Capital Structure Under Climate Change: The Roles of Social Norms and Regulatory Risk

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Abstract

In the face of growing climate-related challenges, firms are increasingly influenced by external pressures in shaping their decisions including the choices of financial sources. This paper explores how climate change social norms (CCSN) and regulatory risk influence firms' capital structure decisions. Using the data from the Yale Climate Opinion Maps, we measure societal pressures related to public climate change awareness across regions. Regulatory risk is captured at the firm level using machine learning techniques that assess firms' exposure to climate-related discussions in earnings calls. Our analysis reveals a significant negative association between firms' reliance on long-term debt and CCSN or regulatory risk, suggesting that firms reduce them in response to these external pressures. In contrast, short-term debt shows a positive association with CCSN, indicating a shift towards shorter-term liabilities. Further analysis reveals that these effects are amplified for financially distressed and highly emitted firms. These findings are crucial for policy designs aiming to raise public awareness of sustainability and reduce emissions while ensuring that businesses are not overburdened with excessive financial costs.

Keywords: Climate change social norms; Regulatory risks; Capital structure.

Introduction

Climate change is an urgent and pressing issue, posing significant risks to both the environment and human societies (Hayward, 2012; Popovski & Mundy, 2012). The growing awareness of this issue, combined with the urgency to address it, has led to increasing pressure on firms from a range of stakeholders. While financial investors have traditionally been key players in exerting pressure on firms regarding these risks (Krueger et al., 2020; Bolton & Kacperczyk, 2021), this scrutiny has expanded to include broader forces such as regulatory bodies (Ivanov et al., 2024; Kepa & Moslener, 2024). A recent survey by Stroebel & Wurgler (2021) found that regulatory activities are expected to pose the most significant climate-related risks in the near future, followed by stakeholder pressures, including changing preferences among employees and customers. As existing research indicates, social norms—the shared beliefs and expectations within a community—are also playing an increasingly prominent role in shaping corporate behavior (Hilary & Hui, 2009; Callen & Fang, 2015). These norms exert informal but powerful pressure on firms to align their actions with broader societal values. In regions where environmental values are strongly emphasized, firms are responding by adopting precautionary strategies. For example, they often reduce their workforce and scale down operations in response to prolonged temperature surges (Li et al., 2020) or maintain higher levels of cash reserves to prepare for future environmental activities (Zhang et al., 2024).

Building on this context, our study seeks to explore how these external factors, particularly climate change social norms (CCSN) and regulatory risk, shape firms' capital structures. CCSN represents the social pressures related to climate change awareness, which can vary significantly across regions. Using survey data from the Yale Climate Opinion Maps (YCOM), we follow existing research to define and construct a composite measure of CCSN, capturing the level of public concern around climate change in different states (Cialdini & Jacobson, 2021; Zhang et al., 2024). For regulatory risk, we utilize firm-level data from Sautner et al. (2023), who applied machine learning techniques to assess a firm's exposure to climate-related regulatory risks based on the content of earnings calls. This approach captures the frequency and depth of conversations, both from management presentations and discussions with analysts, regarding regulatory interventions, thereby reflecting firms' concerns about compliance costs and environmental regulations.

Our findings show an inverse relationship between firms' long-term debt levels and external pressures such as climate change social norms (CCSN) and regulatory risk, with higher pressures associating with lower long-term debt usage. This finding aligns with previous research, which highlights that both social norms and regulatory risks are increasingly recognized as critical factors influencing corporate decision-making (Zhang et al., 2024; Ivanov et al., 2024). Additionally, highly emitted firms face unique risks in the transition to a low-carbon economy due to evolving societal norms, shifts in consumer preferences, and technological uncertainties. They are also subject to growing scrutiny from investors and credit providers, who increasingly prioritize environmental performance (Chava, 2014; Krueger et al., 2020; Bolton & Kacperczyk, 2021; Ilhan et al., 2023). We further test whether highly emitted firms, given their heightened exposure to regulatory risk and CCSN, adjust their capital structures differently from less environmentally exposed firms. The results reveal that these firms significantly reduce their total and long-term debt, reflecting the intense pressure they face to adapt to regulatory and societal demands. Furthermore, financially distressed firms operate under tight financial constraints and heightened default risk, making them more vulnerable to external shocks. Research indicates that regulatory compliance costs increase their operational burden, while indirect costs, such as reduced investments in productive activities like R&D, further strain their financial health (Kneller & Manderson, 2012; Jaraite et al., 2014). We further test and show that distressed firms reduce their reliance on total debt more aggressively than non-distressed firms, suggesting that these firms respond more conservatively to CCSN and regulatory risk in their capital structure decisions.

We conducted several robustness checks to validate our findings. First, we used the 2016 Paris Agreement as a quasi-experimental approach to address potential firm-level endogeneity concerns related to regulatory risk. Specifically, we applied propensity score matching (PSM) to create a matched sample of control and treated firms that were significantly impacted by the accord. Then, we used a Difference-in-Differences (DiD) model to isolate the impact of regulatory risk on treated firms compared to the control group, demonstrating its causal effect on capital structure. For state-level CCSN, we employed a two-stage least squares (2SLS) approach with instrumental variables, including the adoption of climate action plans (CAP) and the political orientation of a state (specifically, whether it is politically Democratic). These tests mitigate endogeneity concerns for both regulatory risk and CCSN. Additionally, we used multilevel models to account for firm- and state-level variations, confirming consistent effects of CCSN and regulatory risk on debt ratios. Subsample analyses were also performed, excluding key election years and specific states to ensure that political events or regional outliers did not skew the results. Finally, given the multifaceted nature of CCSN, we tested alternative measures, such as behavioral questionnaires and the number of registered electric vehicles per state as a descriptive norm, with results remaining robust across these specifications.

This paper contributes to the literature in three folds. First, we provide empirical evidence of a strong negative relationship between CCSN, regulatory risk, and firms' total debt and long-term debt ratios, while documenting a positive relationship between CCSN and short-term debt. These findings suggest that firms reduce their long-term debt exposure as a response to both societal and regulatory pressures, opting instead for short-term financing to maintain financial flexibility in the face of uncertainty. This adds to the literature on capital structure by introducing CCSN and regulatory risk as important external determinants of corporate leverage, expanding beyond the traditional focus on firm-specific factors.

Second, we contribute to the growing body of research on the impact of social norms on economic behavior. While previous studies have examined the influence of norms such as religion, societal trust, or gambling attitudes on corporate decisions (Callen & Fang, 2015; Hilary & Hui, 2009; Kumar et al., 2011), we empirically examine the impact of climate change social norms (CCSN)—a key social norm in today's environmental context—on firms' capital structure decisions. Closely related work by Zhang et al. (2024) investigates the effect of CCSN on cash holdings. By focusing on the relationship between climate-related social expectations and financial strategies, we expand the understanding of how external social pressures shape firms' economic behavior.

