

# VALUATION EFFECTS OF CORPORATE SOCIAL RESPONSIBILITY

**Ali Fatemi<sup>a</sup>**  
**DePaul University**

**Iraj Fooladi<sup>b</sup>**  
**Dalhousie University**

**Hassan Tehranian<sup>c</sup>**  
**Boston College**

## Abstract

This paper develops a valuation model of the firm that provides for the expenditure of corporate resources in support of community, social or environmental causes. We show that under certain circumstances CSR expenditures create value for the firm. We also test our model by simulations and confirm that, at least based on our choice of variables, CSR does pay off in the form of value creation.

***JEL Classification:*** G30, G32

***Keywords:*** *Corporate Social Responsibility, Valuation, Shareholders' value*

<sup>a</sup> Driehaus College of Business, DePaul University, <sup>b</sup> Rowe School of Business, Dalhousie University, <sup>c</sup> Carroll School of Management, Boston College. The authors are grateful to Yonggan Zhao, Mathew Morey, Jay Cai, and Nguyen Thanh Cuong and participants the Financial Management Association Europe, Multinational Finance Society, and Gobar Finance conferences for their helpful comments. Iraj Fooladi acknowledges with thanks financial support from Mackay Fund at Dalhousie.

## I. Introduction:

A heightened level of interest in the topic of corporate social responsibility (CSR) has led to a significant increase in the volume of studies dealing with its various dimensions. While most of the earlier research was carried out by researchers in the fields of strategic management and business ethics (Waddock & Graves, 1997; Roman, Hayibor, & Agle, 1999; Margolis & Walsh, 2001; Orlitzky & Benjamin, 2001), scholars in the field of economics and finance have recently joined the debate in an effort to investigate the link between social and financial performance (see, for example, Barnea & Rubin, 2010; Statman, 2005; Goss & Roberts, 2011; Kempf & Osthoff, 2007; Huppé, 2011; Kotchen & Moon, 2011; Servaes & Tamayo, 2013).

A number of studies dealing with CSR have addressed the issue in a *normative* context. From this perspective, the traditional corporate governance literature treats CSR expenditures as the allocation of corporate resources in pursuit of activities that are not in the best interest of shareholders and may or may not create value for other stakeholders.<sup>1</sup> Accordingly, the firm is advised to focus on maximizing shareholder profits (narrowly defined) and leave the decisions about social responsibility to the shareholders. Therefore, in this framework, the firm's only social responsibility is to maximize profits. In contrast, the stakeholder theory of firm assigns critical importance to the societal role played by the firm. In this framework, CSR activities are regarded as an integral component of a firm's mission. This proposition makes the case that, although an important consideration, shareholders' interests should not be the firm's only concern. Accordingly, CSR is the right thing to do because firms have responsibility to any person or entity that is affected by (or affects) their activities (see Freeman, 1984; Freeman & McVea, 2001; Freeman, Wicks, & Parmar, 2004).

Recently, however, a more pragmatic approach has emerged that leads to a convergence of these two views. Central to the core of this approach is the argument that “[f]irms are institutions created to serve human needs” (Roberts, 2004, p. 20) and that “[i]t is also necessary that all the relevant interests [not just those of shareholders] are recognized and taken into account” (p. 21). Accordingly, it can be said that the “stockholder *versus* stakeholder” debate has given way to the notion that the creation of value for shareholders may be possible at the same

---

<sup>1</sup> This strand of literature sets forth a simple view of agency theory that is associated with Milton Friedman (1970) and Michael Jensen (Jensen, 2005; Jensen & Meckling, 1976, 2005).

time that the interests of other stakeholders are taken into account. Therefore, whereas consideration of CSR as an exogenous issue gives rise to a conflict between the interests of the investors and those of other stakeholders, this new perspective recognizes CSR in the light of its contributions to the value creation process.<sup>2</sup> Accordingly, the firm is expected to proceed and engage in such activities if and when they create value for its stakeholders, shareholders included.

Regardless of which model is a better predictor of corporate behavior, the effect of CSR engagement on the value of the firm and its performance is of paramount importance. It has been in this spirit that researchers in the field of finance have begun to investigate the link between corporate financial performance and CSR objectives. These investigations, however, have not produced consistent result. While many researchers report a positive relationship between CSR and firm performance, others report the opposite. Yet, another group of researchers reports an inverse U relationship, i.e., a firm's performance improves with a moderate level of CSR and worsens at higher levels of CSR expenditure. Without being exhaustive, we summarize the findings of a few of these studies in four broad categories dealing with the effect of CSR on performance, financing costs, riskiness, and value of the firm.

By far, the largest group of these studies deals with the relationship between CSR and firm performance. Included among these is the work of Dimson, Karakas, and Li (2012) who document an average 4% abnormal return for firms that successfully initiate CSR engagement. However, they find no market reaction where the engagement is not successful. They also document that when the firm's engagement is in the area of climate change or corporate governance, the market reaction is stronger. Wu and Shen (2013) find a significant relationship between a bank's performance and its CSR activities and Schreck (2011) report a strong link between performance and (single stockholder-related issues of) CSR.<sup>3</sup> Examining the nature of CSR activities, as reported in the KLD database for the S&P 500 firms between 1991 and 2008, Hong, Kubik, and Scheinkman (2012) argue that CSR activities rise with firms' performance but not the other way around. They argue that when firms "do well," they build up financial slack that enables them to "do good" by engaging in CSR activities, i.e., "less-constrained firms spend

---

<sup>2</sup> That is to say that it requires an evaluation of the 'business case' for CSR.

<sup>3</sup> However, Schreck's analysis fails to uncover the direction of causality.

more on goodness.” Erhemjants, Li, and Venkateswaran (2012) report that firms with better performance are more inclined to engage in CSR activities. However, examining the *Socrates* database, they report that firms with a higher level of R&D activity and firms in “new economy industries” are more likely to get involved with CSR activities. When it comes to the relationship between firms’ size and CSR engagements, they report a U-shaped relationship; very small and very large firms have a higher likelihood of engaging in CSR. Cornett, Erhemjants, and Tehranian (2014) report find similar results for the banking industry.

Mănescu (2011) uses detailed data on ESG attributes of a panel of large, publicly-traded U.S. firms between July 1992 and June 2008 and finds that only one of these, i.e., community relations, has a positive effect on risk-adjusted stock returns. Examining the relationship between job satisfaction and firm value, Edmans (2010) finds that the “100 Best Companies to Work for in America” generate annual returns of 2.4–3.7% more than their peers. Based on these results, he argues that job satisfaction is positively related to firm value, that CSR can improve shareholder returns and that in the short-run markets do not fully value the intangible assets generated by CSR. Addressing the question from the broader sustainability perspective, Eccles, Ioannou, and Serafeim (2012) compare a group of 180 high sustainability corporations to a matched sample of low sustainability firms. They find that high sustainability firms exhibit fundamentally different characteristics in terms of the roles played by the boards of directors, the incentive structure of their executive, procedures for stakeholder engagement, and their tendency to be more long-term oriented. They also report findings indicating that high sustainability firms significantly outperform their counterparts over the long term. Finally, Margolis, Elfenbein, and Walsh (2012) conduct a meta-analysis of 251 studies dealing with the empirical link between corporate social performance and financial performance and find a positive, albeit small, effect.<sup>4</sup>

Goss and Roberts (2011) study the cost of borrowing and find that firms at the lower end of the CSR spectrum bear a higher cost of borrowing. The cost is also high for firms with high CSR expenses. Thus, the premise of their work is that beyond a certain level socially responsible activities do not help the firm. Ge and Liu (2012) argue that through a reduction of informational asymmetries between the firm and the suppliers of capital, CSR activities should lead to a

---

<sup>4</sup> Interestingly, Kotchen and Moon (2011) analyze the behavior of nearly 3,000 publicly traded firms and find that those with a record of social irresponsibility are more likely to engage in CSR activities.

reduction of the firm's perceived degree of riskiness and bond yields. To test this hypothesis, they examine the effect of CSR disclosure and performance on bond yield spreads. Using a sample of U.S. public bond issues during the 1992-2009 period, they find that both CSR disclosure and the overall CSR performance are associated with lower bond yield spreads. This is consistent with the findings of El Ghouli et al. (2011) and Plumlee et al. (2010), who show that U.S. firms with superior CSR performance enjoy cheaper equity financing. However, employing a relatively small data set (332 firms) for a five-year period, Izzo and Magnanelli (2011) report finding that the cost of debt has a positive association with their chosen measure of CSR performance. Therefore, they conclude that not only is CSR not a value driver, it is a waste of resources that can negatively affect a firm's performance.

