The Moderating Effect of R&D on Corporate Social Responsibility and Equity Financing Cost

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A B S T R A C T

This paper explores the relation between corporate social responsibility and ex-ante cost of equity capital and undertakes to reveal the moderating effect of R&D intensity. The findings indicate that firms with higher CSR score will have higher cost of equity capital, and further infer that the differences in political and financial condition, historical background, and culture reflect on the CSR in various countries. R&D intensity is negatively related to cost of equity capital; moreover, the moderating effect of R&D on the relation between CSR and cost of equity is not significant. Based on the results, it will increase the uncertainty and dampens the moderating effect due to the heavy spending when firms simultaneously execute CSR and R&D. Correspondingly, through the empirical analysis from global perspective, the CSR and R&D intensity significantly influence the cost of equity respectively, while R&D intensity does not affect the relation between CSR and equity financing cost.

Keywords: CSR, Equity Financing Cost, R&D intensity, Moderating Effect

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1. Introduction

Corporate social responsibility (CSR) has become an attractive topic in the recent years since unethical events such as Enron fraud and the "Nike Sweatshop" had broken out, which arose the attention to CSR in both the business and academic field (Yang, Lin, and Chang 2010; Hull and Rothenberg 2008). In the past, companies thought corporate social responsibility as corporate philanthropy and engaging in social agenda beyond that which is required by law merely for the improvement of their public image. As time gone by, CSR has turned into the concept of risk management that can mitigate operational risk and strengthen external relationships, and will create firm value eventually if it is properly combined with business strategy. For successful implementation of CSR to add market value to firm, CSR strategy should correspond with the firm's specific corporate objectives and core competencies (Cochran and Wood 1984; Tsoutsoura 2004). It is almost unimaginable for a multinational corporation to be without a CSR policy nowadays. (The Economist, 2012)

Through the years, the definitions of CSR have evolved to become more extensive and refined. CSR does not only include how a firm should treat their employees but also all relative stakeholders like customers, suppliers, the community, and the environment. As defined by European Communities (2001) "CSR is a concept whereby companies integrate social and environmental concerns in their business operations and in their interaction with their stakeholders on a voluntary basis." According to the report of Ethical Performance (2001), "At its best, CSR is defined as the responsibility of a company for the totality of its impact, with a need to embed society's values into its core operations as well as into its treatment of its social and physical environment. Responsibility is accepted as encompassing a spectrum – from the running of a profitable business to the health and safety of staff and the impact on the societies in which a company operates." World Business Council for Sustainable Development (WBCSD, 2004) further defines CSR as "the continuing commitment by business to contribute to economic development while improving the quality of life of the workforce and their families as well as of the community and society at large". Overall, CSR is a multi-dimensional concept, which is regarded as a differentiation strategy to establish competitiveness, further, CSR should become integral to firm's overall strategy and be combined with firm's core capability to bring out more market value of firm. CSR is a necessity rather than a choice for firms. (Thornton 2008; Porter and Kramer 2006)

With the growing awareness of CSR, firms start to release CSR reports to disclose financial and non-financial information. According to KPMG research report, of the 250 largest multinational corporations, 64% published CSR reports in 2005. On the other side, the concept of socially responsible investment (SRI) is growing nowadays. SRI considers social justice, environment, going-concern, and financial performance to achieve financial and social benefit, it has changed from margin into mainstream and is now an investment philosophy adopted by large institution such as pension funds and insurance companies (Sparkes and Cowton 2004).

The sustained attention of CSR has induced many scholars to research on the relationship between CSR and corporate financial performance (CFP). Some scholars indicated that the relation between CSR and CFP is positive (Nelling and Webb 2009; Waddock and Graves 1997); while others pointed out that there is negative correlation between CSR and CFP. And some other studies suggested that CSR is not related to CFP at all (McWilliams and Siegel 2000). In a word, there are no identical conclusions until recent years (El Ghoul et al. 2011; Yang, Lin, and Chang 2010). The controversy over the relation between CSR and CFP attracted some researchers to further discuss what reasons lead to inconsistent conclusions and it was discovered that the inconsistency may be due to flawed empirical analysis. Waddock, Surroca, and Tribo (2009) sorted out some reasons which have been proposed in the past studies

regarding to inconsistent results, including the measurement problem, omission of variables, and a lack of clear direction of causality between CSR and CFP.

First of all, there is the measurement problem of CSR. Early researches on CSR tended to select a single item as proxy, which means they focused more on the single dimension of CSR and less on the aggregate social performance measure. However, CSR is a multidimensional concept which all possible impact on relative stakeholders need to be considered as proxy in the model. If researchers only take a single dimension as proxy for CSR, this measurement problem will contribute to the masking of any observable linkage with financial performance (Waddock, Surroca, and Tribo 2009; Nelling and Webb 2009; Humphrey, Lee, and Shen 2012; Hillman and Keim 2001). Second, there is the omission the variables. There are numerous business factors which could be firm's competitive advantages, especially the intangible assets including innovation, human resources, reputation, and organizational culture (Padgett and Galan 2009; Waddock, Surroca, and Tribo 2009). For instance, McWilliams and Siegel (2000) point out that the relation between CSR and CFP is significant, but turn into insignificant after including R&D as a variable in the mode. Briefly, the omission of important variables may generate spurious correlation between CSR and financial performance. Third, there is the direction of causality. Instead of trying to figure out the impact of CSR on financial performance, some scholars state that financial performance perhaps will positively influence CSR. Furthermore, CSR is both a predictor and a consequence of CFP; that is, a virtuous circle within CSR and CFP. (Waddock and Graves 1997; Waddock, Surroca, and Tribo 2009; Nelling and Webb 2009; Charles-Henri and Stéphane 2002)

Talking to the value of intangible assets, most scholars use resource-based view (RBV) theory as criterion. Firms with assets that are valuable, rare, and hard to imitate with a competitive advantage and are expected to earn superior financial performance. More specifically, RBV proposed that differences in firm performance are primarily the consequence of differences in intangible resources, such as innovation, human resources, reputation, and culture (Russo and Fouts 1997; Barney, Wright, and Ketchen 2001; McWilliams and Siegel 2011). Research and development (R&D) has been associated with the innovation capacities of firms, which includes product and process innovation, in order to generate competitive advantages over rivals (Lichtenberg and Siegel 1991; Waddock, Surroca, and Tribo 2009). Further, McWilliams and Siegel (2000) demonstrate, R&D is a significant driver of firm performance: the relation between CSR and CFP is upwardly biased by the omission of R&D. Thus, R&D is a crucial variable and should be taken into consideration for firm's market value.

