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Corporate Social Responsibility and Technological Innovation

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ABSTRACT: This study examines the relation between corporate social responsibility (CSR) and firm innovation. We replicate and extend the work of Mao and Weathers (2019), who investigate employee treatment and innovation, and find that CSR has an incremental effect on innovation outcomes (measured as citation-weighted patent counts) beyond the documented effect of employee treatment. The CSR effect mostly comes from CSR strengths rather than concerns. This effect remains robust after we address potential endogeneity concerns using three identification strategies. We also find that the CSR effect exists only in situations of more effective board monitoring, stronger CEO leadership, and greater employee human capital, and is greater in complex firms. Our overall evidence is consistent with the argument that CSR enhances technological innovation as it helps firms develop internal resources and capabilities related to creative corporate culture, long-term orientation, and employee knowledge and skills that are critical and conducive to innovation success.

JEL Classifications: M14; O31.

Keywords: corporate social responsibility; innovation; internal capabilities; patent.

I. INTRODUCTION

Corporate social responsibility (CSR) is one of the most important factors that have been shaping business practices. In recent decades, a growing number of U.S. firms have devoted substantial resources to CSR initiatives (Porter and Kramer 2006). Yet, how pursuing CSR helps advance firms' economic success remains an ongoing debate. Not only do theoretical arguments differ on whether CSR benefits business (e.g., Freeman 1984; Friedman 1962), but empirical studies also provide mixed evidence on the relation between CSR and firm performance (e.g., Malik 2015; McWilliams and Siegel 2000; Hull and Rothenberg 2008). Due to the complexity of the underlying mechanisms and intervening variables in the relation between CSR and firm performance, researchers call for more studies on the specific benefits CSR has that contribute to firm value (Servaes and Tamayo 2013; Hull and Rothenberg 2008; Branco and Rodrigues 2006). Given the significant role of innovation in firms' long-term value creation, this study explores the innovation benefits of CSR to provide insights as to how CSR furthers economic success.

Conceptually, CSR is closely related to long-term growth and sustainable development, which concurs with the objectives of corporate innovation. Researchers have long argued that addressing social and environmental concerns and anticipating future changes in the related issues provide opportunities for companies to develop innovative methods, processes, and

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products and services (Asongu 2007; Fombrun and Gardberg 2000; Stigson 2002; Husted and Allen 2006). Business leaders and observers echo this view by pointing out that CSR means continuously looking at innovation and improvement, and a CSR leader is more likely to become an innovation leader (Deloitte 2012; Capozucca and Sarni 2012). Tracking CSR initiatives of 30 large corporations, Nidumolu, Prahalad, and Rangaswami (2009) find that "sustainability is a mother lode of organizational and technological innovations" and represents innovation's new frontier. Despite the sound intuition and the prevalence of anecdotes, systematic empirical evidence is limited on whether CSR promotes technological innovation.

In a related study, Mao and Weathers (2019; hereafter, MW) examine the effect of employee treatment, one of the aspects of CSR, on innovation. We first replicate their work, and then extend it along four dimensions. First, we take a broader view of CSR and draw on the resource-based view of the firm (RBV) to establish a theoretical link between CSR and innovation by arguing that CSR helps firms develop internal resources and capabilities related to creative corporate culture, long-term orientation, and employee knowledge and skills that are conducive to innovation success. MW's theoretical constructs center on employee treatment, and they use items in the MSCI KLD ESG (KLD) database that are related to employee treatment as empirical proxies. Specifically, they combine 16 items from four dimensions: six from employee relations, eight from community, one from diversity, and one from product. Since our theoretical constructs focus on firms' preferences and attitudes toward stakeholder engagement as well as environmental and social issues, we use all items in the dimension of employee relations, community, diversity, and environment.[1] We first replicate their work and find that their employee treatment measures are positively related to citation-weighted patent counts, our measure of technological innovation. We then find that our CSR measure has an incremental effect on firm innovation beyond that of employee treatment.

Second, as common in accounting research, endogeneity can complicate the interpretation of the effect of CSR or employee treatment on innovation. MV address endogeneity concerns using a two-stage least squares (2SLS) regression with the state-level noncompete enforceability index and an indicator of blue states as instrumental variables (IVs). We employ three identification strategies: (1) a propensity-score matching (PSM) approach to control for endogenous self-selection arising from observable factors and the effect of nonlinear terms of these factors; (2) a 2SLS regression using the average CSR score in the same state, the same industry (excluding the firm itself), and local political corruption as IVs; and (3) a difference-in-differences (DiD) estimation using the initiation of CSR rating as an exogenous shock to CSR performance to address possible reverse causality. We refrain from using the two IVs in MW because these IVs may not satisfy the exclusion condition by affecting innovation through multiple channels (Samila and Sorenson 2011; Conti 2014; Jost, Glaser, Kruglanski, and Sulloway 2003). Our DiD estimation is built on the work of Chatterji and Toffel (2010)—firms initially rated poorly on social performance by the rating agencies subsequently achieve greater improvements than those rated more favorably to protect reputation and public image. Admittedly, it is impossible to completely resolve the endogeneity issues even if we attempt different identification strategies and obtain consistent results across these approaches.

Third, pursuing CSR is not without cost as CSR activities consume corporate resources that would otherwise be allocated to generating profit for shareholders (Friedman 1962). Although CSR can benefit shareholders (Malik 2015), not all firms can internalize these benefits (Barnea and Rubin 2010; Kitzmueller and Shimshack 2012). Thus, it is important to identify the contextual situations in which firms are more likely to reap innovation benefits from investing in CSR. We perform various cross-sectional analyses to explore such situations, which are absent in MW. Specifically, we find that the effect of CSR on innovation exists only in situations of more effective board monitoring, stronger CEO leadership, and greater employee human capital, and is greater in more complex firms.

Last, MW select 13 strength indicators and three concern indicators to construct their employee treatment index. We include all strength and concern indicators from the four dimensions to create the CSR measure and then decompose it into a strength measure and a concern measure. This approach allows us to further identify the mechanisms through which CSR affects innovation, as CSR strengths and concerns map different aspects—CSR strengths reflect a firm's strategies, initiatives, and programs to address social and environmental issues and CSR concerns largely catch negative CSR events (Di Giuli and Kostovetsky 2014; Mattingly and Berman 2006). We find innovation outcomes are primarily driven by CSR strengths, suggesting it is the proactive CSR policies and actions that tend to foster a creative culture and long-term thinking.

Our study makes contributions to the CSR literature in several ways. First, we replicate and extend a recent study and find that CSR has an incremental effect on innovation above that of employee treatment. Second, by documenting a beneficial role of CSR in improving firms' innovation outcomes, we show that CSR initiatives, while primarily intended for promoting the social good, can create firm value in the long run through improving innovation outcomes, which provides insights to the ongoing debate on whether and in what ways CSR benefits shareholders. Third, we identify several contextual situations in which CSR is more likely to provide innovation benefits, advancing our understanding of the internalization of CSR benefits.

[1] We do not include the product dimension for two reasons: (1) it contains a number of items that are outside the scope of CSR (Lins, Servaes, and Tamayo 2017), and (2) some items, such as R&D/innovation used by MW, are mechanically related to innovation.

Last, we find that CSR strengths and concerns affect innovation asymmetrically—it is primarily CSR strengths that matter for corporate innovation. By contrast, Bhattacharya and Sen (2004) find that outsiders are more sensitive to negative corporate behavior (CSR concerns), suggesting that CSR strengths and concerns may affect firms' internal decisions and market participants' responses differently.

Our study also adds to the literature on corporate innovation by documenting an important strategy to enhance firm innovation advantage. Researchers have long searched for various factors that drive corporate innovation. Many studies examine external factors such as legal, institutional, and market forces and environments that help firms overcome obstacles to innovation.[2] While these factors are important in shaping firms' incentives to pursue innovation, they are generally external and beyond firm control. Our findings are of interest and have important managerial implications in that pursuing CSR falls within the realm of managerial decisions and can be strategized by the firm.

II. LITERATURE AND HYPOTHESIS

Related Literature and Theory

Researchers argue that CSR is a source of opportunity, innovation, and competitive advantage, and pursuing CSR should make a firm more innovative (Husted and Allen 2006; Asongu 2007; Fombrun and Gardberg 2000; Stigson 2002). Asongu (2007) highlights the importance of CSR for innovation by adding innovation as a valid argument for justifying CSR along the lines of four traditional arguments—moral obligation, sustainability, license to operate, and reputation. However, as pointed out by Asongu (2007), the innovation argument has not yet received the level of attention it deserves.

A theoretical link between CSR and innovation can be established by drawing on the theory of RBV. RBV presumes that firms are heterogeneous, with each firm possessing a unique set of tangible and intangible resources and capabilities, generally referred to as internal attributes (Barney 1991). If these resources are rare, are valuable, and cannot be easily copied and substituted by other firms, they constitute a firm's sustainable competitive advantage. RBV has been adopted as a fundamental theoretical basis for studying internal factors that drive firm competitive advantage. For example, the entrepreneurship literature utilizes RBV to analyze and test internal factors that drive technological innovation. Specifically, Del Canto and Gonzalez (1999) distinguish financial, physical, and intangible resources and conclude that intangible resources that are embodied in people and organizations are the main determining factors for firms to carry out R&D activities.

Scholars also apply the RBV framework to CSR to understand why firms pursue CSR. Hart (1995) asserts that certain types of firms invest in environmental social responsibility because this helps them develop and maintain a competitive advantage. Branco and Rodrigues (2006) provide a broader elaboration on why firms pursue CSR, and affirm that CSR provides internal benefits, or external benefits, or both, where internal benefits are generally associated with corporate culture, know-how, and employee skills while external benefits are related to corporate reputation and a trusting relationship with external stakeholders. It is these specific benefits that put a firm in an advantageous position and represent the true value of CSR. Some studies test the RBV theory by relating firm-level social performance to accounting profitability (e.g., Russo and Fouts 1997). Still, it is suggested that a clearer validation of the theory requires focus on intermediate influences (such as innovation) that can lead to such performance (Ray, Barney, and Muhanna 2004).