Becchetti, Giacomo, and Pinnacchio (2008) examine the performance of firms in the Domini social index. They find that firms in the index have, on average, higher total sales per employee and lower return on equity than similar firms outside the index. However, they also have lower conditional volatility. Bouslah, Kryzanowski, and M'Zali (2013) find that the riskiness of the firm increases as concerns about its employees, diversity and corporate governance increase. Fatemi, Fooladi, and Wheeler (2009) compare the characteristics of firms in the DS 400 index with those of similar firms not included in the index. They report that when compared to their control group over the period 1990-2005, firms in the DS 400 index produce statistically identical returns and exhibit similar market risk characteristics. However, they find that their idiosyncratic risk is significantly lower in every year at the 1% level. They also report that firms that are added to the DS 400 Index experience a positive abnormal return upon the announcements of such occasions. The reverse holds for firms that are deleted from the index.

Albuquerque, Durnev, and Koskinen (2012) develop an asset pricing model of corporate social responsibility in which CSR is modeled as an investment in higher customer loyalty. Empirically testing the model, they find evidence that CSR firms exhibit lower systematic risk and expected returns, and that increased industry CSR adoption lowers the systematic risk of non-adopters as well. Barnea and Rubin (2010) report finding that at low levels of CSR expenditure, the link between these expenditures and a firm's value is positive, but that the relationship becomes negative when these expenditures go beyond a certain level. Utilizing data for 2,261 firms in 43 countries over the 2002-2008 period, Hawn and Ioannou (2012) examine

the differential impacts of symbolic and substantive corporate ESG actions on firm performance, contingent on its level of prior CSR-based intangible assets. Their results suggest that symbolic ESG actions in the presence of higher intangibles have a higher positive impact on the firm's market value. Also utilizing data from a large sample, Servaes and Tamayo (2013) find that CSR activities enhance the value of the firm when they are accompanied by high public awareness (as proxied by advertising intensity).

Evaluating the question from an investments perspective, and comparing returns of four indexes of socially responsible companies with that of the S&P 500 index, Statman (2005) finds that Socially Responsible Investment (SRI) indexes performed better than the S&P 500 during the 1990s and worse during the early 2000s. On the other hand, comparing the characteristics of mutual funds investing in responsible firms with a group of randomly selected conventional funds, Bello (2005) reports that socially responsible funds do not differ significantly from conventional funds in characteristics such as diversification and returns. Statman and Glushkov (2009) report that an investment strategy that is long with CSR leaders and short with laggards would have produced an annual excess risk-adjusted return of 6.12% for the period 1992-2007. Finally, Huppé (2011) reports finding a significant positive relationship between CSR and investment performance. However, comparing the pre- and post-2005 results, he finds that a trading strategy based on an equally-weighted, long-only portfolio of good CSR companies produced significantly lower abnormal returns in the post-2005 period than it did in the 1992-2005 period. He, therefore, concludes that it may have become more difficult to achieve superior investment results via a security selection process that is based on the CSR criteria. As such, CSR characteristics may now be fully priced in the market value of these companies.

## **II. Valuation Consequences of CSR:**

The lower unique risk of the DS 400 companies reported by Fatemi, Fooladi, and Wheeler may be interpreted as evidence in support of the assertion that socially responsible firms enjoy a lower risk profile than their counterparts. This lower risk profile may be driven by the investors' perception of the firm's characteristics when compared to its conventional peers. For example, investors may perceive that such firms offer products or services that are less controversial, generate their products and services in a more responsible and less risky manner,

are more mindful of their environmental footprint and are less likely to face adverse actions by other stakeholders.

When combined with other positive effects that CSR may generate (relatively more stable demand from a loyal customer base, lower probability of consumer boycotts, fewer business interruptions arising from environmental risks and challenges, a less hostile or a more committed/dedicated workforce, etc.) such expenditures will have the potential to exert a significant influence on the value of the firm. More specifically, while CSR expenses have the potential to drain the firm's resources and reduce its immediate cash flows, their intermediate- and long-term benefits can outweigh the costs. Further, they can have a positive influence on the value of the firm by improving its probability of survival, lengthening the longevity of its stream of cash flows, or lowering its cost of capital. Stated differently, within a traditional discounted cash flow model described by Equation (1), CSR expenses can lead to lower levels of Cash Flows in early periods ( $t = 1, \dots, n-1$ ) but higher levels in later periods ( $t = n, n + 1, \dots$ ).

$$V_0 = \sum_t CF_t / (1 + K)^t, \quad (1)$$

Where  $CF_t$  denotes cash flows at time  $t$  and  $K$  denotes cost of capital. Further, CSR expenditures can lead to an improved probability of survival and, thus, reduce the firm's cost of capital. The net effect on the value of the firm is, therefore, dependent on the magnitude of the improvement in cash flows relative to the required outlays as well as the magnitude of the improvement in probability of default and the reduction in the cost of capital.

In order to evaluate this effect in this paper we develop two valuation models. In our first model, we focus exclusively on the impact of CSR on the cost of capital and the (*discrete*) probability distribution of survival. Therefore, we disregard the direct impact of CSR on the magnitude of cash flows. However, we allow for their indirect impact emanating from their effect on the conditional probability of survival. Within this formulation, we show that the impact of CSR on the value of the firm depends entirely on its influence on the probability of survival. We develop this discrete model further by considering the direct impact of CSR expenses on the firm's cash flows. With this extension of the model, we are able to derive conditions under which CSR can create value for the firm.

We then develop a second model that assumes a continuous probability distribution of survival. Relying on this assumption, we are able to introduce a valuation model that utilizes the concept of hazard and survival functions, which better facilitate empirical testing by using duration data. We test both models with simulations and our results are generally supportive of the notion that CSR creates value.

