Shale gas booms and environmental CSR

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Abstract

Using staggered county-level shale gas developments, we examine whether uncertain environmental risks affect firms' environmental CSR. We find that firms headquartered in shale gas boom counties significantly increase environmental CSR compared with firms in nonboom counties. Furthermore, we show that the impact of shale gas booms on environmental CSR is more pronounced when firms' litigation risk is higher, when firms have more stakeholder interactions, and when firms' orientation is more long-term. The increased environmental CSR driven by the shale boom is associated with subsequent firm value. We provide evidence that firms trade off the benefits and potential legal liability of internalizing physical environmental risk in environmental CSR decisions.

JEL Classification: M14, O13

Keywords: Environmental CSR; Shale gas booms; Stakeholder; Corporate social responsibility

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1. Introduction

Over the decades, corporations have emphasized their duties to society. Among their efforts to become socially responsible members of society, corporations have exerted efforts to protect the environment because of their adverse impacts on the environment and human health.[1] Researchers have tackled the reasons why firms engage in environmental CSR and examined how firms' environmental CSR is related to firm attributes such as institutional environment, internal corporate governance, and ownership (e.g., Ambec and Lanoie, 2008; Berchicci and King, 2007; Gillan et al., 2021). In particular, environmental disasters undoubtedly increase the value of firms' environmental CSR, and the firms are likelier to be environmentally proactive after the environmental shock. Dyck et al. (2019) and Liang and Ronneboog (2017) use the 2010 BP Deepwater Horizon oil spill as an unexpected shock to examine the relationship between environmental events and CSR. While these studies examine the impact of environmental risk on environmental CSR, the economic costs and impacts of reputational damage are confined to specific oil-related firms. However, the environmental risk is imposed on certain firms and also spread to the various stakeholders in the economy. As environmental concerns intensify among stakeholders, it is important for firms to react and adjust their environmental policies when environmental events occur. Using a large sample of United States (US) public firms, recent evidence has shown that environmental changes have important implications for corporate decisions, such as capital structure and productivity (Ginglinger and Moreau, 2019; Jin et al., 2021). However, there is limited evidence for a comprehensive investigation of the relationship between environmental events and CSR. We complement this growing literature on environmental CSR by exploiting environmental events across US localities.

In this study, we use the staggered shale gas discoveries across US counties as exogenous events that increase the uncertainty of environmental risk. Shale gas developments

[1] For example, Xu and Kim (2022) document that US firms produced 27.24 billion pounds of toxic chemicals in 2015 alone.

are appealing for this study for several reasons. First, shale gas developments generate new environmental issues for firms and related stakeholders because technological breakthroughs in gas extraction (hydraulic fracturing (fracking)) have expanded the areas of oil and gas development that are otherwise inaccessible. Second, while shale gas developments are salient events in local society, the scientific impacts of shale gas booms on the local environment are ambiguous to both locals and academics. This attribute amplifies the uncertainty of environmental risk, which differs from other environmental changes, such as climate rise, based on the common expected environmental consequences. Lastly, the staggered changes in shale gas development permit a difference-in-differences approach. This approach provides a better identification strategy than that of studies with a single shock. Furthermore, we can compare treatment and control firms from the same state in the same year by implementing state-by-year fixed effects. Given that individual states legislate and enforce environmental regulations, this helps us control the regulatory risk channel (Spence, 2017; Seltzer et al., 2022).

According to the literature on corporate environmental policies, optimal environmental investments hinge on the costs of sustainable activities and the expected legal liabilities (Xu and Kim, 2022; Shapira and Zingales, 2017). The model implies that to maximize firm value, a firm should determine the level of environmental commitments by trading off the benefits of eco-friendly commitments with the potential costs of legal liabilities.

Under this cost-benefit framework, there are several reasons that the shale boom affects firms' environmental CSR. First, ongoing shale gas developments controversies in a local community increase firms expected legal liabilities. With the great attention given to shale gas drilling, local stakeholders will be incentivized to monitor firms' environmental activities. The enhanced concerns take the form of penalties for environmental violations (Karpoff et al., 2005), press coverage on environmental behaviors (Flammer, 2013), regulator risk (Seltzer et al., 2022), or environmental CSR itself (Chava, 2014), which are significant determinants of expected legal liabilities and firm value. Therefore, as the expected legal liabilities from environmental shocks increase, firms are likelier to utilize environmental CSR to build reputation.

Second, shale gas developments evoke the demand for a clean environment. Regardless of whether the gas extraction has adverse effects on the environment, stakeholders in a local community understand that they should bear the negative externality and the possible bearing costs due to the nature of pollution. These stakeholders may demand that local firms engage in environmental protection activities even if the activities are costly to firms (Bénabou and Tirole, 2006, 2010). Therefore, based on the implications of CSR literature that emphasize corporations' role in catering to stakeholders' demand (Bialkowski and Starks, 2015; Riedl and Smeets, 2017; Chen et al., 2020), we anticipate that the demand for green will increase the expected benefits of improving environmental performance, thereby allowing firms to increase environmental CSR after the shale booms. It should be noted that the above arguments are not mutually exclusive. For example, firms either proactively reduce greenhouse gas emissions to relieve concern about the higher abnormal temperature in a community or prepare for future Environmental Protection Agency (EPA) regulations.

Third, the impact of fracking on the local environment appears over the long run. So far, prior research has shown inconsistent evidence of the impact of the shale boom on the environment. However, people can easily infer that excessive use and development of shale gas result in environmental problems. Firms are strongly incentivized to invest in costly long-term projects for stakeholders' interests if they believe that the environmental effects of shale oil developments are latent and sluggish. Committing to long-term environmental projects multiplies the benefits of environmental CSR when adverse shock on the environment persists for a long period. Since environmental CSR involves long-term planning for commitments with latent returns, this argument is more persuasive. (Christensen et al., 2021).

Based on the above reasons, we believe that shale gas developments improve environmental CSR because of the increased expected legal liabilities, the local stakeholders' demand for a clean environment, and the long-term environmental effects. In addition, we predict that the increasing impact of shale gas activities on environmental CSR is concentrated in firms with higher litigation risk, higher stakeholder interactions, and long-term horizons. Furthermore, if environmental commitments foster strong alignment, we predict an improvement in firm value for firms that increase environmental CSR after the shale gas shock.

The alternative hypothesis predicts that the shale gas boom does not affect the local firms' environmental CSR. First, the environmental risk of fracking is confined to related firms (e.g., oil or drilling companies). Thus, firms may have fewer incentives to change their green efforts following the shale boom. Second, from a firm's perspective, analyzing the environmental impact of shale gas and internalizing the risk into its eco-friendly policies is challenging because the short-term impact of the shale boom on the local environment and human health is unclear. Within the cost-benefit framework, the limited impacts on a firm's operations and little knowledge regarding the environmental consequences of fracking induce firms to underestimate the value of green activities. Therefore, an empirical question is whether the shale boom affects firms' environmental CSR.

To examine the impact of shale booms on environmental investments, we use the MSCI KLD database (KLD), which provides comprehensive data on firm-level CSR ratings, including environmental performance. Using 15,443 firm-year observations from 359 counties in 28 states between 2000 and 2013, we find that shale gas booms significantly increase firms' environmental CSR. Specifically, the increase in environmental CSR by treatment firms explains 20.4% of the sample's standard deviation of environmental CSR. Further, increased environmental performance is mainly driven by firms' efforts to increase environmental strengths rather than reduce environmental concerns. The main findings are robust after controlling for time-invariant firm-level factors and excluding firms in industries that benefited from shale gas development.

We conduct several tests to corroborate a robust interpretation of the association between the shale gas boom and environmental CSR. First, we discover that the average environmental CSR in a county is not associated with the shale boom occurrence, which alleviates concerns about the reverse causality and supporting the validity of the difference-in-differences approach. Second, we find no pre-treatment trends in environmental CSR between the firms in shale boom counties and those in nonboom counties. Third, we employ propensity score matching to control for the ex-ante firm characteristics between treatment and control firms. We find similar results when using the propensity-score matched sample.

Next, we explore some moderators that amplify the effect of the shale boom. First, we expect the effect of the shale boom on environmental CSR to be more pronounced when firms face greater litigation risk. This anticipation is because stakeholders are likelier to pay attention to the environmental issues and monitor firms with such environmental (social) issues. The treatment effect is stronger when a firm operates in a high-polluting industry, is located in a county with environmental litigations, and has a higher litigation risk estimated by accounting variables. Second, the impact of the shale boom on environmental CSR is more pronounced for firms with higher stakeholder interactions. Eco-friendly firms utilize their strengths to maintain or enlarge future businesses because stakeholders have greater concerns about firms' environmental (social) duties. Consistent with the prediction, there is a strong association between the shale boom and the environmental CSR of firms with more suppliers, customers, and business segments. Third, long-term-oriented firms are more likely to increase environmental CSR. Because the unsettled effects of fracking generate long-term environmental changes, firms with long-term horizons are likelier to consider this environmental risk. The impact of shale booms is more evident when a firm has higher ownership by long-term institutional investors; however, it is reduced in the case of an older CEO.

Moreover, we examine the association between shale booms and other CSR activities (e.g., community, diversity, employee relations, product, and human rights) and overall CSR activities. We find evidence that shale booms lead firms to exert effort for the community. However, the impact of shale booms on other CSR scores is statistically insignificant. These results suggest that local firms strategically allocate resources to the prosocial demands of their local communities.

In addition, we examine whether the change in environmental investments following shale booms affects firm value. An increase in environmental CSR after shale booms is positively associated with the change in Tobin's q, thereby providing supportive evidence that environmental CSR is value-enhancing.

Finally, we explore one alternative explanation that predicts a positive relationship between the shale boom and environmental CSR. Because the shale boom exogenously increases local credit supply, local firms can acquire more resources for environmental protection via the local lending market. To address the alternative explanation, we examine whether the shale boom reduces a firm's financial constraints. we find that the shale boom firms have lower interest coverage, worse credit ratings, lower likelihood of paying dividends, and lower payout ratios. The evidence contradicts the view that the shale boom relaxes local firms' financial constraints and thus improves their CSR ratings.