Hypothesis

Innovation is usually required to address societal or environmental problems. CSR consists of such elements as lowering product and process environmental impacts and offering products that meet a particular social need (e.g., McWilliams and Siegel 2001; Porter and Kramer 2006). These social- and environment-friendly outcomes do not come automatically or easily but require innovative ideas, approaches, and solutions. Firms must generate new products, redesign current offerings, create and utilize new materials, develop lower-cost methods, reengineer processes for production, and so on (Bansal 2005; McWilliams and Siegel 2001). All these help firms develop technological know-how and enhance employee knowledge and skills.

In addition, serendipitously seeking imaginative new methods to address environmental and social issues builds a capacity for creativity and problem solving (Branco and Rodrigues 2006) as well as experimentation and trial-and-error processes (Glavas and Piderit 2009). This mode can spread throughout the organization to promote a common internal language and information-sharing routines (Howard-Grenville and Hoffman 2003). Also, both CSR and innovation focus on longer time

[2] Specifically, prior studies find that the following external factors have implications for corporate innovations: institutional investors (Aghion, Van Reenen, and Zingales 2013), analyst coverage (He and Tian 2013), laws and regulations (Atanassov 2013; Fan and White 2003; Armour and Cumming 2008; Acharya, Baghai, and Subramanian 2014; Atanassov and Liu 2020), and market forces (Dang and Xu 2018; Fang, Tian, and Tice 2014; Hsu, Tian, and Xu 2014).

horizons by incurring immediate costs while awaiting future benefits (Wang and Bansal 2012). Such a mindset that emphasizes long-term growth over myopic benefits is crucial to the success of innovation (Manso 2011). With a creative culture and constant vigilance for innovative opportunities, firms can identify new types of products and services that are not related directly to social purposes but may not have occurred without CSR initiatives to influence the corporate culture.

DuPont and Toyota are the cases in point. Considering the social and environmental impacts of its operations, DuPont bases its business model on innovation driven by science and technology and develops innovative processes to reduce greenhouse gas emission and energy consumption throughout its business (Asongu 2007). Similarly, concerned with exhaust emissions, Toyota developed an innovative model, the Prius, a hybrid electric/gasoline vehicle that emits as little as 10 percent of the harmful pollutants conventional vehicles produce, while it consumes only half as much gas. Prius has given Toyota such a substantial lead that other car makers are licensing the technology (Porter and Kramer 2006).[3]

In addition, CSR enhances human resource management and results in a skilled and dedicated workforce that paves the way for innovation to take place. Firms reputed for CSR undertakings are more able to attract and recruit high-quality employees (Peterson 2004). By facilitating good employee relations, CSR can also energize their motivation, morale, commitment, and loyalty, and induce long-term human capital investment with the firms (Turban and Greening 1997; Greening and Turban 2000). For example, Balakrishnan, Sprinkle, and Williamson (2011) find that corporate giving ameliorates employment contracting frictions and promotes desired behaviors from employees. MW argue and find that employee treatment, an aspect of CSR practice, affects firm innovation by fostering employees' desire to invest in the long-term growth of the firm.

Creative culture, long-term orientation, communication and coordination, and human capital are important ingredients for the success of innovation. Carayannis, Samara, and Bakouros (2014) list organizational, administrative, and institutional problems as major obstacles to innovative activities. Wakelin (1998) argues that the tacit, specific, and noncodifiable nature of technology makes informal mechanisms of developing innovative capabilities through enhancing core competencies that are embodied in people and organizations more preferable. Because CSR helps firms develop these internal resources and capabilities, we propose the following hypothesis:

H1: CSR is positively related to corporate innovation outcomes.

While we focus on one of the benefits of pursuing CSR, there are potential costs associated with the undertakings. Shareholder theory proposed by Friedman (1962) maintains that CSR activities consume corporate resources that would otherwise be allocated to generating profit for shareholders. As in most studies in the CSR literature reviewed by Malik (2015), we argue that CSR initiatives, while intended for promoting the social good, can benefit shareholders.[4] Specifically, firms delegate financial resources to CSR to benefit society, which generates intangible resources and capabilities that are critical to corporate innovation. However, not all firms can internalize these benefits. For example, self-interested managers may overinvest in CSR to build their personal reputation or to entrench themselves (Barnea and Rubin 2010; Kitzmueller and Shimshack 2012). Also, a firm may lack the strong leadership and effective workforce to systematically integrate CSR into its core business strategies (Porter and Kramer 2006). Furthermore, complex firms that tend to rely on formal and financial types of controls to manage and coordinate innovative activities may benefit more from CSR-facilitated corporate culture (Del Canto and Gonzalez 1999). Thus, we conduct four cross-sectional analyses in our empirical tests to identify the contextual situations in which CSR has a stronger effect on innovation. Specifically, we examine whether board monitoring, CEO leadership, human capital, and firm complexity make firms better internalize the benefits of CSR investment.

III. DATA, VARIABLES, AND MODEL

Data and Sample

We collect financial data from Compustat and CSR ratings data from the KLD database. Starting from 1991, KLD assessed firms' CSR performance with a binary indicator (either 0 or 1) along seven dimensions: community, diversity, employee relations, environment, human rights, product, and corporate governance. We collect innovation output data (patents and citations) from three sources: (1) the National Bureau of Economic Research (NBER) Patent Citation database,[5] (2) the Harvard

[3] In a dramatic move aimed at expanding the market and meeting challenges from all-battery electric cars, Toyota decided in April 2019 to give global automakers free access to its nearly 24,000 hybrid-vehicle patents through 2030. Hybrid vehicles now account for some 3 percent of all vehicles sold worldwide, and Toyota manufactures around 80 percent of the hybrid vehicles.

[4] Firms may pursue CSR for other strategic reasons. For example, Jia, Gao, and Julian (2020) find that firms engage in CSR undertakings to insure against stock price risk arising from short selling threats.

[5] Please find the dataset at https://data.nber.org/patents/

TABLE 1

Sample Selection

	Attrition	Remaining Obs.
Number of Observations in Compustat from 1991 to 2007		114,479
Exclude Observations in Industries with No Patents Granted	(2,837)	111,642
Exclude Observations with Missing Information on Firm Size, Return on Assets, Leverage, Capital Expenditure, Property, Plant, and Equipment, Intangible Assets, Cash Holdings, WWIndex, Book-To-Market Ratio, Firm Age, and State of Location	(40,875)	70,767
Exclude Observations without Data on CSR	(59,699)	11,068
Final Sample		11,068

Business School (HBS) patent and inventor database,[6] and (3) patent and citation data provided by Kogan, Papanikolaou, Seru, and Stoffman (2017) (hereafter, KPSS).[7] The NBER patent dataset, created by Hall, Jaffe, and Trajtenberg (2001), provides annual data on patent assignee name, number of patents, number of citations received by each patent, technological class of patent, year of patent application filing, and year of patent granting. Only patents that have been granted are included in the dataset. The NBER dataset contains patents granted from 1976 to 2006. Since it typically takes two years for a patent application to get approved, patents that were applied for in 2005 and 2006 were likely pending review as of 2006 and did not yet appear in the dataset. Thus, the dataset likely covers patents that were applied for before 2005.[8] As shown in Appendix A, among patents that were granted by 2006, 46,800 were applied for in 2003, 23,676 in 2004, 6,260 in 2005, and 280 in 2006. The HBS and the KPSS datasets cover patents that were granted up to 2010 and these patent applications were likely filed before 2009 (i.e., 2008 is probably the latest year for the application of patents that were included in the datasets). We use these two datasets to supplement the NBER data.[9]

Our sample period for firm-year observations spans from 1991 to 2007. We measure innovation outcome based on the year in which a patent was applied for (application year), as it is closer to when the actual innovation occurred than the grant year (Griliches, Pakes, and Hall 1987). Because we relate CSR data at year t to innovation data at year $t+1$, we require data availability on patents whose applications were filed between 1992 and 2008.

Our sample selection starts with 114,479 firm-year observations in Compustat from 1991 to 2007 (excluding firms in the financial and utility industries, as they are subject to different regulatory rules). Since not all industries patent their innovation, we follow Hirshleifer, Low, and Teoh (2012) and exclude firms in any four-digit SIC industries that have no patents between 1976 and 2010. We are left with 111,642 observations. We then remove observations with missing values on firm size, return on assets, leverage, market-to-book ratio, cash holdings, financial constraint index, capital expenditure, firm age, property, plant, and equipment, intangible assets, industry competition, and state of location, which reduces the sample to 70,767 observations. Last, we require data availability on CSR. Our final sample includes 11,068 firm-year observations from 2,403 distinct firms. Table 1 details the sample selection process.[10] To reduce sample selection bias, we follow the innovation literature and include all firms with and without patent information. For firm-years without patent data, we set patents and citations to zero.

[6] Please find the dataset at https://dvn.iq.harvard.edu/dvn/dv/patent

[7] Please find the dataset at https://github.com/KPSS2017/Technological-Innovation-Resource-Allocation-and-Growth-Replication-Kit

[8] If a firm filed a patent application in 2005 and the patent was not granted in 2006, it would not be included in the dataset.

