THE EFFECT OF R&D INTENSITY ON CORPORATE SOCIAL RESPONSIBILITY

Robert C Padgett
Universidad de Salamanca
José I. Galán
Universidad de Salamanca

Abstract

This study examines the impact that Research and Development (R&D) intensity has on Corporate Social Responsibility (CSR). We base our research on the Resource Based View (RBV) theory, which contributes to our analysis of R&D intensity and CSR because this perspective explicitly recognizes the importance of intangible resources. Both R&D and CSR activities can create assets that provide firms with competitive advantage. Furthermore, the employment of such activities can improve the welfare of the community and satisfy stakeholder expectations, which might vary according to their prevailing environment. As expressions of CSR and R&D vary throughout industries, we extend our research by analyzing the impact that R&D intensity has on CSR across both manufacturing and non-manufacturing industries. Our results show that R&D intensity positively affects CSR and that this relationship is significant in manufacturing industries, while a non-significant result was obtained in non-manufacturing industries.

Keywords:
Competitive Advantage, Corporate Social Responsibility, Industry, Resource Based View Theory, Research and Development.

Universidad de Salamanca
Dpt. Administración y Economía de la Empresa
Salamanca, 37007 – Spain
Tel.: +34 923 294500 Ext. 3329
rpadgett@usal.es
jigalan@usal.es

1. INTRODUCTION

The importance of corporate social responsibility in managerial practice worldwide has encouraged academics to study its effects and how firms can or cannot obtain benefits from CSR practices. There has been a growing number of publications that study CSR, with mixed results and no clear understanding due to the vagueness and intangibility of the term (Frankental, 2001). Moreover, there are numerous definitions of CSR and often no clear definition is given in the studies, making theoretical development and measurement difficult (McWilliams, Siegel and Wright, 2006).

Another reason for the difficulty in measuring CSR is that the behaviours involved occur across a wide range of industries with significantly different characteristics, backgrounds, and performances in the different CSR domains (Graves and Waddock, 1994; Waddock and Graves; 1997). Thus, the difficulty of conducting research in the field of CSR is compounded and heightened by both its complexity and the fact that compared to other business functions its appearance as a legitimate area of enquiry in management literature is very recent (Harrison and Freeman, 1999).

This research builds on recent and very important studies that have investigated the relationship between CSR and the financial performance of firms. One of the most important findings helping researchers to measure this relationship accurately was reported by McWilliams and Siegel (2000), who proved that CSR is positively correlated with R&D intensity. Other research that corroborates this finding is the study conducted by Hull and Rothenberg (2008). We aim to study the impact of R&D on CSR closely to determine and explain the behaviour of this effect in order to provide insight for those who want to continue studying the relationship between CSR and financial performance, including R&D as a necessary variable in their models.

Previous studies, such as those by Berrone, Surroca and Tribo (2007), Bouquet and Deutsch (2008), Hull and Rothenberg (2008), McWilliams and Siegel (2000, 2001), and Prior, Surroca and Tribo (2008), have discovered that these variables are correlated when studying the impact of CSR and another variable. However, none of these researches have studied the direct impact of R&D on CSR, so we considered it necessary to study this effect in order to fill this gap in the literature.

The fundamental framework we have used as the basis for our study is the Resource Based View (RBV) theory, which can contribute to our analysis of R&D intensity and CSR because this perspective explicitly recognizes the importance of intangible resources, such as know-how, corporate culture and reputation (Russo and Fouts, 1997). Furthermore, other researchers agree with the use of RBV for studying these variables by stating that the usefulness of RBV in the study of CSR

is due to the emphasis it places on the importance of specific intangible resources, as they are very difficult to imitate and substitute (Branco and Rodrigues, 2006).

Our research adopted a panel data methodology. This technique allows us to control the risk of unobserved heterogeneity on the manager's conceptions of social responsibility and company strategy (Bouquet and Deutsch, 2008). Our main hypothesis states that R&D intensity positively affects CSR. We take a step forward in our second hypothesis by examining this effect between firms in manufacturing and non-manufacturing industries. We expect this effect to be stronger in firms in manufacturing industries, as previous studies such as the ones by Hadlock, Hecker and Gannon, (1991), positing that manufacturing industries have high R&D concentration, and by Hull and Rothenberg, (2008); McWilliams and Siegel, (2000); Rothenberg and Zyglidopolous, (2007), have stated that R&D intensive firms are likely to have high CSR.

This article contributes to the literature in several different ways: firstly, we are studying an effect between two variables that until now has not been studied in this way; secondly, we are studying the impact of one variable on the other between manufacturing and non-manufacturing industries; finally, we are using a panel data methodology that gives robustness to our research.

The remainder of the paper is organized as follows: the second section reviews the Resource Based View theory and the empirical evidence, and the hypotheses are presented; the third section describes the data and estimation method used in our analysis; the results are discussed in our fourth section and, finally, the fifth and last section presents our conclusions to this research.

2. THEORY AND HYPOTHESES
2.1. The Resource Based View and Competitive Advantage

The Resource Based View (RBV) was developed from the idea of the industrial organization (IO) view of the firm (Bain, 1959; Porter, 1980, Russo and Fouts, 1997), which stated that a firm's success was wholly determined by external factors. Early resource-based researchers found this unrealistically limited and turned to Penrose (1959) for motivation in developing theories for the RBV of the firm (Russo and Fouts, 1997). To argue against the IO view of the firm, several theorists such as Dierickx and Cool (1989), Prahalad and Hamel (1990) and Wernerfelt (1984) constructed the resource-based theory stating that a firm's success was not wholly determined by external factors but also by its internal characteristics.