Our study contributes to the literature in several ways. First, it adds to the CSR literature investigating the impact of physical environmental changes on firms' environmental CSR (e.g., Dyck et al., 2019; Liang and Ronneboog, 2017). Although previous studies focus on one environmental shock to examine the effects of physical environmental events, this study exploits the staggered changes in county-level shale gas booms. This approach is advantageous because the environmental shock only affects a group of firms, leaving a set of counterfactuals for unaffected firms. Thus, this study's evidence enables us to better understand a causal interpretation of the relationship between environmental risk and environmental CSR. The growing studies highlight the impact of environmental changes (e.g., climate change and sea level rise) on corporate decisions (Ginglinger and Moreau, 2019; Jin et al., 2021). While these climate changes and sea level rise are common environmental concerns that firms undoubtedly consider for future businesses, the impact of shale gas shocks on daily business is rather questionable for firms. With unreached consensus on the environmental effects of shale gas developments, the shock provides interesting implications for green policies for managers and firms.

Second, our study contributes to the existing literature on the impact of firms' geographical locations on their CRS activities. Liang and Renneboog (2017) find that CSR fundamentally relates to a country's legal origin. Cai et al. (2016) present evidence that country factors, such as economic development, civil liberties, political rights, cultures toward harmony, and autonomy, play an important role in explaining firms' CSR performance. Several studies investigate how social factors within the US affect firms' CSR. According to Di Giuli and Kostovetsky (2014), at the state level, firms exhibit higher CSR performance when headquartered in Democratic-leaning rather than Republican-leaning states at the county level. Jha and Cox (2015) and Hoi et al. (2018) examine the relationship between social capital and CSR. Both studies reveal the importance of county-level social capital in determining CSR activities.

Our study differs from prior studies in several ways. First, it utilizes unpredictable gas developments, which are caused by new drilling technologies, and performs difference-in-differences tests in order to focus on time-varying social interactions within local communities. This differs from prior studies that use inherited and stable social attributes within firms' operations. Second, our results indicate that firms' CSR policies are issue-specific. Firms tend to respond to changes in environmental CSR practices only after people pay attention to the local environment. Lastly, we demonstrate some channels through which stakeholders play a role in shaping local firms' environmental CSR.

Lastly, this study contributes to the literature on the effect of shale gas booms on economies. Prior studies investigate how shale booms affect banks and local economies. Shale booms increase bank lending (Plosser, 2014), mortgage lending through bank branch networks (Gilje et al., 2016), and nonfinancial business establishments are conditional on lending markets and industries (Gilje, 2019). This study focuses on CSR, which is a growing and vital corporate decision. This study is closely related to the findings of Spence (2017), which reveal that companies involved in developing shale gases in US local communities are less likely to address environmental issues than overseas oil and gas companies. The study focuses on the impact of shale gas developments on the environmental practices of oil and oil-related firms. However, our empirical evidence suggests that environmental concerns spread to local communities and thus affect other industry firms.

The rest of this paper is structured as follows: Section 2 provides background information on shale gas development. In Section 3, we describe the data and provide summary statistics. In Sections 4-6, we present the empirical results. Finally, we conclude the paper in Section 7.

2. Background information on shale booms

Over the last two decades, the United States (US) has experienced the shale gas revolution due to technological gas extraction advancements. Specifically, since the first development of the Barnett Shale in 2003, the combined use of horizontal drilling and hydraulic fracturing (fracking) has dramatically increased the viable shale gas reserves, which were thought to be economically unprofitable. These technology-driven shale booms directly impact communities where shale gas resources exist. The shale boom communities have experienced significant economic changes, such as local employment (Gilje, 2019) and local credit supply (Gilje et al., 2016; Gilje, 2019).

However, with the rise of shale gas developments, US communities are gradually paying attention to the potential perils of shale gas drilling in their territory. One of the biggest issues in shale gas development is environmental. For example, the environmental risks of fracking include water contamination from the use of water and chemical fluids, air contamination from the emissions of toxic pollutants and greenhouse gases, and earthquakes caused by wastewater injection into underground wells.[2] These mounting concerns related to shale gas have led to numerous studies investigating the environmental contamination of shale

[2] Cooper et al. (2016) provide details on the environmental impacts of shale gas and related studies.

gas development. However, as shown in Cooper et al. (2016), extant research provides an inconclusive evaluation of the effect of shale gas on environmental contamination and human health. Cooper et al. (2016) attribute the disagreement in the environmental effects of shale gas development to a short-term investigation period, small sample sizes, and varying research methodologies.

Despite the ambiguous scientific impact of shale gas development on the environment, the locals perceive fracking as a severe environmental threat. With the salient images (consequences) of pollution, local communities sensitively react to the environmental risk of fracking. In addition, the salience of shale gases is intensified by polarized opinions and media coverage. To the extent that people tend to shape their opinions relying on the events (information) that are easily accessible (Macy et al. 2019), the persistent exposure to opposing opinions regarding fracking and its related news induces the public to elevate the environmental risk of fracking. Anti-fracking protestors have tried to influence the public by addressing the dangers of shale gas development and have gained communities' attention and consent. As a result, some US communities have banned shale gas drilling within their borders.[3] However, in response to the fracking ban, the industry continues to influence local governments to limit regulations on fracking. Some municipalities have overturned their fracking bans due to possible industry legal actions.[4] Overall, the debates on fracking are ongoing and have unresolved environmental effects.

3. Data and summary statistics

We obtain data on shale booms from Gilje et al. (2016) and Gilje (2019).[5] The data

3For example, see "Where Communities Have Banned Fracking," www.bostonglobe.com/news/nation/2014/12/18/wherecommunities-have-bannedfracking/05bzzqiCxBY2L5bE6Ph5iK/story.html (Dec. 18, 2014); "To Ban or Not to Ban? The Fight over Fracking Intensifies," www.americanbar.org/groups/litigation/committees/realestate/news_analysis/articles_2014/open/0814-fight-to-ban-fracking.html (Sept. 3, 2014).

4 "Battles Escalate Over Community Efforts to Ban Fracking," https://www.nationalgeographic.com/science/article/130823-battles-escalate-over-towns-banning-fracking (August 24, 2013).

5 The data is available at Erik Gilje's website: https://finance.wharton.upenn.edu/~gilje/. we thank

covers the shale well discoveries associated with horizontal fracking from 2003 to 2019 across 28 US states. Using the county-month level observations in shale boom data, we can identify each state's shale boom counties and nonboom counties in a given year.

We obtain firms' environmental CSR from the MSCI ESG KLD (KLD) database. KLD provides firms' environmental performance in 12 subcategories, comprising seven strengths and five concerns. For each strength (concern) subcategory, KLD assesses if a firm has committed a good (bad) deed under that environmental criterion.[6]

Our sample period starts in 2000, three years before the first drill of the horizontal well in 2003, and ends in 2013 because KLD provides comprehensive coverage of environment ratings up to 2013. To construct the sample for the empirical analyses, we begin with firm-year observations in the KLD database from 2000 to 2013. We drop the firms headquartered in states that do not experience shale booms.[7] This procedure leaves 17,751 firm-year observations. Next, we merge the firm-level control variables, constructed from Compustat and Thomson-Reuters 13F databases, with the county-level control variables from the Census Bureau, US Bureau of Labor Statistics, and Northeast Regional Center for Rural Development. After excluding observations with missing control variables, we have 15,443 firm-year observations.

[Insert Table 1 here]

Table 1 presents our sample's summary statistics. The definitions of variables are provided in Table A1 in the Appendix. Panel A of Table 1 describes the summary statistics on shale booms. During the sample period, there are 28 states where shale booms occurred and 359 counties where the companies are headquartered in those states. Eighty-eight counties experienced at least one horizontal fracking, and 9,123 wells were drilled during the sample period. Panel B of Table 1 presents the number of observations, mean, median, standard

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Professor Gilje for sharing this data.

[6] Likewise, other CSR dimensions (e.g., community, employee relation, product, diversity, and human rights) have their subcategories (indicators) that measure the strengths and concerns of the firms' social activities.

[7] The zip code of the firm's headquarters is from Bill McDonald's website: https://sraf.nd.edu/data/augmented-10-x-header-data/. we are grateful to Professor McDonald for sharing this data.

deviation, minimum, and maximum for environmental CSR. In the sample, the average and the standard deviation of environmental investment are 0.004 and 0.736, respectively. Panel B of Table 1 also shows the summary statistics of firm-level and county-level control variables. We winsorize all the continuous variables at 1% and 99% levels. We find that the average total assets are 8,651 million dollars, the average leverage is 0.206, the average Tobin's q is 2.009, and the average institutional ownership is 69.7%. Compared with average Compustat firms, the firms in our sample are larger and have lower leverage, higher market-to-book ratio, and higher institutional ownership. This result is consistent with prior CSR literature using the KLD database (Deng et al., 2013; Di Giuli and Kostovetsky, 2014; Krüger, 2015; Khan et al., 2016).