For policymakers, recognizing these financial adjustments is essential for designing regulations that support, rather than impede, firms' capacity to invest in environmental transitions. Initiatives such as green bonds, grants, and subsidies can play a crucial role in bridging the debt financing gap for sustainable projects (Azhgaliyeva et al., 2020; Qadir et al., 2021).

The remainder of the paper is structured as follows: Section 2 presents the literature review and develops the hypotheses. Section 3 outlines the data and methodology and provides descriptive statistics. Section 4 covers the main results, analysis, and robustness checks. Finally, Section 5 offers concluding remarks.

2. Literature review and conceptualization

2.1. Social norms

Social norms are defined as the predominant behaviors, attitudes, beliefs, and codes of conduct within a group (Cialdini & Jacobson, 2021). There are generally two key distinctions for defining social norms: descriptive and injunctive (Cialdini & Trost, 1998; Kallgren et al., 2000). Descriptive norms refer to what most people do - the most commonly observed behavior in a given situation, typically adopted by the majority. Injunctive norms, on the other hand, refer to what most people approve of doing. Morris et al. (2015) used metaphors to describe these norms as navigational tools, associating descriptive norms to a ship's autopilot and injunctive norms to its radar, guiding behavior accordingly. Autopilot allows a ship to maintain a steady course without constant human intervention, keeping it on the correct trajectory. While radar provides a vision of the ship's location relative to its destination, helping to guide its direction. Melnyk et al. (2011) provided evidence supporting the idea that compliance with descriptive norms can serve as a heuristic shortcut, simplifying decision-making by reducing the cognitive effort required. While Morris et al. (2015) noted that adherence to injunctive norms often involves strategic considerations about social status and material benefits. Therefore, we will focus on injunctive norms as our primary measure of social norms concerning climate change, as they better capture the role of social approval, expectations, and the pressure individuals may feel to align with widely accepted behaviors.

When individuals identify as part of a group, they tend to experience a cognitive shift, perceiving themselves in terms of the group's typical behaviors and attitudes rather than their own unique personal traits (Terry & Hogg, 1996; Vignoles & Moncaster, 2007). Norms within a community arise not from individuals' inner selves, but from their shared social context (Morris et al., 2015). Since norms are viewed as context-specific regulators of behavior rather than inherent traits, they provide greater insight into how behavior patterns differ across situations and contexts (Henrich et al., 2005; Gelfand et al., 2013). Previous studies have also explored how different norms influence corporate behavior. For instance, companies situated in areas with strong religious influences tend to be more risk-averse financially and are less likely to commit financial reporting errors, illustrating the significant impact of local culture and societal expectations on corporate practices (Hilary & Hui, 2009; McGuire et al., 2012).

Regarding climate change, prior research has demonstrated that social norms can significantly influence individual energy conservation behaviors. When households learn about their neighbors' efforts to reduce energy consumption, they are significantly more likely to adjust their own energy usage in response (Nolan et al., 2008; Allcott, 2011). Furthermore, Hu (2022) demonstrated that households with friends who have experienced flooding or been targeted by flood insurance campaigns are 1-5 percent more likely to increase their flood insurance purchases. Similarly, research on the sustainable food movement has explored the role of normative strategies in decisions about purchasing green food products (Kim & Chung, 2011; Thøgersen et al., 2012) and the influence of social norms on buying sustainable groceries (Hanss & Böhm, 2013).

2.2 CCSN and capital structure

Environmental risks – ranging from regulatory challenges, such as fines or new compliance demands, to physical threats from climate events like hurricanes or droughts (Dessaint & Matray, 2017; Hong et al., 2019), and transitional risks associated with the shift to a greener economy, which may render certain technologies obsolete or lead to stranded assets (Delis et al., 2024) - are becoming increasingly significant for firms. Norms shaped by peer actions and societal expectations suggest that managers in high CCSN areas are particularly mindful of reputational risks, prompting them to align their strategies closely with prevailing social expectations (Cialdini & Goldstein, 2004; Goldstein et al., 2008). Managers in these regions tend to integrate these risks more thoroughly into their strategic decisions. Zhang et al. (2024) show that there is a positive relationship between CCSN and corporate cash reserves, suggesting that managers tend to maintain higher cash levels to facilitate future investments in environmental initiatives. Their findings further reveal that companies in regions with weaker CCSN have lower cash reserves even when exposed to considerable climate risks. This financial vulnerability could negatively impact a broad range of stakeholders, especially when climate risks are elevated. In this sense, being able to absorb these shocks is critical, and by maintaining financial flexibility by lowering debt levels (Gorbenko & Strebulaev, 2010; Fahlenbrach et al., 2021), managers ensure that their firms retain the financial agility needed to respond to sudden environmental incidents, invest in emerging technologies, or modify operational strategies without the limitations imposed by significant debt repayments. On the credit supply side, difficulties in verifying firms' actual environmental commitments, due to the potential for greenwashing, increase information asymmetry (Delmas & Burbano, 2011; Doan & Sassen, 2020). This ambiguity adds uncertainty for lenders, who face a higher risk of misrepresentation regarding firms' sustainability practices (Maroun, 2020; Abeysekera et al., 2021). Consequently, lenders are required to conduct more thorough due diligence, raising the cost and complexity of lending, especially in societies with strong environmental awareness, where public expectations demand comprehensive environmental disclosure (Thompson & Cowton, 2004). As climate change is increasingly recognized as a key risk factor influencing loan terms and conditions (Javadi & Masum, 2019), it is reasonable to expect that in regions with higher CCSN, lenders may need to adapt their risk assessment models accordingly. Such adjustments result in more conservative lending practices, characterized by higher interest rates and less borrower-friendly loan provisions (Brown et al., 2021), prompting them to reduce their debt levels. Based on these observations, we propose the following hypothesis:

H1: Firms in regions with stronger climate change social norms are expected to have more conservative debt structures.

2.3 Regulatory risk and capital structure

Environmental risk has become a key consideration in credit risk management, with banks increasingly assessing firms' environmental criteria in determining loan terms (Javadi & Masum, 2019). Firms with poor environmental performance face risks such as liabilities for pollution cleanup and reputational damage, which can undermine financial stability and earning potential (Thompson & Cowton, 2004; Mengze & Wei, 2015). This risk perception results in tougher borrowing conditions or higher financing costs, as lenders adjust to the potential for regulatory changes and compliance costs. Research has established that regulatory risks associated with climate policy—whether through market-driven mechanisms or direct regulatory controls (Lamperti et al., 2020)—can significantly impact a firm's creditworthiness, as firms may face new financial pressures and compliance costs (Capasso et al., 2020; Delis et al., 2024). As policymakers set ambitious environmental targets, firms whose business models fail to align with these standards face heightened risks of financial instability and potential default (Kempa & Moslener, 2024). These climate regulations impose direct compliance costs on firms, often necessitating investments in cleaner technologies or incurring expenses related to carbon pricing mechanisms, such as purchasing emission allowances or paying carbon taxes (Engau & Hoffmann, 2011).

