CORPORATE SOCIAL RESPONSIBILITYAND INVENTORY POLICY[1]

Lucía Barcos, Alicia Barroso, Jordi Surroca, Josep A. Tribó

Abstract

In this article, we study the impact of implementing corporate social responsible (CSR) practices on firms' inventory policy. We propose that there is an inverted U-shaped relationship between firms' CSR and their inventory levels. Two elements explain such a proposal. First, stakeholders have different interests regarding the outcome of the inventory system. Specifically, we hypothesize that customers put pressure on firms to increase inventories; employees have conflicting views regarding inventories, and for this reason they do not put pressure on firms in a particular direction; and environmental activists force firms to reduce inventories. The second element to explain the previous relationship is that there is a different level of stakeholder proactiveness contingent on the intensity in the implementation of social responsible policies. While employee demands are a priority for every firm, we posit that there is variation in the relative importance attached to customers and the natural environment: for low levels of CSR, customers are more relevant; and for higher levels of CSR, the natural environment gains importance.

We test this theoretical prediction using a database that contains financial information from COMPUSTAT, and CSR data from the KLD database. Our final sample includes 1,881 US companies (9,269 observations) for the period 1996-2006. Results provide support to our theoretical contentions.

Our findings will be helpful to strategic and tactical decision-making processes on inventory management and will allow researchers to offer concrete advice on the likely outcomes of various stakeholder relationship practices in order to improve the effectiveness of inventory systems.

Keywords: corporate social responsibility; stakeholders; inventories.

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1. Introduction

In recent years, there has been increasing interest among researchers and managers in the strategic and operational implications of corporate social responsibility (CSR). CSR is conceptualized as being the broad array of discretionary actions that a company develops in its efforts to deal with and create close relationships with its numerous stakeholders, including employees, communities, customers, suppliers, shareholders, and the natural environment (McWilliams and Siegel, 2001). CSR appears in situations where the company engages in practices that go beyond compliance, such as: incorporating social characteristics into products and manufacturing processes, adopting progressive human resource management programs, achieving higher levels of environmental performance through recycling and pollution abatement and supporting local businesses (McWilliams et al., 2006).

In examining the role of CSR in corporations, most scholars have focused on the influence of CSR on firm strategy at all levels of the organization: corporate, business, and functional level. At corporate level, CSR has been seen to be related to strategies of internationalization (Gardberg and Fombrun, 2006) and diversification (McWilliams and Siegel, 2001). Research has also shown that engaging in CSR activities is a form of strategic investment upon which firms build their business strategies, whether through product differentiation, when CSR is used to establish a strong reputation and to differentiate its products from those of its competitors, or cost leadership, since CSR activities entail lower costs because of the reduction in raw materials, waste disposal, and in the firms' compliance and liability costs (Hart, 1995). At a functional level, CSR positively influences innovation and shapes the job design, the recruitment and training of employees, the degree of hierarchy, the structure of managers' compensation schemes, the corporate culture and the operational design (Russo and Fouts, 1997; Russo and Harrison, 2005).

Remarkably, research on the operational consequences of CSR is still embryonic. Most of the studies in this area are based on case studies that show how the adoption of CSR principles influences operational issues such as lean manufacturing practices, manufacturing quality, supply chain management, product design, and total quality management (e.g., Dechant and Altman, 1994; Handfield et al., 1997; Porter and Van Der Linde, 1995; Shrivastava, 1995). Despite these advances, however, rigorous empirical evidence documenting the operational consequences of CSR is scarce and only focuses on the effect of environmental performance—a dimension of CSR—on measures of manufacturing performance such as productivity, costs or defects (Pil and Rothenberg, 2003). Thus, the purpose of this study is to investigate the relationship between these discretionary actions directed towards stakeholders and firms' inventory investment.

To articulate arguments linking CSR to inventories we rely on the literature on the strategic and operational consequences of CSR and especially on recent case-based studies that analyze the influence stakeholders can have on the design and implementation of an inventory management system (de Vries, 2005, 2009). According to these case-based studies, inventory systems are not always the result of a pre-determined approach, but the outcome of a political process in which different organizational members take part. These organizational members, or stakeholders, differ in their perceptions, interests and capacity to shape corporate decisions. Thus, stakeholders can use their influence to shape key dimensions of the inventory system in order to affect the features of the system that are more adequate and interesting according to their own private interests. In this line, this paper addresses the issue of the effect of CSR improvements connected to employees, customers, and the natural environment on a firm's relative inventory level.

We develop a set of theoretical contentions that we later test using a database of 1,881 different US companies (9,269 observations) for the period 1996-2006. It includes financial data from COMPUSTAT and data on social responsibility from the KLD database.

The main finding of this study is that CSR and inventory-to-sales ratio are not linearly related. Specifically, we have found increases in firms' inventory-to-sales ratio for low levels of social responsibility and decreases in this ratio for high levels of proactivity towards stakeholders. Two elements explain this relationship. First, stakeholders have different interests regarding the outcome of the inventory system, and each stakeholder tries to exercise its influence on a firm's inventory policy in a different manner. In particular, customers put pressure on increasing a firm's inventory level in order to avoid stock-outs. Environmentalists, in turn, pressure firms in the opposite direction in order to avoid wasteful inventory accumulation that may potentially damage the environment. Second, the relative influence of each stakeholder varies with the intensity in the implementation of a CSR policy. Employee demands are a priority for every firm. However, there is variation in the relative importance of customers and the natural environment: firms in the initial stages of the implementation of CSR policies prioritize customers over the environment; while the environment is prioritized in firms whose CSR policy is fully developed. Altogether, both elements are shown to justify an inverted U-shaped relationship between CSR and firm inventory level.