Most of the previous studies concern the association between CSR and financial performance, and only a few studies examine how CSR influences firm's cost of equity capital, which reflect capital market participants' perceptions of CSR and has recently become a popular topic in the academic field. Other prior researches omit important variables which are related with the firm's market value and lead to flawed empirical analysis. Hence, to fill the gap, this paper will accurately investigate the relationship between CSR and cost of equity; moreover, examine the association between CSR and R&D, and the moderating effect of R&D on CSR and cost of equity.

This paper contributes to the existing literature on several ways. First, most prior studies have examined the CSR-related issue only on single country or geographic area. In this paper, we investigate the relation among CSR, R&D, and cost of equity capital from a global perspective. Second, previous literature mainly focuses on the effect of CSR or R&D on financial performance respectively, we replace financial performance with cost of equity capital to examine the effect of CSR or R&D in global samples. We provide empirical results that cost of equity capital will increase as CSR score increase, while higher degree of R&D intensity will

lower cost of equity capital. Third, this paper sheds light on the direct effect of CSR or R&D with cost of equity respectively and the moderating effect of R&D on the CSR and cost of equity.

This remainder of this paper is organized as follows: Section 2 provides the literature review and hypotheses development. Section 3 describes the data collection and research design. Section 4 presents the empirical results. Section 5 concludes this paper by summarizing the research findings, outlining the limitations and offering suggestions for future research.

2. Theory and Hypotheses

2.1 Theory

There have been a large number of studies that discuss the effect of CSR on financial performance, but still fulfilled with inconsistent results in this line. These mixed results reflect that contrasting theoretical views on the relation between CSR and financial performance. "Most of prior studies only focus on the accounting-based or market-based measures of financial performance; few studies examine capital market participants' perception of CSR." (El Ghoul et al. 2011). Instead of financial indicators as return of asset (ROA) or Tobin Q, cost of equity capital is another important proxy for firms' value. The importance of cost of equity is summarized as follows. First, the cost of equity capital is the required rate of return for investors to maintain their expenditure in the firm and reflects the perceived riskiness of the firm's future cash flows. The lower firm's cost of equity implies a reduction in the perceived riskiness of its cash flows. Briefly speaking, the market can forecast a firm's future cash flows by cost of equity to determine its current market value. Second, some research suggest that effective corporate governance, better nonfinancial disclosure, and good organizational culture will lower cost of equity capital through reducing information asymmetry (El Ghoul et al. 2011; Richardson and Welker 2001; Sharfman and Fernando 2008). From the mentioned above, this paper will discuss the impact of CSR on cost of equity capital instead of traditional financial indicators.

Since it is important for companies and investors to know whether better CSR performance can impact cost of equity capital, the prior studies have conducted empirical research on this issue. Some studies show the significant negative relation between CSR and cost of equity capital. For example, Feldman, Soyka, and Ameer (1997) find that investors realize that firms with better environmental performance are less risky. Bassen, Meyer, and Schlange (2006) also support the inverse association between CSR and cost of equity from the viewpoint of lower risk exposure via better CSR performance. Besides, Cheng, Collins, and Huang (2006) and Plumlee et al. (2010) also find that firms with stronger shareholder rights regimes and higher levels of financial transparency are associated with significantly lower costs of equity capital. However, not as popularly-known as it seems, certain studies still show that there is a positive relation between CSR and cost of equity capital. Richardson and Welker (2001) find the influence of social disclosures and the cost of equity capital to be significantly positive. This positive relationship is mitigated among firms with better financial performance. Brammer, Brooks, and Pavelin (2006) also point out firms with higher social performance scores realize lower returns.

The line of CSR and cost of equity capital has produced mixed findings on the CSR effect. There are three primary theories in the extent literature which explain the relations between CSR and cost of equity capital, including information asymmetry, investor preference, and estimation risk. The first is reduced information asymmetry, it means that information asymmetry between agent and principle will result in poor CSR performance. Reducing information asymmetry will lower the non-diversified risk, which leads to lower required rate

of return asked by investors; that is, cheaper cost of equity. Enhanced information disclosure is a good way to decrease the risk of information asymmetry (Richardson and Welker 2001). For example, Reverte (2012) proves that a significant inverse relation between CSR disclosure ratings and the cost of equity capital with a sample of Spanish listed firms. S.Dhaliwal et al. (2011) also show a lower cost of equity capital derived from better information disclosure of financial or non-financial information. "Market equilibrium" proposed by Merton (1987) is another method to reduce information asymmetry. Merton states that with a larger investor base, the firm would be required to disclose more financial and non-financial information hence mitigating the agency problem, thus resulting in a lower cost of equity capital and a higher market value for a firm. This argument is supported by Heinkel, Kraus, and Zechner (2001) proving that the fewer investors hold the stock of a firm, the lower the effect of risk diversification, resulting in the higher cost of equity. Therefore, firms with a larger investor base will attribute to better CSR performance and lower cost of equity capital in the end (Heinkel, Kraus, and Zechner 2001; El Ghoul et al. 2011; Merton 1987).