## II.a A Model with Discrete Probability Distribution:

To develop a simple valuation model that provides for a higher probability of survival and a lower cost of capital, we define

$p = p(\lambda)$  as the probability that a firm survives beyond any given period and

$R = R[p(\lambda)]$  as its cost of capital, where

$\lambda$  represents the resources deployed by the firm to become (or remain) a socially responsible entity (e.g., expenditure made in support of environmental, social, or governance issues). As such, it can be measured as a percentage of operating expenses or, for that matter, revenues. Then, in general, we may define the value of the firm as a function of  $R$  and  $p$ .

$$V = V[p(\lambda), R[p(\lambda)]] \quad (2)$$

Taking the total derivative of  $V$  with respect to  $\lambda$ , we obtain

$$\frac{dV}{d\lambda} = \left[ \frac{\partial V}{\partial p} + \frac{\partial V}{\partial R} \frac{\partial R}{\partial p} \right] \frac{dp}{d\lambda} \quad (3)$$

$\begin{matrix} (+) & & (-) & & (-) & & (?) \end{matrix}$

The term in brackets in Equation (3) is clearly positive. Therefore, in this setup, the sign of  $\frac{dV}{d\lambda}$

depends only on the sign of  $\frac{dp}{d\lambda}$ . If we assume that the likelihood of a firm's survival is a

monotonically increasing function of  $\lambda$ , then it is clear that, other things equal, CSR creates value at all levels. On the other hand, if the relationship is non-monotonic (i.e., if we generalize Barnea and Rubin's findings on the relationship between CSR and performance to that of CSR



and the probability of survival), then there will be an optimum expenditure level of CSR that would maximize the firm's value. One way to deal with this issue is to develop a valuation model similar to that of Fooladi, Roberts, and Skinner (1997) and Jonkhart (1979) who use the probability of default in pricing corporate bonds. To apply the essence of their models, consider the firm at the beginning of time  $t$ . Given that it has survived the preceding  $t-1$  periods, there is a probability  $p_t$  that it will survive period  $t$ , in which case it will pay its shareholders  $y_t$  per share. Therefore,  $1-p_t$  will be the probability that the firm may default during period  $t$  and fail to pay its shareholders the sum of  $y_t$ . If the firm does default, it will have to go through the process of bankruptcy at the conclusion of which it will make a payment of  $CF_{ts}$  per dollar value of common equity outstanding at time  $t$ . This payment will be made at time  $t + s$ , where  $s$  represents the number of periods to clear the bankruptcy process and pay the settlement amount. Therefore, the expected cash flows at time  $t$  for a dollar invested in common stock will be:

$$[p_t y_t + (1 - p_t) CF_{ts} (1 + I_{t+s})^{-s}] \left( \prod_{j=1}^t p_{j-1} \right), \quad (4)$$

where  $I_{t+s}$  is the expected  $s$ -period spot rate at time  $t$ . Note that the settlement schedule shown in (4) does not exclude the possibility of zero  $s$  or immediate payments.

Defining  $Q_t$  as the certainty equivalent factor for the marginal investor, value of the cash flows at time  $t$  (defined as  $CECF_t$ ), will be:

$$CECF_t = Q_t [p_t y_t + (1 - p_t) CF_{ts} (1 + I_{t+s})^{-s}] \left( \prod_{j=1}^t p_{j-1} \right) \quad (5)$$

The risk-averse investor will be indifferent between the *promise* of receiving the expected risky cash flow at time  $t$  and the *assurance* of receiving its certainty equivalent. As a result, the general valuation form may be defined as:

$$V = \sum_{t=1}^{\infty} \frac{CECF_t}{(1 + I_t)^t}, \quad (6)$$

or 
$$V = \sum_{t=1}^{\infty} \frac{[p_t y_t + (1 - p_t) CF_{ts} (1 + I_{t+s})^{-s}] \left( \prod_{j=1}^t p_{j-1} \right)}{(1 + R_t)^t} \quad (7)$$

where  $R_t$  is the discount rate for the cash flow obtained at time  $t$  and  $I_t$  denotes the risk-free  $t$ -period spot rate.

Now consider a second firm, one that is strictly comparable to our heretofore-considered firm except that it is not perceived to be a socially responsible firm. For this second firm, there is a probability that it will survive period  $t$  and pay  $y_t$  per dollar value of common shares (as of the beginning of period  $t$ ) and a probability that it will default and would fail to pay  $y_t$  at the end of period  $t$ . Following the same procedure, it can be seen that the value of this firm is:

$$V' = \sum_{t=1}^{\infty} \frac{[p'_t y_t + (1-p'_t)CF_{ts}(1+I_{t+s})^{-s}](\prod_{j=1}^t p'_{j-1})}{(1+R'_t)^t} \quad (8)$$

If  $p'_t < p_t$ , then  $\prod_{j=1}^t p'_{j-1} < \prod_{j=1}^t p_{j-1}$  and if  $R'_t > R_t$ , it is easy to show  $V' < V$ . Note that here we have assumed the settlement payment,  $CF_{ts}$ , is the same for both firms.<sup>5</sup> With the setup presented in (7) and (8), it would be easy to show circumstances under which  $V'_0 < V_0$  if  $p'_t < p_t$ .

However, by just focusing on the cost of capital and the survival likelihood in this setup, we are implicitly assuming that CSR expenses would not alter the pattern or the magnitude of the firm's cash flows. But cash flows may, indeed, be affected in one of two ways:

1. CSR engagement enhances revenues and cash flows if the demand curve for the firm's products or services shifts to the right, as its customers react positively to its socially responsible activities (e.g., consider Patagonia's advantage over comparable clothing retailers).
2. CSR engagement reduces earnings and cash flows if socially responsible expenditures do not provide offsetting benefits.

Thus, in addition to  $p$  and  $R$ , CSR expenditures may influence growth of the firm's cash flows, i.e.,  $g = g(\lambda)$ . With this provision, our valuation model presented in (2) would be extended to:

$$V = V[p(\lambda), R[p(\lambda)], g(\lambda)], \quad (2')$$

---

<sup>5</sup> A more general development would provide for a different settlement payment but the results are invariant with regard to this change.

and the condition presented in Equation (3) will be extended to:

$$\frac{dV}{d\lambda} = \left[ \frac{\partial V}{\partial p} + \frac{\partial V}{\partial R} \frac{\partial R}{\partial p} \right] \frac{dp}{d\lambda} + \frac{\partial V}{\partial g} \frac{dg}{d\lambda} \quad (3')$$

$\begin{matrix} (+) & (-) & (-) & (+) \end{matrix}$

Within this framework, the relationship between CSR expenditures and the value of the firm becomes also dependent on the sign of  $\partial g(\lambda)/\partial \lambda$ . Note that here, as in (3) above, we can safely assume that  $\partial V/\partial p > 0$ ,  $\partial V/\partial R < 0$ ,  $\partial R/\partial p < 0$ , and  $\partial V/\partial g > 0$ . Therefore, the sign of  $dV/d\lambda$  depends of the signs of  $dp/d\lambda$  and  $dg/d\lambda$ . We can rule out the possibility that the sign of the former may be negative as it is counter-intuitive and lacking in empirical support. Indeed, given the evidence that socially responsible firms enjoy a lower degree of unique risk (e.g., see Fatemi et al., 2009), a strong argument can be advanced in favor of the proposition that responsible firms enjoy a higher chance of survival ( $dp/d\lambda > 0$ ). Therefore, the sign of  $dV/d\lambda$  depends on  $dg/d\lambda$ . If it can be assumed that cash flows of socially responsible firms enjoy higher rates of growth (i.e., unambiguously), then the clear implication is that CSR expenditures always create value. However, if the sign of  $dg/d\lambda$  is dependent on the magnitude of CSR expenditures (as reported by some of the studies summarized in Section I), firm value may be positively affected by such expenditures within a certain range, and not so outside it.

To arrive at this, let us assume that, at least for some range of  $\lambda$ ,  $dp/d\lambda > 0$ . Within this range,  $dg/d\lambda > 0$  would be a sufficient but not necessary condition for having  $dV/d\lambda > 0$ . The

necessary condition would require  $W \frac{dp}{d\lambda} > -\frac{\partial V}{\partial g} \frac{dg}{d\lambda}$ , where  $W = \left[ \frac{\partial V}{\partial p} + \frac{\partial V}{\partial R} \frac{\partial R}{\partial p} \right] > 0$ , which

$\begin{matrix} (+) & (-) & (-) & (+) \end{matrix}$

indicates that at least for some levels of expenditure, CSR activities create value for the firm.