4. Effect of shale booms on environmental investments

4.1. Research design

We examine the effect of shale booms on firms' environmental CSR and adopt the following difference-in-differences estimation. We use the following ordinary least squares (OLS) regression:

$$Environemnt\ CSR_{i,c,s,\,t} = \beta_0 + \beta_1 Shale\ boom_{c,\,t} + \beta_2 X_{i,\ c,s,\,t} + + \mu_c + \pi_{s,\,t} + \varepsilon_{i,\,c,\,s,t} \qquad (1)$$

where *i* indicates firm, *c* indicates county, *s* indicates a state, and *t* indicates the year. In Equation (1), the dependent variable is *Environmental CSR*. To compute the variable, we first construct the number of environmental strengths (environmental concerns) by adding the seven indicators of strength (five concerns). We deduct the number of concerns from the number of strengths and obtain the environmental CSR variable. *A shale boom* indicates whether a firm is headquartered in a county where a shale boom occurred. The *Shale boom* variable is measured as either the indicator or the number of shale development activities, according to Gilje (2019). Shale boom (indicator) equals one if a county in which a firm is headquartered at year *t* is in the top tercile of all county-years with shale development activity, and zero if otherwise. Once the variable is set to one, all the county's subsequent years are also set to one.[8] *Total shale wells* is the total number of shale wells drilled in the county where a firm is headquartered from 2003 to year t. $X_{i,\ c,s,\ t}$ is a set of firm characteristics and county characteristics. In line with prior CSR studies (e.g., Ferrell et al., 2016; Chen et al., 2020), we include firm size, measured as the natural logarithm of total assets, leverage, ROA, Tobin's q, cash holdings, R&D intensity, advertising, sales growth, an indicator of whether the firm pays dividends, and the percentage of shares held by institutional investors. To control for local economic conditions, we include county-level measures (i.e., population, income per capita, and unemployment rate). Because social capital surrounding corporate headquarters is associated with the firm's CSR (Jha and Cox, 2015; Hoi et al., 2018), we add the county-level social capital index proposed by Rupasingha et al. (2008). The social capital index for US counties is available for 1990, 1997, 2005, 2009, and 2014. We use the 1997 social capital index for 2000-2004, the 2005 index for 2005-2008, and the 2009 index for 2009-2013.[9] The regression specification controls for a set of fixed effects. To control for the time-invariant differences among counties, we include county fixed effects (μ_c). State-by-year fixed effects ($\pi_{s,\ t}$) control for time-varying differences across states, such as state-level economic conditions, changes in the political environment, or regulation changes by state law. Finally, we double cluster the regressions by county and year to account for any sources of within-county or within-year correlation in errors.[10]

The estimation of the effect of shale booms is β_1, which is the main interest coefficient. This coefficient measures the change in environmental CSR for firms located in counties with the aftermath of a shale well discoveries relative to a control group of firms in the same state

[8] Gilje (2019) defines the occurrence of a shale boom in a county if the county at time *t* is in the top quartile of county years with shale well activity. we use the top tercile to identify the shale boom county to enhance the coverage of boom counties. Based on the top tercile definition, 94.55 % of all shale wells are covered in affected counties, while 90.96 % are covered when employing the top quartile definition. As a robustness test, we replace the boom indicator with the top quartile definition, reestimate the equation (1), and find similar results.
[9] Alternatively, we linearly interpolate the social capital index to fill in the years 2000-2004, 2005–2008, and 2009-2013 and find similar results.
[10] Alternatively, we cluster standard errors by county because shale booms vary. we find qualitatively similar results with statistical significance at the conventional level (untabulated).

but in counties with no shale developments. If firms perceive that environmental issues are important in a county, the coefficient of $\beta_1$would be positive.

4.2. Determinants of shale booms

One concern with examining the effect of shale booms on environmental CSR is that the shale boom is unrelated to the prevailing corporate environmental CSR activities. This section addresses this concern by exploring the several determinants of shale booms. Following Acharya et al. (2014) and Serfling (2016), we estimate a Cox proportional hazard model, in which a failure event is the occurrence of shale boom (i.e., *Boom (indicator)*) in each county. The sample consists of 2,862 county-year observations across the 359 counties in Panel A of Table 1. Once the shale boom occurs, all subsequent years for the county are excluded. We control for several county-level characteristics, including population, income per capita, unemployment rate, and social capital index. To test whether the shale booms are unrelated to the pre-existing corporate environmental activities, we also control for all firms' average environmental CSR (overall CSR, including environmental CSR) in a given county year. All explanatory variables are lagged by one year and standardized, with a mean of zero and a standard deviation of one.

[Insert Table 2 here]

Table 2 presents the results of the Cox proportional hazard model. Income per capita is negatively associated with the shale boom, as shown in column 1. Notably, the averaged environmental CSR coefficient is positive but statistically insignificant. The results indicate that the shale boom is unrelated to corporate environmental efforts. Column 2 replaces averaged environmental CSR with averaged CSR to explore whether the local firms' overall CSR activities are associated with shale gas development activities. The coefficient on averaged CSR is insignificant. In column 3, we include averaged environmental CSR and averaged CSR together in the model and find that the coefficients on the two variables are both insignificant. We further include the change in explanatory variables in column 4. The results show that the income per capita remains negatively associated with the shale boom, while the unemployment rate and the population change are positively related to the shale boom. Further, columns 5 and 6 include the state-fixed effects and state-year fixed effects. The unemployment rate and the population change are not statistically correlated with the shale boom; however, the coefficient on income per capita remains negatively significant.

Overall, although the analysis cannot rule out the endogeneity concern that the shale gas boom is exogenous from any local conditions, the results in Table 2 demonstarte that the shale boom in a local community is unrelated to the pre-existing corporate environmental activities, alleviating the concern regarding reverse causality and supporting the validity of the research design setting.

4.3. Baseline results

Table 3 reports the results from OLS regressions of environmental CSR on the shale boom and control variables. Columns 1 and 2 present the analysis estimates in which the dependent variable is *Environmental CSR*, the difference between environment strength and concern. *Boom (indicator)* and *Log(total shale wells)* coefficients are positive and statistically significant. These results support the hypothesis that shale gas booms increase environmental CSR. The effect of the shale boom on environmental CSR is economical. For example, in column 1, the estimated coefficient of *Boom (indicator)* is 0.150. According to the estimates, the shale boom is associated with a 0.150 increase in environmental CSR, representing 20.4 % of the standard deviation of environmental CSR. Similarly, given that the standard deviation of environment investment is 0.736, the estimated coefficient of *Log (total shale wells)* indicates that a one-standard-deviation increase in the logarithm of total shale wells results in a 0.034 standard deviation increase in environment investment (0.036 * 0.701 /0.736 = 0.034).

Further, we investigate whether an increase in environmental ratings is associated with the increase in positive environmental activities or the decrease in negative environmental activities. In columns 3-6, we regress *Environment strength* (*Environment concern*) on the two shale boom variables and other control variables. We find that the coefficient on *Boom (indicator)* is positive and significant in environment strength (column 3), whereas it is negative and significant in environment concerns (column 5). These results imply that increased environmental performance is mainly driven by firms' efforts to increase their environmental strengths. The coefficient on *Log (total shale wells)* is positively related to environmental strength and negatively to environmental concern. However, the coefficients are not statistically significant (columns 4 and 6). Following that, we examine whether unobservable firm-specific factors affect the relationship between environmental CSR and the shale boom. We replace county fixed effects with firm fixed effects and reestimate the regressions. As shown in columns 7 and 8, the coefficients on the shale boom variables are positive and significant at the 5 % level. The results indicate that the unobservable, time-invariant, and firm-level characteristics are unlikely to impact the main findings. Lastly, we exclude because firms in oil, construction, financial, and real estate industries because they directly benefitted from the shale gas well developments (Gilje 2019).[11] Columns 9 and 10 report the results. The coefficient on *Log (total shale wells)* is positive and insignificant, while the coefficient on *Boom (indicator)* remains positive and significant at the 5% level. This result indicates that shale-gas-related industries do not drive increased environmental activities.

Table 3 shows that the shale boom increases firms' environmental CSR. After the shale boom, firms in affected counties prioritize enhancing environmental strengths over reducing environmental weaknesses. The results are robust after controlling for firm fixed effects and excluding firms directly affected by the shale booms.

[Insert Table 3 here]

4.4. Timing of changes in environmental investments surrounding the shale booms

The difference-in-differences estimation in Table 3 assumes no pre-treatment differences in environmental CSR activities between treated firms in shale boom counties and

[11] The industries are classified using Fama and French 49 industries.

control firms in non-shale boom counties. To examine whether any pre-treatment trends exist between the treated firms and control firms, we use the exact regression specification in column 1 of Table 3. In the same vein, we replace *Boom (indicator)* with the following seven variables: *Year t-2* (indicator), *Year t-1* (indicator), *Year t* (indicator), *Year t+1* (indicator), *Year t+2* (indicator), *Year t+3* (indicator), *Year t+4*$^{+}$, where *Year t* is the first year of a shale boom and *Year t+4*$^{+}$ indicates four or more years after the boom.

[Insert Table 4 here]

Table 4 presents the results from examining the pre-treatment trends. The control variables are included in all regressions, but their estimates are not reported for brevity. As shown in column 1, the coefficients on *Year t-2* and *Year t-1* are statistically insignificant. The coefficients on *Year t+1*, *Year t+3*, and *Year t+4*$^{+}$ are positive and significant. These results suggest no significant difference in environmental CSR between the treated and control firms in the pre-periods and that environmental CSR only increases after the shale boom occurs. We divide the environmental CSR into environment strength and environment concern, and then reestimate the regressions in columns 2 and 3. Except for the coefficient on *Year t-1* in environment strength, the estimates generally show that the pre-existing trends are not statistically different from zero. To address the possibility that the pre-trends in environment strength are due to the particular industries, we exclude firms directly influenced by the shale booms (i.e., oil, financial, real estate, and construct industries) and reestimate the regressions in columns 1-3. Across columns 4-6, the coefficients on *Year t-2* and *Year t-1* are statistically insignificant, indicating no pre-treatment trends. Thus, Table 4 provides evidence to support the parallel assumption underlying the difference-in-differences tests.

4.5. Propensity score matching analysis

Using propensity-score matching, we examine the robustness of the baseline results. The matching enables control for the differences in ex-ante characteristics between treatment and control firms before the shale booms. Additionally, this approach alleviates a potential concern that environmentally oriented firms choose to locate in shale boom counties. To construct the propensity-score matched sample, we first estimate a logit regression with the dependent variable equal to one if a firm experiences shale boom and zero if otherwise, and the independent variables identical to those in Table 2 (i.e., Log (total assets), Leverage, ROA, Tobin's q, Cash, R&D intensity, Advertising, Sales growth, Dividend (indicator), and Institutional ownership). The matched treated and control firms must be in the same industry (two-digit SIC code) and year. This matching procedure yields a sample of 149 firms with a shale boom and 149 firms without. The descriptive statistics of matching variables for the treated and control firms are presented in Panel A of Table. As shown in columns 3 and 4, the differences in firm characteristics are not statistically different from zero, indicating that the matched control firms have similar firm characteristics to the treatment firms.