In addition to direct costs, climate regulations also lead to indirect compliance costs that can constrain firms' financial health over time. Regulatory demands often crowd out other productive investments, reducing firms' ability to allocate resources toward projects that could enhance growth or profitability. Consequently, funds that might have supported expansion, R&D, or other revenue-generating activities are redirected toward meeting regulatory requirements (Pizer & Kopp, 2005; Kneller & Manderson, 2012). Research by Ivanov et al. (2024) further indicates that firms exposed to regulatory measures, such as California's cap-and-trade system, face higher interest rates on bank loans, suggesting that lenders also perceive elevated financial risks in these firms.

These observations highlight the financial pressures stemming from regulatory risk. As a result, firms with greater exposure to regulatory risks are likely to maintain lower debt ratios, aiming to buffer against the financial demands and uncertainties of an evolving regulatory environment. Therefore, we hypothesize:

H2: Firms with higher climate regulatory risks are expected to have more conservative debt structures.

2.4 The joint impact of CCSN and regulatory risk

Given that CCSN reflects societal expectations for environmental responsibility, and regulatory risk represents formal policy-driven pressures, we expect that the combination of high CCSN and regulatory risk will have a compounded effect on firms' debt decisions. In regions with strong CCSN, managers are likely to feel a normative obligation to align corporate practices with community values (Vignoles & Moncaster, 2007; Gelfand et al., 2013). When this social pressure is coupled with high regulatory risk, the perceived coercive pressure intensifies, creating a dual motivation to adopt conservative financial practices. In such environments, managers may assess the risks associated with debt more cautiously, anticipating future regulations that could impose additional financial burdens. The prospect of stricter environmental policies amplifies concerns about compliance costs, potential penalties, and reputational damage, making it costlier to maintain higher leverage. This dual pressure from social and regulatory sources makes a conservative capital structure a prudent response, as firms aim to safeguard against both social backlash and regulatory penalties. Consequently, we hypothesize:

H3: Firms in regions with high climate change social norms and high regulatory risk are expected to have more conservative debt structures.

3. Data and empirical design

3.1 Data sources and key variables

We first extract our accounting data from Compustat annual reports. Following established data pre-processing protocols (Frank & Goyal, 2003; Fahlenbrach et al., 2020), we excluded companies under specific regulations impacting their capital structures, notably financial institutions with Standard Industrial Classification (SIC) codes from 6000 to 6999. We also removed utility companies and NGOs with SIC codes from 4900 to 4949, and those beginning with 8000s and 9000s. Firms lacking total asset data, or reporting negative figures for cash, short-term investments, and sales were omitted. Our final sample comprised 26,221 firm-year observations spanning from 2010 to 2022.

While CCSN is a multifaceted and emerging concept, foundational understandings of social norms have been shaped by Cialdini et al. (1990) and McGuire et al. (2012). Zhang et al. (2024) extend these insights, using survey data on environmental attitudes to measure CCSN. Following Zhang et al. (2024), we use three specific questions from the Yale Climate Opinion Maps (YCOM) survey to measure this variable. These questions, which have been consistently included in the survey over the years, gauge respondents' perceptions by calculating the percentage of people by state (1) "who think that global warming is happening"; (2) "who think that global warming will harm people in the US a moderate amount/a great deal" and (3) "who are somewhat/very worried about global warming? Then, we apply principal component analysis (PCA) to those three selected questions and extract the first major component. This component is used as our measure for CCSN. A higher value on this measure indicates a greater level of CCSN, reflecting stronger community consensus regarding climate change. We subsequently use data on the number of registered electric vehicles per state from the US Department of Energy as a proxy of social norm in our robustness tests.

We leverage firm-level regulatory risks derived from Sautner et al. (2023), who employ machine learning techniques to evaluate firm-level climate change exposure, including regulatory risks, by examining relevant keywords in earnings calls. The measure is quantified by counting the frequency of specific bigrams, such as “carbon taxes” or “cap and trade markets,” which reflect regulatory interventions. These bigrams are identified throughout the entirety of the earnings calls, including both management presentations and discussions with analysts. Therefore, the measure reflects not only the salience of climate issues for management but also the combined view of key stakeholders about firms’ climate change regulatory exposure. We utilize the global company key along with the US zip codes of the firms' headquarters to integrate regulatory risk data and CCSN data from Yale’s database back into Compustat.

3.3 Empirical design

To test our hypotheses, we examine various indicators for our dependent variables (*D*), including total debt relative to assets (Debt_total), long-term debt relative to assets (Debt_LT), and short-term debt relative to assets (Debt_ST). For each measure, we proceed to estimate the following baseline model:

$$D_{it} = \alpha + \beta X_{it} + \theta Firm\ Control_{it} + Industry\ FE_i + Year\ FE_t + \epsilon_{it} \quad (1)$$

where we, in turn, use CCSN and regulatory risk as *X* in the equation to test the first and second hypotheses. Control variables and fixed effects of industrial sectors and years are included in the baseline model. We then incorporate the interaction term between CCSN and regulatory risk, keeping the overall setup unchanged, to test the third hypothesis.

Following the literature (Rajan & Zingales, 1995; Frank & Goyal, 2009), we include a wide range of control variables that could potentially affect corporate capital structures. These include firm size, represented by the natural logarithm of a firm’s total assets, suggesting that larger firms with more stable cash flows may face lower default risks and, therefore, carry more debt. Additionally, asset tangibility, calculated as the ratio of tangible assets to total assets, indicates that firms with more tangible assets can secure more leverage due to higher collateral value. Return on assets (ROA), defined as earnings before interest divided by total assets, aligns with the pecking order theory (Myers, 1984), which posits that more profitable firms prefer to fund operations internally, thus reducing leverage. Working capital, expressed as a ratio to total assets, illustrates a firm's liquidity and its ability to finance operations internally, potentially decreasing its dependence on external debt. And finally, Tobin-Q, a ratio that measures a company's market valuation relative to its asset base, is calculated by dividing the sum of the company's market capitalization and the difference between its total asset book value and common equity, by its total asset book value. We expect firms with higher market valuations may rely less on debt due to greater investor confidence and potentially cheaper access to equity markets.

3.4 Preliminary analysis

The descriptive statistics and the correlation matrix in Table 1 provide a general overview of the main variables used in the analysis. "Debt_total" has an average value of 0.226, with a breakdown revealing that firms primarily rely on long-term debt (mean of 0.207), while short-term debt is less prominent (mean of 0.028). The correlation matrix shows modest positive correlations between CCSN and regulatory risk with debt ratios. This preliminary view of the data will be followed by further analysis, where regression models will provide deeper insight into the nature of these relationships.