## II.b: Simulations for the Model with Discrete Probability Distribution:

In order to gain insight and develop a better understanding of the relationship between CSR expenses and the value of the firm, we run a simulation computing the value of the firm under various circumstances. To further simplify our model, and to make the simulation more tractable (and without loss of generality) we make the following assumptions:

- i) For a given level of  $\lambda$ , the conditional probability of survival is constant over time, i.e.,  $p_1 = p_2 = \dots = p$
- ii) Settlement is immediate and proportionate to the yield, i.e.,  $CF_{ts} = Cy_t$ , where  $y_t = y_0(1+g)^t$  is payment per share at time  $t$ <sup>6</sup>.
- iii) In addition to  $p$  and  $R$ , CSR expenditure also affects growth of cash flows, i.e.,  $g = g(\lambda)$

With these assumptions, and considering that  $p$ ,  $g$ , and  $R$  are all affected by CSR expenses ( $\lambda$ ), Equation (7) may be re-written as:

$$V = y_0[p(\lambda) + (1 - p(\lambda))C] \left( \frac{p(\lambda)(1 + g(\lambda))}{(1 + R[p(\lambda)]) - p(\lambda)(1 + g(\lambda))} \right) \quad (9)$$

To conduct simulations we need to make assumptions about the size of CSR expenditures as a percentage of revenues or operating costs. We also need to *assume* explicit functional forms for  $p = p(\lambda)$ ,  $g = g(\lambda)$ , and  $R = R[p(\lambda)]$ . Without loss of generality, the following assumptions are made with regard to the variables involved in this simulation:

- Lambda: A variable ranging from zero to 0.10 as a percentage of operating expenses in increments of 0.01. (A zero value implies no CSR expenditures.)
- Initial Probability: a random variable ranging from 0.97 to 0.99 in increments of 0.001.
- Functional form:  $p = p_0 + \varepsilon\lambda$ , where  $\varepsilon$  is a random variable ranging from zero to 0.10 in increments of 0.01.
- Initial Growth: 2.5%.
- Functional form:  $g = g_0 - \mu\lambda$ , where  $\mu$  is a random variable ranging from zero to 20 in increments of 1.0.<sup>7</sup>
- Initial Discount rate: 12%.
- Functional form:  $R = R_0 - \gamma\lambda$ , where  $\gamma$  is a random variable ranging from zero to 40 in increments of 1.0.
- C: A random variable ranging from zero to 0.20 in increments of 0.01.

<sup>6</sup> The model can easily be extended to one with delayed, fixed, or zero settlement without changing the results.

<sup>7</sup> Note that, as explained earlier, CSR expenditure may enhance growth of cash flows under certain circumstances. Not only do we ignore this possibility here, we assume the opposite: that CSR expenditures lead to lower rates of growth. Therefore, we are introducing a bias against finding a favorable valuation effect.

$y^0$  :                      \$0.40 per share.

With these values, in one extreme case, the growth rate can drop from its initial value of 2.5% to 0.5%. Further, in the best-case scenario, the cost of capital can decline to 8% from its base case of 12%. The impact of CSR expenditures on the conditional probability of survival ranges from nil at one extreme to a drop of 1% at the other.

Utilizing the “R” programming language we compute share values at different levels of CSR expenditure, ranging from 0% to 10% of the operating expenses. For each level, we randomly assign values to  $\varepsilon$ ,  $\mu$ , and  $\gamma$  (with the resulting  $p(\lambda)$ ,  $g(\lambda)$ , and  $R[p(\lambda)]$ ) and compute the share value from Equation (9). We repeat this experiment 5,000 times for each level of Lambda—a total of 55,000 experiments—and report the minimum, maximum, mean, median, 1<sup>st</sup> quintile, and 3<sup>rd</sup> quintal resulting values for each level.<sup>8</sup> Results, as reported in Table 1, indicate that CSR expenditures enhance the value of the firm, regardless of whether we evaluate the mean or the median of changes. Specifically, a firm that allocates 10% of its operating expenses to CSR would, on average, experience a 16% higher value. (The corresponding increase for the median value is 14%.) Note, however, that as the proportion of CSR expenditures increases, the disparity between the values of firms that perform well and those that do not becomes wider.

The results reported in Table 1 are the artifacts of our underlying assumptions that CSR expenditures lead to an improvement in the probability of survival, a reduction in the discount rate, and a deterioration of the growth of cash flows for the firm. While the economic intuition behind these assumptions may be clear, our choices for the specific values assigned to these variables or the choice of functional forms that relate CSR expenses to these variables are open to debate.<sup>9</sup> In a test of robustness of these results, with regard to the magnitude of these variables, we cut in half our assumed favorable effect of CSR expenditures on improving the probability of survival and in lowering the cost of capital. We also double in size their assumed negative effect in reducing the growth of cash flows. To these ends, we assume:

$\varepsilon$  is a random variable ranging in value from zero to 0.055 in increments of 0.005,

$\mu$  is a random variable ranging in value from zero to 40 in increments of 1.0, and

---

<sup>8</sup> In the Appendix we include a sample of programming commands for the zero lambda cases for each set of probability distributions.

<sup>9</sup> Indeed, unlike what we have assumed, the functional forms may be non-linear.

$\gamma$  is a random variable ranging in value from zero to 20 in increments of 1.0.

With these values, the maximum enhancement to the probability of survival is now 0.55%, compared to 1% previously. In an extreme case, the growth rate can potentially decline to -1.5% from the initial 2.5% rate. Further, in the best-case scenario, the cost of capital may drop from 12% to 10%. Given this set of values for key variables, a lambda value of 0.10, and the initial probability of survival of 0.97, under the best-case scenario CSR expenditures have the potential to increase the value of the firm by a factor of 27%. Under the worst-case scenario, the drop in value would also be 27%. However, if the initial probability of survival is set at a higher level of 0.99, the potential increase in value will be 33% and the potential drop at the 30% level.

As in the previous simulation, the specific values assigned to  $\varepsilon$ ,  $\mu$ , and  $\gamma$  are chosen at random to compute value of the firm according to Equation (9). This experiment is repeated 5,000 times for each level of lambda (a total of 55,000 experiments) and the results are summarized in Table 2. According to these results, both the mean and median share values decrease (albeit slightly) with CSR expenditures. On average, firms that allocate 10% of their operating expenses to CSR experience a valuation decrease of almost 6%. (The corresponding reduction for the median of valuation change is 7%.) However, firms that operate successfully increase their value by 27%. On the other hand, firms that do not perform well experience a 33% reduction in their share values if they increase their CSR expenditure from zero to 10% of their operating expenses.

### **II.c A Model with Continuous Probability Distribution:**

In our simulations, thus far, we have assumed that absent any changes in CSR expenses the conditional probability of survival remains constant. We now reconsider this assumption. Consider the assumptions employed by Fooladi et al. (1977) in their study of duration of bonds with default risk. In their model, the underlying assumption is that as a bond approaches maturity the chance of default becomes larger. Therefore, the probability of a bond's survival moves exponentially through the time (i.e.,  $p_t = p_0^t$ ). While this is considered a reasonable assumption for bonds as they approach their maturity, the same cannot hold for the problem at hand. Specifically, assuming so would carry the implication that the probability of survival suffers a gradual and steady decline as the firm matures over time and becomes more established. This, in

turn, would imply that the firm's operations become less valuable as it becomes more established. Exceptions aside (e.g., Enron, Lehman Brothers), this is counterintuitive and inconsistent with real-world observations. On the contrary, intuition suggests that long-standing firms have a higher probability of surviving from one period to the next. In other words, one may posit that the longer a firm has been in business, the lower its probability of default in the immediate future. Nonetheless, regardless of how the probability of default is modeled over time, we need to evaluate the effect of CSR on the probability distribution of default or survival.