[9] The HBS dataset has no identifier, so we are unable to link it with Compustat for independent analysis. We thus use its citations data points to update the NBER citations up to 2010. For example, if a patent was granted in 1996 with the number of citations being 40 by 2006 based on the NBER data, we will update its citations to 50 if the HBS data show that it received citations of 50 as of 2010. We then use the KPSS dataset to update patents applied for up to 2008 (with 2010 as the grant year). To sum up, we use the NBER dataset for patents applied for before 2003 (with updated citations up to 2010 from the HBS dataset) and the KPSS dataset for patents applied for from 2003 to 2008. Appendix A presents comparisons of patents applied for and granted between the NBER data and the KPSS data. Generally, the coverages of the two datasets are similar. We choose the NBER dataset as the basis dataset because it was extensively used in prior studies on innovation (for the sake of comparability with the extant literature) and it contains truncation adjustment factors.

[10] The yearly distribution of our sample is as follows: 193 (1991); 198 (1992); 197 (1993); 199 (1994); 237 (1995); 251 (1996); 248 (1997); 263 (1998); 269 (1999); 289 (2000); 486 (2001); 551 (2002); 1,500 (2003); 1,568 (2004); 1,550 (2005); 1,543 (2006); and 1,526 (2007).

Measuring Corporate Social Responsibility

We operationalize the CSR construct as the CSR ratings score from KLD. Following prior studies (Lins et al. 2017; Gao, Lisic, and Zhang 2014; Kim, Park, and Wier 2012), we exclude the governance, human rights, and product dimensions in calculating the CSR score. Corporate governance is quite a distinct construct from CSR. In addition, different components of the KLD governance dimension may produce ambiguous effects on innovation, although conceptually corporate governance should have a positive effect on innovation. For example, KLD considers high managerial compensation as a concern and high reporting quality as a strength. Prior studies find that high managerial compensation can motivate risk taking and thus promote innovation (Sheikh 2012) and accounting conservatism, often viewed as an indicator of high reporting quality, may actually dampen firm innovation (Chang, Hilary, Kang, and Zhang 2015). There is little variation in the human rights dimension given that almost 95 percent of the firm-years have zero values. The product category contains a number of elements outside of the scope of CSR, such as product strategy and innovation (Lins et al. 2017), and these elements can cause a mechanical relation between CSR and innovation. Thus, our CSR measures include four KLD dimensions: community, diversity, employee relations, and environment.

Although KLD maintains consistent standards in assessing strengths and concerns, the number of strengths and concerns for most dimensions varies each year. For example, the community dimension had four strengths and four concerns from 1991 to 1993, and KLD started to add two more strengths—“support for education” and “non-US charitable giving”—in 1994, which brought the total number of strengths to six in 1995. Given the changes over years, a simple summation of strengths and concerns each year may result in different weights across the years. To avoid this issue, we scale the firm strength (concern) score for each dimension by the number of strengths (concerns) in the same dimension each year to ensure comparability. We thus obtain a net CSR score, referred to as *CSR,* as the difference between the adjusted strength score and the adjusted concern score. We obtain similar results if we use raw CSR score (total strengths minus total concerns).[11]

Measuring Innovation Outcomes

To assess whether CSR undertakings promote firms' overall innovation productivity, we focus on innovation output measured as citation-weighted patent counts (i.e., the number of patents applied for in a given year multiplied by the counts of citations they receive). This measure captures both the quantity and quality of innovation outcome (Hall et al. 2001; Trajtenberg 1990).[12] Patent citations are made over time and thus earlier patents in general have higher citation counts than later ones. Hall et al. (2001) find that 50 percent of the citations are made to patents at least ten years older than the citing patent. This demonstrates that patents have long-term value.

To correct for the truncation bias arising from citation lag, we employ the year fixed effects method—dividing the number of citations for a patent in a year by the average number of citations received by all patents in that year in the same three-digit technology class. This method gives us an adjusted measure of patent citations that accounts for the trend in innovative activities in a particular industry. Given the right-skewed distribution of citation-weighted patent counts, we take the natural logarithm transformation and denote the variable as *Cit_Weighted_Pat*. In robustness checks, we also use the quasi-structural method to correct for the truncation bias by multiplying each patent's citations by an index, created by estimating the shape of the citation-lag distribution, from the NBER patent database.

Regression Model

To examine the effect of CSR on innovation outcome, we estimate the following regression model:

$$
\begin{aligned}
Cit\_Weighted\_Pat_{t+1} = {} & \beta_0 + \beta_1 CSR_t + \beta_2 SIZE_t + \beta_3 BTM_t + \beta_4 ROA_t + \beta_5 Cash_t + \beta_6 WWIndex_t + \beta_7 PPENT_t \\
& + \beta_8 Intangible_t + \beta_9 Leverage_t + \beta_{10} Capex_t + \beta_{11} AGE_t + \beta_{12} HHIndex_t + \beta_{13} Acquisition_t \\
& + \beta_{14} InstShares_t + \beta_{15} R\&D_t + Industry\ fixed\ effects + Year\ fixed\ effects \\
& + State\ of\ location\ fixed\ effects + \varepsilon_{t+1} \qquad (1)
\end{aligned}
$$

where the dependent variable $Cit\_Weighted\_Pat_{t+1}$ is the natural logarithm of one plus citation-weighted patent counts. Our variable of interest is CSR_t, on which a significant positive coefficient is expected to be consistent with our hypothesis. We

[11] For example, if a firm has two strengths and one concern in the community dimension in 1995, the raw CSR score is 1 (2 – 1 = 1) and the adjusted CSR score is 2/6 – 1/4 = 1/12, where 6 is the total number of community strengths and 4 is the total number of community concerns.

[12] Hall, Jaffe, and Trajtenberg (2005) argue that self-citations reflect less need of external acquisition of technology and lower risk of rapid entry by competitors. Because self-citations represent strong competitive advantages and are more valuable than external citations, we include self-citations in measuring the value of patents. However, our results remain qualitatively unchanged if we exclude self-citations.

relate CSR in the current year (t) to innovation output one year after (t+1) to account for time it takes for innovative efforts to bear fruit.

We control for various factors that could affect a firm's innovation outcome. Because firms with greater financial resources more likely engage in both CSR and innovative activities, we account for the effect of firm financial strength by including firm size (*SIZE,* estimated as the natural logarithm of sales), accounting performance (*ROA,* estimated as net income before extraordinary items scaled by total assets), leverage (*Leverage,* estimated as total debts divided by total assets), cash reserves (*Cash,* estimated as cash and cash equivalent divided by total assets), and financial constraint (*WWIndex,* estimated as the Whited and Wu [2006] index) as controls. Firm size can also be a proxy for complexity, which affects the importance of culture in facilitating innovative activities. Management of high quality may be good at strategically pursuing CSR and promoting innovation, and we include the book-to-market ratio (*BTM*) to control for management quality. We also control for asset structure, physical capital investment, firm life cycle, and industry competition by including the ratio of physical assets to total assets (*PPENT*), intangible assets to total asset ratio (*Intangible*), capital expenditure to total asset ratio (*Capex*), firm age (*AGE*), and the Herfindahl-Hirschman index (*HHIndex*).

Prior studies find that firms make innovation-oriented acquisitions to enhance innovation performance (e.g., Zhao 2009). Other studies find that superior CSR performance helps complete acquisitions (e.g., Deng, Kang, and Low 2013). To capture the effect of mergers and acquisitions, we control for an indicator of acquisitions (*Acquisition*), which equals one if a firm engages in mergers and acquisitions in the past three years. Acquisitions can also proxy for firm sophistication. We collect acquisitions data from the Mergers and Acquisitions Database of the Securities Data Company (SDC). As institutional shareholders can affect both CSR (Chen, Dong, and Lin 2020) and innovation (Aghion, Van Reenen, and Zingales 2013), we include the percentage of institutional shareholdings (*InstShares*) in the regression. We obtain institutional ownership data from Thomson Reuters Stock Ownership. R&D expenditure represents innovation input, and we control for *R&D* to extract the effect of CSR on innovation efficiency. To reduce the influence of outliers, we winsorize all continuous variables at the 1st and 99th percentiles. Robust standard errors are adjusted for clustering at the firm level. Detailed variable definitions are presented in Appendix B.

We also control for time-invariant industry factors by including industry indicators based on the two-digit SIC codes. This control is important because industries may differ in patenting practice and citing propensity as well as preference in pursuing CSR. We also control for aggregate time effects because there appears to be an upward trend in the number of patents granted during the past decades. Last, we control for state-of-location fixed effects, considering that variations in political orientation, religious beliefs, and state anti-takeover legislation can have implications for CSR pursuits and/or innovation activities, and there may exist a geographical spillover effect on CSR and innovation (Bottazzi and Peri 2003; Di Giuli and Kostovetsky 2014).

IV. PRIMARY EMPIRICAL RESULTS

Summary Statistics

Panel A of Table 2 presents summary statistics of all variables used in our main analyses for the full sample. On average 20 patents are granted to each firm every year, while the number of citation-weighted patent counts is 32. These statistics are generally in line with prior studies (e.g., Hirshleifer et al. 2012). The mean value of *CSR* is −0.027 for the entire sample period, and we find that the average CSR score is positive from 1991 to 2002 and turns negative from 2003 with the expansive coverage of KLD. Our control variables are also consistent with prior studies (e.g., Mao and Weathers 2019).

To visualize how firms with good CSR performance differ from those without, we partition the sample into two subsamples based on whether a firm has a positive CSR score. Comparison results of the two subsamples are reported in Panel B of Table 2. The average number of granted patents is 36.369 (12.336) for firms with positive (negative) CSR score, and the corresponding number of citation-weighted patent counts is 62.440 (17.416). These differences are statistically significant, providing preliminary evidence that firms with good CSR ratings are more innovative than firms that score low in CSR performance.