The second theory is investor preference effects. As Richardson and Welker (2001) mentioned, "investor preference effects arise if investors are willing to accept a lower rate of return on investments by an organization that supports a social cause for which some investors have an affinity." This suggestion is consistent with the emergence of Green Funds and Ethical Investing (Reyes and Grieb, 1998). It also has a direct relationship to the literature in organizational behavior, management, and marketing that suggests that advertising with a social dimension can be employed to legitimate the firm in the eyes of consumers and contribute to the firms' product/service market success (Garrett, 1987; Menon and Menon, 1997). With the increasing attention on CSR, investors start desiring to invest ethically (Beal, Goyen, and Phillips 2005). Customers choose to purchase goods or services which support the social issue they support, they believe that they are directly or indirectly dedicated to the social issue by "voting" their dollars (McWilliams and Siegel 2000; Richardson and Welker 2001). El Ghoul et al. (2011) also mentioned that socially conscious investors prefer to include firms with better CSR in their expenditure portfolio. Therefore, a firm with better CSR performance will raise funds more easily and thus lower the cost of equity capital.

The third theory is perceived risk. Waddock and Graves (1997) indicated that socially irresponsible firms may be exposed to uncertain lawsuits in the future. For example, if a firm ignores product safety and sells an unsafe product, this will increase the chance of future litigation cost. Feldman et al. (1997) also propose that firms paying more attention on environmental issues lower perceived risk to investors. Hong and Kacperczyk (2009) further indicate that "sinful" industry such as tobacco or nuclear power will face higher litigation risks, which implies that "sinful" industries have higher level of non-diversifiable risk. Consistent with El Ghoul et al. (2011), a firm with higher level of systematic risk and poor CSR performance will face higher cost of equity.

Many studies have examined the relation between CSR and corporate financial performance, but the opinions still are diversified. To explain inconsistent findings, Aupperle and Van Pham (1989) propose a possible explanation that not only social orientation policy will influence firm's financial performance but also other factors like its organizational culture, business strategies, reward systems, resources, and capabilities which can impact a firm's profitability. It implies that the relation between CSR and corporate financial performance can be easily masked owing to omission of other important factors. For instance, McWilliams and Siegel (2000) and Nelling and Webb (2009) indicate that the relationship between financial performance and CSR disappears when adding other variables into econometric models, such as research and development intensity (R&D).

As mentioned in lots of literatures, intangible resources including innovation, know-how, human resources, reputation, and organizational culture truly play an important role in a firm's financial performance. From the Resource-Based view of firm (RBV), firms can recognize the importance of intangible resources that will add a competitive advantage and are expected to sustain superior financial performance, and identify these rare, valuable, and inimitable resources (Waddock, Surroca, and Tribo 2009). For instance, research and development expenditure (R&D) is associated with innovation capabilities of firms which is regarded as long-term expenditure to help firm obtain competitive advantage through product and process innovation (Padgett and Galan 2009). Compared with other intangible resources like reputation, R&D is much more tangible due to it is regarded as expense or cost (Eberhart, Maxwell, and Siddique 2004). More specifically, "R&D is considered to be a form of investment in 'technical' capital. Investment in technical capital results in knowledge enhancement, which leads to product and process innovation. This innovative activity enables firms to enhance their productivity (McWilliams and Siegel 2000)." Lichtenberg and Siegel (1991) also support this viewpoint by reporting a strong positive correlation between R&D investment and growth in total factor productivity. The past literatures also consider whether other unobservable firm characteristic or critical business factors which will impact on cost of equity exist. Some studies have shown that R&D expenditure, reputation, firm's culture, and employee relation which will impact the association with CSR and cost of equity (Nelling and Webb 2009; Charles-Henri and Stéphane 2002).

The academic research has provided strong evidence that R&D does play an important role in corporate financial performance (CFP) through empirical analysis. Lichtenberg and Siegel (1991) and Scherer (1999) focus on the productivity growth via increasing R&D expenditure, both provided a strong evidence of a positive relation between R&D and productivity. Not only increasing productivity, some studies also propose that R&D will add the market value and stock return for firms. Ehie and Olibe (2010) find positive correlation between R&D and market value through examining U.S. firms over an 18-year period. Sougiannis (1994) even indicates that a dollar increased in R&D expenditures will lead to an increase of two dollars in profit and five dollars in market value over a 7-year period. Pindado, de Queiroz, and de la Torre (2010) point out that firm size and firm growth positively moderate firm value and R&D spending, while free cash flow, labor intensity, and capital intensity is a negative effect. In addition, Lin, Lee, and Hung (2006) show that expenditure in R&D does help improve long-run economic performance by stating that R&D is a kind of technical capital expenditure which enhances knowledge and productivity through product and process innovation. In a word, R&D including product and process innovation is a significant driver of firm performance. Furthermore, Han, Kim, and Srivastava (1998), Hull and Rothenberg (2008), and Padgett and Galan (2009) have suggested that R&D should be considered as moderator in the models for the previous ambiguous empirical results of CSR-CFP.

As known, corporations execute business strategy for creating competitive advantages to maximum shareholders' wealth and the market value of firms. Both CSR and R&D are critical strategies for firms and there are some commonalities between them. First, both CSR and R&D are regarded as differentiation strategy, and both create competitive advantages through process and product innovation. Firms that implement R&D investment may realize CSR-related issue simultaneously (Lin, Yang, and Liou 2009). For example, if a firm adopts differentiation strategy through CSR resources, such as recycled products or organic pest control, it may also include investment in R&D. Using organic methods constitutes a process innovation for the farmer, and also fulfills the need of some consumers who want the goods they purchase to have certain socially responsible attributes (McWilliams and Siegel 2000). As a result, the firm that invests in R&D not only reduces pollution but also realizes corporate social responsibility.

Second, Hinloopen (1997) indicates that market force is not sufficient enough to induce firms to invest R&D to social optimal amount. Considering the benefit created from R&D cannot totally be internalized, or so-called spill-over effect, firms choose R&D investment amount lower than the social optimal amount. Therefore, we infer that if a firm not only cares about shareholders but also stakeholders, then the amount of R&D investment for stakeholders will be larger than for shareholders alone, that is, the relation between CSR and R&D is positive.