According to the RBV, firms with assets that are valuable and rare possess a competitive advantage and may expect to earn superior returns, and those firms whose assets are also difficult to replicate may record a sustained superior financial performance (Barney, 1991; Grant, 1991; Roberts and Dowling, 2002).

Yet the RBV is not only about internal competencies and how they can generate competitive advantages; the firm is also affected by external factors. "Resources cannot be evaluated in isolation. A resource that is valuable in a particular industry or at a particular time might fail to have the same value in a different industry or chronological context" (Collis and Montgomery, 1995:120)

According to Grant (1991), resources are classified as tangible, intangible, and personnel-based. Tangible resources include physical resources such as infrastructure, equipment, raw materials, and financial reserves. Intangible resources include reputation and technology. Personnel-based resources involve such concepts as culture, training, commitment, loyalty and knowledge. None of these resources is productive on its own, but a combination of these is what will make the firm productive. (Russo and Fouts, 1997)

The RBV can contribute to our analysis of R&D intensity and CSR because this perspective explicitly recognizes the importance of intangible resources such as know-how, corporate culture and reputation (Russo and Fouts, 1997). Moreover, other researchers agree with the use of the RBV to research these variables by stating that the usefulness of the RBV in the study of CSR is explained by the emphasis it places on the importance of specific intangible resources, as they are very difficult to imitate and substitute (Branco and Rodrigues, 2006).

2.2. Importance of CSR and R&D for Firms to Obtain Competitive Advantages

We will begin by giving the definition of CSR used by McWilliams and Siegel (2001), whereby CSR involves those situations in which the firm takes part in "actions that appear to further some social good, beyond the interests of the firm and that which is required by law" (117:2001). It has been proven that a high level of CSR is a strategy that firms can use to differentiate themselves (Hull and Rothenberg, 2008; Mackey, et. al., 2007; Siegel and Vitaliano, 2007) in order to obtain certain competitive advantage. Moore (2001) and Harrison and Freeman (1999) make an important point when they state that social performance and economic performance should not be separated, since in order to determine whether a firm is "good", it has to perform well on both counts. Research and development (R&D) is another way a firm can obtain competitive advantage (Hull and Rothenberg, 2008), with the long-standing theoretical literature linking investment

in R&D with improvements of the firm in the long run (McWilliams and Siegel, 2000; Griliches, 1979).

CSR can be viewed as a type of investment used as a mechanism for product differentiation, where CSR can be positioned in the context of 'resources', in which CSR policies would help to improve processes for developing products and services, and of 'outputs', where CSR policies and attributes would have a direct impact on a firm's product. For example, firms can maintain a level of CSR by having products with "CSR attributes (such as pesticide-free fruit) or by using CSR-related resources in their production processes (such as naturally occurring insect inhibitors and organic fertilizers)" (McWilliams and Siegel, 2001). It has been found that the introduction of new and improved processes and products is positively related with R&D intensity (Hitt, Hoskisson, Johnson, and Moesel, 1996). Innovative strategies employed by firms have a substantial impact on processes; in order to create new products and services that have a competitive advantage, they must meet the four criteria described by the RBV theory, namely, they should be valuable, rare, inimitable, and the organization must be organized to deploy these resources effectively (Barney, 1991). Using these criteria, resources that may lead to a competitive advantage include socially complex resources such as reputation, corporate culture, long-term relationships with suppliers and customers, and knowledge of assets (Barney, 1986; Hillman and Keim, 2001; Leonard, 1995; Teece, 1998)

At the same time, researchers contend that it is important for businesses to look beyond their narrow focus of social responsibility and take social concern into consideration in strategic management decisions, as this will ensure business interests in the long term by creating a close bond with their community (Carlson, Grove and Kangun, 1993; Quazi and O'Brien, 2000). Further research shows that consumers prefer products and invest in firms that care for the environment and maintain good citizenship behaviour (Zaman, Yamin and Wong, 1996; Gildia, 1995; Quazi and O'Brien, 2000), which helps the firm to build a good reputation and image as valuable resources that can create a competitive advantage for it.

Schnietz and Epstein (2005) agree with McWilliams and Siegel (2001) and Lantos (2001) in that CSR creates a reputation that a firm is honest and reliable, giving financial value to the firm. In response to this reputation, consumers will typically assume that the products of these types of firms are of good quality, and they become difficult for other firms to imitate. In addition, firms in industries with skilled labour shortages have used CSR as a means to recruit and retain workers. Brammer and Pavelin (2006) state that depending on a firm's industry and environment, social responsibility actions must vary in order to fulfil general stakeholder expectations and build a good reputation.

At the same time, firms can profit through the use of R&D, since R&D intensive industries usually have 'entry barriers' where companies can achieve effects such as economies of scale and product differentiation (Porter, 1979). These effects help firms to obtain a competitive advantage over other firms. How R&D investment affects firm productivity is a question that is of considerable interest to several researchers. There is the seminal work by Griliches (1981) and his hedonic model based on US firm-level data, which used market value as an indicator of the firm's productivity from investments in R&D. Several other researchers have used this same model to prove that there is a positive relationship between R&D investments and the market value of the firm (Cockburn and Griliches, 1988; Hall, 1993; Hirschey, 1982; Jaffe, 1986).

R&D is considered to be a form of investment in 'technical' capital that results in knowledge enhancement, which leads to product and process innovation. This innovative activity allows firms to enhance their productivity (McWilliams and Siegel, 2000). Studies such as those by Ben-Zion (1984), Clark and Griliches (1984), Griliches (1998), Guerard, Bean and Andrews (1987), Hall (1999) and Lichtenberg and Siegel (1991) report similar results that confirm a positive correlation between R&D investment and firm growth. Investment in R&D involving innovation related with CSR processes and products is attractive to some consumers, such as recycled products or organic pest control. McWilliams and Siegel (2001) stated that using a differentiating strategy in order to obtain a competitive advantage through the use of CSR resources may also include investment in research and development (R&D).