In addition, relative to negative-CSR firms, positive-CSR firms are larger, older, more profitable, less financially constrained, and have greater growth opportunities, lower cash balances, lower leverage, and lower institutional shareholdings. The mean value of R&D for positive-CSR firms is lower than that for negative-CSR firms although the median is higher, suggesting that firms pursuing CSR do not necessarily invest more in R&D than their less CSR-leaning counterparts. Positive-CSR firms have higher capital expenditure than negative-CSR firms. These disparate firm features suggest that socially responsible firms differ systematically from firms with poor CSR performance. To isolate the effect of CSR on innovation, we account for these differences by controlling for time-varying firm and industry factors and by using the propensity-score matching approach.

TABLE 2

Descriptive Statistics

Panel A: Full Sample

Variable	# of Obs.	Mean	Median	Std. Dev.	25th	75th
Pat_{t+1}	11,068	20.209	0.000	68.485	0.000	6.000
$Cit\_Weighted\_Pat_{t+1}$	11,068	32.166	0.000	179.812	0.000	5.088
CSR_t	11,068	−0.027	0.000	0.280	−0.200	0.125
$SIZE_t$	11,068	6.994	7.005	1.721	5.859	8.133
BTM_t	11,068	0.415	0.364	0.271	0.229	0.552
ROA_t	11,068	0.042	0.054	0.104	0.019	0.091
$Cash_t$	11,068	0.177	0.092	0.204	0.027	0.256
$WWIndex_t$	11,068	−0.347	−0.343	0.087	−0.407	−0.281
$PPENT_t$	11,068	0.271	0.213	0.218	0.099	0.386
$Intangible_t$	11,068	0.167	0.104	0.178	0.020	0.263
$Leverage_t$	11,068	0.209	0.191	0.185	0.030	0.321
$Capex_t$	11,068	0.056	0.039	0.053	0.022	0.071
AGE_t	11,068	2.972	2.944	0.708	2.398	3.664
$HHIndex_t$	11,068	0.080	0.051	0.067	0.041	0.085
Acquisition	11,068	0.288	0.000	0.453	0.000	1.000
InstShares	11,068	0.565	0.651	0.339	0.349	0.825
$R\&D_t$	11,068	0.112	0.007	0.439	0.000	0.066

Panel B: Comparisons Between Firms with Positive and Negative CSR

	$CSR > 0$ (n = 3,626)		$CSR <= 0$ (n = 7,442)		Difference Tests (t-stat.)	
Variable	**Mean**	**Median**	**Mean**	**Median**	**t-test**	**Wilcoxon Test**
Pat_{t+1}	36.369	1.000	12.336	0.000	14.48	18.67
$Cit\_Weighted\_Pat_{t+1}$	62.440	0.000	17.416	0.000	9.58	18.96
CSR_t	0.269	0.198	−0.171	−0.143	103.75	85.96
$SIZE_t$	7.526	7.544	6.735	6.739	22.68	22.97
BTM_t	0.376	0.320	0.434	0.388	−10.87	−12.70
ROA_t	0.055	0.063	0.035	0.050	9.94	12.15
$Cash_t$	0.172	0.096	0.179	0.090	−1.83	0.78
$WWIndex_t$	−0.374	−0.376	−0.333	−0.329	−23.27	−23.01
$PPENT_t$	0.271	0.225	0.271	0.205	−0.03	2.94
$Intangible_t$	0.165	0.105	0.168	0.103	−0.95	0.79
$Leverage_t$	0.205	0.191	0.211	0.191	−1.83	−0.08
$Capex_t$	0.058	0.043	0.056	0.037	2.18	7.18
AGE_t	3.115	3.178	2.902	2.833	15.09	15.10
$HHIndex_t$	0.073	0.049	0.084	0.055	−8.10	−11.71
Acquisition	0.317	0.000	0.273	0.000	0.98	0.08
InstShares	0.531	0.621	0.582	0.667	−7.38	−8.13
$R\&D_t$	0.103	0.014	0.117	0.005	−1.69	6.95

This table reports summary statistics for a sample of 11,068 firm-year observations from 1991 to 2007 in Panel A and the comparison between firms with positive CSR score and firms with negative or zero CSR score in Panel B.
Variables are as defined in Appendix B.

Baseline Regressions

To distinguish whether the effect of CSR on innovation works through more innovation input or greater innovation efficiency, we estimate Equation (1) by first excluding R&D expenditure and then including R&D expenditure and report the estimated results in Table 3. In column 1, we do not include R&D, thus the coefficient on CSR captures the impact of CSR on

TABLE 3

Corporate Social Responsibility and Innovation Outcomes

	$Cit\_Weighted\_Pat_{t+1}$			
Variable	**(1)**	**(2)**	**(3)**	**(4)**
CSR_t	0.561***	0.543***		
	(4.39)	(4.28)		
CSR_{t-1}			0.510***	
			(3.64)	
CSR_Str_t				1.098***
				(5.68)
CSR_Con_t				0.135
				(0.93)
$SIZE_t$	0.332***	0.375***	0.395***	0.325***
	(9.34)	(10.14)	(8.56)	(8.81)
BTM_t	−0.394***	−0.348***	0.113***	−0.323***
	(−4.76)	(−4.24)	(4.84)	(−3.91)
ROA_t	−1.060***	−0.454*	−0.719**	−0.276
	(−4.54)	(−1.94)	(−2.48)	(−1.23)
$Cash_t$	0.894***	0.701***	0.619**	0.615***
	(4.08)	(3.17)	(2.37)	(2.78)
WWIndex	−2.746***	−2.109***	−2.402***	−1.752***
	(−4.24)	(−3.30)	(−2.82)	(−2.84)
$PPENT_t$	−0.424	−0.401	−0.356	−0.459
	(−1.26)	(−1.20)	(−0.92)	(−1.38)
$Intangible_t$	−0.363	−0.369	−0.370	−0.331
	(−1.42)	(−1.45)	(−1.26)	(−1.38)
$Leverage_t$	−0.209	−0.221	−0.109	−0.177
	(−1.31)	(−1.38)	(−0.62)	(−1.12)
$Capex_t$	2.349***	2.307***	2.019***	2.395***
	(4.10)	(4.04)	(2.91)	(4.18)
AGE_t	0.063	0.059	0.048	0.045
	(1.26)	(1.20)	(0.79)	(0.91)
$HHIndex_t$	4.251***	4.265***	4.861***	4.005***
	(2.98)	(2.99)	(3.27)	(3.15)
Acquisition	0.132***	0.127***	0.127***	0.135***
	(3.20)	(3.09)	(2.80)	(3.33)
InstShares	0.028	0.018	−0.024	0.058
	(0.32)	(0.21)	(−0.25)	(0.69)
$R\&D_t$		0.334***	0.355***	0.327***
		(5.18)	(4.42)	(5.10)
Constant	−3.598***	−3.719***	−4.283***	−3.424***
	(−11.65)	(−11.95)	(−11.71)	(−11.16)
Industry FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
State of Location FE	Yes	Yes	Yes	Yes
Observations	11,068	11,068	8,652	11,068
R^2	49.70%	50.02%	52.28%	50.85%

***, **, * Denote significance at the 1 percent, 5 percent, and 10 percent levels, respectively.

This table reports the results from the OLS regression of citation-weighted patent counts on CSR score and control variables. Column 1 does not include R&D expenditure. Column 2 includes R&D expenditure. Column 3 relates CSR to innovation output two years after (*t*+2). Column 5 relates CSR strengths and concerns to innovation output. In parentheses are t-statistics calculated based on standard errors that are clustered at the firm level. Variables are as defined in Appendix B.

innovation outcome through innovation input and innovation efficiency. As expected, the coefficient on CSR_t is positive and significant (coef. = 0.561, t = 4.39). For economic significance, a one-standard-deviation increase in CSR in an average firm is associated with a 15.71 percent increase in the total number of citation-weighted patents. In column 2, we control for R&D expenditure so that the coefficient on CSR captures the effect of CSR on innovation efficiency given the level of R&D spending. The significant positive coefficient on *R&D* is consistent with greater R&D input being associated with high innovation output. More importantly, we find a similar coefficient on CSR_t (coef. = 0.543, t = 4.28), suggesting that CSR impacts innovation outcomes mainly through improved R&D productivity rather than increased R&D activity. This does not support the financing explanation that high-CSR firms, with richer internal resources and greater access to external capital, invest more in R&D activities to boost innovation. The results provide support to H1.

Regarding the control variables, we find that larger firms, firms with higher growth options, and firms having greater financial resources are more innovative. We also find that firms with more capital expenditure generate greater innovation outcomes. Consistent with firms engaging in innovation-driven mergers and acquisitions, we find a positive relation between acquisitions and innovation outcomes. Because not all acquisitions lead to acquiring patents, we further create two granular variables to capture acquisition-related innovation: (1) the number of patents granted to public targets over the three-year period and (2) an indicator of acquiring private targets. Although we have no data on private targets' patents, prior studies suggest that acquiring private targets allows acquirers to gain early access to key technologies (Ransbotham and Mitra 2010). Untabulated results show both variables are significantly positively related to innovation. The coefficient on firm performance is negative, which appears consistent with prior studies, which document mixed evidence on the relation between performance and innovation (e.g., Atanassov 2013; Chang et al. 2015).

Considering the time it takes for firms to generate inventions, we also relate CSR performance to innovation output two years after (*t*+2). As shown in column 3, the coefficient on *CSR* remains positive and significant. We thus focus on innovation outcomes measured at *t*+1 to avoid losing observations, and designate column 2 as the baseline regression for the remaining analyses.