Such finding will be helpful to decision-making processes on inventory management and will allow researchers to offer concrete advice on the likely operational outcomes of integrating different stakeholder in a firm's decision process. Additionally, a clear understanding of the relationship between CSR and inventories may also be beneficial for improving the effectiveness of inventory systems in a setting where firms are more open to satisfy the demands of different interest groups.

The remainder of the paper is organized as follows. Section 2 develops the theoretical underpinnings and presents the hypotheses to be tested. In Section 3, we carry out the empirical analysis. The paper concludes with some final remarks.

2. Theoretical background and hypotheses

2.1. Key stakeholders and inventories

In a recent study, de Vries (2009) has shown that stakeholders influence the design and the implementation of inventory systems in different ways. Different stakeholders have different interests regarding the outcome of such systems, and sometimes they have the power to shape a firm's decision-making processes to select inventory projects that benefit themselves. Building on this work, in this section we develop arguments linking three different types of stakeholders—customers, employees, and the natural environment—and the inventory level of a firm.

Customers/product safety. Through their purchasing power, customers increasingly pressure companies to accept and manage their responsibilities. Product and service quality are two of the most important characteristics demanded by customers (Waddock et al., 2002). High product/service quality is intrinsically related to shorter and more reliable lead times and fewer shortages. Firms may respond to these demands for higher quality through inventory management. One of the functions of inventories is the immediate provision of products to minimize the occurrence of stock-outs, which may lead to customer dissatisfaction. Inventories act as buffers against variations in demand: they allow meeting customer requirements when the final demand cannot be known in advance with precision. Stock availability has a direct effect on total order cycle time and the lack of stocks may force firms to move products out of the established distribution channel with the corresponding costs. The availability of inventories to customers avoids these costs and allows the maintenance of sales (Ballou, 2004). Thus, firms that try to attend to customers' demands as a goal and not only as a means to increase profits , will increase inventory levels in the supply chain. Such policy will normally result in better customer service, measured in terms of ability to respond to customer demands within a certain time (Ballou, 2004; Neale et al., 2003).

Firms can also address customers' demands by supplying them with a widespread offer of products and services. Typically, a wider assortment of products results in higher levels of inventories

(Cachon and Olivares, 2010; Fisher et al., 1995). Therefore, firms will increase their inventory level when trying to meet customers' demands as a goal.[2] Thus, we propose:

Hypothesis 1a. *A firm's social responsible behavior towards customers will have a positive impact on inventory investment.*

Employees. Investing in employee CSR activities such as the provision of a clean and safe working environment, health and education benefits, and profit-sharing payment schemes can have a positive impact on employees' motivation and morale, thereby reducing absenteeism and staff turnover (Branco and Rodrigues, 2006) and stimulating the acquisition of firm-specific human capital by attracting and retaining highly skilled workers (Greening and Turban, 2000).

Such progressive human resource policies have been shown to relate positively to inventory performance (Schonberger, 2007). Lieberman et al. (1999) showed that inventories are lower for plants in which the workforce engages in work process improvements. Indeed, the need for protective buffer inventories could be decreased with worker commitment and motivation. Working with low inventory levels is not likely to occur without quality and continuous improvement orientation, which requires all employees to be actively engaged in improving the production process. In order to achieve such employee engagement, firms should create the appropriate organizational culture, develop incentive systems that reward good operational performance and effort, invest in fostering employee skills, facilitate teamwork, and empower employees (Reid and Sanders, 2005).

However, CSR does not always increase employee commitment to improvement. Workers sometimes enjoy significant power to promote or disgrace top executives. Generous salaries and long-term contracts are dimensions of a firm's CSR that managers may promote in order to obtain employees' support, although sometimes they have a negative effect on financial performance (Pagano and Volpin, 2005). Such situations of protecting workers' interests through long-term labor contracting hinder worker turnover. The result is that firms cannot use worker turnover as a substitute buffer mechanism to inventories (Haltiwanger and Maccini, 1990, 1994). Hence, firms in these circumstances are expected to accumulate more inventories in order to prevent demand shocks.

Therefore, there are two countervailing effects of employee CSR on the level of inventory: on the one hand, policies such as training, empowerment, and rewards are expected to reduce the inventory level and, on the other hand, long-term contracting is expected to increase it. Hence, it is assumed that the overall effect of the employee relations on the inventory level could be neutral.

Hypothesis 1b. *A firm's social responsible behavior towards employees will have a neutral impact on inventory investment.*

Natural environment. Russo and Fouts (1997) distinguish two types of environmental policies: compliance and pollution prevention. Firms following a compliance policy rely on pollution abatement through a short-term "end-of-pipe" approach, often resisting the enactment and enforcement of environmental legislation. The second environmental policy consists of going beyond compliance to focus on prevention, with a systematic approach that emphasizes source reduction and process innovation. Compliance and prevention polices are supported by different resource bases. Compliance is achieved primarily by using technologies that treat waste once produced and, therefore, they do not fundamentally vary the production or service delivery process. Contrarily, a proactive environmental policy is expected to lead firms to redesign their production or service delivery process. The result of a proactive improvement in pollution prevention is a reduction in waste and pollution during the manufacturing process (Hart, 1995).

[2] Some researchers have pointed out that production systems such as lean manufacturing may work with low inventory levels while attending customer requirements (Lieberman et al., 1999). However, as explained in the next subsection, these systems take place in companies that also attach high importance to other stakeholders such as workers and the environment.

