO_2 emitted by sales volume
- β are parameters to be estimated
- $SIZE_{it}$ corresponds to the size of the company as represented by its total assets
- CRISIS is a dummy variable that identifies the economic crisis period, 2008 and 2009
- RTDO ECO $\times$ $CRISIS_{it}$ corresponds to the ROA for the period of crisis, 2008 and 2009
- RTDO M-A $\times$ $CRISIS_{it}$ corresponds to the total CO_2 emitted per sales volume for the period of crisis, 2008 and 2009
- $KYOTO_{it}$ is a dummy variable that identifies whether the country in which the company is registered has ratified the Kyoto Protocol
- $SC.INTENSIVE_{it}$ is a dummy variable that identifies whether the sector in which the company operates is intensive in CO_2 emissions
- ε is the component failure.

DOI: 10.1002/bse

Results of Empirical Analysis

Descriptive Analysis

Table 2 shows the descriptive statistics associated with the mean and standard deviation of each of the variables used in the proposed model. From their analysis one can conclude that environmental performance in the years of the economic crisis dropped from its average value of 9651991.2 to 8215928.1541, which means that in this period of crisis, the emissions of greenhouse gases have fallen and companies in the last 2 years have been greatly concerned with environmental issues.

With respect to economic performance in the years of the economic crisis, this has also declined significantly from 20.18 to 4.77 and this result means that the benefits of international companies have declined in the years of economic crisis.

Table 3, which displays the correlation matrix of the proposed models, shows that the variable most correlated with the dependent variable for financial performance is company size, while the least correlated is the proxy intensive sectors. Regarding the dependent variable for environmental performance, the most correlated variable is environmental performance in the years of crisis, and the least correlated is financial performance in the years of crisis. The remaining variables did not show strong correlations with each other.

Multivariate Analysis

Regarding the results of multivariate analysis, Table 4 shows the estimates for the random effects linear models because the Hausman test cannot reject the hypothesis of non-correlation between individual effects and the independent variables, so more efficient estimation of random effects is necessary.

Table 4 shows that model 1, in which the dependent variable is financial performance measured by ROA, has a low explanatory power as inferred from the R^2 value equal to 0.070. Regarding the variables that it purports to compare, only the SIZE variable is positive and statistically significant at 99% (P-value < 0.01). As for the other variables, RTDO M-A, CRISIS and RTDO M-A × CRISIS are not statistically significant, the first two variables being

	Mean	Standard deviation
RTDO M-A (total emissions)	9651991.92	26816423.757
RTDO ECO	20.1830	148.72609
SIZE	7.9848	2.33580
RTDO ECO × CRISIS	4.7755	104.69510
RTDO M-A × CRISIS	8215928.1541	25190509.73646

Table 2. Descriptive statistics

		RTDO ECO	RTDO M-A	1	2	3	4	5
	RTDO M-A	−0.047						
1	SIZE	0.439**	0.140**					
2	RTDO ECO × CRISIS	0.699**	−0.015	−0.147**				
3	RTDO M-A × CRISIS	−0.044	0.922**	0.129**	−0.014			
4	CRISIS	−0.126**	0.138**	0.044	0.032	0.228**		
5	SC.INTENSIVE	−0.018	−0.054	−0.029	−0.007	−0.048	−0.004	
6	KYOTO	−0.074*	−0.056	0.010	−0.020	−0.052	0.021	0.716**

Table 3. Bivariate correlations
**P-value < 0.01; *P-value < 0.05.