[Insert Table 5 here]

Panel B of Table 5 presents the results of the OLS regressions. The dependent variables are *Environmental CSR*, *Environment strength*, and *Environment concerns*. In columns 1 and 2, we find that the coefficients on *Boom (indicator)* and *Log (total shale wells)* are positive and significant at the 10 % level, supporting that the baseline results are robust when using the propensity-score matching approach. The estimated coefficient of *Boom (indicator)* (0.137) indicates a 0.137 increase in environmental CSR, representing 15.7 % of the standard deviation of environmental CSR. Column 2's coefficient on Log (total shale wells) indicates that a one-standard-deviation increase in *Log (total shale wells)* is translated into a 0.108 standard deviation increase in environment investment (0.064 * 1.473 / 0.870 = 0.108).[12] As shown in columns 3-6, the results in the matched sample are consistent with Table 3's baseline findings: the increase in environmental strengths is significant, but the decrease in environmental concerns is insignificant.

Overall, the propensity-score matching analyses confirm the robustness of baseline

[12] The standard deviation of *Log (total shale wells)* and environmental CSR in propensity-score matched samples are 1.473 and 0.870, respectively.

results.

4.6. Effect of shale boom on environmental investment: Subcategory analyses

We investigate what aspects of environmental activities are affected by shale booms to better understand the impact of shale booms on firms' environmental CSR. We separately reestimate the regressions in Table 3 to each subcategory (i.e., five strengths and seven concerns).

Table A2 in the Appendix reports the results. In Panel A, among five environmental strengths, we discover that two environmental strengths are positively associated with shale booms. After the shale boom, firms concentrate their efforts on increasing the use of recycled material (Recycle) and investment in low-carbon technologies (Cleanenergy). In terms of environmental concerns, the coefficient on Boom (indicator) is negative and significant, with Hazardwaste as the dependent variable. The result suggests that firms reduce waste proactively after the shale boom occurs in their local community. However, the *Boom (indicator)* coefficients are positive and significant in columns 10 and 11, contradicting the hypothesis that firms commit to improving environmental performance. The two dependent variables have a shorter data coverage period than the others, which may explain the opposite results. In addition, the unexpected direction of the coefficients might be because these two environmental concerns apply to a limited number of firms (ozone of 2 firms and agriculture of 16 firms). Therefore, to control for within-firm variations, we replace county-fixed effects with firms-fixed effects in Panel B. Columns 10 and 11 show that the coefficients on *Boom (indicator)* become insignificant. With firm-fixed effects estimation, we further find that firms experiencing shale boom 1) prevent pollutants (polprevent), 2) increase the use of recycled materials, 3) invest in low-carbon technologies, 4) improve waste management, and 5) decrease regulatory costs.

Overall, the subcategory analyses show that shale booms induce firms to increase environmental edges rather than to reduce environmental deficiency, which is consistent with the results of environmental strengths and concerns in Table 3.

4.7. Cross-sectional analysis

We conduct several cross-sectional tests to shed light on the mechanisms underlying the impact of the shale boom on environmental CSR. First, we focus on the potential legal costs. Local stakeholders, such as the media, regulatory authorities, and investors, will increase their scrutiny and take legal action against local firms with related issues if the shale boom raises environmental concerns in the local community. Significantly, the firms with higher environmental (social) issues are more likely to be highlighted, resulting in those firms putting their efforts into environmental reputations. Thus, the effect of the shale boom on environmental CSR is expected to be more pronounced when firms have higher litigation risk. To test the prediction, we use two measures to proxy for a firm's litigation risk: 1) high pollution (indicator) that equals one if a firm operates in high polluting industry and zero if otherwise (Flammer and Kacperczyk, 2015), 2) litigation county (indicator) that equals one if a county where the firm is located has environment litigations, and zero otherwise, and 3) high ex-ante litigation risk (indicator) that equals one if a firm's estimated ex-ante litigation risk is in the top quartile of sample and zero otherwise. We estimate the ex-ante litigation risk following model (2) of Table 7 in Kim and Skinner (2012). We interact these three indicators with *Boom (indicator)*.

Second, we explore other stakeholders' roles in firms' environmental commitments. To the extent that a firm's stakeholders consider CSR activities, including environmental CSR, in their decision-making (Darendeli et al., 2022; Dai et al., 2021) and they pay attention to ongoing environmental issues on shale gas developments, improving environmental CSR helps firms maintain and facilitate their relationship with other stakeholders. Therefore, the shale boom effect should be stronger for firms with many stakeholders. To capture the level of stakeholders' interactions, we use two measures. The first metric is the number of suppliers and customers because they are essential stakeholders (e.g., Acemoglu et al., 2012; Carvalho et al., 2021), and social and environmental responsibility matters to them (Schiller, 2018; Darendeli et al., 2022; Dai et al., 2021). Similarly, as another measure, we use the number of business segments because having many business segments requires more coordination with various and different related parties. For each measure, we construct an indicator equal to one if the measure is above the sample median and zero if otherwise, and then we interact the indicators with the shale boom dummy.

Third, we investigate whether the shale boom has a stronger effect on environmental CSR when the firm emphasizes the long-term horizon. Because CSR activities require a long-term investment horizon (Stein 1989; Bénabou and Tirole 2010), and the impact of shale oil developments on the environment gradually increases over time, the response to the latent environmental changes matters for firms with long-term horizons. Thus, we predict the effect of the shale boom on environmental CSR to be more pronounced for firms with long-term perspectives. We employ CEO age as a measure that deters long-term commitments because old CEOs have fewer incentives to adapt to long-run environmental risk. Next, we focus on the composition of shareholders with different investment horizons for another measure of the long-term horizon. According to Bushee (1998), we identify institutions as transient and nontransient (i.e., quasi-indexer and dedicated). The idea is that orientation of transient institutions is more short-term oriented than that of nontransient institutions.[13] We obtain CEO age from Execucomp and institutional classification from Bushee's website.[14] Old CEO (indicator) is defined as one if the CEO's age is above the sample median and zero if otherwise. Similarly, high nontransient institutional ownership (indicator) is one if the ownership of nontransient institutions is above the sample median and zero if otherwise. The indicators are interacted with the shale boom indicator, and the interaction term is included in equation (1).

[Insert Table 6 here]

Table 6 presents the results. Consistent with the prediction, Panel A demonstrates that

[13] One argues that quasi-indexers are passive and lack the motives to put efforts into environmental CSR. However, quasi-indexers influence a firm's governance structure and performance (Appel et al., 2016).
[14] https://accounting-faculty.wharton.upenn.edu/bushee/. WE thank Professor Bushee for sharing the data.

the effect of the shale boom is stronger when firms have higher litigation risk: the coefficients on interaction terms *Boom (indicator)* × High pollution (indicator), *Boom (indicator)* × Litigation county (indicator), and *Boom (indicator)* × High ex-ante litigation risk (indicator) are positive and significant at least 10 % level. In Panel B, we find that the coefficients on *Boom (indicator)* × High number of customers and suppliers (indicator) and Boom (indicator) × High number of business segments (indicator) are positive and significant at the conventional level, indicating that the treatment effect is more pronounced when the firm has more stakeholder interactions.[15] Lastly, in Panel C, the coefficients on Boom (indicator) × Old CEO (indicator) are negative and significant, and Boom (indicator) × High nontransient institutional ownership (indicator)) are positive and significant. These findings are consistent with the expectation that firms with long-run orientation increase environmental activities following shale booms.[16]

4.8. Effect of shale booms on other CSR activities

We investigate the association between shale booms and other CSR activities to further examine whether shale booms stimulate firms to devote other aspects of social activities. While shale gas drilling serves as a shock to the local community's environmental issues, it induces firms to reassess their social commitments to the local society. Thus it enhances firms' overall CSR activities. For this test, we estimate the OLS regression as in Equation (1), with the dependent variables being the other five dimensions of CSR (i.e., Community, Diversity, Employee relations, Product, and Human rights) and the aggregated CSR score being the sum of the six dimensions, including Environmental CSR.

Table A3 in the Appendix reports the results. First, in columns 1 and 2, we find the increasing impact of shale booms on aggregate CSR. However, the coefficients on *Boom*

[15] We investigate whether firms incorporated in states with a higher level of stakeholder orientation (i.e., the implementation of constituency statute) affect the relationship between the shale boom and environmental CSR. The moderating effect of constituency statutes is limited. This is likely because the distribution of incorporation is heavily concentrated in Delaware (64.3% of the sample).

[16] We have qualitatively similar results when interacting *Log (total shale wells)* variable with the variables in Table 6 and estimating the regressions (untabulated).

(indicator) and *Log (total shale wells)* are insignificant at the conventional level. Subsequent, we find that the coefficient on *Log (total shale wells)* is positive and significant in column 4, whereas that on *Boom (indicator)* is insignificant. This evidence suggests that shale booms make firms to exert their effort for the community. To the extent that the shale booms are environmental events that attract the community's attention, local firms significantly respond and increase engagement in the community's focal issues following the shale booms. In columns 5-12, the coefficients on *Boom (indicator)* and *Log (total shale wells)* are insignificant across all regressions. These results suggest that the shale booms do not lead to firms enhancing social activities for diversity, employment relations, product quality, and human rights.

The results show that shale gas development induces firms to prioritize environmental issues and commitments. Other CSR activities do not appear to be diving shale booms. The results suggest that the firms strategically choose their social activities based on specific social issues. The results contrast the view that CSR activities reflect community isomorphism or altruism (Marquis et al. 2007, Jha and Cox 2015, Hoi et al. 2018).

4.9. Shale boom, environmental CSR, and firm value

Our main findings indicate that shale booms induce firms to increase their environmental CSR by raising concerns. The natural question is whether the changes in environmental CSR can positively affect firm value. Thus, we explore the relationship between the firm's changes in environmental CSR due to the shale boom and future firm value. Similar to Gormley and Matsa's (2016) approach, we use only firms that experienced the shale boom and calculate the changes in Tobin's q from *Year t-1* to *Year t+n,* where *Year t* is a year when the boom occurred in the county where the firm operates. We construct an indicator that equals one if the firm's environmental CSR increases from *Year t-1* to *Year t+3* and zero otherwise. We then regress Tobin's q on the constructed indicator with year-fixed effects.