One possible avenue for such an inquiry is to utilize models that are suitable for duration data, such as "Survival" or "Hazard" functions and analyze disruption of revenues for firms considered not socially responsible. The advantage offered by these functions is that they better facilitate empirical testing.<sup>10</sup> For example, by estimating the hazard rate through an analysis of duration data, one can gain a much better understanding of the pattern of change in the likelihood of failure, and whether this likelihood increases, decreases, or remains constant over time.

Let us assume that the length of time that a firm stays in business is defined by the random variable  $T$ , with a continuous probability distribution of  $f(t)$ . The probability that the firm may go out of business before any given time  $t$ ,  $\text{Prob}(T \leq t)$ , can be determined by the

Cumulative Probability Distribution 
$$F(t) = \int_0^t f(s)ds .$$

The *unconditional* probability that the company can survive at least for  $t$  years, the *survival function*, is  $S(t) = 1 - F(t)$ . The *conditional* probability of default in a short interval between times  $t$  and  $(t + \Delta t)$ , given that the firm has survived for  $t$  years, is:

$$\frac{F(t + \Delta t) - F(t)}{S(t)} \tag{10}$$

And, on the limit,

$$h(t) = \lim_{\Delta t \rightarrow 0} \frac{F(t + \Delta t) - F(t)}{\Delta t S(t)} = \frac{f(t)}{S(t)} = -\frac{d \ln S(t)}{dt} \tag{11}$$

---

<sup>10</sup> To gain a more detailed understanding of models of duration analysis, see Kiefer (1988) and Greene (1993).

The term  $h(t)$  in (11) is the *hazard function* and, following the spirit of the argument by Greene (1993), it is the rate at which the firm may go out of business after time  $t$ , given that it has survived for at least  $t$  years. It is possible to model the *hazard function* directly (or to make an assumption about its shape) and work backwards to obtain  $S(t)$  and  $f(t)$  by integrating (11). Utilizing the concepts of *hazard* and *survival* functions in our valuation model, the formulation becomes much more straightforward if we define  $X(t)$  as the sum of present values of all cash flows received up to and including the time of default. The expected value of all these present value cash flows, including the last settlement, would determine the firm's value.

$$V = \int_0^{\infty} X(s) f(s) ds \quad (12)$$

$$\text{where, } X(t) = \int_0^t y_j e^{-Rj} dj + CF_{ts} e^{-R(t+s)} \quad (13)$$

and  $y_j$ ,  $R$ , and  $s$  are defined the same as earlier in the case of discrete functions. To make our model more tractable, as in the case of discrete probability distribution, we assume that settlement is immediate and proportionate to the yield, i.e.,  $CF_{ts} = Cy_t$ , where  $y_t = y_0 e^{gt}$  is payment per one-dollar share at time  $t$ . With these assumptions (13) would change to:

$$X(t) = \int_0^t y_0 e^{-(R-g)j} dj + Cy_0 e^{-(R-g)t} \quad (14)$$

Taking the integral and rearranging the terms, we obtain

$$X(t) = y_0 \left[ \frac{1}{R-g} - \frac{1}{R-g} e^{-(R-g)t} + C e^{-(R-g)t} \right] \quad (15)$$

Note that the first two terms in (15), in essence, represent the formula for the present value of a growing annuity. Substituting for  $X(t)$  in Equation (12) from (15), we obtain the firm's value.

$$V = y_0 \int_0^{\infty} \left[ \frac{1}{R-g} - \frac{1}{R-g} e^{-(R-g)t} + C e^{-(R-g)t} \right] f(t) dt \quad (16)$$



To obtain an explicit figure for the firm's value, we need to know the density function  $f(t)$ . This may be accessed by observing duration data for firms with inter-temporally changing patterns of CSR engagement and with various levels of such expenditures. For our modeling purpose, we may make an assumption about the *hazard rate*, the rate at which a firm may default after time  $t$ , given that it has survived up to that time. As discussed earlier, this rate may be increasing or decreasing over time. However, in the absence of observable data, one may assume an inter-temporally constant hazard rate for firms with no CSR engagement. This means that the conditional probability of failure in a short interval after time  $t$  is the same for all  $t$ .

Assuming a constant hazard rate of  $\varphi$  and integrating backward to obtain the *survival function* and the density function, we obtain  $f(t) = \varphi e^{-\varphi t}$ . Substituting this into (16), taking the integral and simplifying the terms, we obtain:

$$V = y_0 \left[ \frac{1 + \varphi(\lambda)C}{R(\lambda) - g(\lambda) + \varphi(\lambda)} \right] \quad (17)$$

#### II.d Simulations for the Model with Continuous Probability Distribution:

At any time  $t$ , given that it has survived the previous  $t$  years, firm value decreases as the hazard rate increases beyond time  $t$ . That is to say,  $\partial V / \partial \varphi < 0$ . Assuming that CSR expenditures would slow this rate, we conduct simulations, where  $\varphi = \varphi_0 - \alpha \lambda$ , with  $\alpha$  as a random variable ranging from zero to 0.5 with increment of 0.05 (with  $\varphi_0 = 0.10$ , thus making sure that  $\varphi$  will range from 0.05 to 0.10, and maintaining our previous assumptions for the range and functional forms of other variables). It should be noted that the length of time a firm stays in business has an inverse relation with  $\varphi$ . Therefore, as  $\varphi$  declines from 0.10 to 0.05, this length doubles.

As with the discrete probability distribution case, we conduct two sets of simulations. The first set assumes  $\mu$  is a random variable that ranges from zero to 20 in increments of 1.0 and  $\gamma$  is a random variable ranging from zero to 40 with an increment of 1.0. The second set assumes  $\mu$  is a random variable that ranges from zero to 40 in increments of 1.0 and  $\gamma$  is a random variable ranging from zero to 20 with an increment of 1.0. This assures that the assumed benefits of CSR engagement (in terms of reducing cost of capital) are cut to half and that the assumed negative

effect on cash flows is doubled. In both sets  $\alpha$  is a random variable ranging from zero to 0.5, with increment of 0.05.

We compute firm values for each level of CSR expenses by randomly choosing these variables from their range and repeat the experiment 5,000 times at each level (a total of 55,000 experiments). The results are summarized in Tables 3 and 4 and show that as CSR expenditures increase so do mean and median firm values. These results also indicate that as CSR expenditures increase, the divergence between values of firms with high and low performance widens. However, this divergence takes place to a much lesser extent than what was observed with the case of discrete probability distributions.

For the first set of simulations (Table 3), results indicate that a firm's decision to increase its CSR expenditures from zero to 10% (of its operating expenses) results in a 24% increase in mean share price and a 22% increase in its median. For the second case, where we assume CSR expenses have a lower positive effect in reducing the discount rate and more of a negative impact in reducing the growth of cash flow, the corresponding increases in mean and median share values are 10% and 8%, respectively.

### **III. Summary and Concluding Remarks:**

In this paper we analyze the effect of CSR engagement on the value of the firm. We develop a model of the firm that delineates the circumstances under which such CSR expenditures may affect the value of the firm.

The essence of our models is the argument that the upfront costs of CSR engagement may be more than offset by their positive effects over the intermediate- and long-term cash flows. At the same time, such CSR expenditures may increase the firm's probability of survival and reduce its cost of capital. As such, CSR engagement may benefit the firm in a number of ways, some of which are well documented in the extant body of literature dealing with the effects of CSR on firm's performance, its financing costs, and its degree of riskiness. Examples of such positive effects include the ability of the firm to secure a more loyal customer base, hire and retain a more dedicated workforce, avoid the costs associated with adverse actions by labor

unions, consumer-advocacy groups, or governmental agencies empowered to monitor its activities.