*** **Table 1** ***

4. Empirical results

Table 2 presents the results from estimating Equation (1), where the dependent variables are firms' debt ratios, including total debt (Debt_total), long-term debt (Debt_LT), and short-term debt (Debt_ST). For Debt_total in columns (1) to (3), CCSN consistently shows a statistically significant negative coefficient, around -0.0064 to -0.0062. A one-standard-deviation increase in CCSN (1.8784) is associated with a 5.32% decrease in Debt_total relative to its mean, indicating that firms in regions with stronger climate change norms tend to use less total debt. Additionally, Reg_risk exhibits a negative and significant impact on Debt_total, with a one-standard-deviation increase in Reg_risk (0.2601) resulting in a 1.28% decrease in Debt_total relative to its mean. The interaction term CCSN_Reg_risk, included in column (3), is also negative and significant, suggesting that regulatory risk amplifies the effect of CCSN on total debt usage.

*** **Table 2** ***

Turning to Debt_LT in columns (4) to (6), CCSN displays a similarly strong, negative association with long-term debt, with coefficients ranging from -0.0076 to -0.0074. This translates to a 6.89% decrease in Debt_LT relative to its mean for a one-standard-deviation increase in CCSN. This finding is economically significant, highlighting that firms in high climate-norm regions rely substantially less on long-term debt. Reg_risk also shows a negative impact on Debt_LT, with a one-standard-deviation increase in Reg_risk leading to a 1.31% decrease in Debt_LT relative to its mean. The interaction term (CCSN_Reg_risk) is negative and significant, indicating a compounded effect of climate norms and regulatory risk on long-term debt levels.

For Debt_ST in columns (7) to (9), CCSN is positively associated with short-term debt, with coefficients around 0.0031 to 0.003, significant at the 1% level. This implies that firms in regions with strong climate norms may reduce their long-term debt but increase reliance on short-term debt. A one-standard-deviation increase in CCSN leads to a 20.58% increase in Debt_ST relative to its mean, demonstrating a substantial shift towards short-term financing in response to climate norms. However, Reg_risk does not have a statistically significant effect on Debt_ST, suggesting its impact may be more pronounced on longer-term debt structures.

The control variables behave as expected and exhibit significant associations with debt ratios. The logarithm of total assets and the ratio of fixed assets are positively related to both total and long-term debt, while return on assets and working capital to assets show significant negative relationships with debt measures, aligning with their roles as indicators of profitability and liquidity. Tobin's Q also has a significant negative association across debt ratios, indicating that firms with higher growth opportunities tend to use less debt.

The observed patterns suggest that firms may perceive these external pressures—CCSN and regulatory environments—as significant risk factors, leading to more conservative financial policies. These pressures introduce uncertainties regarding future compliance requirements, reputational risks, and societal expectations. Although sustainability investments, such as adopting eco-friendly technologies, reducing carbon emissions, or obtaining green certifications (Camilleri, 2015; Chen, Han, & Jebran, 2020), are essential for enhancing long-term operational resilience and securing legitimacy, they impose immediate financial burdens. Such investments typically require substantial upfront capital and can strain firms' cash flows and profitability, which complicates the servicing of existing debt (Gjergji et al., 2021). This increased financial burden may deter firms from taking on additional long-term obligations, particularly in environments where future regulatory actions remain uncertain. Long-term debt, commonly used to finance large, capital-intensive projects, such as upgrading production facilities to meet stricter environmental standards, can expose firms to the risk of regulatory changes or societal backlash if expectations shift further. If firms in strong CCSN states perceive high regulatory risks, they might particularly avoid long-term debt to keep their financial options open for future necessary adaptations or compliance costs.

4.2 Additional analysis of high emissions

Climate change regulations are specifically targeted at firms with high emissions, placing them at the forefront of regulatory examination. Such firms are especially vulnerable to transitory climate risks due to the potential shifts in policy that may require swift reductions in emissions. Delis et al. (2024) illustrate this heightened risk exposure by showing that climate regulations have led to wider loan spreads for fossil fuel companies compared to their non-fossil fuel counterparts. Firms with high emissions face increased public scrutiny, especially in high CCSN states, to adopt sustainable practices and meet environmental standards, exposing them to significant reputational and financial risks (Bansal & Clelland, 2004). For instance, oil companies attract media coverage during events like oil spills, as such incidents are deemed more newsworthy (Luo et al., 2012). This increased attention can intensify stakeholder pressure, which may force firms to adjust their capital structure to manage reputational risks and ensure compliance with regulatory and social expectations. These risks influence firms' credit rating, which leads to higher costs of capital (Chava, 2014). Furthermore, managers of these highly visible firms are often believed to view themselves as particularly vulnerable to future criticism (Bartley & Child, 2011). As a result, we expect them to perceive even greater risk when operating in regions with strong climate change social norms (CCSN). The integration of social norms into a firm's strategic planning, therefore, becomes crucial not only for environmental sustainability but also for maintaining financial stability and access to capital. On the banking side, lenders exhibit heightened caution when financing firms with substantial emissions. Bauer & Hann (2010) reveal that environmental issues represent not only a reputational risk but also a significant economic risk for lenders, affecting their willingness to extend credit. Moreover, banks may also face legal risks; close ties with high-emission firms could subject them to liability for environmental damages (Pitchford, 2001). Hence, we expect firms with greater environmental impact to be more responsive to both social norms and regulatory pressures by lowering their leverage. We proceed to test that conjecture by estimating the following model:

$$D_{it} = \alpha + \beta X_{it} + \gamma X_{it} * Highly_{emitted} + \theta Firm\ Control_{it} + \ Industry\ FE_i + \ Year\ FE_t\ + \epsilon_{it} \qquad (2)$$

The relevant variables, CCSN, and regulatory risk, are represented as X in the equation, with the coefficient of interest, γ, capturing the interaction of these variables with highly emitted firms. The Carbon Disclosure Project (CDP) identifies the most carbon-intensive firms based on emissions measured in million metric tons of CO_2. Following Nguyen & Phan (2020), we classify firms as highly emitted if their industries are defined as carbon-intensive according to CDP criteria.

Table 3 presents the analysis results, showing that for highly emitted firms, CCSN has a significantly stronger negative effect on total and long term debt ratios. This suggests that firms with higher emissions reduce their debt levels more sharply in response to stronger CCSN pressures. Additionally, regulatory risk exerts a substantial negative impact on total debt for highly emitted firms, while it is not significant for other firms, thereby confirming our conjecture.

*** **Table 3** ***

4.3 Additional analysis of financial distress

The capital structure's trade-off theory (Kraus & Litzenberger, 1973; Andrade & Kaplan, 1998) suggests that debts are decreased if firms face a higher risk of bankruptcy. Hence, if CCSN and regulatory risks increase financial distress, firms may reduce their debts to avoid higher bankruptcy risks. We follow the literature to proxy financial distress using Altman's Z-score, where a lower Z-score indicates a higher likelihood of bankruptcy (Nguyen & Phan, 2020; Islam et al., 2022). We divide, then, firms into subsamples based on their Z-score quantiles. Firms in the lowest quantile are classified as financially distressed (FD), while those in the highest quantile are considered undistressed (UD). We expect to find a stronger negative relationship between CCSN and regulatory risk with debt ratios among firms facing higher levels of financial distress, as these firms are more likely to reduce debts in response to the heightened risk.