McWilliams and Siegel (2000) proved that CSR is positively correlated with R&D intensity "because both are associated with product and process innovation" (2000:607). If CSR and R&D are highly correlated, an equation that includes CSR and does not include R&D intensity as determinant of a firm's performance will turn out to be upwardly biased. Other researchers have also suggested that R&D should be included as a moderator in theoretical models that have received mixed or ambiguous empirical support (Han, et. al., 1998; Hull and Rothenberg, 2008).

Therefore, a longitudinal study of the interactions between R&D intensity and CSR variables is called for (Hull and Rothenberg, 2008), as one that will provide insight and facilitate an understanding of the interaction that exists between these two variables.
Based on the above arguments, we therefore suggest the following hypothesis:

H1: R&D intensity positively affects CSR.

Earlier research (Graves and Waddock, 1994) has shown that there are clear differences between different industries in levels of investment in R&D (Waddock and Graves, 1997). Furthermore, the characteristics of a firm's industry have been hypothesized to be a key influence on its social performance (McWilliams and Siegel, 2000), since industries differ according to the stage of the product lifecycle they are in. The use of CSR as a differentiation strategy will be present depending on the industry's lifecycle, since little product differentiation is expected in the embryonic and growth stages because firms are focused on perfecting processes and satisfying growing demands (McWilliams and Siegel, 2001). Some industries will be young and companies active in them will have a range of alternative investment projects, whereas mature industries offer fewer alternative investment opportunities to their companies. (Brammer and Millington, 2008) In addition, depending on the industry, companies may have a different view of CSR actions and the way they are implemented in their R&D processes. Quazi and O'Brien (35:2000) state that "the broader dimension of social responsibility, therefore, calls for innovation in production and marketing to reap the benefits of proactive social action". The authors give the example of pollution control and how some companies consider it to be an unnecessary expense, thereby perceiving it negatively in financial terms. Meanwhile, other firms may argue that pollution is a sign of inefficiency and flawed technology that also costs the firm money and affects the community. This second perspective is supported by Ahmed, Montagno and Flenze (1998), who have found that environmentally friendly companies have better productivity and profitability than non-environmental firms.

R&D intensity varies according to the industry, and is usually more intense in manufacturing industries than in non-manufacturing ones. For example, the automotive industry has initiated intensive R&D programmes in order to develop a new kind of technology-based competition in response to current environmental changes, long-term increases in petrol prices and regulatory efforts to curb the threat of global climate change (Khaledabadi and Magnusson, 2008).

These types of changes and increasing stakeholder pressure on firms to tackle social issues are driving more and more companies to engage in CSR activities (Quazi, 2003). Moreover, R&D intensive industries such as pharmaceuticals may face particular incentives to engage in CSR activities that boost the long-term supply of highly skilled labour. (Brammer and Millington, 2008) Another reason that manufacturing industries might increase their CSR activities is that, according to Nicolleti and Scarpetta (2003), there are more industry-specific regulations are in manufacturing industries than in non-manufacturing ones.

Williamson, Lynch-Wood and Ramsay (2006) state that manufacturing processes have significant economic and environmental impacts, which have led firms to develop CSR practices that favour our environment. Many firms are

adopting voluntary environmental management systems, signing international agreements such as the UN Global Compact, or have joined local projects to minimise waste. "These trends have largely been driven by an increasing demand for "transparency" from stakeholders, and perceived consumer demand for environmental quality" (Chapple, Paul and Harris 348:2004). These national and industry forces create environments in which stakeholders and local competitors have different expectations of what the appropriate levels and types of corporate citizenship should be (Gardberg and Fombrun, 2006), with more pressure being placed on manufacturing industries because they are believed to use up more resources, create more waste and have a higher intensity of R&D activities than their non-manufacturing counterparts simply because of the nature of their processes.

Consequently, we decided to look for differences in the intensity of the impact of R&D on CSR activities between manufacturing industries, which are those that are acknowledged to have a high intensity of R&D, and non-manufacturing ones. To do so we developed the following hypothesis:

H2: R&D intensity positively affects CSR with a higher intensity in manufacturing industries than in non-manufacturing industries.

3. METHODS
3.1.Data and Sample

In order to associate R&D intensity with CSR we needed data to create a single database on how firms interact with their stakeholders and society along with corporate financial data. The corporate financial data are taken from Thomson's Datastream and the CSR data are from KLD (Kinder, Lyndenberg, and Domini) Research and Analytics, Inc.

Over 40 peer-reviewed articles, representing a variety of academic fields (including finance, economics, management and sociology) have used KLD data to research companies' social, environmental and governance performance (KLD, 2008). Some of these articles are: Cuesta-González, et al., 2006; Hull and Rothenberg, 2008; Márquez and Fombrun, 2005; McWilliams and Siegel, 2000; Schnietz and Epstein, 2005; Waddock and Graves, 1997.

KLD uses screens to monitor corporate social performance (see Sharfman, 1996, for an assessment of data validity). These screens are divided into positive and negative ones, with positive ones signifying company strengths and negative ones signifying company weaknesses. The screens are divided into groups that reflect the firm's general corporate social performance.

The period researched has a span of 16 years, from 1991 to 2007. We excluded companies with missing data, and in order to perform our analysis we divided our sample into three groups. The first model comprised 5,799 observations and 1,217 companies, which is used to explain Hypothesis 1; the second and third models were developed to explain Hypothesis 2, where the second model contained only manufacturing companies and comprised 2,724 observations and 575 companies, and finally, the third model contained non-manufacturing companies and comprised 3,075 observations and 642 companies.