Environmental performance is related to low inventory levels given that the objective of reducing waste and pollution generated from components and parts is achieved by working with lower inventory levels. For example, efforts to reduce energy requirements (electricity, gas, and oil) and water consumption, which ultimately have an impact on air emissions and water pollution, have led firms to decrease storage facilities (Sarkis et al., 2004) and with that, inventory levels. In addition, CSR's goal of eliminating pollutant, obsolete materials can be fulfilled by means of reduced inventories (Sarkis et al., 2004). Then, higher levels of environment CSR leading to environmental efficiency—the reduction of environmental impact through more efficient use of natural resources (Rothenberg et al., 2001)—will generate lower inventory levels. This is our third hypothesis:

> **Hypothesis 1c.** *A firm's social responsible behavior towards the natural environment will have a negative impact on inventory investment.*

2.2. Corporate social responsibility and inventories

The purpose of this section is to connect a firm's overall social responsibility to its inventory policy once we take into consideration the previous theoretical statements.

Existing research suggests that stakeholder pressure is one of the most important drivers of CSR (Agle et al., 1999; Bansal and Roth, 2000; Mitchell et al., 1997; Kassinis and Vafeas, 2006). Stakeholders' ability to influence corporate decisions stems from their contributions to their survival and profitability (Clarkson, 1995); the power, legitimacy, and urgency of their claims (Mitchell et al., 1997); their control of critical resources (Pfeffer and Salancik, 1978); and their ability to pressure other groups on whom the firm depends (Frooman, 1999). Diverse stakeholders, such as employees (Turban and Greening, 1997), customers (Christmann, 2004) and environmental groups (Sharma and Henriques, 2005) increasingly pressure corporations to behave responsibly. However, stakeholders differ in their ability to pressure firms (Mitchell et al., 1997) and firms also differ in how their managers perceive the relative importance of different stakeholders in influencing CSR practices (Henriques and Sadorsky, 1999). As a consequence, firms differ in how they deal with different stakeholders. The primary source of these variations is the extent to which the firm is resource-dependent on those stakeholders. Hence, firms are not likely to address the issues and concerns of all stakeholders all the time (Jawahar and McLaughlin, 2001). Instead, they will pay more attention to those issues of stakeholder groups who control resources that are critical for the firm's success. In turn, these stakeholders' pressures shape firms' social and environmental strategy.

Customer preferences and monitoring are the main reasons for a firm to adopt more socially responsible strategies. As public concerns about social and environmental issues grow, customers increasingly consider social factors when taking their purchase decisions, thereby affecting corporate performance (Christmann, 2004). Several studies have shown that customer pressure is an important driver of a firm's social conduct, particularly to those firms that try to attend to customers' demands as a goal but not as a means to increasing profits. For example, Christmann and Taylor (2006) study the factors that influence the firm's level of social responsibility and conclude that firms choose their level of compliance with social and environmental standards depending on customer pressure.

Remarkably, as firms become more socially responsible, they consider broader interests other than those of customers. Specifically, firms that follow a proactive strategy take into account the interests of different stakeholders simultaneously (Murillo-Luna et al., 2008). Thus, firms with low levels of CSR focus their attention mainly on their customers and capital providers, while socially responsible firms consider the interests of all stakeholders.

Considering the effects of customers, employees and the natural environment on inventories described in Hypotheses 1a-1c, we expect low levels of CSR to have a positive impact on the level of inventories, while high social responsibility will reduce that level. Accordingly, we propose:

Hypothesis 2. *A firm's social responsible behavior has a curvilinear (inverted U-shaped) relationship with inventory investment.*

In Appendix 1, we derive such a relationship formally considering the theoretical contentions of Hypotheses 1a, 1b and 1c, as well as the arguments behind Hypothesis 2 (the marginal importance of customer CSR decreases with CSR, while the environment CSR and employee CSR increase).

3. Empirical analysis

3.1. Description of data and variables

We carried out our empirical analysis making use of a sample of U.S. firms extracted from the COMPUSTAT database for the period 1996-2006. We merged this database with the KLD database, which provides information on CSR based on a series of items that capture strengths and concerns on social issues for five different stakeholders, namely: customers, employees, environment, community and corporate governance (see Appendix 2). From this sample, we selected only those companies that were active for at least 4 years during the period 1996-2006 and excluded companies that were involved in mergers and acquisitions. Additionally, we removed outliers by excluding the top and bottom 1% of companies in terms of the inventory-to-sales ratio. Our final database contains data on 1,881 different US companies with 9,269 observations for the period 1996-2006. Finally, we control for inflation by using variables expressed in the same price term and relative values.