CSR Strengths and CSR Concerns

CSR strengths and concerns differ in feature and scope. CSR strengths generally reflect a firm's strategies, initiatives, and programs to address social issues; it is these proactive policies and actions that tend to foster a creative culture and long-term thinking (Di Giuli and Kostovetsky 2014; Mattingly and Berman 2006). CSR concerns, on the other hand, largely reflect negative CSR events which can harm stakeholders' trust of the firm. Thus, examining CSR strengths and concerns separately can further our understanding of the mechanisms through which CSR affects innovation. We measure CSR strengths (concerns) as the sum of adjusted strengths (concerns) score for the four social rating dimensions of the KLD data. We estimate Equation (1) by replacing *CSR* with *CSR_Str* and *CSR_Con* and report the results in column 4. The coefficient on CSR strengths is positive and significant (coef. = 1.098, t = 5.68) and the coefficient on CSR concerns is not significant (coef. = 0.135, t = 0.93). The overall results suggest that innovation outcomes are primarily driven by positive CSR policies and strategies. This is not surprising because the overarching philosophy of the policies and strategies to promote social good nurtures an innovative culture and an engaging workforce. To conserve space, we do not report the coefficients on control variables hereafter.

Replication and Extension of Mao and Weathers (2019)

With different research questions and theoretical constructs, MW combine employee-related items in the KLD data as their empirical proxies to examine the relation between employee treatment and innovation. In this section, we first replicate their work and then add our CSR measure to examine whether the CSR measure has an incremental effect. MW's primary employee treatment measure, *ETI,* is constructed by summing six items from employee relations, eight from community, one from diversity, and one from product. They also create three channel measures (*Failure Tolerance, Exploitation Protection,* and *Working Environment*) using different combinations of the 16 items used in *ETI.*[13]

To replicate their work (their Tables 2 and 3), we estimate Equation (1) by replacing CSR with *ETI* first and then *Failure Tolerance, Exploitation Protection,* and *Working Environment,* and report the estimated results in Table 4. In column 1, the coefficient on *ETI* is positive and significant, consistent with MW. In column 2, the coefficients on *Exploitation Protection,* and *Working Environment* are positive and significant and the coefficient on *Failure Tolerance* is positive but not significant. Thus,

[13] MW have 13,728 observations from 1995 to 2008 and we have 11,068 observations from 1991 to 2007. After considering three factors, our sample size is generally comparable to theirs. First, there are 787 observations from 1991 to 1994 that are in our sample but not in their sample. Second, there are 1,592 observations in 2008 that are in their sample but not in our sample. Third, we remove 2,837 observations in industries that have no patents from 1976 to 2010 (they did not).

TABLE 4

Replication and Extension of the Work of Mao and Weathers (2019)

	$Cit\_Weighted\_Pat_{t+1}$			
Variable	**(1)**	**(2)**	**(3)**	**(4)**
ETI_t	0.221***		0.101**	
	(5.47)		(2.35)	
$Failure\ Tolerance_t$		0.074		0.019
		(1.05)		(0.27)
$Exploitation\ Protection_t$		0.262***		0.133*
		(3.52)		(1.84)
$Working\ Environment_t$		0.265***		0.152**
		(4.23)		(2.20)
CSR_Str_t			0.724***	0.632***
			(3.25)	(2.81)
Control Variables	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
State of Location FE	Yes	Yes	Yes	Yes
Observations	11,068	11,068	11,068	11,068
R^2	50.71%	50.84%	51.13%	51.19%

***, **, * Denote significance at the 1 percent, 5 percent, and 10 percent levels, respectively.
This table replicates the work of Mao and Weathers (2019) in columns 1 and 2 and extends it in columns 3 and 4. *ETI* is MW's employee treatment index, which is the sum of 16 items from KLD including retirement benefits, cash profit sharing, workforce reduction, union relations, charitable giving, innovative giving, non-U.S. charitable giving, support for housing, support for education, other community strength, negative economic impact, other community concern, employee involvement, work/life benefits, other employee relations, and R&D/innovation. *Failure Tolerance* is the sum of the first three items, *Exploitation Protection* is the summation of the middle nine items, and *Working Environment* is the sum of the last four items. Control variables as in Table 3 are included but their coefficients are not reported for brevity. In parentheses are t-statistics calculated based on standard errors that are clustered at the firm level.
Other variables are as defined in Appendix B.

in general we can replicate MW results. Then we add our CSR measure to the regressions. To be comparable with MW's measures which consist mostly of CSR strengths (13 strengths and three concerns), we use our CSR strength measure (*CSR_Str*). As reported in columns 3 and 4, the coefficient on *CSR_Str* remains positive and significant, suggesting that our CSR measure has an incremental effect beyond that of employee treatment.

Propensity-Score Matching (PSM)

Firms may have different cost-benefit equations for investing in CSR. Those that choose to invest more can be systematically different in attributes from those that invest less. It is therefore possible that the differences in firm attributes that correlate with CSR decisions, rather than CSR *per se,* drive the relation between CSR and innovation. To ensure that our results are not marred by self-selection bias, we match firms based on a similar preference for investing in CSR and thus effectively control for endogenous self-selection effects arising from firm and industry factors. Given that the relation between innovation and firm attributes may not be linear, using PSM can also control for the effect of nonlinear terms of these attributes.

We first run a logit model to predict whether a firm will obtain a positive CSR score. Specifically, we model firms' CSR decisions as a function of all the control variables included in Equation (1) plus the average of CSR scores in the same state and the same two-digit SIC code industry excluding the firm itself (*State_Ind_CSR*) and local political corruption (*Corruption*). We measure local corruption as the yearly number of corruption convictions from each U.S. federal judicial district scaled by the population in the district.[14] We match each positive-CSR-score firm with a negative-CSR-score firm based on the propensity score (i.e., the predicted probability of $CSR > 0$). The search algorithm finds the propensity score closest to that of the positive-

[14] The convictions are for crimes such as bribery, extortion, election crimes, and criminal conflicts of interest. The conviction data are maintained by the U.S. Department of Justice's Public Integrity Section (PIN) at https://www.justice.gov/criminal/pin

TABLE 5

Corporate Social Responsibility and Innovation Outcomes: Propensity-Score Matching

Panel A: Covariate Balance Test

Variable	$CSR_t > 0$	$CSR_t <= 0$	t-stat (difference)
$State\_Ind\_CSR_t$	−0.013	−0.015	0.71
$Corruption_t$	0.302	0.305	−0.41
$SIZE_t$	7.216	7.268	−1.18
BTM_t	0.400	0.408	−1.15
ROA_t	0.047	0.046	0.44
$Cash_t$	0.176	0.170	1.22
$WWIndex_t$	−0.358	−0.361	1.63
$PPENT_t$	0.261	0.270	−1.56
$Intangible_t$	0.166	0.169	−0.56
$Leverage_t$	0.202	0.207	−1.09
$Capex_t$	0.055	0.056	−0.51
AGE_t	3.036	3.061	−1.30
$HHIndex_t$	0.074	0.076	−1.27
$Acquisition_t$	0.309	0.308	0.03
$InstShares_t$	0.551	0.542	1.04
$R\&D_t$	0.113	0.108	0.42

Panel B: Propensity-Score Matching Regression

	$Cit\_Weighted\_Pat_{t+1}$	
Variable	Coef.	t-stat
CSR_t	0.348***	2.94
Control Variables	Yes	
Industry FE	Yes	
Year FE	Yes	
State of Location FE	Yes	
Observations	5,632	
R^2	51.09%	

*** Denotes significance at the 1 percent level.
This table reports the results from the propensity-score matching approach. Panel A compares firms having positive CSR score with matched control firms having non-positive CSR score. The regression in Panel B includes all the control variables as in Table 3, but their coefficients are not reported for brevity. The t-statistics are calculated based on standard errors that are clustered at the firm level.
Variables are as defined in Appendix B.

CSR-score firm observation in the same year until the first decimal place. The control firm identified in this way has the same predicted probability of having a positive CSR score but in fact fails to meet social and environmental criteria (i.e., having a negative CSR score). This ensures that any resulting differences in outcomes (innovation) between the two groups of firms reflect CSR treatment effects rather than firm and industry characteristics that determine the choice of CSR investment.

The propensity-score matching produces 2,816 control firm-year observations, for a total matched sample of 5,632 observations (50.89 percent of the full sample). In addition, the matching appears effective in forming a balanced sample of treatment firms (firms with $CSR > 0$) and control firms (firms with $CSR \leq 0$), as the covariate balance test (Panel A in Table 5) indicates no significant differences in CSR-choice-related firm characteristics between the two groups. We apply the matched sample to the baseline specification and find that the coefficient on *CSR* (Panel B of Table 5) remains positive and significant (coef. = 0.348, t = 2.94). The results show that the effect of CSR on innovation is robust to controlling for self-selection bias.

TABLE 6

Corporate Social Responsibility and Innovation Outcomes: 2SLS

Variable	First-Stage CSR_t (1)	Second-Stage $Cit\_Weighted\_Pat_{t+1}$ (2)
$State\_Ind\_CSR_t$	0.236***	
	(3.90)	
$Corruption_t$	−0.025**	
	(−2.07)	
CSR_t		2.302***
		(4.09)
Control Variables	Yes	Yes
Industry FE	Yes	Yes
Year FE	Yes	Yes
Observations	10,534	10,534
R^2	19.60%	44.20%
Weak Identification Test:	Partial R^2 = 4.89%	
	Partial F-statistic F (2, 10534) = 270.74 Prob > F = 0.000	

***, ** Denote significance at the 1 percent and 5 percent levels, respectively.
This table reports the results from the two-stage least squares (2SLS) regression using the instrumental variable approach. Control variables as in Table 3 are included but their coefficients are not reported for brevity. In parentheses are t-statistics calculated based on standard errors that are clustered at the firm level.
Variables are as defined in Appendix B.