The paper develops two valuation models. The first focuses on the impact of CSR on the cost of capital and the probability distribution of survival. As such, it ignores the direct impact of CSR on the magnitude of cash flows but allows for its indirect impact due to its effect on the conditional probability of survival. Within this formulation, we show that the valuation effect of CSR is dependent entirely on its influence on the probability of survival. When further extended to take into account the direct impact of CSR expenditures on the cash flows of the firm, the model provides us with the conditions under which CSR can lead to the creation of value. A second model is then developed that assumes a continuous probability distribution of survival, producing a valuation model that utilizes the concept of hazard and survival functions. These models show that CSR expenditures can lead to value creation even under the punitive assumption that they lead to a reduction of future cash flows.

Simulating these models, our results indicate that under certain circumstances a firm's commitment to socially responsible expenditures unambiguously leads to the creation of value for its shareholders. As such our result support notions of profit-maximizing CSR (Gillan et al., 2010) and sustainable value creation model (Fatemi & Fooladi, 2013). These simulation results are also in agreement with the overwhelming majority of empirical findings, suggesting a positive effect on the value of the firm arising from CSR activities.

## References:

- Albuquerque, R. A., A. Durnev, and Y. Koskinen (2012), "Corporate Social Responsibility and Asset Pricing in Industry Equilibrium," Working Paper, Boston University.
- Barnea, A. and A. Rubin (2010), "Corporate Social Responsibility as a Conflict Between Shareholders," *Journal of Business Ethics*, 97, 71-86.
- Becchetti, L., S. Di Giacomo, and D. Pinnacchio (2008), "Corporate Social Responsibility and Corporate Performance: Evidence from a Panel of US Listed Companies," *Applied Economics*, 40(5), 541-567.
- Bello, Z. (2005), "Socially Responsible Investing and Portfolio Diversification," *Journal of Financial Research*, 28(1), 41-57.
- Bouslah, K., L. Kryzanowski, and B. M'Zali (2013), The Impact of the Dimensions of Social Performance on Firm Risk. *Journal of Banking and Finance*, 37(4) 1258-1273.
- Cornett, M. M., O. Erhemjamts, and H. Tehranian (2014), "Corporate Social Responsibility and its Impact on Financial Performance: Investigation of U.S. Commercial Banks," Working Paper, Boston College.
- Derwall, J., N. Guenster, R. Bauer, and K. Koedijk (2005), "The Eco-efficiency Premium Puzzle," *Financial Analysts*, 61, 51-63.
- Dimson, E., O. Karakas, and X. Li (2012), "Activism in Corporate Social Responsibility," Presented at the Annual Meetings of the Financial Management, Europe in Istanbul.
- Eccles, R. G., I. Ioannou, and G. Serafeim (2012), "The Impact of a Corporate Culture of Sustainability on Corporate Behavior and Performance," National Bureau of Economic Research Working Paper Series No. 17950.
- Edmans, A. (2010), "Does the Stock Market Fully Value Intangibles? Employee Satisfaction and Equity Prices," Working Paper, University of Pennsylvania.
- El Ghouli, S., O. Guedhami, C. C. Y. Kwok, and D. R. Mishra (2011), "Does Corporate Social Responsibility Affect the Cost of Capital?," *Journal of Banking and Finance*, 35(9), 2388-2406.
- Erhemjamts, O., Q. Li, and A. Venkateswaran (2012), "Corporate Social Responsibility and its Impact on Firm's Investment Policy, Organizational Structure, and Performance," Presented at the 2011 Annual European Meetings of the Financial Management Association, Istanbul.
- Fatemi, A. and I. Fooladi (2013), "Sustainable Finance: A New Paradigm," *Global Finance Journal*, 24, 101-113
- Fatemi, A., I. Fooladi, and D. Wheeler (2009), "The Relative Valuation of Socially Responsible Firms: An Exploratory Study," In: de Bettignies, H.-C. and F. Lépineux eds., *Finance for a Better World: The Shift Toward Sustainability*, Basingstoke, UK: Palgrave Macmillan.
- Fooladi, I., G. Roberts, and F. Skinner (1997), "Duration for Bonds with Default Risk," *Journal*

*of Banking and Finance*, 21(1), 1-16.

Freeman, R. E. (1984), *Strategic Management: A Stakeholder Approach*, Boston: Pitman.

Freeman, R. E. and J. McVea (2001), "A Stakeholder Approach to Strategic Management," In: Hitt, M. A., R. E. Freeman, and J. S. Harrison eds, *Handbook of Strategic Management*, Oxford: Blackwell, 189-207.

Freeman, R. E., A. C. Wicks, and B. Parmar (2004), "Stakeholder Theory and the Corporate Objective Revisited," *Organization Science*, 15(3), 364-369.

Friedman, M. (1970), "The Social Responsibility of Business is to Increase its Profits," *New York Times Magazine*, September 13.

Ge, W. and M. Liu (2012), "The Impact of Corporate Social Responsibility Disclosure and Performance on the Cost of Corporate Bonds," Working Paper, University of Manitoba.

Gillan, S.L., J.C. Hartzell, A. Koch, and L.T. Starks, 2010. Firms' environmental, social and governance (ESG) choices, performance and managerial motivation. Working paper, University of Texas at Austin.

Goss, A. and G. Roberts (2011), "The Impact of Corporate Social Responsibility on the Cost of Bank Loans," *Journal of Banking and Finance*, 35, 1794-1810.

Greene, W. H. (1993), *Econometrics Analysis*, New York: Macmillan Publishing Company

Hawn, O. and I. Ioannou (2012), "Do Actions Speak Louder than Words? The Case of Corporate Social Responsibility (CSR)," SSRN Working Paper.

Hong, H., J. D. Kubik, and J. A. Scheinkman (2012), "Financial Constraints on Corporate Goodness," National Bureau of Economic Research Working Paper 18476.

Huppé, G. A. (2011), "Alpha's Tale: The Economic Value of CSR," PRI Academic Network Conference, Sigtuna, Sweden.

Izzo, M. F. and B. S. Magnanelli (2011), "Does it Pay or Does Firm Pay? The Relation Between CSR Performance and the Cost of Debt," SSRN Working Paper.

Jensen, M. C. (2005), "Value Maximization, Stakeholder Theory, and the Corporate Objective Function," In: Chew, D. H. and S. L. Gillan eds. (2005), *Corporate Governance at the Crossroads. A Book of Readings*, New York: McGraw-Hill Irwin, 7-20.

Jensen, M. C. and W. F. Meckling (1976), "Theory of the Firm: Managerial Behavior, Agency Costs, and Ownership Structure," *Journal of Financial Economics*, 3, 305-60.

Jensen, M. C. and W. F. Meckling (2005), "The Nature of Man," In: Chew, D. H. and S. L. Gillan eds. (2005), *Corporate Governance at the Crossroads. A Book of Readings*, New York: McGraw-Hill Irwin, 87-102.

Jonkhart, M. J. L. (1979), "On the Term Structure of Interest Rates and the Risk of Default," *Journal of Banking and Finance*, 3, 253-262.