Table 4 presents the results of the analysis. The results indicate that for FD firms, CCSN has a significantly negative effect on total debt ratios, with almost double the magnitude compared to UD firms. This suggests that firms facing higher financial distress reduce their debt levels more sharply in response to stronger CCSN. Similarly, regulatory risk has a notable negative impact on total debt for distressed firms, while it remains insignificant for UD firms, further reinforcing that financially vulnerable firms are more responsive to regulatory pressures by lowering their leverage.

*** **Table 4*****

5. Robustness checks

5.1. Instrumental variable approach for CCSN

For CCSN, reverse causality is not a primary concern in this analysis, as it is unlikely that corporate debt levels directly influence CCSN. Nonetheless, the model may be subject to omitted variable bias, particularly if CCSN is correlated with unobserved regional characteristics that also affect firms' capital structure. To deal with this, we employ a two-stage least squares (2SLS) approach to re-estimate Equation 1. Following Zhang et al. (2024), we utilize the adoption of climate action plans (CAP) as an instrumental variable. Specifically, we define the indicator variable CAP, which takes a value of one if a state has either implemented or is in the process of designing a CAP, and zero otherwise. We hypothesize that CCSN is likely to increase in these states, as public policies are directly associated with social norms (Nyborg, 2003). Climate action plans typically include greenhouse gas (GHG) emissions reduction targets and outline actions to achieve those goals. Additionally, these plans may incorporate strategies for resilience, clean energy targets, and various economic and social objectives. Given this, it is unlikely that the state-level adoption of CAPs directly impacts firms' debt levels.

Our second instrumental variable is the political orientation of a state, specifically whether it is considered politically Democratic. To capture this, we define an indicator variable, Democrat, which takes a value of one if a Democratic presidential candidate won the state in at least two of the three presidential elections from 2010 to 2022 (2012, 2016, and 2020), and zero otherwise. This variable reflects the political climate and ideology prevalent in the state over a sustained period. We draw on prior research showing that political ideology may have influenced individual beliefs and behaviors (Lee et al., 2015; Howe et al., 2015). In Democratic-leaning states, individuals tend to exhibit stronger pro-environmental attitudes and are more likely to support climate action initiatives. However, it is unlikely that a state's political affiliation directly impacts a firm's capital structure decisions, making it a suitable instrumental variable.

*** **Table 5** ***

The results of the instrumental variable (IV) regressions are presented in Table 5, with Panel A displaying the outcomes for the first IV and Panel B for the second IV. The first-stage regression results, shown in column 1 of both panels, use CCSN as the dependent variable. We have included the same control variables from our baseline model specified in Equation 1. Both instrumental variables demonstrate a significant and positive relationship with CCSN, consistent with the requirements for a valid IV, thus confirming their relevance. Additionally, the Kleibergen-Paap test statistics are all significant, hence rejecting the null hypothesis of weak instruments. In the second-stage regressions, where the instrumented CCSN (derived from the first stage) is used, the coefficients are significantly negative for the major debt ratios. These results align with our baseline findings, confirming that higher levels of CCSN are associated with a lower level of corporate debts.

5.2. A quasi-experiment for regulatory risk

To address potential endogeneity concerns with the regulatory risk in our baseline model, we implement a robustness check using a quasi-experimental approach. Specifically, we exploit the 2016 Paris Agreement as an exogenous policy shock that increased regulatory scrutiny for firms with high emissions. This approach allows us to observe the impact of regulatory risk on debt levels in a setting where regulatory risk is plausibly exogenous.

We first use Propensity Score Matching (PSM) to match highly emitted firms those expected to face heightened regulatory scrutiny post-2016 (Capasso et al., 2020) with similar firms that are less exposed to regulatory risk. This matching reduces selection bias by creating a control group that closely resembles the treated group in terms of pre-treatment characteristics. Next, we apply a Difference-in-Differences (DiD) model below to isolate the impact of increased regulatory risk. We define 2016 as the intervention year and create a post-treatment indicator (post) for observations from 2016 onwards. The interaction term (treated_post) between the post-2016 and treated group captures the differential effect on debt levels for treated firms, serving as a proxy for the impact of heightened regulatory risk due to the Paris Agreement.

$$D_{it} = \alpha + \beta_1 Treated_i + \beta 2\mathrm{Post}_\mathrm{t} + \beta 3(\mathrm{Treated}_\mathrm{i} * Post_t) + \theta Firm\ Control_{it} + \ FE_{it} + \epsilon_{it} \qquad (3)$$

The results of our PSM and DiD analysis are presented in Table 6. The PSM results demonstrate an effective balance between the treated and control groups across the primary covariates. Mean differences between the groups are minimal, with % bias values consistently below 5%, indicating negligible differences between the groups. Additionally, p-values are above 10% for all covariates, confirming that none of the differences are statistically significant.

*** **Table 6** ***

Using the 2016 Paris Agreement as an exogenous shock demonstrates that regulatory risk significantly impacts debt structure decisions among treated firms. The treat_post coefficient for total debt is -0.0229, significant at the 5% level (p = 0.014), indicating that these treated firms reduced their debt by approximately 2.3% relative to the control group after 2016. For long-term debt, treat_post is -0.0239, also significant at the 5% level, indicating a similar reduction. In contrast, the effect on short-term debt is not significant, with a treat_post coefficient of -0.0009 (p = 0.695). These results confirm that regulatory risk causally affects capital structure, particularly in terms of reducing long-term debt.

5.3 Multilevel models

Given the hierarchical nature of our data, with observations nested within both firms and states, a standard panel model may not fully capture the layered structure of our dataset. To address this complexity and better differentiate the impacts at each level, we utilize a multilevel modeling approach. This method introduces random intercepts at both the firm and state levels, allowing us to account for unobserved heterogeneity that may influence firms' capital structure decisions.

Table 7 displays the results from this multilevel model, which largely confirms the patterns observed in the baseline analysis. CCSN retains a significant negative association with long-term debt (Debt_LT), supporting the conclusion that firms in regions with stronger climate norms tend to reduce their reliance on long-term debt. Regulatory risk continues to show a negative and significant impact on both total and long-term debt, consistent with the interpretation that increased regulatory pressures push firms toward more conservative debt structures. The interaction term (CCSN_Reg_risk) also remains negative and significant for long-term debt, underscoring the compounded effect of societal norms and regulatory risk on capital structure.