Two-Stage Least Squares Estimation

Given that the propensity-score matching addresses self-selection bias arising from observable firm and industry characteristics, we further tackle the potential endogeneity issue with the 2SLS estimation procedure. The purpose of the 2SLS estimation is to extract the exogenous variation in CSR using IVs in the first stage and then use the exogenous part of CSR in the second stage (the innovation regression). We use the average CSR score in the same state and the same industry (*State_Ind_CSR*) and local corruption (*Corruption*) as IVs. A firm generally follows its peer firms in CSR performance due to industry peer pressure and local spillover effect. Given that corruption contradicts the spirit of social responsibility, firms located in corrupt areas should be less likely to pursue CSR. Thus, these two variables satisfy the relevance requirement of IVs. They also satisfy the endogeneity requirement, as there is no economic rationale to suggest that they are related to firms' innovation outcomes.

In the first stage, we estimate an OLS regression of CSR on *State_Ind_CSR*, *Corruption*, and all the control variables in Equation (1) and obtain a predicted value of CSR score and use it in the second-stage regression. The results from the first stage are reported in the first column of Table 6. As expected, *State_Ind_CSR* and *Corruption* are significantly related to *CSR*. The instruments also pass the relevance test as the partial R^2 is 4.89 percent and the F-statistic from the joint test of excluded instruments is 270.74, higher than the critical F-value of 8.96 proposed by Stock, Wright, and Yogo (2002). We report the results from the second-stage regression in column 2. The coefficient on the predicted CSR score is positive and significant, suggesting that our results are robust to the control for CSR endogeneity using the IV approach.

The effectiveness of the 2SLS estimation critically depends on the quality of IVs. MW use the state-level noncompete enforceability index and an indicator of blue states as IVs. We refrain from using them because they may not satisfy the exclusion condition. Samila and Sorenson (2011) argue that the enforcement of noncompete covenants can impede innovation in at least three ways: (1) through the slowing of spillovers, (2) through the reduction of entrepreneurship, and (3) through the inefficient matching of employees to employers. They find that strong enforcement of noncompete agreements play a negative role in innovation. Conti (2014) argues that noncompete covenants can promote risky and high-potential technological activities because firms can reap the rewards of these activities. He finds that firms with noncompete protection are more likely to pursue risky R&D projects. Thus, it seems that noncompete enforceability can affect firm innovation through multiple channels. Political leaning, on the other hand, can also affect firm innovation potentially given that more conservative individuals (Red) are more risk averse and more liberal individuals (Blue) are more risk taking (Jost et al. 2003). That said, we acknowledge that our IVs may also suffer drawbacks.

Quasi-Natural Experiment

Our last identification strategy is to use the initial CSR ratings as an exogenous shock to firm CSR performance for a DiD analysis, which helps us further address endogeneity issues such as reverse causality and correlated omitted variables. Chatterji and Toffel (2010) argue that poor ratings assessed by independent agencies, like government disclosure regulations that require firms to disclose potentially embarrassing information, can prompt managerial actions to improve firm performance and ratings. They find that firms initially rated poorly on CSR subsequently achieve greater improvements than those first rated more favorably. The improvements in CSR, as the result of actions taken in response to the poor ratings, are driven by the initiation of the rating process unrelated to innovation *per se*. The initial coverage of firms by the rating agencies thus provides a quasi-natural experiment for us to establish a causal link from CSR to innovation. Cheng, Ioannou, and Serafeim (2014) employ this exogenous shock to test the causal relationship from CSR to firm access to finance.

To implement the DiD analysis, we use the year of 1991, in which KLD debuted CSR ratings, as the base year. We classify a firm as initially poorly rated (initial low CSR) if its initial CSR score is negative and as initially favorably rated (initial high CSR) if its initial CSR score is positive. We compare changes in innovation output from the three years leading up to the initial rating (i.e., 1989, 1990, and 1991) to those in the three years after the initiation (i.e., 1992, 1993, and 1994) between initial low CSR firms and initial high CSR firms. Specifically, we estimate the following regression model:

$$\begin{aligned} Cit\_Weighted\_Pat_{t+1} = {} & \beta_0 + \beta_1 After_t + \beta_2 InitialLowCSR_t + \beta_3 After * InitialLowCSR_t + \beta_4 SIZE_t + \beta_5 BTM_t + \beta_6 ROA_t \\ & + \beta_7 Cash_t + \beta_8 WWIndex_t + \beta_9 + PPENT_t + \beta_{10} Intangible_t + \beta_{11} Leverage_t + \beta_{12} Capex_t \\ & + \beta_{13} AGE_t + \beta_{14} HHIndex_t + \beta_{15} Acquisition_t + \beta_{16} InstShares_t + \beta_{17} R\&D_t \\ & + Industry\ fixed\ effects + State\ of\ location\ fixed\ effects + \varepsilon_{t+1} \end{aligned} \quad (2)$$

where *After* is an indicator variable that takes the value of 1 for 1992, 1993, and 1994 and 0 for 1989, 1990, and 1991, and *InitialLowCSR* equals 1 for initial low CSR firms and 0 for initial high CSR firms. We do not include year fixed effects because they are perfectly correlated with, and thus fully absorbed by, the indicator *After*. In Equation (2), the point estimate of β_2 represents the difference in innovation output between initial low CSR firms and initial high CSR firms before the inception of the rating, and that of β_3 (the DiD estimator) captures the incremental changes in innovation output by initial low CSR firms relative to initial high CSR firms from the pre- to post-initial CSR rating period.

Consistent with Chatterji and Toffel (2010), we find that initially poorly rated firms achieve greater improvement in their CSR than initially favorably rated firms (Panel A in Table 7). Because it is unclear whether the initial low CSR firms that did not improve their CSR performance serve as treated or control firms, we exclude them in estimating Equation (2). We present the results in Panel B of Table 7. In column 1, the coefficient estimate on $After * InitialLowCSR$ is positive and significant at the conventional level, indicating initial low CSR firms achieve greater innovation output than initial high CSR firms from the pre- to post-initial CSR rating period. The coefficient on *InitialLowCSR* is insignificant, suggesting there is no pre-treatment effect. The coefficient on *After* is negative and significant, suggesting a downward trend in patent counts for control firms. We further conduct an F-test on the sum of *After* and $After * InitialLowCSR$ and find that it is marginally significant, suggesting that initial low CSR firms experience an increase in innovation in the subsequent years. We obtain similar results if we drop the indicator *After* and include year fixed effects. The overall evidence suggests that the exogenous shock to firm CSR performance by the initial rating coverage leads to improved innovation outcomes. One caveat of using initial CSR rating as a quasi-experiment is that the treatment assignment is non-random as it would be in a "perfect" DiD analysis. Thus, the causal relation from CSR to innovation should be interpreted with caution.

V. CROSS-SECTIONAL ANALYSES

To explore contextual situations in which firms can better internalize CSR benefits, we conduct four cross-sectional analyses. Specifically, we examine whether the effect of CSR on innovation varies with board monitoring, CEO leadership, employee human capital, and firm complexity.

Prior studies find that managers may overinvest in CSR to enhance personal prestige and cover up misbehavior (Friedman 1970; Hemingway and Maclagan 2004). This agency problem can be mitigated by board monitoring. Thus, we expect the positive impact of CSR on innovation to be greater in situations of more effective board monitoring. We measure board monitoring as a combination of the percentage of outside directors, director attendance, and director ownership. Specifically, we create a composite index by first ranking the three variables and then averaging the ranked values. We add this index (*Board*) and its interaction term with CSR to Equation (1) and report the estimated results in Table 8. Consistent with board monitoring improving the effect of CSR on innovation, we find that the coefficient on the interaction term is positive and

TABLE 7

Corporate Social Responsibility and Innovation Outcomes: Initial Rating Coverage as a Shock to CSR Performance

Panel A: Univariate Comparison

	Δ*CSR*
Initial Low CSR (n = 162)	0.026
Initial High CSR (n = 371)	−0.045
t-stat (difference)	2.49**

Panel B: Multivariate Change Analysis

	Cit_Weighted_Pat	
Variable	**(1)**	**(2)**
After	−0.155**	
	(−2.46)	
LowCSR_Improve	0.031	0.029
	(0.10)	(0.10)
After ∗ *LowCSR_Improve*	0.302**	0.303**
	(2.50)	(2.51)
F-test of *After* ∗ *LowCSR_Improve* and *After* (p-value)	0.08	
Industry FE	Yes	Yes
Year FE		Yes
State of Location FE	Yes	Yes
Observations	957	957
R^2	79.03%	79.05%

** Denotes significance at the 5 percent level based on two-tailed tests.
This table reports the results from the difference-in-differences (DiD) analysis based on the quasi-natural experiment of initial CSR ratings coverage by rating agencies. A firm is classified as an initial low CSR firm if its CSR rating in 1991 is negative and as an initial high CSR firm if its CSR rating in 1991 is positive. *LowCSR_Improve* is an indicator variable equal to one if a firm falls into the initial low CSR group and also improves its CSR performance in the subsequent years, and zero if a firm falls into the initial high CSR group. *After* is an indicator that takes a value of zero for 1989, 1990, and 1991 and a value of one for 1992, 1993, and 1994. Because *After* is perfectly correlated with year indicators, column 1 includes *After* without year fixed effects and Column 2 includes year fixed effects without *After*. Control variables as in Table 3 are included but their coefficients are not reported for brevity. In parentheses are t-statistics calculated based on standard errors that are clustered at the firm level.
Variables are as defined in Appendix B.

significant. The coefficient on *CSR* is positive but not significant, suggesting that the innovation benefits of CSR do not exist for poorly governed firms.