[Insert Table 7 here]

Table 7 reports the results. Firms with improved environmental rating after shale booms exhibit significant increases in firm value. In column 1, the coefficient of *Increase in environmental CSR (indicator)* is 0.498. This estimate indicates that compared with other firms, firms that increase environmental CSR have 49.8 percentage points higher Tobin's q, representing 25.3 % of the average Tobin's q in *Year t-1*. The benefits from the increased environmental CSR have persisted for ten years. The declining effect reaches approximately 132.5 percentage points by *Year t+10*. The results suggest that, following the rise of environmental issues in a community, firms that improve their environmental ratings are likelier to experience an increase in their firm value. These results thus imply a link between the environmental profile and firm value.

4.10. Shale booms and financial constraints

In this section, we address an alternative economic channel by which shale booms affect environmental CSR. Gilje (2019) and Gilje et al. (2016) show that shale gas discoveries increase local credit supply exogenously. Increased credit inflows help local firms improve their environmental performance and toxic emissions to the extent that the local credit shock relaxes the financial constraints of local firms (Xu and Kim, 2022). We expect the financial constraints to be relieved after the shale gas boom if it helps mitigate local firms' financial constraints. To address this alternative explanation, we test the impact of the shale boom on various financial constraint proxies: interest coverage, credit rating, dividend indicator, payout ratio, and leverage. We use a sample of firms in Table 3 and regress two shale boom variables (*Boom (indicator)* and *Log(total shale wells)*) on financial constraint proxies. In the regressions, we control for county fixed effects, state-year fixed effects, and time-varying county characteristics in Table 3. In addition, we include the natural logarithm of total assets, Cash, Capex, PPE, and Tobin's q as firm-level control variables (Xu and Kim, 2022).

Table A4 in the Appendix presents the results. After the shale boom, firms are likelier to be financially constrained. The shale booms are associated with lower interest coverage, lower credit rating, lower likelihood of paying dividends, and lower payout.[17] The firms that experience shale booms have higher leverage, but the coefficient on *Log (total shale wells)* is statistically insignificant. Overall, the results in Table A4 suggest that the exogenous increase in local credit supply does not necessarily lead to reducing local firms' financing conditions. Thus, these results provide little support for the view that the relaxation of financial constraints drives the positive relation between the shale boom and environmental CSR due to the increased local credit supply.

5. Conclusion

In this study, we examine whether the evolving environmental risk affects firms' environmental CSR. We hypothesize that firms in shale boom counties increase their environmental CSR based on the cost-benefit framework to the extent that shale gas extractions increase the expected legal liabilities, raise stakeholders' demand for environmental protection, and persist in the long-term.

Using environmental ratings from the KLD database from 2000-2013 period, and employing difference-in-differences tests, we discover that firms in shale boom counties have higher environmental CSR than those in nonboom counties. The rising environmental CSR is primarily driven by environmental strengths such as investments in low-carbon technologies and reductions in product packaging. The pre-treatment trends results show that the parallel assumption in the difference-in-differences design is satisfied. We document in cross-sectional analyses that the impact of shale booms is more pronounced when firms face higher risks of lawsuits or regulatory inspections (e.g., in a high-polluting industry), are affected by many stakeholders, and focus on long-term orientation. The results suggest that firms exert efforts to improve their environmental impact in response to stakeholders' demand for a clean environment.

[17] We set the highest rating (AAA) as 1 and the lowest (D) as 21. The positive coefficients on boom variables imply that the firm receives a worse rating after the shale boom.

In addition, we demonstrate that the effect of shale booms on other CSR activities (e.g., employee relations, diversity, human rights, and product) is limited because the shale gas shocks are closely attached to environmental issues. Moreover, we discover that shale boom firms that improve their environment rating increase their firm value. These results highlight the significance of environmental reputation when environmental issues arise in society.

This study has implications for environmental CSR. We find that firms efficiently allocate their resources in response to environmental risk, indicating that CSR activities generate competitive resources for the firm (Porter, 1991; Flammer, 2013). The evidence on firm value supports the view of doing well by doing good (Edmans, 2011; Deng et al., 2013; Lins et al., 2017). Even if the effect of environmental risk is ambiguous, environmental CSR improves alignment with stakeholders, which benefits firm value.

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Table 1. Summary statistics
This table presents summary statistics for a sample of 15,443 firm-year observations covered in MSCI ESG KLD STATS, Compustat, and Spectrum Institutional 13(F) fillings databases from 2000 to 2013. Panel A presents summary statistics of shale booms. Panel B presents the number of observations (N), mean, median (Median), standard deviation (STD), minimum (MIN), and maximum (MAX) for the variables in the sample. Appendix A1 provides detailed variable descriptions. All continuous variables are winsorized at the 1st and 99th percentile.

Variable	N	Mean	Median	STD	MIN	MAX
Panel A: Summary statistics of shale booms						
Number of states	28					
Number of counties	359					
Number of affected counties	88					
Panel B: Summary statistics of the sample						
Advertisement	15,443	0.011	0	0.03	0	0.183
Boom (indicator)	15,443	0.037	0	0.188	0	1
Cash	15,443	0.188	0.104	0.208	0.001	0.883
Dividend (indicator)	15,443	0.459	0	0.498	0	1
Environmental CSR	15,443	0.004	0	0.736	-5	5
Environment concerns	15,443	0.196	0	0.618	0	5
Environment strengths	15,443	0.2	0	0.613	0	5
Income per capita ($)	15,443	50,075	44,546	20,828	16,366	140,994
Institutional ownership	15,443	0.697	0.744	0.25	0	1.163
Leverage	15,443	0.206	0.172	0.198	0	0.905
Log (total shale wells)	15,443	0.184	0	0.701	0	4.06
Population (million)	15,443	1.825	1.200	2.173	0.008	9.987
ROA	15,443	0.106	0.111	0.13	-0.501	0.445
R&D intensity	15,443	0.037	0	0.076	0	0.438
Sale growth	15,443	0.103	0.055	0.235	-0.526	1.167
Social capital	15,443	-0.678	-0.748	0.797	-1.99	0.958
Tobin's q	15,443	2.009	1.522	1.388	0.78	8.628
Total assets ($ million)	15,443	8,651	1,226	48,060	1	2,175,052
Unemployment (%)	15,443	6.457	6.1	2.238	1.6	18.1

Table 2. Determinants of shale booms

This table presents the estimates of a Cox proportional hazards model. The sample consists of 2,862 county-year observations over the 359 counties in Panel A of Table 1. A failure event is the occurrence of a shale boom (i.e., *Boom (indicator)*) in a given county. Once the shale boom occurs, all subsequent years for the county are excluded. Explanatory variables are standardized to have a mean of zero and a standard deviation of one and are measured one year before the failure event. Appendix A1 provides detailed descriptions of all the firm and county variables. *P*-values are reported in parentheses, and standard errors are clustered at the county level. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
Log(population)	-0.248	-0.263	-0.256	-0.191	-0.174	-0.085
	(0.274)	(0.258)	(0.270)	(0.490)	(0.499)	(0.723)
Log(income per capita)	-0.571**	-0.560**	-0.565**	-0.588**	-0.897***	-1.071***
	(0.014)	(0.015)	(0.015)	(0.028)	(0.005)	(0.001)
Unemployment rate	0.303	0.312	0.305	0.518**	0.337	0.315
	(0.149)	(0.137)	(0.145)	(0.023)	(0.305)	(0.475)
Social capital	-0.205	-0.215	-0.214	0.069	0.568	0.443
	(0.483)	(0.464)	(0.466)	(0.836)	(0.178)	(0.305)
Averaged Environmental CSR	0.129		0.103	0.161	0.109	0.179
	(0.183)		(0.326)	(0.320)	(0.611)	(0.446)
Averaged CSR		0.108	0.044	-0.045	0.071	-0.076
		(0.404)	(0.766)	(0.805)	(0.774)	(0.750)
Change in Log(population)				0.082*	0.025	0.008
				(0.088)	(0.689)	(0.888)
Change in Log(income per capita)				0.258	0.330	0.445
				(0.358)	(0.402)	(0.278)
Change in the Unemployment rate				-0.273	-0.314	0.315
				(0.143)	(0.180)	(0.424)
Change in Social capital				-0.509	-0.522	-0.168
				(0.101)	(0.112)	(0.567)
Changed in Averaged environment CSR				-0.056	-0.024	-0.109
				(0.606)	(0.873)	(0.496)
Changed in Averaged CSR				0.137	0.073	0.085
				(0.315)	(0.643)	(0.638)
State fixed effects	No	No	No	No	Yes	No
State-year fixed effects	No	No	No	No	No	Yes
Observations	2,862	2,760	2,760	2,367	2,367	2,367
Pseudo R-squared	0.0367	0.0361	0.0368	0.0509	0.147	0.375

Table 3. Effect of shale boom on environment investment

This table presents the estimates of the ordinary least squares (OLS) regressions. The dependent variables are Environmental CSR, the difference between the number of environment strengths and the number of environment concerns (columns 1-2 and 7-10), Environment strengths (columns 3 and 4), and Environment concerns (columns 5 and 6). *Boom (indicator)* is an indicator that equals one if a county in which a firm is headquartered at year *t* is in the top quartile of all county years with shale well activity and zero otherwise. Once the variable is set to one, all subsequent years for the county are set to one. *Total shale wells* is the total number of shale wells drilled in the county from 2003 to year *t*. Appendix A1 provides detailed descriptions of all the firm and county variables. *P*-values are reported in parentheses, and standard errors are double clustered at county and year. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