There is another viewpoint about the association between CSR and R&D. In the customer response of marketing academic field, what a person knows about a company (i.e., corporate association) can be separated into two parts. One is corporate ability focused on the company's capabilities for producing products, and the other is CSR associations focused on the company's perceived social responsibility. To be more precise, corporate ability focuses on a firm's expertise in internal research and development (R&D), manufacturing and technological innovation, while CSR associations focus on environmental friendliness, sponsorship of cultural activities, or corporate philanthropy. Furthermore, both corporate ability and corporate social responsibility are not mutually exclusive; a firm can differentiate themselves through exercising both strategies to possess competitive advantage and hence establish reputation among their customers (Brown and Dacin 1997). Therefore, a firm's success is not only determined by external factors, but also internal competencies. In other words, CSR policies are like an internal competency which would help improve processes for products and services; this kind of introduction of improved process and products is positively related with R&D (Padgett and Galan 2009). Thus, Moore (2001) and Harrison and Freeman (1999) suggest that social performance and economic performance should not be separated, since in order to determine whether a firm is 'good', it has to perform well on both strategies (Padgett and Galan 2009).

The following are some examples about the combination of CSR and R&D eventually creating benefit for firms. The first one is 3M. 3M reduced hazardous wastes by 10 tons per year at almost no cost, yielding an annual saving of more than $200,000 by developing a new technique (process innovation) to run quality tests more rapidly on new batches (Porter and Vanderlinde 1995). Another example is DELTA, which is dedicated to environmental protection and green energy. DELTA strives to reduce carbon emissions during the manufacturing process, and their products meet the requirement of European environmental protection standard which led to orders from European countries. In this way, DELTA not only achieves social performance but also increases revenue. The other example is Airbus Group, which was also dedicated to cut fuel cost and emissions by improving the design of fuselage. The wider fuselage also provided passengers greater comfort on long journeys, and thus brought 582 orders for Airbus over 6 years. Airbus Group is also committed to carbon neutral growth by 2020 and then to reduce CO_2 emissions by 50% by 2050, thus the group is allocating increasing resources and investment to developing new technologies and ways of operating for this target. These examples mentioned above show that if a firm combines CSR and R&D well, the competitive advantages will be created and increase the market value of firms eventually.

2.2 Hypotheses

Prior research provides the mixed results for the relationship between CSR and corporate financial performance, but seldom research investigate the linkage between CSR and cost of equity. To address this gap, this research seeks to use implied cost of equity capital to examine the phenomenon of how CSR affects firm value and to provide reasonable explanations for their relationship. From previous studies, we know that a firm with better CSR through reducing information asymmetry or increasing investors' base which can lower the risk and then lower the cost of equity. And most prior research indicate that there is a negative relation between

CSR and cost of equity capital (Sharfman and Fernando 2008; S.Dhaliwal et al. 2011; El Ghoul et al. 2011). Summarizing the previous literature, we predict that firms with better CSR scores will exhibit lower cost of equity capital, as in the following hypothesis:

Hypothesis 1: Better CSR performance will lower the cost of equity.

This study also highlights the effect of R&D on cost of equity. The strategy of R&D expenditure could enable a firm to generate new technology, products, and improved process which may establish entry barriers for competitors (Waddock, Surroca, and Tribo 2009), accelerate the productivity or lower the learning curve via repeating production and economics of scale (Scherer 1999; Lieberman 1984),drive cost down through product and process innovation (Eberhart, Maxwell, and Siddique 2004) to build capabilities to offer better product or services for customers (Brown and Dacin 1997). If firms have the above capabilities generated from R&D, it would promote reasonable decrease in operational risk and stabilize future cash flow by decreasing the cost of equity eventually (Berk, Green, and Naik 2004). Moreover, the book *Pharmaceutical R&D: Costs, Risks and Rewards* also raise an opinion that "R&D not only produces an option on future investments and revenues, but also produces information that reduces the uncertainty about the value of the project. Since the investment on early R&D can be viewed as an investment in information that allows the firm to reduce the uncertainty of its later investments. This "information-producing" function of R&D essentially adds to the value of the R&D investment, and enables firm to reduce the uncertainty of its later investments. That is, "dampening the ineffective cost of capital for R&D." However, some studies regard R&D expenditures as a risk-booster and indicate that the association between R&D and cost of equity capital is positive, because of the inherent uncertainty and information asymmetry of R&D has increased a firm's systematic risk. In a word, the more uncertainty the higher risk premium and then the higher cost of equity. Berk, Green, and Naik (2004) further indicate that firms need more other investments to mitigate the uncertainty of R&D expenditures. To sum up, this study regards R&D as an important strategic asset which will lower the risk and uncertainty of future cash flow. With a global perspective, the hypothesis is developed as follows:

Hypothesis 2: There is a negative relation between R&D expenditure and the cost of equity.

It has been proved that firms with high level of CSR strategy can differentiate themselves in order to obtain competitive advantage (Hull and Rothenberg 2008; Siegel and Vitaliano 2007). On the other hand, R&D is considered to be a form of investment in technical capital that results in knowledge enhancement. Both R&D and CSR activities are associated with product and process innovation which results in creating assets that provide firms with competitive advantage. Hull and Rothenberg (2008) verified that R&D intensity affects CSR in a positive way. They claimed that R&D is considered to be a form of investment which results in knowledge enhancement and leads to CSR-related process and products. Furthermore, if a firm is not only concerned about the interests of shareholders but also the ones of stakeholders, the amount of R&D expenditures related with stakeholders should be higher than the one of shareholders.

This study further highlights how R&D moderates the relationship between CSR and cost of equity. As mentioned early, CSR and R&D are essential business strategies and both are important sources of firms' intangible capital and viewed as long-term investments in intangible assets to reflect on firms' market value (Lin, Lee, and Hung 2006). Siegel and Vitaliano (2007) and McWilliams and Siegel (2000) claim that R&D is a significant driver of firm performances, and should be included as a moderator in the theoretical model by Padgett and Galan (2009) and Hull and Rothenberg (2008). Thus, we should also consider R&D while discussing the CSR-cost of equity. On the other hand, prior research have discussed the direct or indirect

association between CSR and financial performance. Waddock, Surroca, and Tribo (2009) indicate that there is an indirect relationship between CSR and corporate financial performance after considering the mediating effect of a firm's intangible resources. Hence, we are curious about whether variables will translate the direct relation between CSR and cost of equity capital into indirect or so-called the moderating effect over CSR and cost of equity capital. Furthermore, both CSR and R&D are associated with product and process innovation, hence, we regard R&D as a moderator in the model for discussing how R&D moderates the relationship between CSR and cost of equity. We present the following hypothesis:

Hypothesis 3: CSR influence cost of equity capital, which is moderated by R&D.