3.2 Measures and Estimation Method

KLD data are designed as a binary system. For each strength or concern in each variable, rating 1 indicates the presence of a strength or concern, while 0 indicates its absence. For the first hypothesis, *CSR* is our dependent variable, where we used KLD data to develop the same scale used by Hillman and Keim (2001), which is also used by many other authors (Cuesta-González et al, 2006; Hull and Rothemberg, 2008). The CSR rating is scored using a scale ranging from -2 (major concerns), -1 (concern), 0 (neutral), +1 (strength), to +2 (major strength). To check the robustness of our models, we replaced the CSR scale that ranges from -2 to 2 with an alternative specification of the dependent variable, as used in industrial organization and strategy research (Kortum and Lerner, 2000), which is equal to the logarithm of the sum of strengths plus 1 (Kacperczyk, 2008). We obtained a significant result with both measures. We refer to this variable as CSR+ in our results tables.

R&D intensity is our independent variable, where we use a proxy of R&D, calculated by dividing total expenditure on R&D by total sales, basing our study on measures used by McWilliams and Siegel, (2000), Bouquet and Deutsche (2008), and Prior, Surroca and Tribo (2008) which showed that R&D is positively correlated with CSR. Other research that has corroborated the correlation between these two variables includes the study by Hull and Rothenberg (2008), which measured R&D using a 3-year average of R&D expenditures, and yet another study that has recorded the same finding as the studies mentioned above, Berrone et al. (2007), who measured R&D intensity as R&D expenditures to total assets on a log scale.

We include several control variables in our model. We used *company size* because previous articles have suggested that it is closely related to CSR (Johnson and Greening, 1999; Udayasankar, 2008; Waddock and Graves, 1997). To measure company size in our analysis we used net sales (Brammer and Millington, 2008; Kacperczyh 2008) and number of employees (Berman, et. al., 1999), both defined on a log scale.

We used *ROA* (return on assets) as a control variable as well, as it yields the most direct information about the results in the allocation of resources by a firm as it seeks competitive advantage (Hull and Rothenberg, 2008). *ROA* is calculated as *operating income over total assets*.

In addition, we included *Risk* as a control variable, since several studies have found that a firm with proactive CSR engages in managerial practices, such as stakeholder management (Wood, 1991), which tend to anticipate and reduce potential sources of business risk, such as potential governmental regulation, labour unrest, or environmental damage (for details see: Orlitzky and Benjamin, 2001). As a proxy for management risk tolerance, we use the level of debt held (*total debt to total assets ratio*) by the firm (Hull and Rothemberg, 2008).

For our second hypothesis we analyze the same effect as in our first hypothesis, but we divide our sample using SIC industry classification into manufacturing and non-manufacturing industries, to determine where this relationship is more intense.

We used the panel data methodology to estimate our models. Unlike cross-sectional analysis, panel data analysis allows us to control every firm and has its own specificity that gives rise to a particular behaviour closely linked to the company's strategy. This choice was motivated by the importance of considering significant problems that arise when studying the influence that R&D intensity has on CSR.

Unobserved variables can be eliminated by specifying a fixed-effects or a random-effects model, as several sequential (yearly) observations of the same company are recorded. More specifically, given the longitudinal data on firm R&D intensity for firm i at moment t-1 on CSR at moment t can be modelled as follows:

$$CSR_{it} = \alpha + \beta'R\&D_{it-1} + \beta'ROAi\ t-1 + \beta'salesi\ t-1 + \beta'employeei\ t-1 + \beta'riski\ t-1 + ni + vit$$

Where CSR_{it} is firm i's CSR associated with the current year; $R\&D_{it-1}$ is the R&D intensity of firm i associated with the previous year; ROAi t-1, salesi t-1, employeei t-1 are control variables for firm i associated with the previous year; ni is a time invariant firm specific error that captures the effects of unobservable characteristics; vit is the error term. It is important to note that the models also incorporate a yearly trend variable to account for differences over time.

4. RESULTS

Table 1 provides the descriptive statistics (mean and standard deviation) of our three models with both measurements of CSR that we used in our research to make

our analysis more robust. It shows the dependent variables CSR and CSR+ in year t and all independent variables in t-1. One can also observe the sample size of all models and the number of firms, with a total of 5,798 observations and 1,217 firms in model 1. Our model 2, which considers firms in manufacturing industries, has a total of 2,724 observations and 575 firms and, finally, our model 3, which considers firms in non-manufacturing industries, has a total of 3,074 observations and 624 firms.

Table 1 - Main Descriptive Statistics: Comparison Between Models						
	Model 1: Whole Sample		Model 2: Manufacturing Industries		Model 3: Non-Manufacturing Industries	
Variable	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
CSR+	0.6210536	0.6504617	0.6271596	0.6525744	0.6196441	0.6503911
CSR	-0.1296643	1.379216	-0.1169154	1.386099	-0.1386838	1.374846
R&D	0.0924276	2.424787	0.158977	3.498876	0.0329601	0.124602
ROA	7.182965	10.6331	7.110276	11.65514	7.24723	9.641149
Net Sales	14.05634	1.692323	14.03404	1.81485	14.0482	1.607418
Employees	8.519166	1.696531	8.493667	1.698347	8.525471	1.706439
Risk	0.2162667	0.1867397	0.2026556	0.1685136	0.2284379	0.2012748
Sample Size	5798		2724		3074	
N. of Firms	1217		575		624	

CSR+ = Log($\sum$strengths + 1); CSR = Scale ranging from -2 to +2; R&D = R&D to total sales; ROA = Return on Assets; Net Sales = Logarithm of net sales (proxy for size); Employees = Logarithm of employees (proxy for size); Risk = Total Debt to Total Assets Ratio
All independent variables are in t = -1

Table 2 shows the correlation matrix for the total sample. There is a negative significant correlation between the size control variables (net sales and employee) and ROA with both our measures of CSR. As can be seen, we were unable to find a significant correlation between R&D and any measure of CSR, although the impact

of R&D on CSR in the panel data analysis is positive and significant in both model 1 and model 2.