Next, we look at whether CEO leadership moderates the relation between CSR and innovation. CEO leadership can induce greater employee commitment (Phua, Tham, and Wei 2018) and help firms make timely strategic decisions, especially when it is related to uncertainty (Li, Lu, and Phillips 2018). Following Bebchuk, Cremers, and Peyer (2011) and Phua et al. (2018), we measure CEO leadership as CEO pay slice (the fraction of the aggregate compensation of the top-five executive team captured by the CEO) and CEO overconfidence. A CEO is classified as overconfident if her option moneyness is above the industry median values.[15] As in the measure of board monitoring, we create a composite index of CEO leadership by ranking CEO pay slice and then averaging the ranked value and the CEO overconfidence indicator. We interact the index (*CEO*) with CSR and re-estimate Equation (1). As reported in the second column of Table 8, the coefficient on the interaction term is positive and significant, indicating that CEO leadership enhances the CSR effect on innovation. The coefficient on *CSR* is positive and not significant, suggesting that the beneficial effect of CSR exists in firms with strong CEO leadership but not in firms without strong CEO leadership.

[15] We first divide estimated value of in-the-money unexercised exercisable options by the number of unexercised exercisable options to obtain the realizable value of the exercisable options. Then we compute the average exercise price by subtracting the realizable value from the stock price at the fiscal year end. The last step is to obtain the option moneyness through dividing realizable value by exercise price.

TABLE 8

Corporate Social Responsibility and Innovation Outcomes: Cross-Sectional Analyses

	$Cit\_Weighted\_Pat_{t+1}$			
Variable	**Board Monitoring (1)**	**CEO Leadership (2)**	**Employee Human Capital (3)**	**Multi-Segment (4)**
CSR_t	0.138	0.188	−0.071	0.333***
	(1.12)	(1.05)	(−0.51)	(2.60)
$Board_t$	0.074			
	(0.89)			
$CSR_t * Board_t$	0.837***			
	(3.76)			
CEO_t		−0.075		
		(−1.11)		
$CSR_t * CEO_t$		0.672***		
		(3.36)		
$EmpHC_t$			0.102	
			(1.30)	
$CSR_t * EmpHC_t$			1.283***	
			(5.55)	
$MultiSegment_t$				0.078
				(1.34)
$CSR_t * MultiSegment_t$				0.518***
				(2.72)
Control Variables	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
State-of-Location FE	Yes	Yes	Yes	Yes
Observations	11,068	6,911	10,984	11,068
R^2	50.24%	55.20%	50.70%	50.21%

*** Denotes significance at the 1 percent level.
This table reports the results of the OLS regressions examining whether board monitoring, CEO leadership, employee human capital, and firm complexity moderate the relation between CSR and innovation. Control variables as in Table 3 are included but their coefficients are not reported for brevity. The t-statistics are calculated based on standard errors that are clustered at the firm level.
Variables are as defined in Appendix B.

We now consider the role of employee human capital (EHC) in the effect of CSR on innovation. EHC encompasses experience, knowledge, abilities, judgment, and skills of individuals associated with a firm. Following previous studies (Del Canto and Gonzalez 1999; Belo, Li, Lin, and Zhao 2017), we consider two proxies for a firm's EHC: the average employee wage and the average skill level of its labor force. Although not all skills and knowledge of employees are reflected in wages, a higher average wage is a reasonable indicator of a firm with a high degree of accumulated human capital. We use the industry median values for firms in the same industry because of a large number of missing values on labor expenses in Compustat. We obtain the industry-specific labor skill index from Belo et al. (2017). The index captures the level of education, training, and preparation that an average employee requires in the industry to perform a given job at a level of competence. Similarly, we create a composite index for EHC (*EmpHC*) by averaging the ranked values of the two proxies. We interact *EmpHC* with *CSR* and report the estimated results in the third column of Table 8. The coefficient on the interaction term is positive and significant, suggesting employee human capital plays an important role in enhancing the CSR effect on innovation efficiency. The coefficient on *CSR* is negative and not significant and an F-test of the sum of *CSR* and the interaction term is positive and significant (untabulated), suggesting that the CSR effect on innovation exists only in firms with greater employee human capital.

Last, we test the moderating effect of firm complexity. Firms with complex structures tend to rely on formal and financial types of controls to manage and coordinate innovative activities (Del Canto and Gonzalez 1999). This may make CSR-facilitated culture more salient and important in promoting innovation. We use the total number of segments to measure firm complexity. To ease interpretation, we create an indicator variable, *MultiSegment,* to denote multiple-segment firms. We estimate Equation (1) by adding *MultiSegment* and its interaction term with *CSR*. As reported in the last column of Table 8, the beneficial CSR effect exists in both single- and multi-segment firms, but it is stronger in firms with complex structures.

VI. ADDITIONAL ANALYSES AND ROBUSTNESS CHECKS

Trusting Relationship with External Stakeholders

CSR can also promote innovation through a trusting and collaborative relationship with external stakeholders. One such stakeholder is the customer. The trusting relationship facilitates customer feedback on a vast number of issues including product functionality and user preference, which enables the firm to better understand market demands and innovation opportunities. While business customers focus on profit maximization and may not be as concerned about their partners' CSR performance, individual consumers tend to be more heartened by corporate social and environmental investment (Lev, Petrovits, and Radhakrishnan 2010). If the impact of CSR on innovation stems from a trusting relationship with customers, the CSR effect should be more pronounced in consumer-related industries. We create an indicator variable, *ConsumerInd,* to denote firms from consumer-related industries and interact it with *CSR*.[16] We estimate Equation (1) by adding the interaction term. If the trusting relationship explains the relation between CSR and innovation, we should observe a positive coefficient on the interaction term. Untabulated results show that the coefficient on the interaction term is negative, providing little evidence that the CSR effect is stronger for the consumer-related industries. Thus, we document some suggestive evidence that the trusting customer relationship may not be a channel through which CSR impacts innovation.

Green Patents versus Non-Green Patents

Socially responsible firms tend to seek imaginatively new methods to solve social and environmental issues. During this process, they not only generate green patents that are related to social issues but also become more vigilant and creative, which spurs the generation of other inventions. Hence, we expect that CSR facilitates greater innovations, both green and non-green. We follow Carrión-Flores and Innes (2010) and base the classification on the primary three-digit technological categories provided by the United States Patent and Trademark Office (USPTO). Patents that are related to air or water pollution, disposal and control, hazardous waste prevention, recycling, and alternative energy are considered green patents, while others are considered non-green patents.[17] We estimate Equation (1) separately for green and non-green patents. Untabulated results show the coefficient on *CSR* is positive and significant for both types of patents, suggesting that CSR helps firms develop internal capabilities that facilitate different types of innovations.

Individual CSR Dimensions

While combining individual CSR dimensions helps us assess the aggregate effect of CSR performance on innovation outcomes, some researchers argue that each KLD dimension represents a different construct (Mattingly and Berman 2006). To gain understanding of how different aspects of CSR influence innovation, we relate each of the four CSR dimensions to the innovation measure separately. Specifically, we construct a net CSR score for each of the four dimensions of community (*CSR_Com*), employee relations (*CSR_Emp*), diversity (*CSR_Div*), and environment (*CSR_Env*) and estimate Equation (1) by replacing *CSR* with one of the four variables each at a time. We present the estimated results in Table 9.

We find that *CSR_Com, CSR_Emp,* and *CSR_Div* are positive and significantly related to the innovation measure. The coefficient on *CSR_Env* is positive but not significant. To probe what causes this insignificant relation, we examine environment strengths (*Str_Env*) and concerns (*Con_Env*) separately. The results show that both *Str_Env* and *Con_Env* are positively and significantly related to the innovation measure. This is consistent with the notion that firms with greater environment concerns are likely to take initiatives (thus greater environment strengths) to address these concerns (Mattingly and Berman 2006), which produce innovation benefits. The community, diversity, and employee dimensions of CSR do not exhibit similar effects possibly because environmental CSR is more salient to stakeholders than other CSR issues (Berthelot,

[16] The industries with the following SIC codes are defined as consumer-related industries: 0000–0999, 2000–2399, 2500–2599, 2700–2799, 2830–2869, 3000–3190, 3420–3429, 3523, 3600–3669, 3700–3719, 3751, 3850–3879, 3880–3999, 4813, 4830–4899, 5000–5079, 5090–5099, 5130–5159, 5220–5999, 6000–6999, 7000–7299, 7400–9999.

[17] Patents in the following technological classes are classified as green patents: 15, 44, 60, 110, 123, 422, 423, 49, 662, 204, 222, 228, 242, 248, 425, 428, 708, 976, 62, 222, 425, 436, 75, 99, 100, 106, 162, 164, 198, 201, 205, 210, 216, 229, 264, 266, 422, 425, 431, 432, 460, 502, 523, 525, 536, 902, 34, 65, 118, 119, 122, 137, 165, 203, 209, 239, 241, 405, 423, 431, 435, 976, 588, 73, 104, 180, 280, 340, 343, 374, 422, 440.

TABLE 9

Corporate Social Responsibility and Corporate Innovation: CSR Components

	$Cit\_Weighted\_Pat_{t+1}$					
Variable	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
CSR_Com_t	1.474*** (4.10)					
CSR_Div_t		0.557** (2.32)				
CSR_Emp_t			0.655*** (3.66)			
CSR_Env_t				0.125 (0.30)		
Str_Env_t					2.827*** (4.34)	
Con_Env_t						1.447*** (2.60)
Control Variables	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
State of Location FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	11,068	11,068	11,068	11,068	11,068	11,068
R^2	50.01%	49.53%	49.74%	49.42%	50.02%	49.70%

***, ** Denote significance at the 1 percent and 5 percent levels, respectively.
This table reports the results of the OLS regression of citation-weighted patent counts on the community dimension (column 1), diversity dimension (column 2), employee dimension (column 3), environment dimension (column 4), environment strengths (column 5), and environment concerns (column 6). Control variables as in Table 3 are included but their coefficients are not reported for brevity. In parentheses are t-statistics calculated based on standard errors that are clustered at the firm level.
Variables are as defined in Appendix B.