3. Data and Methodology

3.1 Sample selection

The data mainly come from two database. One is DataStream which provides financial data from more than 60 markets and 175 countries around the world. DataStream has been integrated with Institutional Brokers Earnings Services (I/B/E/S) database and Worldscope database. More specifically, Worldscope provides detailed financial data for the individual company, and I/B/E/S provides analyst forecast data which is used to evaluate the cost of equity capital. The other is Thomson Reuters ASSET4, which provides 4300 listed companies' performance regarding environmental, economic, social and corporate governance (EESG). The CSR score is equally-weighted of four aspects as mentioned above and ranges from 0% to 100%. The final sample consists of 8696 observations, covering 1500 different firms and 34 countries from 2010 to 2020.

3.2 Measurement of CSR

Collecting the CSR score from Thomson Reuters ASSET4, which contains a variety of standards of CSR ratings. To more precisely evaluate a firm's social responsibility performance, this paper use four scopes of CSR which involves corporate governance, environment, economy, and social responsibility (EESG) and weighting all components together. If a firm has a higher CSR-score, it means better CSR performance. Four dimensions contain 18 categories that are composed of more than 250 indicators are summarized as follows. The environmental component covers emission reduction, resource reduction, and product innovation; indicators include renewable energy use, waste recycling ratio etc. Economic performance is composed of client loyalty, performance, and shareholder's loyalty. Social performance contains employment quality, health and safety, training and development, diversity, human rights, community, and product responsibility. Corporate governance performance includes board structure compensation policy, board function, shareholder's rights, vision and strategy; some examples of its indicators are percentage of independent board members and anti-takeover devices.

3.3 Measurement of R&D Intensity (RDI)

In this study, R&D expenditures is another main independent variable. Several previous studies have argued to capitalize R&D and have it subsequently amortized much like tangible assets, since it stands for an intangible asset of a firm. However, some states that R&D outlays must be fully expensed in the year they are incurred. Considering the inability to determine a depreciation rate raised from Hirschey and Weygandt (1985), this paper use the ratio of R&D expenditure to total net sales of a company (McWilliams and Siegel 2000; Siegel and Vitaliano 2007; Yang, Lin, and Chang 2010).

$$\text{R\&D intensity} = \frac{\text{R\&D Expenditure}_t}{\text{Total Sales}_t}$$

3.4 Measurement of the Implied Cost of Capital

As indicated by Ghoul, Guedhami, Kwok, and Mishra (2011), "the cost of equity capital is the internal rate of return that the market applies to a firm's future cash flows to determine its current market value." The cost of equity capital is a key element in the operation of companies, where a relatively low cost of equity capital will lead to more competitive advantages.

Based on the previous literature, most scholars agree that ex-post (realized) rate of return and ex-ante (implied) cost of equity capital are the two main methods by which to calculate the cost of equity capital. Fama and French (1997) argue that there are differences and uncertainty related to the factor premiums, where the expected returns estimated by asset pricing models and ex-post (realized) cost of equity capital which may be biased. Therefore, the ex-ante returns (Hail and Leuz; 2006) are used to calculate the cost of equity capital, which are based on current stock prices and analysts' earnings forecasts. However, a few studies indicate which model is the best one to measure the cost of equity capital. Hail and Leuz (2006), Ghoul, Guedhami, Kwok, and Mishra (2011) use the arithmetic average of models to estimate cost of equity capital. Accordingly, the arithmetic average estimate is used to reduce bias from the four models as follows.

Gordon Finite Horizon Model (1997)

$$P_t = \sum_{\tau=1}^{4} \frac{DPS_{t+\tau}}{(1 + r_{GF})^{\tau}} + \frac{NEPS_{t+1} (1 + LTG)^4}{r_{GF} (1 + r_{GF})^4},$$

where

$DPS_{t+\tau} = DPS_0 (1 + LTG)^{\tau}$

P_t = stock price in June of year t

DPS_0 = actual dividend per share in year $t - 1$

LTG = long-term growth forecast in June of year t

r_{GF} = cost of equity capital in Gordon Finite Horizon Model

$NEPS_{t+1} = \dfrac{FEPS_{t+3}}{(1 + LTG)^2}$

Ohlson and Juettner-Nauroth (2005)

$$r_{OJ} = A + \sqrt{A^2 + \frac{FEPS_{t+1}}{P_t}\left(g_2 - (\gamma - 1)\right)},$$

where

$$A = \frac{1}{2}\left((\gamma - 1) + \frac{DPS_{t+1}}{P_t}\right)$$

$DPS_{t+1} = DPS_0$; $g_2 = \dfrac{STG + LTG}{2}$

P_t = stock price of a firm in June of year t

DPS_0 = actual dividends per share in year t-1

$FEPS_{t+\tau}$ = forecasted EPS for year $t + \tau$ recorded in June of year t

r_{OJ} = cost of equity capital in Ohlson and Juettner-Nauroth's model

$$STG = \frac{FEPS_{t+2} - FEPS_{t+1}}{FEPS_{t+1}} \; ; \; (\gamma - 1) = r_f - 0.03$$

Easton (2004)

$$P_t = \frac{FEPS_{t+2} + r_{ES} \, DPS_{t+1} - FEPS_{t+1}}{r_{ES}^2},$$

where

$DPS_{t+1} = DPS_0,$

P_t = stock price of a firm in June of year t

DPS_0 = actual dividends per share in year t-1

$FEPS_{t+\tau}$ = forecasted EPS for year $t + \tau$ recorded in June of year t

r_{ES} = cost of equity capital in the Easton model

Claus and Thomas (2001)

$$P_t = B_t + \sum_{\tau=1}^{5} \frac{ae_{t+\tau}}{(1 + r_{CT})^\tau} + \frac{ae_{t+5} \, (1 + g)}{(r_{CT} - g) \, (1 + r_{CT})^5},$$

where

P_t = stock price of a firm in June of year t

B_t = book value per share at the beginning of year t

r_{CT} = cost of equity capital in the Claus and Thomas Model

$ae_{t+\tau} = FEPS_{t+\tau} - r_{CT} \, B_{t+\tau-1}$ = expected abnormal earnings for year t