Table 2. Correlation Matrix of Total Sample						
	CSR+	CSR	R&D	ROA	Net Sales	Employees	Risk
CSR+	1.0000						
CSR	0.7059***	1.0000					
R&D	0.0106	0.0145	1.0000				
ROA	-0.0251*	-0.0386***	-0.0560*	1.0000			
Net Sales	-0.0410***	-0.0552***	-0.0634***	0.1139*	1.0000		
Employees	-0.0281***	-0.0480***	-0.0481***	0.0573*	0.8678***	1.0000	
Risk	0.0244**	0.0198	-0.0096	0.1862***	0.1755***	0.1318***	1.0000
*p<0.10; **p<0.05; ***p<0.01						

Table 3 presents the results of the panel data analysis for our three models using CSR as our dependent variable and R&D as explanatory variable, controlling for size (net sales and employees), ROA and risk, using a 1-year lag between CSR and all independent variables. As can be observed in Model 1, R&D, Net Sales and employees are significant, whereas ROA and risk variables are not. The effect that R&D has on CSR is positive at a significance level of $p<0.01$, and model 1 has an R-squared within 0.0414. When we performed the Hausman Specification Test to determine whether or not to use a fixed-effects model or a random-effects model in our analysis, we obtained a negative result. In view of this negative result, we had to perform the Sargan-Hansen statistic, which resulted in 54.887, thus the model of choice for our analysis is a fixed-effects model.

Table 3 - Comparison Between Models with CSR Measure									
	Model 1: Whole Sample CSR			Model 2: Manufacturing Industries CSR			Model 3: Non-Manufacturing Industries CSR		
	Coef	Std Err	Sig	Coef	Std Err	Sig	Coef	Std Err	Sig
R&D	0.014856	0.0012873	***	0.0136896	0.0015502	***	-0.1759526	0.392761	
Net Sales	-0.1644	0.0802835	*	-0.1762979	0.1194407		-0.1406568	0.1100122	
ROA	0.000216	0.0021904		-0.0034267	0.0028165		0.0046161	0.0034156	
Employees	0.148521	0.0860951	*	0.1635475	0.1313423		0.1055313	0.1159956	
Risk	-0.01084	0.21024		0.1309141	0.3413905		-0.0659303	0.2669777	
_cons	1.217404	0.6252478	*	1.49645	0.9634171		1.494705	0.9164471	
R-squared within	0.0414			0.0432			0.0475		
σ_u	0.82682512			0.84669619			0.80925		
σ_e	1.1810379			1.1686181			1.1920106		
F from regression (Prob>F)	20.96		***	16.56		***	5.5		***
Corr(u_i), xb	-0.0194			-0.016			-0.0186		
Number observations	5798			2724			3074		
Number groups	1217			575			642		
Chi2 Hausman - fixed x random	54.887 † (-21.55)		***	29.1		*	7.67		

Estimation also includes dummy for the years (1992 - 2007)
*p<0.10;
**p<0.05;
***p<0.01
† Since chi2 from Hausman test was negative, value corresponds to Sargan-Hansen statistic

Table 4 shows the results of the panel data analysis for our three models using CSR+ (our second measure of CSR) instead of CSR. Model 1 obtained similar results in Table 4 as it did in Table 3, where R&D also affects CSR+ in a positive

way at a p<0.01 level. These results confirm our first hypothesis, where we state that R&D intensity affects CSR in a positive way.

Table 4 - Comparison Between Models with CSR+ Measure								
	Model 1: Whole Sample CSR+			Model 2: Manufacturing Industries CSR+			Model 3: Non-Manufacturing Industries CSR+	
	Coef	Std Err	Sig	Coef	Std Err	Sig	Coef	Std Err	Sig
R&D	0.0046617	0.0007523	***	0.0048813	0.0007525	***	0.0740021	0.1682013	
Net Sales	-0.1119344	0.0377518	**	-0.0442721	0.0560148		-0.1596036	0.0510554	**
ROA	0.0005733	0.0010914		-0.0012517	0.0015056		0.0024247	0.0015724	
Employees	0.1039918	0.03894	**	0.0554918	0.057032		0.1303517	0.0533218	
Risk	0.1140165	0.0979225		0.0195508	0.1582408		0.2186913	0.1235075	
_cons	1.285845	0.3018529	***	0.9303023	0.4618995	*	1.924293	0.4414174	***
R-squared within	0.0334			0.0358			0.0385		
σ_u	0.39259011			0.38542257			0.41046963		
σ_e	0.55820282			0.5567568			0.55967847		
F from regression (Prob>F)	10.62		***	10.96		***	4.71		***
Corr(u_i), xb	-0.031			0.0713			-0.1795		
Number observations	5798			2724			3074		
Number groups	1217			575			624		
Chi2 Hausman - fixed x random	98.273 † (-26.15)		***	88.930 † (-87.55)		***	43.49		**
Estimation also includes dummy for the years (1992 - 2007) *p<0.10; **p<0.05; ***p<0.01 † Since chi2 from Hausman test was negative, value corresponds to Sargan-Hansen statistic									

Table 3 also shows the results of our panel data analysis for Model 2, where we include firms in manufacturing industries only, and the results for our Model 3 analysis, where we include firms in non-manufacturing firms only. Here we found that R&D intensity positively affects CSR at a $p<0.01$ in Model 2, while Model 3 displays no significance in the effect that R&D intensity has over CSR. After performing the Hausman Specification Test for Model 3, the result showed no significant correlation between the unobserved person-specific random-effects and the regressors, so the random-effects model may be more powerful and parsimonious, thus being our model of choice for Model 3, while the results of this test determined that we should use a fixed-effects model for Model 2.