- Kempf, A. and P. Osthoff, (2007), “The Effect of Socially Responsible Investing on Financial Performance,” *European Financial Management*, 13, 908-922.
- Kiefer, N (1988), “Economic Duration Data and Hazard Functions,” *Journal of Economic Literature*, 26, 646-679.
- Kotchen, M. J. and J. J. Moon (2011), “Corporate Social Responsibility for Irresponsibility,” Working Paper No. 17254, National Bureau of Economic Research.
- Mănescu, C. (2011), “Stock Returns in Relation to Environmental, Social and Governance Performance: Mispricing or Compensation for Risk?,” *Sustainable Development*, 9(2), 95-118.
- Margolis, J. D., H. A. Elfenbein, and J. P. Walsh (2012), “Does it Pay to be Good... And Does it Matter? A Meta-Analysis of the Relationship Between Corporate Social and Financial Performance,” Working Paper, Harvard University, Washington University in St. Louis, and University of Michigan.
- Margolis, J. D. and J. P. Walsh (2001), *People and Profits? The Search for a Link Between a Company's Social and Financial Performance*, Mahwah, NJ: Erlbaum.
- Orlitzky, M. and J. D. Benjamin (2001), “Corporate Social Performance and Firm Risk: A Meta-Analytic Review,” *Business and Society*, 40, 369-396.
- Plumlee, M., D. Brown, R. M. Hayes, and S. Marshall (2010) “Voluntary Environmental Disclosure Quality and Firm Value: Further Evidence,” Working Paper, University of Utah and Portland State University.
- Roberts, J. (2004), *The Modern Firm*, Oxford: Oxford University Press.
- Roman, R., S. Hayibor, and B. Agle (1999), “The Relationship between Social and Financial Performance,” *Business and Society*, 38(1), 109-125.
- Schreck, P. (2011), Reviewing the Business Case for Corporate Social Responsibility: New Evidence and Analysis,” *Journal of Business Ethics*, 103, 167-188.
- Servaes, H. and A. Tamayo (2013), “The Impact of Corporate Social Responsibility on Firm Value: The Role of Customer Awareness,” Forthcoming, *Management Science*.
- Statman, M. (2005), “Socially Responsible Indexes: Composition and Performance,” SSRN Working Paper Series.
- Statman, M. and D. Glushkov (2009), “The Wages of Social Responsibility,” *Financial Analysts Journal*, 65(4), 33-46.
- Waddock, S. A. and S. Graves (1997), “The Corporate Social Performance–Financial Performance Link,” *Strategic Management Journal*, 19, 303-317.
- Wu, M. and C. Shen, 2013. Corporate Social Responsibility in the Banking Industry: Motives and Financial Performance. *Journal of Banking and Finance*, 37, 3529-3547.

**Table 1: Simulation results for the discrete model set 1: 5,000 computations for each level of Lambda.**

| <b>LAMBDA</b>  | <b>0</b> | <b>0.01</b> | <b>0.02</b> | <b>0.03</b> | <b>0.04</b> | <b>0.05</b> | <b>0.06</b> | <b>0.07</b> | <b>0.08</b> | <b>0.09</b> | <b>0.1</b> |
|----------------|----------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|------------|
| <b>Minimum</b> | 3.068    | 3.035       | 3.001       | 2.918       | 2.939       | 2.886       | 2.804       | 2.773       | 2.777       | 2.729       | 2.722      |
| <b>Maximum</b> | 3.826    | 4.011       | 4.225       | 4.437       | 4.594       | 4.93        | 5.276       | 5.515       | 5.853       | 5.991       | 6.45       |
| <b>Mean</b>    | 3.433    | 3.476       | 3.528       | 3.571       | 3.627       | 3.693       | 3.749       | 3.766       | 3.843       | 3.892       | 3.981      |
| <b>Median</b>  | 3.418    | 3.462       | 3.511       | 3.554       | 3.605       | 3.667       | 3.719       | 3.723       | 3.784       | 3.817       | 3.894      |
| <b>1st Qu.</b> | 3.235    | 3.273       | 3.316       | 3.351       | 3.4         | 3.427       | 3.445       | 3.443       | 3.476       | 3.458       | 3.513      |
| <b>3rd Qu.</b> | 3.614    | 3.67        | 3.726       | 3.764       | 3.834       | 3.923       | 4.009       | 4.042       | 4.154       | 4.224       | 4.361      |

In this table, we compute firm values ( $V$ ) from Equation (9) by randomly assigning values to  $p_0$  (from 0.97 to 0.99 in increments of 0.001),  $\varepsilon$  (from zero to 0.10, in increment of 0.01),  $\mu$  (from zero to 20, in increment of 1.0), and  $\gamma$  (from zero to 40, in increment of 1.0), which result in values for  $p(\lambda)$ ,  $g(\lambda)$ ,  $R[p(\lambda)]$ , and  $V$ . For each level of CSR expenditure ( $\lambda$ ), we repeat the experiment 5,000 times and report the minimum, maximum, mean, median, 1<sup>st</sup> and 3<sup>rd</sup> quintals.

**Table 2: Simulation results for the discrete model set 2: 5,000 computations for each level of Lambda.**

| <b>LAMBDA</b>  | <b>0</b> | <b>0.01</b> | <b>0.02</b> | <b>0.03</b> | <b>0.04</b> | <b>0.05</b> | <b>0.06</b> | <b>0.07</b> | <b>0.08</b> | <b>0.09</b> | <b>0.1</b> |
|----------------|----------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|------------|
| <b>Minimum</b> | 3.068    | 2.988       | 2.892       | 2.811       | 2.744       | 2.62        | 2.583       | 2.469       | 2.443       | 2.385       | 2.301      |
| <b>Maximum</b> | 3.826    | 3.905       | 3.983       | 4.056       | 4.219       | 4.273       | 4.415       | 4.581       | 4.675       | 4.753       | 4.865      |
| <b>Mean</b>    | 3.431    | 3.406       | 3.378       | 3.359       | 3.334       | 3.314       | 3.3         | 3.281       | 3.259       | 3.256       | 3.233      |
| <b>Median</b>  | 3.419    | 3.396       | 3.363       | 3.342       | 3.314       | 3.289       | 3.277       | 3.246       | 3.222       | 3.205       | 3.175      |
| <b>1st Qu.</b> | 3.236    | 3.209       | 3.186       | 3.162       | 3.13        | 3.1         | 3.061       | 3.022       | 2.977       | 2.941       | 2.892      |
| <b>3rd Qu.</b> | 3.612    | 3.595       | 3.557       | 3.542       | 3.519       | 3.504       | 3.515       | 3.503       | 3.496       | 3.525       | 3.527      |

In this table, once more we compute firm values ( $V$ ) from Equation (9) by randomly assigning values to  $p_0$ ,  $\varepsilon$ ,  $\mu$ , and  $\gamma$  but this time we pick the range for these variables so that the favorable effects of increasing  $P$  and reducing  $R$  are cut in half and the negative effect of reducing  $g$  are doubled. Again, for each level of CSR expenditure ( $\lambda$ ), we repeat the experiment 5,000 times and report the minimum, maximum, mean, median, 1<sup>st</sup> and 3<sup>rd</sup> quintals of  $V$ .