*** **Table 7** ***

5.4 Subsample analysis

To further validate our findings, we divide the sample and conduct additional tests to ensure that the results are not influenced by firms concentrated in specific regions or time periods. Following prior research (Hilary & Hui, 2009; Zhang et al., 2024), we limit the sample to mitigate the heightened effect of political views on climate change perception by excluding election years and 2017, when the Trump administration withdrew the U.S. from the Paris Accord. Second, we remove observations from California, the largest Democratic state with the highest number of firms in the sample, and from the Gulf States (Alabama, Florida, Louisiana, Mississippi, and Texas), as these states are particularly vulnerable to climate change compared to others. These exclusions aim to ensure that the findings are not driven by the unique characteristics of these regions or periods.

Table 8 presents the results of these robustness checks which exhibit results consistent with those found in the baseline models. The consistency of the coefficients across different specifications provides support for the robustness of our findings, even after accounting for regional variations, and time-specific influences.

*** **Table 8** ***

5.5 Alternative measures

Given that CCSN is a multifaceted variable, it is plausible that our primary measure may not fully capture all its key characteristics. This section outlines two distinct approaches to address this concern. We construct an alternative CCSN measure based on two behavioral questions. The first asks whether individuals discuss global warming occasionally or frequently, capturing the extent of climate-related discourse in their social interactions. The second asks whether they have personally experienced the effects of global warming, reflecting a more direct and personal engagement with climate issues. We then apply PCA to extract the first component from the two questions, using it as our first alternative measure of CCSN. For the second alternative, we use descriptive social norms as a proxy for CCSN by measuring the number of registered electric vehicles (EVs) per state, based on data from the U.S. Department of Energy. The prevalence of EV registrations serves as an indicator of public commitment to sustainable practices and the societal acceptance of green technology, offering a more regionally grounded perspective on climate norms.

The results from these alternative measures are presented in Table 9. Consistent with our baseline findings, the coefficients remain significant and negative. These results further support the findings of our analysis, indicating that the impact of CCSN on corporate financing decisions is not sensitive to the choice of norm proxy.

*** **Table 9** ***

Conclusion

This study delves into the complex relationship between external environmental pressures—climate change social norms and regulatory risk—and firms' capital structure. The findings point to a consistent pattern: firms facing stronger CCSN and higher regulatory risks reduce their reliance on long-term debt, favoring short-term financing options. This strategic shift reflects a growing recognition among firms that long-term commitments in an uncertain regulatory and social landscape could expose them to heightened financial risks. Financially distressed firms display a stronger reduction in both total and long-term debt, which indicates that these firms are particularly vulnerable to external pressures. Further, high-emission firms exhibit a stronger reaction to regulatory risk, particularly in reducing long-term debt, suggesting that they anticipate future regulations will impose significant costs. These patterns expand traditional views in corporate finance, illustrating how environmental pressures can affect capital structure decisions beyond standard economic determinants.

These insights are particularly useful for policymakers and financial regulators. The results suggest that firms facing strong social and regulatory pressures may require access to adaptive financing mechanisms that support environmental investments without disproportionately impacting financial stability. For example, developing targeted green financing tools could help high-emission and financially constrained firms navigate regulatory demands while preserving their financial resilience. Such measures may better align environmental objectives with corporate financing practices, potentially easing the transition toward more sustainable business models. Future research could explore how specific financing instruments, such as green bonds or sustainability-linked loans, may support firms in high CCSN regions or sectors with significant environmental exposure.

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Table 1: Descriptive statistics and correlations

The table presents the summary statistics and correlations for the main variables. Significance levels are indicated by ***, **, and * for 1%, 5%, and 10%, respectively.

	count	mean	std	25%	50%	75%
Debt_total	26221	0.2260	0.1953	0.0368	0.2040	0.3598
Debt_LT	26221	0.2072	0.1888	0.0201	0.1798	0.3358
Debt_ST	26221	0.0283	0.0604	0.0001	0.0076	0.0288
CCSN	26221	0.7521	1.8784	-0.7181	0.7815	2.1628
Reg_risk	26221	0.0512	0.2601	0.0000	0.0000	0.0000
AssetTotal_log	26221	6.8519	1.9853	5.5212	6.8727	8.1670
Asset_fixed	26221	0.4017	0.3011	0.1475	0.3145	0.6325
ROA	26221	0.0459	0.2083	0.0243	0.0983	0.1489
WC	26221	0.2642	0.2425	0.0803	0.2226	0.4124
TobinQ	26221	1.2051	0.6379	0.6401	1.1443	2.0000

	Debt_total	Debt_LT	Debt_ST	CCSN	Reg_risk	AssetTotal_log	Asset_fixed	ROA	WC
Debt_total	1.000***								
Debt_LT	0.974***	1.000***							
Debt_ST	0.150***	-0.016**	1.000***						
CCSN	0.041***	0.029***	0.033***	1.000***					
Reg_risk	0.020***	0.017***	0.004	0.026***	1.000***				
AssetTotal_log	0.379***	0.400***	-0.047**	-0.003	0.017***	1.000***			
Asset_fixed	0.220***	0.214***	0.029***	-0.190	0.079***	0.158***	1.000***		
ROA	0.134***	0.157***	-0.073*	-0.220	-0.007	0.462***	0.246***	1.000***	
WC	-0.428	-0.390	-0.241	0.126***	-0.037**	-0.441	-0.369	-0.378	1.000***
TobinQ	-0.339	-0.324	-0.148	0.139***	-0.052*	-0.143	-0.297	-0.048**	0.373***

Table 2: Baseline results

The table presents regression estimates of the impact of climate change social norms (CCSN), and regulatory risk on debt ratios. All regressions include a constant, industry and year fixed effects, and control for the logarithm of total assets (AssetTotal_log), fixed assets to total assets (Asset_fixed), return on assets (ROA), working capital to assets (WC), and Tobin's Q. Standard errors, clustered at the firm level, are reported in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