Cormier, and Magnan 2003; Marquis, Toffel, and Zhou 2016). Overall, the results suggest that all four dimensions of CSR matter to corporate innovation outcomes.

Other Robustness Tests

We perform additional robustness tests to further validate our results (untabulated for brevity). First, because KLD expanded its coverage of firms in 2001, we examine the sample firms from 1991 to 2000 and those from 2001 to 2007 separately to examine whether our results are driven by the expanded sample firms in later years. We find that the coefficient on *CSR* is 0.459 ($t = 2.07$) for the early period and 0.656 ($t = 5.77$) for the late period, suggesting that the CSR effect does not depend on the KLD coverage expansion and different time periods.

Second, in our baseline regression above, we set *R&D* to zero for firm-years with missing R&D expenditure in Compustat. To examine the sensitivity of our results to this choice, we re-estimate our baseline regression only for firms with positive values in *R&D* and our results remain unchanged (coef. = 0.615, $t = 4.26$). Given that not all firms would patent their inventions, we restrict our sample firms to those with positive patent counts and our inferences remain unchanged (coef. = 0.360, $t = 2.76$).

Third, we further employ a measure of citation-weighted patent counts using the quasi-structural method to correct for truncation bias, and scale the innovation measure *Cit_Weighted_Pat* by firm size (the logarithm of total assets) to account for possible nonlinear relationship between innovation outcome and firm size. Our results are qualitatively the same. Last, we control for additional time-varying factors that may affect both CSR and innovation: CEO equity incentives, managerial ability, and unionization, and our results remain robust.

VII. CONCLUSIONS

In this study, we examine whether CSR strategies contribute to corporate innovation success, measured by citation-weighted patent counts. Innovation affords firms sustainable competitive advantage and is crucial to their future growth.

Examining the relation between CSR and innovation allows us to identify a specific tangible benefit of CSR that leads to long-term value creation, and thus contributes to the ongoing debate over whether and in what ways CSR initiatives benefit shareholders. Drawing on the theory of RBV that CSR helps firms to develop internal resources and capabilities that are associated with creative culture, long-term orientation, and enhanced employee skills, we hypothesize that pursuing CSR promotes innovation.

As MW study the effect that employee treatment, one of the aspects of CSR, has on innovation using the same CSR data source, we first replicate their work and then find that our CSR measure has an incremental effect on innovation beyond that of employee treatment. In identifying the contextual situations in which firms are more likely to internalize CSR benefits, we find that the effect of CSR on innovation only exists in situations of more effective board monitoring, stronger CEO leadership, and greater employee human capital, and is greater in more complex firms. We also find that in general CSR strengths rather than CSR concerns matter to innovation, suggesting that it is proactive CSR policies and actions that tend to foster a creative culture and long-term thinking. We further find that CSR facilitates innovations, both green and non-green, suggesting that CSR helps firms develop internal capabilities that promote different types of innovations. Last, we provide some suggestive evidence that the trusting relationship with external stakeholders, as an external benefit provided by CSR, does not explain the documented relation between CSR and innovation.

Our study has several limitations and caveats. First, we argue that CSR helps firms develop internal resources and capabilities related to creative corporate culture, long-term orientation, and employee knowledge and skills that are critical and conducive to innovation success. While we provide compelling evidence on the relation between CSR and innovation, we do not provide direct evidence that CSR helps firms develop internal resources and capabilities that are difficult to capture. Second, while patent counts are an output measure of innovation and more appropriate for our research question than an input measure, not all firms patent their inventions. To address this bias, we remove firms in industries that have no patents between 1976 and 2010. However, there may still exist variations in patenting practices across firms within an industry. Last, due to the availability of patent data, our sample period ends in 2008. Although we find a similar effect of CSR on innovation in the 1990s and the 2000s, we caution that our results may not generalize to the most recent period.

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APPENDIX A

Comparisons of Patents Granted between the NBER Data and KPSS (2017) Data

	KPSS		NBER	
Application Year	Total Patents	Public Firm Patents	Total Patents	Public Firm Patents
1976	65,797	23,769	51,676	21,980
1977	65,987	23,513	51,971	21,866
1978	65,596	22,697	51,863	20,972
1979	65,728	22,606	52,125	20,888
1980	66,503	23,064	53,809	21,436
1981	63,948	22,310	52,966	20,980
1982	65,041	22,845	54,949	21,507
1983	61,589	21,332	51,757	20,267
1984	67,096	22,941	56,197	22,209
1985	71,480	23,947	60,165	23,673
1986	75,124	23,986	62,953	23,888
1987	81,536	24,783	67,581	25,318
1988	90,250	26,723	75,388	28,365
1989	96,217	28,778	80,683	30,475
1990	99,440	29,542	83,514	31,519
1991	100,315	30,976	85,170	32,608
1992	103,958	33,138	89,001	33,968
1993	108,385	34,567	92,229	36,374
1994	123,406	40,215	106,047	43,004
1995	144,803	49,789	126,991	54,165
1996	144,982	49,637	127,336	54,585
1997	169,696	61,366	150,724	66,275
1998	168,626	61,573	150,026	67,487
1999	180,868	68,631	160,550	73,265
2000	196,755	75,862	171,830	78,393
2001	208,842	81,433	175,868	78,262
2002	205,925	83,177	154,436	67,596
2003	190,819	81,250	107,835	46,800
2004	180,031	77,457	55,746	23,676
2005	162,846	70,326	15,237	6,260
2006	132,927	53,870	905	280
2007	89,252	33,456		
2008	41,520	15,025		
2009	8,675	2,823		
2010	397			

APPENDIX B

Variable Definitions

Measures of Innovation	
Pat_{t+1}	Number of patents applied for by (and ultimately granted to) a firm during the year.
$Cit\_Weighted\_Pat_{t+1}$	Natural logarithm of citation-weighted patent counts, which is total number of citations for all patents applied for by a firm during the year with citations being adjusted based on the year and industry fixed effects, i.e., divided by the number of citations received by all patents in the same year in the same three-digit technology class as the patent.
Measures of CSR	
CSR_t	Net adjusted score of CSR rating, measured as adjusted strengths minus adjusted concerns for four social rating categories of the KLD ratings data: community activities, diversity, employee relations, and environmental record. Adjusted strength (concern) score is estimated by scaling the raw strength (concern) score of each category by the number of strengths (concerns) of that category in a year.
CSR_Str_t	The sum of adjusted strengths for the four social rating categories of KLD ratings data: community activities, diversity, employee relations, and environmental record.
CSR_Con_t	The sum of adjusted concerns for the four social rating categories of KLD ratings data: community activities, diversity, employee relations, and environmental record.
CSR_Emp_t	Net adjusted score for the employee dimension of KLD ratings data, which is adjusted strengths minus adjusted concerns of the employee dimension.
CSR_Env_t	Net adjusted score for the environment dimension of KLD ratings data, which is adjusted strengths minus adjusted concerns of the environment dimension.
Str_Env_t	Adjusted strengths of the environment dimension.
Con_Env_t	Adjusted concerns of the environment dimension.
Control Variables for Baseline Regression	
$SIZE_t$	Natural logarithm of sales (Sales).
BTM_t	Book value of equity (CEQ) divided by market value of equity (PRCC_F * CSHO).
ROA_t	Net income before extraordinary items (IB) divided by total assets (AT).
$Cash_t$	Cash and cash equivalent (CHE) divided by total assets (AT).
$WWIndex_t$	Whited and Wu (2006) financial constraint index estimated as −0.091 * ((IB + DPC)/AT) – 0.062 * positive dividend + 0.021 * (DLTT/AT) – 0.044 * log (AT) + 0.102 * Industry sales growth – 0.035 * sales growth.
$PPENT_t$	Net property, plant, and equipment (PPENT) divided by total assets (AT).
$Intangible_t$	Intangible assets (INTAN) scaled by total assets (AT).
$Leverage_t$	Leverage ratio calculated as long-term debt (DLTT) plus short-term debt (DLC) divided by total assets (AT).
$Capex_t$	Capital expenditure (CAPX) divided by sales (Sales).
AGE_t	Number of years since a firm entered Compustat.
$HHIndex_t$	The Herfindahl-Hirschman Index (HHI), computed as the sum of the squares of the market share of each firm in an industry each year. The market shares are computed based on firm sales, and industry is defined in accordance with two-digit SIC code.
Acquisition	An indicator variable that equals 1 if a firm engage in mergers and acquisitions in the past three years, and 0 otherwise.
InstShares	The ratio of institutional ownership to the number of shares outstanding.
$R\&D_t$	R&D expenses (XRD) divided by sales (SALES) (missing values are set to zero).
Other Variables	
$CSR\_Ind\_CSR_t$	Annual average of CSR of firms in the same state and the same industry (two-digit SIC code) excluding the firm itself.
$Corruption_t$	The yearly number of corruption convictions from each U.S. federal judicial district scaled by the population in the district.
$Board_t$	The average of the ranked values of percentage of outside directors, director attendance, and director ownership.
CEO_t	The average of the ranked value of CEO pay slice and an indicator variable of CEO overconfidence.
$EMPHC_t$	The average of the ranked values of employee wage and the skill level of the labor force, where employee wage is measured as the industry median value and industry-specific labor skill index is obtained from Belo et al. (2017).
$MultiSegment_t$	An indicator variable equal to 1 for multi-segment firms and 0 otherwise.