DOI: 10.1002/bse

	Economic results∧			Environmental results		
Variables	Coeff. (SE)	*T*	*P*-value	Coeff. (SE)	*T*	*P*-value
RTDO ECO				**−52600000** (15000000)	**−3.51**	**0.000**
RTDO M-A	0.0047519 (0.0073164)	0.65	0.516			
SIZE	**19.32536** (6.105055)	**3.17**	**0.002**	**2211084** (1013592)	**2.18**	**0.030**
CRISIS	55.49602 (230.5789)	0.24	0.810	**38000000** (7492908)	**5.07**	**0.000**
RTDO ECO × CRISIS				**148918.7** (70251.23)	**2.12**	**0.035**
RTDO M-A × CRISIS	−0.0047518 (0.0073164)	−0.65	0.516			
KYOTO				−3950492 (3357324)	−1.18	0.240
SC.INTENSIVE				**25500000** (3352873)	**7.60**	**0.000**
Constant	−103.609 (196.0157)	−0.053	0.597	**−139912.2** (68445.56)	**−2.04**	**0.041**
	$R^2 = 0.070$ $F = 6.68$ (*P*-value = 0.0000) Hausman test chi-square = 0.03			$R^2 = 0.2139$ $F = 18.59$ (*P*-value = 0.0000) Hausman test chi-square = 3.82		

Table 4. Explanatory models
Instrumental variables for static panel data models. Random effects according to Hausman test results. All models include time dummies.
∧Includes ordinal variable identifying sector.
Because the variables are statistically significant.

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positive and the third one negative. The results obtained with this first model show that environmental performance does not have an influence, either positive or negative, on the company's financial performance and therefore we do not accept Hypothesis 1, which posited that the greater the investment in environmental social responsibility, the greater the financial performance.

In model 2, in which the dependent variable is environmental performance represented by RTDO M-A, obtained by dividing the total CO_2 emissions by sales volume, the explanatory power is greater than in model 1 as can be deduced from the R^2 value equal to 0.2139. All variables except KYOTO are statistically significant and therefore positively influence the environmental performance of the company.

The variable RTDO ECO, which measures financial performance, is negative but statistically significant at 99% (P-value < 0.01). The SIZE variable is positive and statistically significant at 95% (P-value < 0.05), also CRISIS, represented as a dummy variable that identifies the economic crisis period between 2008 and 2009, is positive and statistically significant at 99% (P-value < 0.01).

The interaction variable RTDO ECO × CRISIS representing financial performance in a crisis period is positive and significant at 95% (P-value < 0.05) and the SC.INTENSIVE dummy variable that identifies whether the area in which the company operates is intensive in CO_2 emissions is also positive and statistically significant at 99% (P-value < 0.01).

The results obtained in model 2 indicate that Hypothesis 2 can be accepted in the form in which it was postulated, that in times of economic crisis, the positive synergy between environmental and financial performance will be higher.

Discussion of the Results

The debate in the literature on the relationship between environmental and financial performance shows that there is no unanimity. While some authors have obtained a positive result, i.e. environmental performance has a positive effect on financial performance (Waddock and Graves, 1997; Preston and O'Bannon, 1997; Simpson Kohers, 2002, Hillman and Keim, 2001; Orlitzky *et al.*, 2003, Lopez *et al.* 2007; Prado-Lorenzo *et al.*, 2008), other authors claim that the relationship is negative (Bromiley and Marcus, 1989; Davidson and Worell, 1988). In contrast, yet other authors argue that there is no relationship at all between the two variables and if there were it would be too complex to find (Margolis and Walsh, 2003; Ulmann, 1985).

Analysis of the results of the first model show that environmental performance does not have either a positive or negative influence on a company's financial performance and therefore these results are consistent with the provisions of Margolis and Walsh (2003) and Ulmann (1985), who see no relationship between environmental and financial performance and state that if there were one, it would be too complex to find.

The results of the second model proposed are more in line with the initial hypothesis. However, some authors argue that the measures and the costs of reducing emissions should be postponed due to the effect on large companies of the economic crisis that began in 2008 (Karaibrahimoglu, 2010), adducing that in times of crisis organizational behavior should be more conservative and defensive, such that companies stop investing in sustainable projects and do not change their methods of production (Cheney, 1990).