	Debt_total			Debt_LT			Debt_ST		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
CCSN	-0.0064***		-0.0062***	-0.0076***		-0.0074***	0.0031***		0.0030***
	(0.0019)		(0.0019)	(0.0018)		(0.0018)	(0.0007)		(0.0007)
Reg_risk		-0.0111***	-0.0083**		-0.0104**	-0.0071*		-0.0010	-0.0014
		(0.0041)	(0.0038)		(0.0045)	(0.0038)		(0.0017)	(0.0017)
CCSN_Reg_risk			-0.0055***			-0.0065***			0.0010
			(0.0020)			(0.0020)			(0.0007)
AssetTotal_log	0.0355***	0.0354***	0.0354***	0.0415***	0.0414***	0.0414***	-0.0092***	-0.0092***	-0.0092***
	(0.0018)	(0.0018)	(0.0018)	(0.0017)	(0.0017)	(0.0017)	(0.0006)	(0.0006)	(0.0006)
Asset_fixed	0.0387***	0.0401***	0.0399***	0.0504***	0.0520***	0.0517***	-0.0222***	-0.0228***	-0.0223***
	(0.0105)	(0.0105)	(0.0104)	(0.0101)	(0.0101)	(0.0101)	(0.0035)	(0.0035)	(0.0035)
ROA	-0.0696***	-0.0677***	-0.0688***	-0.0563***	-0.0540***	-0.0554***	-0.0197***	-0.0207***	-0.0197***
	(0.0098)	(0.0097)	(0.0097)	(0.0093)	(0.0092)	(0.0092)	(0.0037)	(0.0037)	(0.0037)
WC	-0.1589***	-0.1599***	-0.1583***	-0.0396***	-0.0407***	-0.0388***	-0.1569***	-0.1565***	-0.1571***
	(0.0101)	(0.0101)	(0.0102)	(0.0104)	(0.0104)	(0.0105)	(0.0075)	(0.0075)	(0.0075)
TobinQ	-0.0620***	-0.0622***	-0.0621***	-0.0592***	-0.0594***	-0.0593***	-0.0047***	-0.0045***	-0.0047***
	(0.0031)	(0.0031)	(0.0031)	(0.0030)	(0.0030)	(0.0030)	(0.0010)	(0.0010)	(0.0010)
Adj. R-squared	0.3447	0.3434	0.345	0.3243	0.3219	0.3246	0.2	0.1984	0.2
Industry FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
Observations	26,221	26,221	26,221	26,221	26,221	26,221	26,221	26,221	26,221

. **Table 3: Additional analysis of high emissions**

The table presents regression estimates analyzing additionally the impact of highly emitted firms with regulatory risk and with climate change social norms on debt ratios. All regressions include a constant, industry and year fixed effects, and control for the logarithm of total assets (AssetTotal_log), fixed assets to total assets (Asset_fixed), return on assets (ROA), working capital to assets (WC), and Tobin's Q. Standard errors, clustered at the firm level, are reported in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

	Debt_total		Debt_LT		Debt_ST	
	(1)	(2)	(3)	(4)	(5)	(6)
CCSN	-0.0063***		-0.0075***		0.0031***	
	(0.0019)		(0.0018)		(0.0007)	
CCSN_Highly_emitted	-0.0089***		-0.0081**		-0.0013*	
	(0.0032)		(0.0032)		(0.0008)	
Reg_risk		-0.0056		-0.0049		-0.0018
		(0.0040)		(0.0041)		(0.0017)
Reg_risk_Highly_emitted		-0.0259***		-0.0259**		0.0038
		(0.0093)		(0.0107)		(0.0045)
AssetTotal_log	0.0351***	0.0354***	0.0412***	0.0414***	-0.0093***	-0.0092***
	(0.0018)	(0.0018)	(0.0017)	(0.0017)	(0.0006)	(0.0006)
Asset_fixed	0.0392***	0.0406***	0.0508***	0.0525***	-0.0222***	-0.0229***
	(0.0104)	(0.0105)	(0.0101)	(0.0101)	(0.0035)	(0.0035)
ROA	-0.0684***	-0.0668***	-0.0552***	-0.0532***	-0.0195***	-0.0208***
	(0.0097)	(0.0097)	(0.0092)	(0.0092)	(0.0037)	(0.0037)
WC	-0.1582***	-0.1597***	-0.0390***	-0.0405***	-0.1569***	-0.1565***
	(0.0101)	(0.0101)	(0.0104)	(0.0104)	(0.0075)	(0.0075)
TobinQ	-0.0626***	-0.0623***	-0.0596***	-0.0595***	-0.0048***	-0.0045***
	(0.0031)	(0.0031)	(0.0030)	(0.0030)	(0.0010)	(0.0010)
Adj. R-squared	0.346	0.344	0.325	0.322	0.200	0.199
Industry fixed effect	Y	Y	Y	Y	Y	Y
Year fixed effect	Y	Y	Y	Y	Y	Y
Observations	26,221	26,221	26,221	26,221	26,221	26,221

Table 4: Additional analysis of financial distress

The table presents the results testing financial distress as a potential moderator. It provides the results from subsample regressions where firms are categorized into financially distressed (FD) and undistressed (UD) based on their Z_score. All regressions include a constant, industry and year fixed effects, and control for the logarithm of total assets (AssetTotal_log), fixed assets to total assets (Asset_fixed), return on assets (ROA), working capital to assets (WC), and Tobin's Q. Standard errors, clustered at the firm level, are reported in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Dependent Variable:	Debt_total		Debt_LT		Debt_ST	
	FD	UD	FD	UD	FD	UD
CCSN	-0.0101***	-0.0043	-0.0110***	-0.0047	0.0025*	0.0029*
	(0.0037)	(0.0038)	(0.0034)	(0.0036)	(0.0014)	(0.0016)
Reg_risk	-0.0118**	-0.0109	-0.0079	-0.0090	-0.0062***	0.0018
	(0.0059)	(0.0142)	(0.0059)	(0.0142)	(0.0019)	(0.0036)
CCSN_Reg_risk	-0.0003	-0.0125*	-0.0015	-0.0122*	0.0008	0.0007
	(0.0033)	(0.0072)	(0.0033)	(0.0071)	(0.0009)	(0.0020)
AssetTotal_log	0.0409***	0.0205***	0.0454***	0.0212***	-0.0083***	-0.0029***
	(0.0026)	(0.0026)	(0.0025)	(0.0025)	(0.0008)	(0.0011)
Asset_fixed	0.0610***	-0.0018	0.0596***	0.0027	-0.0020	-0.0359***
	(0.0178)	(0.0176)	(0.0170)	(0.0170)	(0.0057)	(0.0083)
ROA	-0.0376***	0.1477***	-0.0202	0.1366***	-0.0239***	0.0059
	(0.0135)	(0.0410)	(0.0123)	(0.0393)	(0.0066)	(0.0128)
WC	-0.1549***	-0.1925***	-0.0608***	-0.1559***	-0.1307***	-0.0997***
	(0.0143)	(0.0268)	(0.0134)	(0.0256)	(0.0090)	(0.0147)
TobinQ	-0.0521***	-0.0543***	-0.0490***	-0.0507***	-0.0037*	-0.0095***
	(0.0062)	(0.0080)	(0.0059)	(0.0077)	(0.0022)	(0.0028)
Adjusted R-squared	0.3237	0.3127	0.3156	0.2961	0.2313	0.3822
Industry fixed effect	Y	Y	Y	Y	Y	Y
Year fixed effect	Y	Y	Y	Y	Y	Y
Observations	6,402	6,402	6,402	6,402	6,402	6,402