We conduct our cross-company panel data analysis using a relative inventory measure (*Inv_sales*), defined as the ratio of inventory to cost of goods sold—sales in inventory prices. This is our dependent variable. According to our theoretical setting, the main explanatory variable of our interest is a firm's CSR. Additionally, and based on previous literature (Rumyantsev and Netessine, 2007; Gaur et al., 2005, and Lieberman et al., 1999), we also include the following control variables: firm size, gross margin, lead time, sales growth, financial structure and sales uncertainty. The proxies used for these explanatory variables are the following: corporate social responsibility (*CSR*) is measured using the rating provided by the KLD database, which is the sum of the values that correspond to the CSR of five different stakeholders (customers, employees, environment, community and corporate governance). For approaching the CSR of each stakeholder, we take the difference between a firm's strengths and concerns in relation to each stakeholder, which are proxied by a set of different items (Waddock and Graves, 1997).[3] In this way we have defined *Customer CSR*, *Employee CSR* and *Environment CSR* [4] needed in order to test Hypotheses 1a, 1b and 1c.[5] For control variables, company size (*Size)* is approached by means of total assets. This variable will measure possible scale economies in inventory storage as well as the effect of diversification given that large firms tend to be more diversified. Gross margin (*Gross Margin*) is the ratio of the difference between sales and the cost of goods sold to the sales amount. This variable captures inventory underage cost, that is, the cost of having a low inventory level (Silver et al., 1998). The larger the gross margin, the larger the underage cost. For lead time or delays (*Lead Time)*, we use the average number of days of accounting payable outstanding (Rumyantsev and Netessine, 2007). We consider a firm's financial structure, proxied through the debt-to-equity ratio (*Debt Capital*), because this is a standard determinant of inventory investment (Kashyap et al., 1994; Carpenter et al., 1994; Tribó, 2001). This variable captures eventual asset substitution problem (Jensen and Meckling, 1976): the larger a firm's leverage, the riskier a firm's investment policy and the larger inventory accumulation. We also

[3] Further information is available at http://www.kld.com/research/stats/index.html

[4] In the determination of environment CSR, we have included those items of community CSR that cover environmental issues. Moreover, such overlapping between community and environment CSR has led us to neglect a specific analysis of the impact of community CSR on inventories.

[5] We have rescaled the measures on CSR in order to avoid negative values and facilitate their interpretation.

include sales growth (*Sales Growth*) measured as the percentage annual growth of sales as a proxy of growth opportunities. Finally, following Cachon and Terwiesch (2005), demand uncertainly (*Sigma*) is calculated by estimating sales in terms of the lagged value of sales and taking the standard deviation of residuals. This model specification yields the smallest mean squared error.

3.2. Preliminary evidence

Summary statistics and Spearman correlations among variables are reported in Table 1. The results show that the Spearman correlation between customer CSR and inventory-to-sales ratio is positive (6.5%), while between environment CSR and inventory-to-sales ratio it is negative (-6.4%). Concerning the correlations between the overall CSR as well as Employee CSR and inventory-to-sales ratio, they are not significantly different from zero.

[INSERT TABLE 1 ABOUT HERE]

We have also analyzed (available upon request) the normalized weight of *Customer CSR*, *Environment CSR* and *Employee CSR* within the overall CSR firm value. We consider two scenarios: observations with CSR ratings in the first quartile of the distribution and those in the last quartile of the CSR distribution. We have found that for higher levels of CSR, there is a significant decrease in the weight of the customers, from the most important stakeholder in the first quartile of the CSR distribution (38.6%) to the least important in the last quartile (17.2%). The weight of the natural environment increases in a significant way from 25.7% to almost 40%, while that of workers also increases but in a non-significant way. These results conform to the idea that for larger values of CSR, customers' interests reduce their importance in favor of other stakeholders, particularly for environmental groups. In the following section we connect this result with the existence of an inverted U-shaped relationship between CSR and inventory-to-sales ratio.

3.3. Model specification

We contrast our theoretical contentions relying on regression techniques and taking advantage of the panel data structure of our sample. Our basic specification is as follows:

$$Inv\_Sales_{it+1} = \beta_0 + \beta_1 CSR + \beta_2 CSR_{it}^2 + \beta_3 Size_{it} + \beta_4 Gross\ Margin_{it} + \beta_5 Lead\ Time_{it} + \beta_6 Sales\ Growth_{it} + \beta_7 Debt\ Capital_{it} + \beta_8 Sigma_{it} + \sum_{S=1}^{9} \beta_{8+s} Dummy_{Sit} + \sum_{T=1}^{10} \beta_{17+T} Dummy_{Tit} + \varphi_i + \varepsilon_{it} \quad (1)$$

where we use two subscripts to account for time-specific (*t*) and company-specific (*i*) effect. We denote the sectoral and temporal dummy variables $Dummy_{Sit}$(at 1-digit SIC code) and $Dummy_{Tit}$.

We employ a linear instead of a multiplicative regression (log transformation) since in the specification we include quadratic terms on CSR in order to test Hypothesis 2.

Our estimating equations for testing Hypotheses 1a, 1b and 1c is equivalent to specification (1), but replacing the overall *CSR* by *Customer CSR*, *Employee CSR* and *Environment CSR*.

We recognize the possibility that the error term (φ_i) may be correlated with changes in a firm's social responsible policies (first endogeneity problem). We tackle this problem by conducting estimations in differences (fixed-effect estimation). A second endogeneity problem is the reverse causality issue (connected with ε_{it}). It may be the case that firms improve their inventory management due to the introduction of new technology. In this situation, the successful introduction of such new technology will require firms to satisfy their stakeholders' interests in order to ensure their commitment in the acquisition of the required skills for the implementation of the new inventory policy. Hence, the relationship would be from inventories to a firm's CSR. In order to prevent both endogeneity problems, we have advanced the dependent variable by one period and we have conducted system GMM estimation (Arellano and Bond, 1991), where we have taken different temporal lags of these variables as instruments of the potential endogenous variables (CSR).