	Environment CSR		Environment Strength		Environment Concerns		Environment CSR		Environment CSR	
							Firm FE		Exclude oil, financial, real estate and construct	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Boom (indicator)	0.150***		0.095**		-0.054		0.150**		0.122**	
	(0.005)		(0.016)		(0.114)		(0.022)		(0.049)	
Log(*total shale wells*)		0.036*		0.020		-0.016		0.048**		0.023
		(0.059)		(0.239)		(0.164)		(0.043)		(0.294)
Log(total assets)	0.016	0.016	0.147***	0.147***	0.132***	0.132***	-0.132***	-0.132***	0.055***	0.055***
	(0.160)	(0.158)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Leverage	-0.012	-0.012	0.030	0.030	0.042	0.042	0.151***	0.153***	-0.065**	-0.064*
	(0.650)	(0.671)	(0.213)	(0.204)	(0.106)	(0.108)	(0.006)	(0.005)	(0.047)	(0.051)
ROA	0.337***	0.337***	0.463***	0.463***	0.126***	0.125***	0.045	0.049	0.545***	0.545***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.005)	(0.005)	(0.512)	(0.469)	(0.000)	(0.000)
Tobin's q	0.011**	0.011**	0.015***	0.015***	0.004	0.004	-0.020***	-0.019***	0.012**	0.012**
	(0.015)	(0.015)	(0.000)	(0.000)	(0.224)	(0.225)	(0.003)	(0.003)	(0.011)	(0.011)
Cash	0.002	0.002	0.032	0.032	0.031	0.031	0.062	0.062	0.023	0.023
	(0.963)	(0.954)	(0.271)	(0.266)	(0.183)	(0.183)	(0.197)	(0.200)	(0.565)	(0.558)
R&D intensity	0.461***	0.463***	1.091***	1.092***	0.630***	0.629***	-0.434***	-0.432***	0.722***	0.724***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.003)	(0.003)	(0.000)	(0.000)
Advertising	0.863***	0.863***	0.499***	0.499***	-0.364***	-0.364***	-0.496	-0.479	0.687***	0.688***
	(0.000)	(0.000)	(0.002)	(0.002)	(0.000)	(0.000)	(0.277)	(0.294)	(0.000)	(0.000)
Sales growth	-0.106***	-0.105***	-0.051***	-0.051***	0.055**	0.054**	0.076***	0.076***	-0.063**	-0.063**
	(0.000)	(0.000)	(0.005)	(0.005)	(0.043)	(0.043)	(0.001)	(0.001)	(0.014)	(0.015)

Dividend (indicator)	-0.006	-0.006	0.073***	0.073***	0.079***	0.079***	0.053**	0.054**	-0.011	-0.011
	(0.711)	(0.704)	(0.000)	(0.000)	(0.000)	(0.000)	(0.037)	(0.034)	(0.567)	(0.567)
Institutional ownership	0.026	0.025	-0.121***	-0.121***	-0.146***	-0.146***	-0.075*	-0.075*	-0.028	-0.028
	(0.335)	(0.345)	(0.000)	(0.000)	(0.000)	(0.000)	(0.074)	(0.076)	(0.349)	(0.347)
Log(population)	-0.380*	-0.399*	-0.562***	-0.583***	-0.182	-0.183	-0.030	-0.028	-0.493*	-0.527*
	(0.085)	(0.070)	(0.001)	(0.000)	(0.208)	(0.205)	(0.339)	(0.383)	(0.078)	(0.061)
Log(income per capita)	0.152	0.128	-0.128	-0.146	-0.280**	-0.274**	-0.328***	-0.334***	0.140	0.120
	(0.301)	(0.384)	(0.259)	(0.201)	(0.014)	(0.016)	(0.002)	(0.002)	(0.405)	(0.472)
Unemployment rate	-0.025**	-0.026***	-0.025***	-0.025***	0.000	0.001	-0.034***	-0.035***	-0.033***	-0.034***
	(0.011)	(0.009)	(0.003)	(0.003)	(0.960)	(0.920)	(0.005)	(0.005)	(0.002)	(0.002)
Social capital	0.186***	0.186***	0.111***	0.111***	-0.075***	-0.075***	0.140***	0.140***	0.169***	0.170***
	(0.000)	(0.000)	(0.001)	(0.001)	(0.007)	(0.007)	(0.001)	(0.001)	(0.000)	(0.000)
County fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	No	No	Yes	Yes
Firm fixed effects	No	No	No	No	No	No	Yes	Yes	No	No
State-year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	15,443	15,443	15,443	15,443	15,443	15,443	15,443	15,443	12,022	12,022
Adjusted R-squared	0.141	0.140	0.245	0.245	0.257	0.257	0.471	0.471	0.178	0.177

Table 4. Pre-trend analysis

This table presents estimates of OLS regressions that examine the pre-trend effects of shale booms on environmental CSR. The dependent variables are Environmental CSR, the difference between the number of environment strengths and the number of environment concerns (column 1), Environment strengths (column 2), and Environment concerns (column 3). The regression specification is the same as that in column 1 of Table 2, except that *Boom (indicator)* has the following seven indicator variables: *Year t-2*, *Year t-1*, *Year t*, *Year t+1*, *Year t+2*, *Year t+3,* and *Year t+4*$^{+}$, where *Year t* is the first year of a shale boom and *Year t+4*$^{+}$ indicates four or more years after the boom. *P*-values are reported in parentheses, and standard errors are double clustered at county and year. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

	Environment CSR	Environment Strength	Environment Concern	Environment CSR	Environment Strength	Environment Concern
				Exclude oil, financial, real estate, and construct		
	(1)	(2)	(3)	(4)	(5)	(6)
Year t-2 (indicator)	0.034	0.052	0.017	0.053	0.032	-0.021
	(0.683)	(0.208)	(0.783)	(0.564)	(0.482)	(0.795)
Year t-1 (indicator)	0.030	0.071*	0.041	0.014	0.053	0.039
	(0.721)	(0.060)	(0.569)	(0.889)	(0.269)	(0.650)
Year t (indicator)	0.069	0.011	-0.059	0.019	-0.046	-0.065
	(0.195)	(0.830)	(0.211)	(0.801)	(0.499)	(0.353)
Year t+1 (indicator)	0.099*	0.022	-0.077	0.056	0.005	-0.051
	(0.082)	(0.624)	(0.122)	(0.458)	(0.929)	(0.489)
Year t+2 (indicator)	0.056	0.054	-0.002	-0.015	0.083	0.099
	(0.394)	(0.253)	(0.975)	(0.872)	(0.182)	(0.210)
Year t+3 (indicator)	0.313***	0.277***	-0.035	0.209*	0.278***	0.069
	(0.001)	(0.000)	(0.577)	(0.060)	(0.000)	(0.384)
Year t+4^{+} (indicator)	0.240***	0.159***	-0.081*	0.240***	0.173***	-0.066
	(0.001)	(0.003)	(0.066)	(0.002)	(0.004)	(0.187)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
County fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
State-year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	15,443	15,443	15,443	12,022	12,022	12,022
Adjusted R-squared	0.141	0.246	0.256	0.177	0.296	0.336

Table 5. Effect of shale boom on environmental CSR using propensity score-matched sample

This table presents the results of the effect of the shale boom on environmental CSR using a propensity score-matched sample. The propensity score-matched sample consists of 2,418 firm-year observations (149 firms that experience a shale boom and 149 control firms that do not experience a shale boom). The propensity score is calculated using logit regression of an indicator that experiences shale boom (i.e., *Boom (indicator)*) on the log (total assets), Leverage, ROA, Tobin's q, Cash, R&D intensity, Advertising, Sales growth, Dividend (indicator), and Institutional ownership. Matched firms must be in the same industry (two-digit SIC code) and the same year. Panel A compares matching variables between treatment firms and their control firms. Panel B presents the estimates of OLS regression in which the dependent variables are environmental CSR, the difference between the number of environment strengths and the number of environment concerns (columns 1 and 2), the number of environment strengths (columns 3 and 4), and the number of environment concerns (columns 5 and 6). *Boom (indicator)* is an indicator that equals one if a county in which a firm is headquartered at year *t* is in the top tercile of all county-years with shale well activity, and zero otherwise. Once the variable is set to one, all subsequent years for the county are set to one. *Total shale wells* is the total number of shale wells drilled in the county from 2003 to year *t*. Appendix A1 provides detailed descriptions of all the firm and county variables. *P*-values are reported in parentheses, and standard errors are double clustered at county and year. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

Panel A: Descriptive statistics for propensity score-matched firms

	Firms with a shale boom (149 firms)	Firms without a shale boom (149 firms)	Difference	*P*-value
Log (total assets)	7.279	7.583	-0.304	0.109
Leverage	0.235	0.226	0.009	0.668
ROA	0.119	0.125	-0.006	0.681
Tobin's q	1.738	1.611	0.127	0.188
Cash	0.122	0.101	0.021	0.2
R&D intensity	0.008	0.007	0.002	0.588
Advertising	0.009	0.007	0.002	0.465
Sales growth	0.088	0.06	0.028	0.224
Dividend (indicator)	0.537	0.611	-0.074	0.199
Institutional ownership	0.658	0.69	-0.032	0.306

Panel B: Effect of shale boom on environment investment

	Environment CSR		Environment Strength		Environment Concerns	
	(1)	(2)	(3)	(4)	(5)	(6)
Boom (indicator)	0.137*		0.113**		-0.023	
	(0.064)		(0.021)		(0.676)	
Log(*total shale wells*)		0.064**		0.042*		-0.022
		(0.025)		(0.088)		(0.284)
Log(total assets)	-0.013	-0.014	0.171***	0.171***	0.184***	0.184***
	(0.633)	(0.605)	(0.000)	(0.000)	(0.000)	(0.000)
Leverage	0.068	0.072	-0.013	-0.011	-0.081	-0.083
	(0.531)	(0.510)	(0.854)	(0.876)	(0.439)	(0.429)
ROA	0.182	0.187	0.488***	0.492***	0.307*	0.305*
	(0.334)	(0.318)	(0.002)	(0.002)	(0.057)	(0.057)
Tobin's q	0.001	-0.000	-0.001	-0.002	-0.002	-0.001
	(0.985)	(0.986)	(0.959)	(0.935)	(0.946)	(0.957)
Cash	-0.044	-0.045	-0.451***	-0.451***	-0.407***	-0.406***
	(0.793)	(0.789)	(0.000)	(0.000)	(0.000)	(0.000)