$FEPS_{t+\tau}$ = forecasted earnings per share for year $t + \tau$, if available; otherwise, $FEPS_{t+\tau} = FEPS_{t+\tau-1} * (1 + LTG)$; LTG=consensus long-term growth forecast reported in June of year t

$$B_{t+\tau} = B_{t+\tau-1} + FEPS_{t+\tau} * DPR_{t+\tau}$$

$DPR_{t+\tau} = 0.5$ = expected dividend payout ratio assumed to be 0.5, following Claus and Thomas (2001)

$g = r_f - 0.03$ = the assumed constant growth rate of abnormal earnings set to be equal to the current 10-year risk-free rate less 3%.

Price–Earnings–Growth (PEG) ratio by Easton (2004)

$$P_t = \frac{FEPS_{t+2} - FEPS_{t+1}}{r_{PEG}^2},$$

where

P_t = stock price of a firm in June of year t,

$FEPS_{t+\tau}$ = forecasted EPS for year $t + \tau$ recorded in June of year t,

r_{PEG} = the cost of equity capital in the Price–Earnings–Growth model.

3.5 Empirical Models

Most previous studies propose that a firm with better CSR will lower the cost of equity capital, but most of them take U.S. firms as samples instead of global samples. Hence, we adopt global samples and follow Ghoul et al. (2011) to derive the ex-ante cost of equity capital for building up the empirical models with fixed-effects to eliminate time-variant variables.

In this study, the Model 1 is applied to discuss the relation between CSR and cost of equity capital. R&D is another critical business factor to establish Model 2 for testing the relation between R&D and cost of equity capital. The Model 3 is created to examine the moderating effect of R&D on CSR and cost of equity. Along the lines of Ghoul, Guedhami, Kwok, and Mishra (2011), Ogneva, Subramanyam, and Raghunandan (2007), Doyle, Ge, and McVay (2007), Ashbaugh-Skaife, Collins, and Kinney (2007), Dhaliwal, Li, Tsang, and Yang (2011), and Ge and McVay (2005), the control variables fully take into account and have been empirically demonstrated to affect the cost of equity capital (Hail and Leuz, 2006; Gebhardt, Lee, and Swaminathan, 2001; Dhaliwal, Eheitzman, and Li, 2006), including firm-specific factors: beta (*BETA*), size (*SIZE*), leverage (*LEVERAGE*), the book-to-market ratio (*BTM*), inventory (*INVENTORY*), foreign operations (*FOREIGN*), and loss (*LOSS*), as well as year effect and industry effect.

(Model 1)
$$r_{AVG} = \alpha_0 + \beta_1\ CSR + \beta_2\ BETA + \beta_3\ SIZE + \beta_4\ LEV + \beta_5\ BTM + \beta_6\ INV + \beta_7\ FOREIGN \\ + \beta_8\ LOSS + \beta_9\ YEAR + \beta_{10}\ INDUSTRY + \varepsilon$$

(Model 2)
$$r_{AVG} = \alpha_0 + \beta_1\ R\&D + \beta_2\ BETA + \beta_3\ SIZE + \beta_4\ LEV + \beta_5\ BTM + \beta_6\ INV + \beta_7\ FOREIGN \\ + \beta_8\ LOSS + \beta_9\ YEAR + \beta_{10}\ INDUSTRY + \varepsilon$$

(Model 3)
$$r_{AVG} = \alpha_0 + \beta_1\ CSR + \beta_2\ R\&D + \beta_3 CSR*R\&D + \beta_4\ BETA + \beta_5\ SIZE + \beta_6\ LEV + \beta_7\ BTM \\ + \beta_8\ INV + \beta_9\ FOREIGN + \beta_{10}\ LOSS + \beta_{11}\ YEAR + \beta_{12} INDUSTRY + \varepsilon$$

4. Empirical Results

Table 1 presents the detailed statistics for the estimates on costs of equity. Panel A provides the statistical properties for each model. The mean and median of the average ex-ante cost of equity capital (r_{AVG}) are 0.12 and 0.11 respectively. For all samples, the means for the rGF and rCT models (0.11 and 0.12) are relatively lower than the ones of the rES and rOJ (0.13 and 0.12) and accordingly the "average" ex-ante cost of equity capital (r_{AVG}) is applied to reduce bias (Ghoul, Guedhami, Kwok, and Mishra, 2011). The pearson correlation coefficients among the costs of equity estimates for all samples are shown in Panel B.

Table 1: Descriptive statistics and correlation coefficients for implied equity costs

Panel A: Descriptive statistics for implied equity costs

	N	Mean	Min	Q1	Median	Q3	Max	Std
r_{AVG}	8696	0.12	0.06	0.09	0.11	0.12	0.25	0.05
r_{CT}	8696	0.12	0.05	0.08	0.12	0.10	0.18	0.02
r_{ES}	8696	0.13	0.05	0.10	0.12	0.14	0.31	0.05
r_{OJ}	8696	0.12	0.07	0.10	0.11	0.13	0.22	0.02
r_{GF}	8696	0.11	0.06	0.08	0.10	0.11	0.23	0.04

Panel B: Pearson correlation coefficients between implied equity costs

	r_{AVG}	r_{CT}	r_{ES}	r_{OJ}	r_{GF}
r_{AVG}	1				
r_{CT}	0.645***	1			
r_{ES}	0.927***	0.415***	1		
r_{OJ}	0.978***	0.458***	0.856***	1	
r_{GF}	0.788***	0.698***	0.545***	0.751***	1

In Panel A, r_{AVG} is the average ex-ante or implied cost of equity calculated from the Four models developed by Claus and Thomas (2001), Ohlson and Juettner-Nauroth (2005), Easton (2004), Gordon and Gordon (1997), which denote r_{CT}, r_{OJ}, r_{ES}, r_{GF}. Panel B provides Pearson pair-wise correlations between the implied costs of equity capital. ***, ** and * describe significance at the 1%, 5% and 10% levels, respectively.