3.4. Results

Table 2 shows the results of estimating specification (1).[6] Column 1 of Table 2 shows that there is not a linear relationship between a firm's CSR and its inventory-to-sales ratio as the coefficient of CSR is not significant. Once we decompose a firm's socially responsible behavior in terms of its policy towards different stakeholders, we find the following results (see column 2). First, the coefficient of Customer CSR is positive (0.191 with t=3.837), which indicates that firms aiming at addressing customers' demands tend to accumulate more inventories. In particular, one standard deviation in customer CSR (0.629) implies an increase in the inventory-to-sales ratio of 37.31% from the mean value of this ratio. Such result conforms to Hypothesis 1a. Second, there is a neutral effect of employee CSR on a firm's inventory policy (coefficient 0.033 with t=1.320, which is not significant). This result conforms to Hypothesis 1b. Lastly, firms that are more sensitive to environmental issues reduce their inventory-to-sales ratio (coefficient -0.048 with t=-1.864). In economic terms, an increase in one standard deviation in *Environment CSR* (0.786) leads to a decrease of 11.72% in the inventory-to-sales ratio from its mean value. This result conforms to Hypothesis 1c.

Column 3 shows that there is a non-linear relationship between CSR and the inventory-to-sales ratio. In particular, the linear coefficient is positive 0.123 (t=4.239) and the quadratic coefficient is negative -0.005 (t=-3.945). These results indicate that there is an inverted U-shaped relationship between CSR and inventory-sales ratio reaching a maximum when CSR is 12.3%[7], which corresponds to a slightly larger value than the mean of the CSR distribution, which has a value of 11.8%. This result confirms Hypothesis 2. Once we decompose this non-linear effect considering different types of stakeholders (columns 4, 5 and 6), we do find a positive, convex relationship for customers (both coefficients for the linear and the quadratic term are positive), an inverted U-shaped relationship for employees (the linear coefficient of *Employee CSR* is positive while that of the quadratic term is negative), and a negative concave relationship for the natural environment (both coefficients are negative). Hence, we can infer the relevance of decomposing the CSR among the different stakeholders in order to study its differential impact on a firm's inventory policy. Also, we posit that there are three sources of the non-linear effect of CSR on inventory-sales ratio: 1) the inverted U-shaped connection of employee CSR on a firm's inventory policy; 2) the positive impact of customer CSR on inventory-to-sales ratio; and 3) the negative impact of the natural environment CSR on inventory levels. Note that we have mentioned that increases in the overall value of CSR are associated with significant increases in the natural environment CSR as well as with significant decreases in customer CSR. Finally, the analysis of control variables shows the following: first, larger firms use inventories more intensively. This conforms to the wider product variety of larger firms that need to accumulate more inventories to satisfy diverse demands (Cachon and Terwiesch, 2005).[8] Second, firms with larger gross margins use more inventories. This result is consistent with the fact that larger gross margins mean larger underage (costs of having too small inventories), and hence, firms accumulate more inventories (Silver et al., 1998; Rumyantsev and Netessine, 2007). Lastly, firms with larger debt-to-equity ratios accumulate more inventories. Leverage triggers aggressive

[6] We have conducted some additional analysis (not reported) in which we distinguish between finished-good and non-finished-good inventories. We have found that customers' CSR mainly affect (positively) finished-goods inventories, while environmental sensitivity mainly reduces non-finished goods inventories.

[7] This is the result of –coefficient (CSR)/ (2 × coefficient (CSR^2))=- 0.123/(2×0.005)=12.3

[8] Some papers (Eppen, 1979; Rumyantsev and Netessine, 2007) suggest a negative relationship between firm size and inventories given that larger firms can pool together demand from many locations, which reduces risks. In this case, firms do not need to be hedged with larger inventories. This argument is less important in our sample of socially responsible firms that follow low-risk strategies, which means that inventories play a less important role as a hedging mechanism against demand uncertainty.

investment behavior related to risk-shifting (Jensen and Meckling, 1976). Such investment pattern translates into inventory investment accumulation.

[INSERT TABLE 2 ABOUT HERE]

4. Discussion and conclusions

Our objective was to examine the effect of a firm CSR on its inventory policy. To achieve this goal, we relied on the literature on the influence of stakeholders on corporate decisions and extended it to inventory decisions. Using a sample of 1,881 US firms (representing 9,269 observations) for the period 1996-2006, our analysis provided support for the hypotheses developed. In particular, we found an inverted U-shaped relationship between CSR and the inventory-to-sales ratio.

We explained this nonlinear relationship by the differential effect on inventories of the different CSR components. For customers, we predicted a positive relationship between CSR and inventories. For employees, we expected a neutral relationship. Finally, a more proactive approach to the environment is expected to lead the firm to eliminate all kinds of waste by minimizing inventory.

Our results provided support for these expected relationships. An in-depth exploration of the effects of employee CSR revealed that the neutral relationship was in reality an inverted U-shaped relationship, a result that is consistent with the existence of two countervailing effects. In particular, there is a positive effect on inventories related to long-term labor contracting (and other social concessions such as salary increases), which does not require substantial organizational changes connected to the implementation of a CSR policy. However, the negative effect on inventories related to empowering employees requires a bulk of changes. Such changes can only appear in a setting where an intensive CSR policy is implemented. The final result is an inverted U-shaped relationship.

4.1. Implications from Empirical Tests and Contributions to Theory Development

Our paper is one of the few studies that provide systematic evidence on the influence of stakeholder groups on the characteristics of inventory systems. The results found show the existence of an inverted U-shaped relationship between CSR and inventory-to-sales ratio. This finding may explain the dispersion of results in previous studies on the link between lean production practices and social and environmental performance (e.g., King and Lenox, 2001; Rothenberg et al., 2001). Our research provides two explanations for the conflicting results: the causal relationship may operate in the opposite direction (i.e., from social and environmental performance to inventory investment) and, more importantly, this relationship is more complex than predicted in previous literature: it is curvilinear instead of linear. Our results show that a firm can minimize inventories by placing its emphasis on the inventory planning and control by managers as representatives of shareholders' interests (low CSR levels), or by giving stakeholders both the ability and the responsibility to take active steps related to inventory management and propose solutions to enhance inventory efficiency (high CSR levels).