R&D intensity	3.034***	3.012***	3.410***	3.390***	0.376	0.378
	(0.001)	(0.001)	(0.000)	(0.000)	(0.510)	(0.506)
Advertising	4.620***	4.593***	1.379**	1.363**	-3.241***	-3.230***
	(0.000)	(0.000)	(0.014)	(0.015)	(0.000)	(0.000)
Sales growth	0.182	0.183	0.060	0.062	-0.121	-0.122
	(0.107)	(0.104)	(0.417)	(0.406)	(0.278)	(0.277)
Dividend (indicator)	0.148***	0.145***	0.129***	0.127***	-0.018	-0.018
	(0.003)	(0.003)	(0.000)	(0.000)	(0.600)	(0.617)
Institutional ownership	0.150	0.142	-0.211***	-0.216***	-0.361***	-0.358***
	(0.224)	(0.244)	(0.001)	(0.000)	(0.000)	(0.000)
Log(population)	-0.956*	-0.871	-1.236***	-1.233***	-0.281	-0.363
	(0.089)	(0.110)	(0.004)	(0.003)	(0.370)	(0.253)
Log(income per capita)	0.454	0.461	-0.179	-0.188	-0.633**	-0.649**
	(0.223)	(0.211)	(0.503)	(0.483)	(0.016)	(0.013)
Unemployment rate	-0.035	-0.030	-0.054	-0.050	-0.019	-0.021
	(0.503)	(0.567)	(0.178)	(0.212)	(0.503)	(0.477)
Social capital	0.477***	0.492***	0.392***	0.402***	-0.085	-0.091
	(0.000)	(0.000)	(0.000)	(0.000)	(0.240)	(0.210)
County fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
State-year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2,418	2,418	2,418	2,418	2,418	2,418
Adjusted R-squared	0.176	0.177	0.342	0.342	0.224	0.224

Table 6. Cross-sectional variation in the effect of shale booms

This table presents the estimates of the ordinary least squares (OLS) regressions that examine the cross-sectional variation in the shale boom effect. The dependent variable is environmental CSR, the difference between the number of environmental strengths and concerns. We interact *with Boom (indicator)* in each panel with various indicators. In Panel A, High pollution is an indicator that equals one if a firm operates in high-polluting industries and zero otherwise. Litigation county is an indicator that equals one if a county where the firm is located has environmental litigations and zero otherwise. High ex-ante litigation risk is an indicator that equals one if a firm's ex-ante litigation risk is in the top quartile and zero otherwise. In Panel B, the high number of customers and suppliers (business segments) is an indicator that equals one if above the sample median and zero otherwise. In Panel C, Old CEO is an indicator that equals one if CEO's age is above the sample median and zero otherwise. High nontransient institutional ownership is an indicator that equals 1 if a firm's ownership by nontransient institutions (i.e., quasi-indexer and dedicated institutions) is above the sample median and 0 otherwise. *Boom (indicator)* is an indicator that equals 1 if a county in which a firm is headquartered at year t is in the top tercile of all county-years with shale well activity, and zero otherwise. Once the variable is set to one, all subsequent years for the county are set to one. Appendix A1 provides detailed descriptions of all the firm and county variables. *P*-values are reported in parentheses, and standard errors are double clustered at county and year. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

Panel A: Litigation risk and the effect of shale booms

	Environmental CSR		
	(1)	(2)	(3)
Boom (indicator)	0.123**	0.061	0.082*
	(0.021)	(0.264)	(0.072)
High pollution (indicator)	-0.118***		
	(0.000)		
Boom (indicator) × High pollution (indicator)	0.410**		
	(0.028)		
Litigation county (indicator)		0.032	
		(0.162)	
Boom (indicator) × Litigation county(indicator)		0.145**	
		(0.027)	
High ex-ante litigation risk (indicator)			-0.018
			(0.344)
Boom (indicator) × High ex-ante litigation risk (indicator)			0.237*
			(0.073)
Control variables	Yes	Yes	Yes
County fixed effects	Yes	Yes	Yes
State-year fixed effects	Yes	Yes	Yes
Observations	15,443	15,443	14,907
Adjusted R-squared	0.143	0.141	0.141

Panel B: Stakeholders and the effect of shale booms

	Environmental CSR	
	(1)	(2)
Boom (indicator)	0.104**	0.074
	(0.034)	(0.154)
High number of customers and suppliers (indicator)	-0.018	
	(0.185)	
Boom (indicator) × High number of customers and suppliers (indicator)	0.121*	
	(0.099)	

High number of business segments (indicator)		0.012
		(0.389)
Boom (indicator) × High number of business segments (indicator)		0.164**
		(0.031)
Control variables	Yes	Yes
County fixed effects	Yes	Yes
State-year fixed effects	Yes	Yes
Observations	15,443	15,443
Adjusted R-squared	0.141	0.141

Panel C: Long-term horizon and the effect of shale booms

	Environmental CSR	
	(1)	(2)
Boom (indicator)	0.234**	0.055
	(0.013)	(0.294)
Old CEO (indicator)	-0.035*	
	(0.057)	
Boom (indicator) × Old CEO (indicator)	-0.226**	
	(0.012)	
High nontransient institutional ownership (indicator)		0.062***
		(0.000)
Boom (indicator) × High nontransient institutional ownership (indicator)		0.184**
		(0.010)
Control variables	Yes	Yes
County fixed effects	Yes	Yes
State-year fixed effects	Yes	Yes
Observations	9,797	15,443
Adjusted R-squared	0.178	0.142

Table 7. Firm value after environmental CSR increases

This table presents the estimates from firm-level regressions. Only firms that experienced shale booms are included in this analysis. The dependent variables are changes in Tobin's q from *Year t-1* to *Year t+n*, where *Year t* is the year when the shale booms begin. *An increase in environmental CSR* is an indicator that equals one if the firm experiences an increase in environmental CSR from *Year t-1* to *Year t+3* and zero otherwise. Appendix A1 provides detailed descriptions of all the firm variables. *P*-values are reported in parentheses, and standard errors are clustered at the county level. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

	Dependent variable = Change in Tobin's q				
	Year t-1 to *Year t+3*	*Year t-1* to *Year t+4*	*Year t-1* to *Year t+5*	*Year t-1* to *Year t+7*	*Year t-1* to *Year t+10*
	(1)	(2)	(3)	(4)	(5)
Increase in environmental CSR	0.498*	0.481***	0.432***	0.914***	1.325***
(Indicator)	(0.069)	(0.002)	(0.008)	(0.001)	(0.003)
Year fixed effects	Yes	Yes	Yes	Yes	Yes
Observations	105	99	93	83	54
Adjusted R-squared	0.033	-0.006	-0.042	-0.046	-0.019

Appendix A1. Definitions of the variables This table presents the definitions of the variables.

Variable	Definition
Environment and CSR variables (Source: MSCI ESG KLD database)	
Agriculture	An indicator that equals one if a firm is a substantial producer of agricultural chemicals and zero otherwise.
Benproduct	An indicator that equals one is if a firm proactively invests in products and services that address resource conservation and climate change issues and zero otherwise.
Cleanenergy	An indicator that equals one is if a firm proactively invests in low-carbon technologies and increases the carbon efficiency of its facilities or products and zero otherwise.
Climchange	An indicator that equals one is if a company has controversies related to its climate change and energy-related policies and initiatives and zero otherwise.
Community	Total number of community strengths - Total number of community concerns.
CSR	Sum of environment, community, diversity, employee relations, product, and human rights.
Diversity	Total number of diversity strengths - Total number of diversity concerns.
Employee relations	Total number of employee relations strengths - Total number of employee relations concerns.
Environmental CSR	Environment strength – Environment concerns
Hazardous waste	An indicator that equals one if a firm's liabilities for hazardous waste sites exceed $50 million or the company has recently paid substantial fines or civil penalties for waste management violations and zero otherwise.
Human rights	Total number of human rights strengths - Total number of human rights concerns
Ozone	An indicator that equals one if a firm is among the top manufacturers of ozone-depleting chemicals such as HCFCs, methyl chloroform, methylene chloride, or bromines, and zero otherwise.
Othercon	An indicator that equals one if a firm has controversies related to its environmental impact that is not covered by other MSCI ESG environmental metrics and zero otherwise.
Otherstr	An indicator that equals one if a firm has environment-friendly policies, programs, and initiatives not covered by other MSCI ESG environmental metrics and zero otherwise.
Polprevent	An indicator that equals one if a firm has strong programs and performance in reducing toxic emissions and zero otherwise.
Product	Total number of product strengths - Total number of product concerns
Recycle	An indicator that equals one if a firm proactively reduces the environmental impact of their packaging, including using recycled content material and establishing take-back and recycling programs, and zero otherwise.
Regulatory	An indicator that equals one if a firm paid averaged $40,000 or more in settlements, fines, and/or penalties and zero otherwise.
Submission	An indicator that equals one if a firm has controversies related to its non-GHG emissions and zero otherwise.
Firm characteristics (Source: Compustat unless the variables specify the data source)	
Advertising	Advertising expense (*xad*) divided by total assets (*at*). Missing values are set to zero.
Boom (indicator)	An indicator that equals 1 if a county in which a firm is headquartered at year *t* is in the top tercile of all county-years