The univariate analysis is presented in Table 2 including four panels. In panel A, comparing the mean cost of equity of firms with low and high CSR score based on the median CSR value. The mean cost of equity of firm with high CSR score is 12.02%, while it is 11.7% for firms with low CSR score. The results indicate that the mean cost of equity for firms with high CSR score is 0.32% higher than that for firms with a low CSR score, and the difference is significant at the 1% level. Panel B classifies firms according to the R&D intensity, and we compare the mean cost of equity of firms with low and high R&D intensity based on the median R&D intensity. The mean cost of equity of firms with high R&D intensity is 11.8%, while it is 12.38% for firms with low R&D intensity. The result suggests that the mean cost of equity for firms with high R&D intensity is 0.58% lower than that for firms with a low R&D intensity, and the difference is significant at the 1% level. Therefore, we infer that the cost of equity for firms with higher R&D intensity is lower, which is consistent with our hypothesis.

Before deducing the relation among CSR, R&D intensity, and cost of equity capital, the relation between R&D and CSR is discussed first. We show the comparing results of CSR score with low and high R&D intensity based on the median R&D intensity in panel C, and found out firms with higher R&D intensity has better CSR performance, which is consistent with prior researches. It indicates that both CSR and R&D are regarded as differentiation strategy and firms implementing R&D investment can realize CSR-related issue simultaneously.

In panel D, the firms are classified according to their R&D intensity and CSR score, and compare their mean cost of equity capital. As shown in panel D, for firms with high R&D intensity, the mean cost of equity capital of lower CSR score will be lower than firms with higher CSR score and the difference is significant. While for firms with lower R&D intensity, the difference of cost of equity capital is not significant between two groups of CSR score, which means for firms with low R&D intensity, the level of CSR score doesn't make cost of equity capital differ. These results point out that the relation between CSR performance and cost of equity capital does not change by different level of R&D intensity.

Table 2: Univariate Tests

Panel A. r_{AVG} sort by CSR score

		Obs	Mean of r_{AVG}	
CSR ≥ median	(1)	4394	12.02%	
CSR < median	(2)	4348	11.7%	
Difference	(1)-(2)			0.32%
t-stat.				5.8647***

Panel B. r_{AVG} sort by R&D intensity

		Obs	Mean of r_{AVG}	
R&D≥median	(1)	4346	11.8%	
R&D<median	(2)	4350	12.38%	
Difference	(1)-(2)			-0.58%
t-stat.				-9.1228***

Panel C. CSR score sort by R&D intensity

		Obs	Mean of CSR score	
R&D≥median	(1)	4346	0.74	
R&D<median	(2)	4350	0.72	
Difference	(1)-(2)			0.0298
t-stat.				4.4102***

Panel D. r_{AVG} sort by CSR score and R&D intensity

	CSR ≥ median		CSR < median		Difference	t-stat.
	Obs	r_{AVG}	Obs	r_{AVG}		
R&D≥median	2240	11.92%	2107	11.36%	0.0056	5.1726***
R&D<median	2109	12.26%	2241	12.04%	0.0022	1.9985

Table 2 contains four panels. Total sample includes 8696 firm-year sample observations between 2010 and 2020. Panel A compares the mean cost of equity capital of firms with low and high CSR score based on median CSR value. Panel B compares the mean cost of equity capital of firms with low and high R&D intensity based on the median R&D intensity. Panel C classifies firms based median R&D intensity, and compare the CSR score of firms with low and high R&D intensity. Panel D classifies firms according to their R&D intensity and CSR score, and compare their mean cost of equity capital.

To verify the hypothesis 1, we regress the average implied cost of equity capital on CSR score and the control variables with year and industry fixed-effect. We present the empirical results in Model (1) of Table 3. Based on the prior studies predicting that there will be a negative relation between CSR and cost of equity capital. Surprisingly, the coefficient of CSR and cost of average implied cost of equity capital is significantly positive at 1% level. Under this outcome, we try to figure out the reasons behind this result.

First is the ideal level of CSR. Managers should treat CSR as strategy and try to balance

cost and benefit via supply and demand framework. In other words, the increased revenue from the demand should be equal to the cost of using resources to provide CSR (McWilliams and Siegel 2001). Improper CSR policy will increase firm's expenditure and higher the uncertainty of future cash flows, thus, higher the cost of equity capital. Second, our samples are selected globally, where the value of CSR is viewed differently worldwide. As Yen and André (2019) point out that the value of CSR will be impacted by national, social. cultural environment, level of national economic development, and managers' attitude. Whitley (1999) suggests that "differences in political and financial condition, labor education and culture can explain different attitudes regarding CSR in various countries".

Along the lines of (Ghoul, Guedhami, Kwok, and Mishra, 2011; Ogneva, Subramanyam, and Raghunandan, 2007; Doyle, Ge, and McVay, 2007; Ashbaugh-Skaife, Collins, and Kinney, 2007; Dhaliwal, Li, Tsang, and Yang, 2011; Ge and McVay, 2005), the control variables fully take into account that have been empirically demonstrated to affect the cost of equity capital (Hail and Leuz, 2006; Gebhardt, Lee, and Swaminathan, 2001; Dhaliwal, Eheitzman, and Li, 2006) including firm-specific factors: beta (*BETA*), size (*SIZE*), leverage (*LEVERAGE*), book-to-market ratio (*BTM*), inventory (*INVENTORY*), foreign operations (*FOREIGN*), and loss (*LOSS*) as well as the year effect and industry effect are also included.