This study also shows that the outcome of an inventory system is influenced by the pressures of different stakeholders. Such finding is a contribution to the literature on the ability of stakeholders to influence corporate decisions (McWilliams et al., 2006). This study extends the literature on the implications of social and environmental efforts on manufacturing performance (e.g., Porter and Van Der Linde, 1995) by focusing on a particular dimension of this performance: the inventory policy.

Our study also contributes to the literature that has attempted to identify the relationship between CSR and corporate financial performance. Margolis and Walsh (2003) have stressed the importance of identifying the implications of CSR practices on a firm's operations. Given the influence of a firm's operations on financial performance found in the literature and our findings supporting an association between CSR and firm's operations, any research aimed at studying the financial performance consequences of CSR needs to include operations management variables.

4.2. Practical Implications

A set of practical implications can be extracted from our study:

First, this study shows that the outcome of an inventory system is heavily influenced by the pressures exerted by different stakeholders. Each stakeholder has its own preferences regarding the characteristics of the inventory system. Managers should, therefore, be aware that the success of an inventory system requires taking into account the different views of stakeholders before and during the implementation of the inventory system. Furthermore, we posit that in the initial stages of the implementation of a CSR program, when firms mainly focus on customers' demands, managers should accumulate more inventories. However, firms that develop more intensive CSR policies and try to satisfy the interests of more stakeholders can implement low-inventory level policies efficiently.

Second, our findings suggest that potential complementarities exist among operational practices (e.g., CSR and lean production), and, firms should consider bundling these practices. A firm interested in implementing lean production should first adopt a set of operational practices related to its stakeholders, such as work practices, sales practices, and purchasing and supply practices.

Third, according to our results of a curvilinear relationship between CSR and inventories, the implementation of production policies based on low inventory levels (e.g., a lean production) can be made using two possible strategies: moving the decision power downstream and empowering different stakeholders, or moving it upstream to managers-shareholders. Intermediate positions may lead to inefficiencies in the implementation of such operational policy.

Fourth, once we focus on customers' CSR policy, we have found that the level of inventories is increasing and convex in customer CSR, which means that as the firm moves to higher levels of CSR, every marginal increase in customer CSR requires a major increase in the level of inventories. Managers must, therefore, balance the benefits of improved CSR with its customers (in terms of fidelity, for example) and the costs of a higher inventory level.

Fifth, in the case of employees, the firm can obtain substantial reductions in inventories from high levels of employee CSR. Managers, consequently, should ensure that employees are motivated to make suggestions and implement improvements in inventory management practices.

Sixth, with respect to the environment, our results are in accordance with recent research such that there are opportunities to exploit environmental efforts to further enhance the efficiency of the inventory system, which is an important driver of firm performance. Unfortunately, managers underestimate the benefits of investments in environmental management (King and Lenox, 2002), possibly because these benefits are indirect. Through a process of "creative destruction", environmental improvement efforts force firms to adopt a new perspective to conduct business, with a more entrepreneurial attitude (Corbett and Klassen, 2006). Pollution abatement, for example, requires the redesign of production processes to increase material savings, minimize inventories, and reduce energy consumption (Klassen and Whybark, 1999). We, therefore, encourage managers to assume a commitment towards the natural environment, since through the implementation of environmental improvement programs, the firm's operations will ultimately be improved.

Lastly, our results may be of interest in a context of economic difficulty, as in the current financial crisis. In times of difficulty, many companies redirect their attention to operational issues, leaving aside most of their CSR programs. This study shows that neglecting the demands of stakeholders may affect operational results. In particular, our findings suggest that reducing the investment in CSR leads to an increase in the level of inventories, with the problems associated with such change, when the firm departs from initial high levels of CSR.

In summary, this study shows that attaining superior social performance can be a significant driver of production process efficiencies, especially in the area of inventory management. We hope our research will inspire future studies on the operational consequences of CSR.

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Table 1: Descriptive and correlation matrix

	Mean	DS	Min	Max	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
(1) Inv_Sales	0.322	2.305	0	16.515	1										
(2) CSR (%)	11.820	2.442	1	26	-0.003	1									
(3) Customer CSR (%)	3.849	0.629	1	7	0.065	0.260	1								
(4) Employee CSR (%)	4.853	0.908	1	9	0.019	0.448	0.189	1							
(5) Environment CSR (%)	5.850	0.786	1	10	-0.064	0.292	0.146	0.056	1						
(6) Size	16518.170	74581.140	0.490	1884318	0.065	0.206	0.009	0.073	-0.213	1					
(7) Gross Margin	0.161	0.077	0	1	0.501	0.195	0.078	0.087	-0.075	0.187	1				
(8) Lead Time	115.295	133.278	0.411	1752.62	0.250	-0.002	-0.159	-0.019	-0.137	0.433	0.390	1			
(9) Sales Growth	0.531	37.486	-0.958	36.089	-0.033	0.099	-0.041	-0.034	0.031	-0.047	0.115	0.073	1		
(10) Debt Capital	50.098	78.398	0	275.378	-0.003	0.000	-0.163	-0.044	-0.096	0.087	-0.306	0.020	-0.203	1	
(11) Sigma	219.407	2005.989	4.125	30697.88	-0.004	0.164	0.048	0.124	-0.137	0.086	0.100	0.356	-0.009	-0.010	1

Correlations are significant when they are above .05. All variables are defined in the main text.