Table 4 shows similar results between this effect in Model 2 and Model 3 and our other measure of CSR+. However, with this measure of CSR+, the Hausman Specification Test indicated that we should use a fixed-effects model instead of a random-effects model for both Model 2 and 3. These results confirm our second hypothesis, which states that R&D intensity impacts CSR to a greater degree in manufacturing industries than in non-manufacturing industries.

5. DISCUSSION AND CONCLUSION

The RBV theory allows us to analyze the effect of R&D intensity on CSR because, as we stated before, this theory explicitly recognizes the importance of intangible resources, which are difficult to imitate and substitute. As discussed previously, both CSR and R&D possess characteristics that are consistent with the RBV theory, making them very important resources that will allow a firm to achieve a competitive advantage and at the same time benefit society. Given the importance of these resources in a firm's performance, many studies have focused on understanding the relationship between CSR and financial performance or between R&D and financial performance. Recent studies have shown that in order to measure accurately how CSR affects a company's financial performance, R&D must be included in the study so that the results do not give an upwardly biased estimate of the CSR variable (McWilliams and Siegel, 2000). Several previous studies have also found a significant correlation between these two resources, so it is important to understand the effect that one has over the other.

The results of this research provide support for our first hypothesis, which states that R&D intensity affects CSR in a positive way. R&D is considered to be a form of investment that results in knowledge enhancement, leading to product and process innovation. These product and process improvements can lead to CSR-related processes and products. For example, R&D activities might improve processes and make them more effective, which can also reduce the amount of energy the firm consumes, with the ensuing cost reductions and less pollution. Such activities should also be taken into account as CSR actions of the firm. Previous

research has shown that these two variables depend on the industry they are in, so consistent with our reasoning that product and process innovation brings CSR activities to the firm, we decided to test this effect in both manufacturing and non-manufacturing industries. Our results show that the effect that R&D intensity has on CSR is positive and significant in manufacturing industries, while in non-manufacturing industries R&D intensity has no significant effect on CSR. This finding shows that firms in industries with a higher intensity of R&D also devote efforts to CSR activities. This result might be explained by the fact that manufacturing industries are under more pressures from stakeholders and government policies to carry out CSR activities. Even if this might be true, some firms always choose to exceed stakeholder expectations and policies by engaging CSR actions that minimise waste and reduce energy consumption, and by initiating progressive human resource management programmes (Chapple, Morrison and Harris, 2004).

The academic value of this research is that it has filled a gap in the literature, since to our knowledge there has been no other study that focuses on understanding the effect that R&D intensity has on CSR as we proposed, and our model was estimated using panel data techniques, which are better capable of controlling for inherent heterogeneity than a simple regression. The results of this study enforce previous research that states the importance of taking R&D intensity into consideration when studying the relationship between CSR and a firm's financial performance.

The managerial value of this study is that firms need to take their R&D activities into consideration when developing their CSR strategy, since process and product innovations may already be involved in CSR activities. Thus, innovative firms should focus their efforts on identifying opportunities in their R&D processes to initiate related CSR activities. This will allow the company to manage costs more effectively and determine whether other CSR activities might be necessary to meet stakeholder expectations. This is important for managers following differentiation strategies by investing in R&D and CSR, since they are related activities that provide a firm with a competitive advantage. In addition, firms should make an effort to ensure that they "are a part of a larger society with a wider responsibility reaching beyond the narrow perspective of profit" (Quazi and O'Brien, 33:2000), which is an opportunity for building a sustainable relationship with stakeholders (Polonsky et al., 1997; Quazi and O'Brien, 2000).

For further research it might be interesting to study the effect that R&D intensity has on the CSR of individual manufacturing industries, since this effect might be stronger or weaker depending on the characteristics of the industry. Furthermore, because of CSR's complexity, a study of the effect that R&D

intensity has on different CSR dimensions might provide broader insight and understanding of this effect.

6. REFERENCES

Ahmed, N.U., R.V. Montagno and R.J. Flenze (1998): "Organizational Performance and Environmental Consciousness: An Empirical Study", *Management Decision* 36, pp. 57 – 62.

Bain, J.S. (1959): "Industrial Organization". New York: Wiley.

Barney J. (1986): "Organizational culture: can it be a source of sustained competitive advantage?", *Academy of Management Review*, 11, pp. 656–665.

Barney, J. (1991): "Firm resources and sustained competitive advantage", *Journal of Management*, 17, pp. 99–120.

Ben-Zion, U. (1984): "The R&D and investment decision and its relationship to the firm's market value: Some preliminary results", in Z. Griliches (ed.), *R&D, Patents, and Productivity. University of Chicago Press, Chicago, IL*, pp. 134–162.

Berman, S. L., Wicks, A. C, Kotha, S and Jones, M. T. (1999): "Does stakeholder orientation matter? The relationship between stakeholder management models and firm financial performance", *Academy of Management Journal*, 42:5, pp. 488-506.

Berrone, P., Surroca, J. and Tribó, J.A. (2007): "Corporate ethical identity as a determinant of firm performance: a test of the mediating role of stakeholder satisfaction", *Journal of Business Ethics*, 76, pp. 35-53

Bouquet, C. and Deutsche, Y. (2008): "The impact of Corporate Social Performance on a Firm's Multinationality", *Journal of Business Ethics*, 80, pp. 755-769.

Brammer, S. and Millington, A. (2008): "Does it pay to be different? An analysis of the relationship between corporate social and financial performance", *Strategic Management Journal*, 10, published online.