Other researchers nonetheless argue that in times of economic crisis investment in CSR should be supported, since it has a positive influence on consumer behavior (Mohr *et al.*, 2001). At the same time, Branco and Rodrigues (2008) claim that companies involved in sustainable projects develop good relationships with stakeholders, generating greater economic benefits through their resources and capabilities. Thus, Wilson (2008) suggests that it would be a strategic error not to participate in or reduce expenditure on social projects because of the negative impact it would have on the process of overcoming the economic downturn, especially as social responsibility and demand is most needed in times of economic crisis to build greater confidence in the business world (Air Human Rights, 2008).

The results obtained in this study are more consistent with those authors who support the idea that in times of crisis companies must continue to invest in sustainable projects because they create good relationships with stakeholders, leading to greater economic benefits and, in short, that in times of economic crisis the positive synergy between environmental and financial performance will be higher.

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Another feature of the results is that in periods of crisis, the most profitable companies have increased their interest in the development of more sustainable behavior in relation to the emission of CO_2 in order to differentiate themselves from their closest competitors. The interest shown by companies in the development of more sustainable behaviors can be deduced from the fact that environmental performance in the years of economic crisis has decreased its mean value, which leads us to say that in the period of CO_2 emissions have decreased.

Conclusions

Environmental policy plays an important role in the financial performance of a firm, maybe because profitability could be damaged by the higher production costs of environmental management initiatives, or maybe due to the generation of higher profitability or stock prices. The negative aspect is defended from the point of view of the neoclassical economic model or shareholder capitalism in which the only responsibility of business towards society is the maximization of shareholder values, and that environmentally proactive actions suppose some competitive disadvantages, incurring costs that might otherwise be avoided or which should be borne by others. The second opinion postulates that these sustainable practices can lead to differentiation and competitive market advantages for a firm, something that can form part of the brand for the present and future, as well as affect a corporation's profits. According to this latter argument, it is possible for a bidirectional relationship to exist due to profitable firms being interested in improving their physical environment in order to increase their economic one.

However, an important debate exists in relation to what happens with firms' sustainable practices in the actual economic environment. In this sense, the present research study has sought to analyze the effect of the economic crisis on business performance and the impact that both factors have on the environmental behavior or performance of large international companies. To do this, we analyzed 855 companies belonging to the multinational Forbes Global 2000 Index which voluntarily provided information on greenhouse gas emissions in the Carbon Disclosure Project during the period 2006 to 2009.

To analyze this effect, two hypotheses were posited: the first one, which posed a synergistic relationship between environmental and financial performance, was rejected, whereas the hypothesis that posited synergy between financial and environment performance in times of economic crisis was accepted, as it was confirmed by the data used: companies that care about CSR in times of economic crisis perform better, and therefore in times of crisis companies must continue to invest in sustainable projects to enhance relations with their stakeholders, resulting in greater economic benefits.

This research can be of great relevance for entrepreneurs, managers, academics and society at large as the results refute the idea that in times of economic crisis companies have to reduce spending and lessen their concern for CSR.

In contrast, a proactive environmental policy oriented to reduce CO_2 and greenhouse gas emissions could generate a strategic difference between firms that have higher profitability in this period: sustainable companies generate greater confidence in customers and other stakeholders which reinforces their economic activity. Moreover, knowledge of greenhouse gas emissions can also benefit workers and consumers who prefer to buy from companies that provide this type of information. Firms can also have access to new sources of capital, since governments are introducing financial incentives to reduce greenhouse gas emissions, and reductions in greenhouse gases can be an opportunity to reduce financial risks deriving from natural and financial consequences. 'At the same time, greenhouse gas emission may be an opportunity to enhance a corporation's reputation and can have important benefits, i.e. investors who consider environmental strategies in making investments' (Hoffman, 2005, p. 34).

A limitation of this study is the time period employed; future research should consider the possibility of including a broader time period, and thus the behavior of firms before, during and after the period of economic crisis could be analyzed. The study could also be extended to include more specific sectors, since behavior in times of crisis is different for each type of sector. Finally, it would be of interest to continue the research in the period of economic recovery in order to check the hypotheses and be sure that companies are truly interested in developing more sustainable operations. Moreover, it is recommended to examine the specific relationships between emissions reduction and firm performance at the industry level.

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