Table 2: Relative inventory level contingent on different stakeholders

VARIABLES	(1) Inv_Sales (t+1)	(2) Inv_Sales (t+1)	(3) Inv_Sales (t+1)	(4) Inv_Sales (t+1)	(5) Inv_Sales (t+1)	(6) Inv_Sales (t+1)
CSR	-0.004		0.123***			
	(0.687)		(4.239)			
Customer CSR		0.191***		0.196**		
		(3.837)		(2.132)		
Employee CSR		0.033			0.626***	
		(1.320)			(3.162)	
Environment CSR		-0.048**				-0.100**
		(-1.864)				(-1.980)
CSR^2			-0.005***			
			(-3.945)			
Customer CSR^2				0.123**		
				(2.170)		
Employee CSR^2					-0.057***	
					(-3.063)	
Environment CSR^2						-0.0211**
						(-2.017)
Size (exp-6)	3.410***	3.470***	3.190***	3.150***	2.840***	3.260***
	(10.38)	(6.743)	(8.379)	(5.458)	(6.149)	(5.310)
Gross Margin	0.001*	0.001**	0.001**	0.001**	0.001**	0.001***
	(1.728)	(1.848)	(1.881)	(1.829)	(1.901)	(2.822)
Lead Time (exp -7)	-1.850	1.470	2.450	3.930	4.240	1.180
	(-0.524)	(0.223)	(0.642)	(0.560)	(1.041)	(0.879)
Sales Growth (exp -5)	-0.584	-0.551	0.4490	1.370	0.962	1.170
	(-0.384)	(-0.081)	(0.272)	(0.0385)	(0.534)	(0.368)
Debt Capital	0.001	0.002***	0.001**	0.001	0.001*	0.000
	(1.007)	(4.170)	(2.055)	(0.715)	(1.675)	(0.711)
Sigma (exp-10)	-3.580	-4.200	-5.000	-5.300	-3.700	-5.630
	(-1.447)	(-1.128)	(0.102)	(-1.382)	(-0.975)	(-1.138)
Intercept	0.300	0.636***	0.970***	0.616**	0.984***	0.641
	(0.099)	(2.556)	(3.004)	(2.310)	(3.392)	(1.350)
Observations	9269	9269	9269	9269	9269	9269
Fitness test	615.99 (0.000)	705.51 (0.000)	624.55 (0.000)	673.63 (0.000)	631.49 (0.000)	604.79 (0.000)
AR(2) test	1.35 (0.177)	1.30 (0.194)	1.29 (0.196)	1.27 (0.203)	1.32 (0.188)	1.34 (0.180)
Hansen test	76.93 (0.148)	53.44 (0.734)	65.22 (0.434)	36.22 (0.999)	44.24 (0.972)	48.64 (0.892)

All estimations are conducted using the Arellano and Bond (1991) system GMM technique. We take up to three temporal lags of the potential endogenous variable as instruments. All variables are defined in the main text. The dependent variable is led by one period. Wald test as the fitness test. The J statistic (p-values reported in parentheses) is distributed as chi-squared under the null hypothesis of instrument validity. The AR(2) is a test for a second-order serial correlation in the residuals, which is distributed as N(0,1) under the null hypothesis of no serial correlation. *** p<0.01, ** p<0.05, * p<0.1. T-statistics in parentheses.

Appendix 1: Basic model

We define inventory investment as a function $\not{f}: S \subset \mathcal{R}^3 \to \mathcal{R}$, so that $I = \not{f}(X_1, X_2, X_3)$, where X_1 denotes customer CSR, X_2 denotes employee CSR and X_3 denotes the natural environment CSR. Additionally, we define the overall CSR as $X = X_1 + X_2 + X_3 = W_1(X)X + W_2(X)X + W_3(X)X$, where $W_1(X)$, $W_2(X)$ and $W_3(X)$ are the weights (or marginal importance) of the different CSR dimensions within the overall CSR.

We make the following assumptions:

- From Hypothesis 1a, we assume that $\partial I / \partial X_1 > 0, \forall X_1 \in [1, X_{1max}]$. (A1)
- From Hypothesis 1b, we assume that $\partial \mathrm{I} / \partial \mathrm{X}_2 = 0, \forall \mathrm{X}_2 \in [1, \mathrm{X}_{2max}]$. (A2)
- From Hypothesis 1c, we assume that $\partial \mathrm{I} / \partial \mathrm{X}_3 < 0, \forall \mathrm{X}_3 \in [1, \mathrm{X}_{3max}]$. (A3)
- The effects of X_1, X_2 and X_3 on I are independent, that is, $\partial^2 \mathrm{I} / \partial \mathrm{X_i}\, \partial \mathrm{X_j} = 0$. (A4)
- As explained in the development of Hypothesis 2, the weight of customer CSR ($\mathrm{W}_1(\mathrm{X})$) decreases with CSR, while that of the natural environment ($\mathrm{W}_2(\mathrm{X})$) increases. In the case of employees, its weight ($\mathrm{W}_3(\mathrm{X})$) is not decreasing in X. Empirical evidence shown in the main text is consistent with such assumptions. Thus,

$$\partial W_1(X) / \partial X < 0, \partial W_1(X) / \partial X \geq 0, \partial W_1(X) / \partial X > 0. \quad \text{(A5)}$$

- To simplify, we consider that the weights function $\mathrm{W_i(X)}$ as well as the function on inventories ($\not{f}$) are linear in $\mathrm{X_i}$. (A6)

From these assumptions, we predict:

Hypothesis 2. *I is concave with respect to* X.