Brammer, S. And Pavelin, S. (2006): "Corporate Reputation and Social Performance: The Importance of Fit", *Journal of Management Studies*, 43:3, pp. 435 – 455.

Branco, M.C. and Rodrigues, L.L. (2006): "'Corporate social responsibility and resource-based perspectives", *Journal of Business Ethics*, 69, pp. 111-132.

Carlson, L., Grove, S.J. and Kangun N. (1993): "A content Analysis of Environmental Advertising Campaigns: A Matrix Method Approach", *Journal of Advertising*, 22:3, pp. 27 – 39.

Chapple, W., Morrison Paul, C.J. and Harris, R. (2004): "Manufacturing and Corporate Environmental Responsibility: cost implications of voluntary waste minimisation", *Structural Change and Economics Dynamics*, 16, pp. 347 – 373.

Clark, K. B. and Griliches, Z. (1984): "Productivity growth and R&D at the business level: Results from the PIMS database", in Z. Griliches (ed.), *R&D, Patents, and Productivity, University of Chicago Press, Chicago, IL*, pp. 393–416.

Cockburn, I. and Griliches, Z. (1988): "Industry effects and appropriability measures in the stock market's valuation of R&D and patents", *The American Economic Review*, 78:2, *Papers and Proceedings of the One-Hundredth Annual Meeting of the American Economic Association* (May, 1988), pp 419-423.

Collis, D.J. and Montgomery, C.A. (1995): "Competing on resources", *Harvard Business Review*, July-August, pp. 118-128.

Cuesta-González, M., Muñoz-Torres, M. J. and Fernandez-Izquierdo, M. A. (2006): "Analysis of social performance in the Spanish financial industry through public data. A proposal", *Journal of Business Ethics*, 69, pp. 289-304.

Dierickx, I., & Cool, K. (1989): "Asset stock accumulation and sustainability of competitive advantage", *Management Science*, 35:12, pp. 1504-1511.

Frankental, P. (2001): "Corporate Social Responsibility – a PR invention?" *Corporate Communications: An International Journal*, 6:1, pp. 18-23.

Gardberg, N.A. and Fombrun, C.J. (2006): "Corporate Citizenship: Creating Intangible Assets across Institutional Environments", *Academy of Management Review*, 31:2, pp. 329 – 346.

Gildia, R.L. (1995): "Consumer Survey Confirms Corporate Social Responsibility affects Buying Decisions", *Public Relations Quarterly*, 39, pp. 20 – 21.

Grant RM. (1991): "The resource-based theory of competitive advantage: implications for strategy formulation", *California Management Review*, Spring, pp. 114–135.

Graves, S. B. and Waddock, S. A. (1994): "Institutional owners and corporate social performance", *Academy of Management Journal*, 37:4, pp. 1035–1046.

Griliches, Z. (1979): "Issues in assessing the contribution of R&D to productivity growth", *Bell Journal of Economics*, 10:1, pp. 92–116.

Griliches, Z. (1981): "Market value, R&D, and patents", *Economics Letters*, 7, pp. 183-87.

Griliches, Z. (1998): "R&D and Productivity: The Econometric Evidence", National Bureau of Economic Research for the University of Chicago Press, *University of Chicago Press, Chicago, IL*.

Guerard, J. B., Jr., A. S. Bean and S. Andrews (1987): "R&D management and corporate financial policy", *Management Science*, 33, pp. 1419–1427.

Hadlock, P., Hecker, D. and Gannon, J. (1991): "High technology employment: another view", *Monthly Labor Review*, July, 1991, pp. 26-30.

Hall, B. H. (1999): "Innovation and market value", *National Bureau of Economic Research* Working Paper, 6984.

Hall R. (1993): "A framework linking intangible resources and capabilities to sustainable competitive advantage", *Strategic Management Journal*, 14:8, pp. 607–618.

Han JK, Kim N, Srivastava RK. (1998), "Market orientation and organizational performance: is innovation a missing link?", *Journal of Marketing*, 62:4, pp. 30–45.

Harrison, J.S. and Freeman, R.E. (1999): "Stakeholders, Social Responsibility, and Performance: Empirical Evidence and Theoretical Perspectives", *Academy of Management Journal*, 42:5, pp. 479 – 485.

Hillman, A. J. and Keim, G. D. (2001): "Shareholder value, stakeholder management, and social issues: what's the bottom line?", *Strategic Management Journal*, 22, pp. 125-139.

Hirschey, M. (1982): "Intangible Capital Aspects of Advertising and R & D Expenditures", *The Journal of Industrial Economics*, 30:4, pp. 375-390.

Hitt, M.A., Hoskisson, R.E., Johnson, R.A., Moesel, D.D. (1996): "The Market for corporate control and firm innovation", *Academy of Management Journal*, 39:5, pp. 1084-1119.

Hull, C.E. and Rothenberg, S. (2008): "Firm performance: the interactions of corporate social performance with innovation and industry differentiation", *Strategic Management Journal*, 29, pp. 781-789.

Jaffe, A. B. (1986): "Technological Opportunity and Spillovers of R&D: Evidence from Firms' Patents, Profits and Market Value," *American Economic Review*, 76, pp. 984–1001.

Johnson, Richard A. and Greening, Daniel W. (1999): "The Effects of Corporate Governance and Institutional Ownership types on Corporate Social Performance", *Academy of Management Journal*, 42:5, pp. 564 - 576

Kacperczyk, Aleksandra (2008): "With Greater Power Comes Greater Responsibility? Takeover Protection and Corporate Attention to Stakeholders", *Strategic Management Journal*, published online.

Khaledabadi, H.J. and Magnusson, T. (2008): "Corporate Social Responsibility and Knowledge Management Implications in Sustainable Vehicle Innovation and Development", *Communications of the IBIMA*, 6.