**Table 3: Simulation results for the continuous model set 1: 5,000 computations for each level of Lambda.**

| <b>LAMBDA</b>  | <b>0</b> | <b>0.01</b> | <b>0.02</b> | <b>0.03</b> | <b>0.04</b> | <b>0.05</b> | <b>0.06</b> | <b>0.07</b> | <b>0.08</b> | <b>0.09</b> | <b>0.1</b> |
|----------------|----------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|------------|
| <b>Minimum</b> | 2.051    | 2.038       | 2.018       | 2.002       | 1.976       | 1.978       | 1.953       | 1.933       | 1.916       | 1.892       | 1.892      |
| <b>Maximum</b> | 2.092    | 2.181       | 2.296       | 2.413       | 2.554       | 2.686       | 2.877       | 3.052       | 3.281       | 3.526       | 3.842      |
| <b>Mean</b>    | 2.072    | 2.109       | 2.149       | 2.191       | 2.235       | 2.284       | 2.329       | 2.387       | 2.439       | 2.495       | 2.571      |
| <b>Median</b>  | 2.072    | 2.109       | 2.149       | 2.19        | 2.233       | 2.273       | 2.315       | 2.373       | 2.412       | 2.466       | 2.525      |
| <b>1st Qu.</b> | 2.062    | 2.09        | 2.114       | 2.138       | 2.161       | 2.188       | 2.2         | 2.235       | 2.258       | 2.28        | 2.314      |
| <b>3rd Qu.</b> | 2.082    | 2.127       | 2.183       | 2.24        | 2.306       | 2.376       | 2.444       | 2.524       | 2.597       | 2.675       | 2.787      |

In this table, we compute firm values ( $V$ ) from Equation (17) by randomly assigning values to  $\alpha$  (from zero to 0.5 in increments of 0.05), which with the assumption of  $\varphi_0 = 0.10$ , makes sure that  $\varphi$  will range from 0.05 to 0.10. Our assumptions for the functional forms and ranges of other variables ( $\mu$  and  $\gamma$ ) remain as in Table 1. Our assumed initial value of  $y_0 = 0.40$ . For each level of CSR expenditure ( $\lambda$ ), we repeat the experiment 5,000 times and report the minimum, maximum, mean, median, 1<sup>st</sup> and 3<sup>rd</sup> quintals for  $V$ .

**Table 4: Simulation results for the continuous model set 1: 5,000 computations for each level of Lambda.**

| <b>LAMBDA</b>  | <b>0</b> | <b>0.01</b> | <b>0.02</b> | <b>0.03</b> | <b>0.04</b> | <b>0.05</b> | <b>0.06</b> | <b>0.07</b> | <b>0.08</b> | <b>0.09</b> | <b>0.1</b> |
|----------------|----------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|------------|
| <b>Minimum</b> | 2.051    | 2.018       | 1.978       | 1.947       | 1.905       | 1.873       | 1.843       | 1.81        | 1.768       | 1.732       | 1.731      |
| <b>Maximum</b> | 2.092    | 2.166       | 2.242       | 2.318       | 2.422       | 2.522       | 2.626       | 2.747       | 2.894       | 3.025       | 3.203      |
| <b>Mean</b>    | 2.072    | 2.088       | 2.105       | 2.121       | 2.14        | 2.158       | 2.178       | 2.197       | 2.221       | 2.238       | 2.27       |
| <b>Median</b>  | 2.072    | 2.088       | 2.104       | 2.119       | 2.136       | 2.154       | 2.168       | 2.181       | 2.201       | 2.214       | 2.242      |
| <b>1st Qu.</b> | 2.062    | 2.071       | 2.07        | 2.069       | 2.069       | 2.07        | 2.07        | 2.066       | 2.069       | 2.062       | 2.069      |
| <b>3rd Qu.</b> | 2.083    | 2.107       | 2.138       | 2.17        | 2.206       | 2.239       | 2.277       | 2.312       | 2.357       | 2.386       | 2.442      |

In this table, once more we compute firm values ( $V$ ) from Equation (17) by randomly assigning values to  $\alpha$  (from zero to 0.5 in increments of 0.05),  $\mu$ , and  $\gamma$ . As in the case of discrete probability distribution, this time we pick the range for variables  $\mu$  and  $\gamma$  so that the favorable effects of reducing  $R$  is cut in half and the negative effect of reducing  $g$  are doubled. Again, for each level of CSR expenditure ( $\lambda$ ), we repeat the experiment 5,000 times and report the minimum, maximum, mean, median, 1<sup>st</sup> and 3<sup>rd</sup> quintals of  $V$ .



## APPENDIX:

First set simulation, discrete model; 5,000 times:  $\epsilon(0,0.1,0.01)$ ;  $\mu(0,20,1.0)$ ;  $\gamma(0,40,1.0)$   
 $\lambda=0$

```
>
> #lambda.v<-seq(0,0.1,0.01)
> p0.v<-seq(0.97,0.99,0.001)
> epsilon.v<-seq(0,0.1,0.01)
> mu.v<-seq(0,20,1)
> gamma.v<-seq(0,40,1)
> C.v<-seq(0,0.2,0.01)
>
> #l.lambda<-length(lambda.v)
> l.p0<-length(p0.v)
> l.epsilon<-length(epsilon.v)
> l.mu<-length(mu.v)
> l.gamma<-length(gamma.v)
> l.C<-length(C.v)
>
> n<-5000
> result5000<-rep(NA,n)
>
> for (i in 1:n){
+
+ #n.lambda<-runif(1,1,l.lambda+1)
+ n.p0<-runif(1,1,l.p0+1)
+ n.epsilon<-runif(1,1,l.epsilon+1)
+ n.mu<-runif(1,1,l.mu+1)
+ n.gamma<-runif(1,1,l.gamma+1)
+ n.C<-runif(1,1,l.C+1)
+
+ #lambda<-lambda.v[n.lambda]
+ p0<-p0.v[n.p0]
+ epsilon<-epsilon.v[n.epsilon]
+ mu<-mu.v[n.mu]
+ gamma<-gamma.v[n.gamma]
+ C<-C.v[n.C]
+
+ lambda<-0
+ g0<-2.5
+ R0<-12
+ y0<-0.4
+ p<-p0+epsilon*lambda
+ g<-g0-mu*lambda
+ R<-R0-gamma*lambda
+
+ V<-y0*(p+(1-p)*C)*(p*(1+0.01*g)/((1+0.01*R)-p*(1+0.01*g)))
+ result5000[i]<-V
+ }
> #sort(result5000)
> summary(result5000)
Min. 1st Qu. Median Mean 3rd Qu. Max.
3.068 3.235 3.418 3.433 3.614 3.826
```

**First set simulation, Continuous model; 5,000 times: alpha(0,0.5,0.05);mu(0,20,1.0);gamma(0,40,1.0)  
lambda=0**

```
>
> #lambda.v<-seq(0,0.1,0.01)
> mu.v<-seq(0,20,1)
> gamma.v<-seq(0,40,1)
> C.v<-seq(0,0.2,0.01)
> alpha.v<-seq(0,0.5,0.05)
>
> #l.lambda<-length(lambda.v)
> l.mu<-length(mu.v)
> l.gamma<-length(gamma.v)
> l.C<-length(C.v)
> l.alpha<-length(alpha.v)
>
> n<-5000
> result5000<-rep(NA,n)
>
> for (i in 1:n){
+
+ #n.lambda<-runif(1,1,l.lambda+1)
+ n.mu<-runif(1,1,l.mu+1)
+ n.gamma<-runif(1,1,l.gamma+1)
+ n.C<-runif(1,1,l.C+1)
+ n.alpha<-runif(1,1,l.alpha+1)
+
+ #lambda<-lambda.v[n.lambda]
+ mu<-mu.v[n.mu]
+ gamma<-gamma.v[n.gamma]
+ C<-C.v[n.C]
+ alpha<-alpha.v[n.alpha]
+
+ lambda<-0
+ phi0<-0.1
+ g0<-2.5
+ R0<-12
+ y0<-0.4
+ g<-g0-mu*lambda
+ R<-R0-gamma*lambda
+ phi<-phi0-alpha*lambda
+
+ V<-y0*((1+phi*C)/(0.01*R-0.01*g+phi))
+ result5000[i]<-V
+ }
> #sort(result5000)
> summary(result5000)
Min. 1st Qu. Median Mean 3rd Qu. Max.
2.051 2.062 2.072 2.072 2.082 2.0
```