Proof.

$$\frac{\partial^2 \mathrm{I}}{\partial \mathrm{X}^2} = \frac{\partial^2 \mathrm{I}}{\partial \mathrm{X}_1^2}\left(\frac{\partial \mathrm{X}_1}{\partial \mathrm{X}}\right)^2 + \frac{\partial \mathrm{I}}{\partial \mathrm{X}_1}\frac{\partial^2 \mathrm{X}_1}{\partial \mathrm{X}^2} + \frac{\partial^2 \mathrm{I}}{\partial \mathrm{X}_2^2}\left(\frac{\partial \mathrm{X}_2}{\partial \mathrm{X}}\right)^2 + \frac{\partial \mathrm{I}}{\partial \mathrm{X}_2}\frac{\partial^2 \mathrm{X}_2}{\partial \mathrm{X}^2} + \frac{\partial^2 \mathrm{I}}{\partial \mathrm{X}_3^2}\left(\frac{\partial \mathrm{X}_3}{\partial \mathrm{X}}\right)^2 + \frac{\partial \mathrm{I}}{\partial \mathrm{X}_3}\frac{\partial^2 \mathrm{X}_3}{\partial \mathrm{X}^2} \quad \text{(by A4)}$$

$$\frac{\partial^2 \mathrm{I}}{\partial \mathrm{X}^2} = \frac{\partial \mathrm{I}}{\partial \mathrm{X}_1}\frac{\partial^2 \mathrm{X}_1}{\partial \mathrm{X}^2} + \frac{\partial \mathrm{I}}{\partial \mathrm{X}_3}\frac{\partial^2 \mathrm{X}_3}{\partial \mathrm{X}^2} \quad \text{(by A2 and A6)}$$

Also, $\frac{\partial^2 \mathrm{X}_{\{1\}_{\{3\}}}}{\partial \mathrm{X}^2} = \frac{\partial^2 \mathrm{W}_{\{1\}_{\{3\}}}(\mathrm{X})}{\partial \mathrm{X}^2}\mathrm{X} + 2\frac{\partial \mathrm{W}_{\{1\}_{\{3\}}}(\mathrm{X})}{\partial \mathrm{X}} = 2\frac{\partial \mathrm{W}_{\{1\}_{\{3\}}}(\mathrm{X})}{\partial \mathrm{X}}\left\{\begin{matrix}<\\>\end{matrix}\right\} 0$ (by A5 and A6)

Therefore,

$\frac{\partial^2 \mathrm{I}}{\partial \mathrm{X}^2} = \frac{\partial \mathrm{I}}{\partial \mathrm{X}_1}\frac{\partial^2 \mathrm{X}_1}{\partial \mathrm{X}^2} + \frac{\partial \mathrm{I}}{\partial \mathrm{X}_3}\frac{\partial^2 \mathrm{X}_3}{\partial \mathrm{X}^2} < 0$ (by A1 and A3) $\Rightarrow$ *I is concave with respect to X.*

Appendix 2: KLD social rating criteria

KLD dimension	Area of strength	Area of concern
Community	Philanthropic giving over 1.5 percent of pretax earnings; innovative giving; participating in public/private partnerships aimed at supporting housing initiatives for the disadvantaged; support for local primary and secondary education through long-term commitments.	Substantial fines or civil penalties paid, or major litigation relating to communities in which the firm operates. Corporate relations strained because of plant closings or general breach of agreements.
Diversity	CEO is a woman or minority. Notable progress in promotion of women and minorities, especially to line positions. Diverse representation on board of directors. Outstanding employee benefits addressing work/family concerns. Strong purchasing record with women/minority owned firms. Initiatives in hiring disabled; progressive gay, lesbian, and bisexual policies.	Substantial fines or civil penalties paid as a result of affirmative action controversies. No members of (traditionally) underrepresented groups on board of directors or among senior line management.
Employees	Strong union relations. Long-term policy of company-wide cash profit sharing. Worker involvement/ownership through gain sharing, ESOP, sharing of financial information, participation in decision making. Strong retirement benefits or other innovative/generous benefits.	Notably poor union relations. Payment of significant fines or civil penalties regarding employee safety conditions or major safety controversies. Dramatic recent workforce reductions (layoffs of more than 15 percent in 1 year, 25 percent in 2 years). Substantially underfunded pension plan or inadequate benefits plan.
Natural environment	Substantial revenues from remediation products, innovative products with environmental benefits, company-wide changes in processes to reduce emissions and toxins. Substantial user of recycled materials in manufacturing. Substantial revenues from fuels with environmental advantages or notable conservation projects. Environmentally sensitive new equipment.	Current liabilities for hazardous waste sites exceed $50 million or the firm has recently paid significant fines or civil penalties for waste management violations. Consistent pattern of regulatory problems, or major controversies on environmental degradation. Top producer of CFCs, HCFCs, methyl chloroform, or other ozone depleting chemicals. High relative legal emissions. Producer of agricultural chemicals.
Customers/product safety	Ongoing commitment to quality through long-standing, company-wide quality program judged among industry's best. Leader in industry R&D. Involvement in supplying products and services that benefit the economically disadvantaged.	Payment of substantial fines or civil penalties relating to product safety or antitrust violations. Product liability lawsuits. Major marketing controversy. Involvement in controversial advertising, consumer fraud, or regulatory actions.

Source: Kinder, Lydenberg, Dornini & Co. Adapted and used with permission.