Kortum S, Lerner J. (2000): "Assessing the contribution of venture capital to innovation", RAND *Journal of Economics*, 31:4, pp. 674–692.

Lantos, G. P. (2001): "The boundaries of strategic corporate social responsibility", *Journal of Consumer Marketing*, 18:7, pp. 595-630.

Leonard, D. (1995): "Wellsprings of Knowledge: Building and Sustaining the Sources of Innovation", *Harvard Business School Press: Boston, MA*.

Lichtenberg, F. and D. Siegel (1991): "The impact of R&D investment on productivity: New evidence using linked R&D-LRD data", *Economic Inquiry*, 29, pp. 203–228.

Mackey, A., Mackey, T.B., and Barney, J. B. (2007): "Corporate Social Responsibility and Firm Performance: Investor Preferences and Corporate Strategies", *The Academy of Management Review*, 32:3, pp. 817-835.

Márquez, A. and Fombrun, C. J. (2005): "Measuring corporate social responsibility", *Corporate Reputation Review*, 7:4, pp. 304-308.

McWilliams, A. and Siegel, D.S. (2000): "Corporate social responsibility and firm financial performance", *Strategic Management Journal*, 21:5, pp. 602-609.

McWilliams, A. and Siegel, D.S. (2001): "Corporate social responsibility: a theory of the firm perspective", *The Academy of Management Review*, 26:1, pp. 117-127.

McWilliams, A and Siegel, D.S. and Wright, P.M. (2006): "Guest editors' introduction, Corporate social responsibility: strategic implications", *Journal of Management Studies*, 43:1, pp. 1-18.

Moore, G. (2001): "Corporate Social and Financial Performance: An Investigation in the U.K. Supermarket Industry", *Journal of Business Ethics*, 34, pp. 299 – 315.

Nicolleti, G. and Scarpetta, S. (2003): "Regulation, productivity and growth: OECD evidence", *Economic Policy*, 18:36, pp. 9 – 72.

Orlitzky, M. and Benjamin, J. D. (2001): "Corporate social performance and firm risk: A meta-analytic review", *Business and Society*, 40:4, pp. 369-396.

Penrose, E. (1959): "The theory of the growth of the firm". *New York: Wiley*.

Polonsky, M.J., H.T. Suchard and D. Scott (1997): "A Stakeholder Approach to Interacting with the External Environment", *Australia and New Zealand Marketing Educators Conference Proceedings* 1, pp. 495 – 508.

Porter, M.E. (1979): "The structure within industries and companies' performance", *The Review of Economics and Statistics*, 61:2, pp. 214-227.

Porter, M. E. (1980): "Competitive strategy", *New York: Free Press*.

Prahalad, C. K., & Hamel, G. (1990): "The core competence of the corporation", *Harvard Business Review*, 68:3, pp. 79-91.

Prior, D., Surroca, J., Tribó, J. (2008): "Are socially responsible managers really ethical? Exploring the relationship between earnings management and corporate social responsibility", *Corporate Governance*, 16:3, pp. 160-177.

Quazi, A. and O'Brien, D. (2000): "An Empirical Test of a Cross-national Model of Corporate Social Responsibility", *Journal of Business Ethics*, 25, pp. 33 - 51.

Quazi, A. (2003): "Identifying the Determinants of Corporate Managers' Perceived Social Obligations", *Management Decision*, 41:9, pp. 822 – 831.

Roberts, P.W. and Dowling, G.R. (2002): "Corporate reputation and sustained superior financial performance", *Strategic Management Journal*, 23, pp. 1077-1093.

Rothenberg, S. and Zyglidopolous, SC. (2007): "Determinants of environmental innovation adoption in the printing industry: the importance of task environment", *Business Strategy and Environment*, 16:1, pp. 39-49.

Russo, M.V and Fouts, P.A. (1997): "A Resource Based Perspective on Corporate Environmental Performance and Profitability", Academy of Management Journal, 40:3, pp. 534-559.

Schnietz, K. E. and Epstein, M. J. (2005): "Exploring the financial value of a reputation for corporate social responsibility during a crisis", *Corporate Reputation Review*, 7:4, pp. 327-345.

Sharfman, M. (1996): "The construct validity of the Kinder, Lydenberg & Domini social performance ratings data", *Journal of Business Ethics*, 15:3, pp. 287- 296.

Siegel, D.S. and Vitaliano, D.F. (2007): "An empirical analysis of the strategic use of corporate social responsibility", *Journal of Economics & Management Strategy*, 16:3, Fall 2007, pp. 773–792.

Teece D. (1998): "Capturing value from knowledge assets: the new economy, markets for know-how, and intangible assets", *California Management Review*, 40:3, pp. 55–79.

Udayasankar, K. (2008): "Corporate social responsibility and firm size", *Journal of Business Ethics*, 83, pp. 167-175.

Waddock, S. And Graves, S. (1997): "The corporate social performance – financial performance link", *Strategic Management Journal*, 18:4, pp. 303–319.

Wernerfelt, B. (1984): "A resource-based view of the firm". *Strategic Management Journal*, 5:2, pp. 171-180.

Williamson, D., Lynch-Wood, G. and Ramsay, J. (2006): "Drivers of Environmental Behaviour in Manufacturing SMEs and the Implications for CSR", *Journal of Business Ethics*, 67, pp. 317 – 330.

Wood, Donna J. (1991): "Corporate Social Performance Revisited", *The Academy of Management Review*, 16:4, pp. 691-718.

Zaman, M., S. Yamin, and F. Wong (1996): "Environmental Consumerism and Buying Preference for Green Products", *Proceedings of the Australian Marketing Educators' Conference*, pp. 613 – 626.