Model (2) of Table 3 represents the regression results for examining whether there exists a negative relation between R&D and cost of equity capital or not. From the table, we find that the coefficient of R&D is negative and statistically significant at the 1% level, which means that a firm with higher R&D intensity will have a lower cost of equity capital. In other words, R&D not only increase productivity but also decreases cost via product and process innovation, and further enhances the corporate capability and knowledge management. The most important is that R&D produces information that reduces the uncertainty of the value of a project; it is like "information-producing" function which will add the value of R&D to firms. Some scholars also proposed that R&D truly impacts market value of firm through product and process innovation, knowledge management, and reducing risk(Lin, Lee, and Hung 2006; Berk, Green, and Naik 2004; Ho, Xu, and Yap 2004; Müller and Zimmermann 2009; Pindado, de Queiroz, and de la Torre 2010). Hence, a higher R&D intensity would promote reasonable decrease in operational risk and would stabilize future cash flow, decreasing the cost of equity capital eventually. Through R&D intensity, firms will be equipped with capabilities mentioned above and maintain firm's long-term competitive advantages, and then decrease risk and lower the cost of equity capital, finally adding the market value of firms.

This study also highlights whether R&D moderates the association between CSR and cost of equity capital or not. In our regression model, the moderate effect of R&D and CSR to cost of equity capital is represented as interaction term between these two variables. And if the coefficient of interaction variable is negative, it means the moderate effect of R&D on CSR will lower cost of equity capital and vice versa. In model (3) of Table 3, we present the direct effect of independent variable and moderate effect of R&D. As for the main effect (direct relation), it is found that the association between CSR and cost of equity capital is significantly positive; this means that a firm with better CSR score will lead to higher cost of equity, consistent with model (1). While R&D is has a significantly negative effect on cost of equity capital, it means that higher R&D intensity will lower cost of equity capital, consistent with model (2). As for moderating effect (indirect effect), the interaction of R&D with CSR is not statistically significant but with positive sign, it implies that the R&D intensity doesn't significantly impact the relation between CSR and cost of equity capital. In other words, the positive correlation between CSR and cost of equity capital is not strengthened as R&D intensity rises. Hence, concluding from the regression results, we found that there is direct relationship between CSR and cost of equity capital, and there is not indirect relationship

mediated by R&D intensity in global samples. We further analyzed the reasons for this result, and we inferred that a firm executing CSR and R&D simultaneously will increase the uncertainty and burden heavy spending. Besides, R&D is essential to business strategy for most corporates, it is less likely that firm choose to do R&D only for implementing CSR. Furthermore, CSR and R&D belong to long-term investment, both take time to enhance market value; it is hard to obtain synergy for CSR and R&D immediately.

Table 3: Empirical Results

	(1) r_{AVG}	(2) r_{AVG}	(3) r_{AVG}
CSR	0.00916***		0.00852***
	(7.17)		(6.43)
RDI		-0.0273***	-0.0417***
		(-4.25)	(-3.58)
CSR*RDI			0.0315
			(1.82)
BETA	0.0223***	0.0219***	0.0216***
	(17.95)	(18.09)	(17.62)
SIZE	-0.000972***	0.0000515	-0.001025***
	(-4.01)	(0.201)	(-4.13)
LEVERGAE	0.00621***	0.00582***	0.00564***
	(15.78)	(14.08)	(14.69)
BTM	0.0403***	0.0396***	0.0389***
	(26.21)	(24.17)	(25.74)
INV	0.0364***	0.0341***	0.0311***
	(8.51)	(8.01)	(7.16)
FOREIGN	0.00475***	0.00483***	0.00475***
	(7.28)	(7.86)	(7.65)
LOSS	0.0245***	0.0283***	0.0287***
	(12.69)	(12.69)	(13.12)
Year	Yes	Yes	Yes
Industry	Yes	Yes	Yes
Constant	0.0784***	0.0716***	0.0815***
	(17.86)	(16.30)	(17.83)
Observations	8696	8696	8696
adj. R^2	0.304	0.301	0.305

Table 3 presents the regression results with fixed-effect and control variables from 8696 firm-year observations from 2010 to 2020. r_{AVG} is the average implied cost of equity capital of four models. Model (1) regress implied cost of equity capital (r_{AVG}) on CSR scores. Model (2) regress implied cost of equity capital (r_{AVG}) on R&D intensity. And Model (3) regress CSR, R&D and the interaction term over r_{AVG} to show the moderate effect of R&D. T-statistics are shown in parentheses. ***, ** and * describe significance at the 1%, 5% and 10% levels, respectively.

5. Conclusions

The sample of 8696 global observations is used from 2010 to 2020 and controlled other variables as well as industry and year fixed effect. Examine the relation between CSR and cost of equity first and find out that firms with higher CSR score will have higher cost of equity capital. Then presumed the reasons behind the situation are that most CSR activities take time to realize its impact on cost of equity capital; also, the attitude toward CSR varies from country to country based on political and financial condition, labor education, and culture. Next, we regress R&D intensity on cost of equity capital to test whether higher R&D will lower cost of

equity capital, as the empirical results show, R&D intensity does negatively associate with cost of equity capital. This result verifies that R&D truly impacts market value of firm through reducing risk, knowledge management, and product and process innovation. This study also highlights the moderating effect of R&D on the relation between CSR and cost of equity capital. In the empirical results, we discovered the moderate (indirect) effect is not significant, it implies that R&D intensity will not influence the relation between CSR and cost of equity capital. That is, CSR and R&D intensity respectively have significantly direct impact on cost of equity capital. Inferring the reasons behind this result is when a firm executes CSR and R&D simultaneously, this will increase the uncertainty and dampen moderate effect due to heavy spending. Besides, R&D is essential for business strategy for most corporations, it is less likely that firms choose to do R&D only for implementing CSR. Furthermore, CSR and R&D belongs to long-term investment, it is hard to obtain synergy between CSR and R&D immediately.

To sum up, this study sheds light on the relation between CSR and cost of equity capital, and the moderate effect of R&D from a global perspective. The suggestion is that firms should regard CSR and R&D as a strategy and try to combine with firm's core capacities to create competitiveness, and through establishing intangible assets to add up firm value and social benefit for the public.

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