	with shale well activity, and 0 otherwise. Once the variable is set to 1, all subsequent years for the county are set to 1.
Capex	Capital expenditures (*capx*) divided by total assets (*at*).
Cash	Current assets (*act*) divided by total assets(*at*).
Credit rating	A categorical variable based on S&P domestic long-term credit ratings (*splticrm*): 1 if the rating is AAA; 2 if the rating is AA+, 3 if the rating is AA, and so on. 21 if the rating is D.
Dividend (indicator)	An indicator that equals one if a firm has a dividend (*dvc*) in a given fiscal year and zero otherwise.
High ex-ante litigation risk (indicator)	An indicator that equals one if a firm's ex-ante litigation risk is in the top quartile of the sample and zero otherwise. Following Model 2 in Kim and Skinner (2012), we compute the ex-ante litigation risk as follows: 0.180 × FPS Industry indicator + 0.463 × log(Total assets) + 0.553 × Sales growth - 0.498 × Stock return - 0.359 × Stock return skewness + 14.437 × Stock return standard deviation + 0.0004 × Stock turnover.
High nontransient institutional ownership (indicator)	An indicator that equals one if a firm's ownership by nontransient institutions is above the median and zero otherwise. Nontransient institutions indicate the quasi-indexer and dedicated institutions classified by Bushee (1998).
High number of business segments (indicator)	An indicator that equals one if the number of business segments of a firm is above the sample median and zero otherwise.
High number of customers and suppliers (indicator)	An indicator that equals one if the number of customers and suppliers of a firm is above the sample median and zero otherwise.
High pollution (indicator)	An indicator that equals one if a firm operates in seven high-polluting industries. The seven industries are metal mining (NAICS code 212), electric utilities (2211), chemicals (325), primary metals (331), paper, food, beverage, and tobacco (311 and 312), and hazardous waste management (5622 and 5629). Following Flammer and Kacperczyk (2015), we change the North American Industrial Classification (NAICS) code into four-digit SIC codes for classification.
Increase in environmental CSR (indicator)	An indicator that equals one if the firm experiences a decrease in environmental CSR from *Year t-1* to *Year t+3* and zero; otherwise, where *Year t* is a year when the shale boom begins.
Institutional ownership	The proportion of common shares held by institutional investors. Source: Spectrum Institutional 13(F) fillings.
Interest coverage	Operating income before depreciation (*oibdp*) divided by interest payment (*xint*)
Leverage	Total debt (*dltt*+*dlc*) divided by total assets (*at*).
Litigation county(indicator)	An indicator that equals one if a county (based on the location of the administrative office of the US court) where the firm has environment litigations (Nature of Suit code=893) and zero otherwise. Source: FJC Civil Integrated Database
Old CEO (indicator)	An indicator that equals one if a firm's CEO age is above the sample median and zero otherwise. Source: Execucomp
Payout ratio	The sum of dividend payment and share repurchases (*dvt*+*prstkc*) divided by operating income before depreciation (*oibdp*)
PPE	Total net of property, plant, and equipment (*ppent*) divided by total assets (*at*).
ROA	Cash flows from operations (*oibdp*) divided by total assets(*at*).
R&D intensity	Research and development expense (*xrd*) divided by total

	assets (*at*). Missing values are set to zero.
Sale growth	Change in sales (*sale*) divided by lagged total assets (*at*).
Tobin's q	The market value of assets (*at-ceq+csho*prcc_f*) is divided by the book value of assets (*at*).
Total assets ($ million)	Total assets (*at*).
Total shale wells	Total shale wells is the total number of shale wells drilled in the county from 2003 to year t.
County characteristics	
Averaged CSR	Average CSR of all firms located in a county
Averaged environment CSR	Average environmental CSR of all firms located in a county
Population	The population of a county. Source: Census Bureau.
Income per capita	The income per capita in a county. Source: Census Bureau
Unemployment	The unemployment rate in a county. Source: Local Area Unemployment Statistics of the US Bureau of Labor Statistics
Social capital	The measure of the social capital at the county level. Source: Northeast Regional Center for Rural Development, Rupasingha and Goetz (2008)

Appendix A2. Effect of shale boom on environmental CSR: Subcategory analyses

This table presents the estimates of the ordinary least squares (OLS) regressions. The dependent variables are the subcategories of environmental CSR. The dependent variables are indicators of five environmental strengths (Beneficial Products, Pollution Prevention, Recycling, Clean Energy, and Other Strength) and seven environmental concerns (Hazardous waste, Regulatory Problems, Ozone Depleting Chemicals, Substantial Emissions, Agriculture Chemicals, Climate Change, and Other Concern). *Boom (indicator)* is an indicator that equals one if a county in which a firm is headquartered at year *t* is in the top tercile of all county-years with shale well activity, and zero otherwise. Once the variable is set to one, all subsequent years for the county are set to one. Panel A has the same control variables and fixed effects as column 1 of Table 3. In Panel B, the county-fixed effects are replaced with firm-fixed effects. Appendix A1 provides detailed descriptions of all the firm and county variables. *P*-values are reported in parentheses, and standard errors are double clustered at county and year. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

	Environment strength					Environment concerns						
	Benproduct	Polprevent	Recycle	Cleanenergy	Otherstr	Hazardwaste	Regulatory	Submission	Climchange	Agriculture	Ozone	Othercon
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Panel A. County fixed effects												
Boom (indicator)	-0.000	0.009	0.025***	0.059***	0.004	-0.029***	-0.016	-0.023	-0.010	0.010***	0.001*	-0.011
	(0.983)	(0.422)	(0.002)	(0.002)	(0.729)	(0.001)	(0.156)	(0.180)	(0.563)	(0.003)	(0.086)	(0.180)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
County fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State-year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	13,203	14,726	10,820	14,695	13,128	10,369	15,428	13,207	15,443	10,369	10,369	13,051
Adjusted R-squared	0.118	0.068	0.117	0.187	0.198	0.191	0.167	0.175	0.233	0.188	0.088	0.069
Panel B. Firm fixed effects												
Boom (indicator)	-0.012	0.028**	0.030***	0.060***	-0.013	-0.026***	-0.030**	-0.014	0.001	-0.001	0.000	-0.001
	(0.552)	(0.049)	(0.002)	(0.008)	(0.562)	(0.001)	(0.026)	(0.491)	(0.974)	(0.292)	(0.556)	(0.946)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State-year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	13,203	14,726	10,820	14,695	13,128	10,369	15,428	13,207	15,443	10,369	10,369	13,051
Adjusted R-squared	0.426	0.249	0.543	0.389	0.277	0.842	0.532	0.511	0.670	0.879	0.887	0.502

Appendix A3. Effect of shale boom on other CSR investments

This table presents the estimates of the ordinary least squares (OLS) regressions. The dependent variables are CSR, Community, Diversity, Employee relations, Product, and Human rights. *Boom (indicator)* is an indicator that equals one if a county in which a firm is headquartered at year *t* is in the top tercile of all county-years with shale well activity, and zero otherwise. Once the variable is set to one, all subsequent years for the county are set to one. *Total shale wells* is the total number of shale wells drilled in the county where a firm is headquartered from 2003 to year *t*. Appendix A1 provides detailed descriptions of all the firm and county variables. *P*-values are reported in parentheses, and standard errors are double clustered at county and year. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

	CSR		Community		Diversity		Employee relations		Product		Human rights	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Boom (indicator)	0.175		0.033		-0.003		0.045		-0.020		-0.029	
	(0.181)		(0.257)		(0.951)		(0.457)		(0.533)		(0.224)	
Log(*total shale wells*)		0.057		0.020**		0.001		-0.012		0.007		0.005
		(0.285)		(0.049)		(0.970)		(0.622)		(0.516)		(0.412)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
County fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State-year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	15,443	15,443	15,443	15,443	15,443	15,443	15,443	15,443	15,443	15,443	15,443	15,443
Adjusted R-squared	0.214	0.214	0.129	0.129	0.384	0.384	0.195	0.195	0.165	0.165	0.074	0.074

Appendix A4. Effect of shale boom on financial constraints

This table presents the estimates of the ordinary least squares (OLS) regressions. The dependent variables are interest coverage, credit rating score, dividend (indicator), payout ratio, and leverage. *Boom (indicator)* is an indicator that equals ONE if a county in which a firm is headquartered at year *t* is in the top tercile of all county-years with shale well activity, and zero otherwise. Once the variable is set to one, all subsequent years for the county are set to one. *Total shale wells* is the total number of shale wells drilled in the county where a firm is headquartered from 2003 to year *t*. Appendix A1 provides detailed descriptions of all the firm and county variables. P-values are reported in parentheses, and standard errors are double clustered at county and year. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

	Interest coverage		Credit rating		Dividend (indicator)		Payout ratio		Leverage	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Boom (indicator)	-47.778***		0.202		-0.063***		-0.061*		0.025***	
	(0.000)		(0.183)		(0.008)		(0.061)		(0.010)	
Log(*total shale wells*)		-7.151**		0.182***		-0.023***		-0.019*		0.005
		(0.047)		(0.000)		(0.003)		(0.061)		(0.149)
Log(total assets)	-3.122*	-3.175*	-1.501***	-1.500***	0.097***	0.097***	0.030***	0.030***	0.014***	0.014***
	(0.056)	(0.051)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Cash	79.443***	79.126***	1.866***	1.862***	-0.208***	-0.208***	0.075*	0.075*	-0.244***	-0.243***
	(0.003)	(0.003)	(0.000)	(0.000)	(0.000)	(0.000)	(0.058)	(0.058)	(0.000)	(0.000)
Capex	246.489***	246.785***	1.533*	1.584*	-0.933***	-0.935***	-0.429***	-0.430***	-0.507***	-0.507***
	(0.000)	(0.000)	(0.071)	(0.061)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
PPE	-76.566***	-77.184***	0.151	0.136	0.214***	0.214***	-0.060**	-0.060**	0.231***	0.232***
	(0.000)	(0.000)	(0.550)	(0.590)	(0.000)	(0.000)	(0.014)	(0.014)	(0.000)	(0.000)
Tobin's q	12.462***	12.422***	-0.900***	-0.900***	0.019***	0.019***	0.011**	0.011**	0.011***	0.011***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.016)	(0.017)	(0.001)	(0.001)
Log(population)	-116.009*	-97.801*	2.160***	2.517***	-0.256**	-0.274**	0.152	0.143	0.179***	0.174***
	(0.052)	(0.100)	(0.004)	(0.001)	(0.030)	(0.020)	(0.211)	(0.236)	(0.000)	(0.000)
Log(income per capita)	-22.155	-13.619	1.494**	1.633**	-0.196***	-0.192**	-0.038	-0.033	0.063*	0.060*
	(0.668)	(0.792)	(0.027)	(0.015)	(0.009)	(0.011)	(0.725)	(0.762)	(0.074)	(0.087)
Unemployment rate	-1.211	-1.074	0.200***	0.205***	-0.009**	-0.009**	-0.010	-0.010	0.001	0.001
	(0.697)	(0.730)	(0.000)	(0.000)	(0.028)	(0.028)	(0.203)	(0.207)	(0.773)	(0.794)
Social capital	-7.908	-7.976	0.554***	0.543***	-0.065***	-0.065***	0.074**	0.074**	0.019**	0.019**
	(0.580)	(0.578)	(0.000)	(0.000)	(0.001)	(0.001)	(0.014)	(0.014)	(0.050)	(0.049)

County fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State-year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	12,046	12,046	6,055	6,055	14,815	14,815	13,777	13,777	14,815	14,815
Adjusted R-squared	0.088	0.087	0.565	0.565	0.320	0.320	0.043	0.043	0.202	0.202