Table 5: Regression estimates using two-stage least squares

The table presents 2SLS regression estimates. The IVs used are the presence of climate action plans (CAP) in states and whether a state was won by a Democratic presidential candidate in 2 of the 3 general elections (2012, 2016, and 2020). The same controls and fixed effects are applied. Standard errors, clustered at the firm level, are reported in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Panel A: Climate action plans as IV	First stage		Second stage					
			Debt_total		Debt_LT		Debt_ST	
CAP	0.8694	***	-0.0184	**	-0.0203	**	0.0034	
	(0.0608)		(0.0082)		(0.008)		(0.0023)	
Reg_risk	-0.1810	***	-0.0117	**	-0.0096	*	-0.0042	**
	(0.0629)		(0.0052)		(0.0052)		(0.0017)	
CCSN_Reg_risk	0.1962	***	-0.0011		-0.0013		-0.0010	
	(0.0303)		(0.0036)		(0.0036)		(0.0012)	
Partial R-squared	0.078							
Kleibergen-Paap	204.7	***						
Adj. R-squared	0.728		0.351		0.336		0.215	
Firm controls	Y		Y		Y		Y	
Industry fixed effect	Y		Y		Y		Y	
Year fixed effect	Y		Y		Y		Y	
Observations	26,221		26,221		26,221		26,221	

Panel B: Democratic states as IV	First stage		Second stage					
			Debt_total		Debt_LT		Debt_ST	
Democrat	1.4174	***	-0.0101	***	-0.0111	***	0.0021	*
	(0.0322)		(0.0038)		(0.0037)		(0.0011)	
Reg_risk	-0.1351	***	-0.0101	**	-0.0079		-0.0044	***
	(0.0424)		(0.0051)		(0.005)		(0.0017)	
CCSN_Reg_risk	0.1217	***	-0.0029		-0.0033		-0.0007	
	(0.0203)		(0.0033)		(0.0034)		(0.0011)	
Partial R-squared	0.372							
Kleibergen-Paap	1934.2	***						
Adj. R-squared	0.816		0.355		0.341		0.216	
Firm controls	Y		Y		Y		Y	
Industry fixed effect	Y		Y		Y		Y	
Year fixed effect	Y		Y		Y		Y	
Observations	26,221		26,221		26,221		26,221	

Table 6: A quasi-experimental test for regulatory risk

The presents the results from the Propensity Score Matching (PSM) and Difference-in-Differences (DiD) analyses examining the impact of regulatory risk following the 2016 Paris Agreement on debt ratios among treated and control firms. Panel A displays the PSM balance diagnostics, showing matched covariate means and balance statistics between treated and control groups. Panel B provides DiD estimates for total debt, long-term debt, and short-term debt, including firm controls, industry, and year-fixed effects. Standard errors, clustered at the firm level, are reported in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Panel A: PSM	Treated Mean	Control Mean	% Bias	*p-value*
roa	0.0959	0.0976	-0.9	0.708
assettotal_log	7.7008	7.7021	-1	0.714
tobinq	0.8762	0.8552	3.5	0.214
asset_fixed	0.6921	0.6861	1	0.63
wc	0.1075	0.1067	0.4	0.864

Panel B: DiD	Debt_total	Debt_LT	Debt_ST
treat_post	-0.0269**	-0.0293**	0.0004
	(0.0118)	(0.0121)	(0.0037)
post_2016	0.0708***	0.0666***	0.0069
	(0.0117)	(0.0118)	(0.0046)
treated_group	0.0106	0.0126	0.0003
	(0.0191)	(0.0188)	(0.0068)
Adj. R-squared	0.287	0.254	0.251
Firm controls	Y	Y	Y
Industry and Year FE	Y	Y	Y
Observations	4,208	4,208	4,208

Table 7: Multi-level models

The table presents multilevel regression estimates of the impact of climate change social norms (CCSN) and regulatory risk on debt ratios. The models account for hierarchical data structure, including random intercepts at the state and firm levels to capture unobserved heterogeneity across states and firms. The same controls and fixed effects are applied. Standard errors, adjusted for clustering at the firm level, are reported in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Multi-level models	Debt_total	Debt_LT	Debt_ST
CCSN	-0.0052***	-0.0049***	0.0022***
	(0.0017)	(0.0018)	(0.0007)
Reg_risk	-0.0083**	-0.0072**	-0.0015
	(0.0034)	(0.0034)	(0.0014)
CCSN_Reg_risk	-0.0055***	-0.0065***	0.0010
	(0.0014)	(0.0014)	(0.0006)
AssetTotal_log	0.0352***	0.0412***	-0.0091***
	(0.0011)	(0.0010)	(0.0004)
Asset_fixed	0.0398***	0.0515***	-0.0218***
	(0.0059)	(0.0058)	(0.0022)
ROA	-0.0687***	-0.0560***	-0.0201***
	(0.0061)	(0.0061)	(0.0024)
WC	-0.1580***	-0.0379***	-0.1555***
	(0.0056)	(0.0056)	(0.0022)
TobinQ	-0.0621***	-0.0592***	-0.0048***
	(0.0018)	(0.0018)	(0.0007)
Firm controls	Y	Y	Y
Industry and Year FE	Y	Y	Y
Random effects:			
Firm-level variance	0.01795	0.01686	0.00158
State-level variance	0.00065	0.00013	0.00001
Residual variance	0.00915	0.00900	0.00159
Observations	26,221	26,221	26,221

Table 8: Subsample analysis

The table presents regression estimates based on subsample analyses. Panel A shows results from subsamples excluding election years (2012, 2016, and 2020) and 2017, when the US withdrew from the Paris Accord. Panel B presents results from subsamples excluding California and Gulf states (Alabama, Florida, Louisiana, Mississippi, and Texas). Standard errors, clustered at the firm level, are reported in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Panel A: Years exclusion	Debt_total	Debt_LT	Debt_ST
CCSN	-0.0060***	-0.0073***	0.0029***
	(0.0021)	(0.0020)	(0.0007)
Reg_risk	-0.0075*	-0.0070	-0.0004
	(0.0044)	(0.0046)	(0.0015)
CCSN_Reg_risk	-0.0064***	-0.0071***	0.0010
	(0.0023)	(0.0023)	(0.0006)
Adj. R-squared	0.345	0.326	0.204
Firm controls	Y	Y	Y
Industry and Year FE	Y	Y	Y
Observations	18,262	18,262	18,262

Panel B: States exclusion	Debt_total	Debt_LT	Debt_ST
CCSN	-0.0059**	-0.0061***	0.0015**
	(0.0024)	(0.0023)	(0.0008)
Reg_risk	-0.0114***	-0.0102**	-0.0025
	(0.0044)	(0.0047)	(0.0019)
CCSN_Reg_risk	-0.0034	-0.0049**	0.0013*
	(0.0022)	(0.0022)	(0.0008)
Adj. R-squared	0.361	0.338	0.191
Firm controls	Y	Y	Y
Industry and Year FE	Y	Y	Y
Observations	17,394	17,394	17,394

Table 9: Alternative measures

The table presents regression results using alternative measures. Columns (1), (3), and (5) use CCSN_alter, derived from the first component of a PCA, on two behavioral questions: discuss global warming occasionally or often, and have personally experienced the effects of global warming. Columns (2), (4), and (6) use EV_register, state-level registrations of electric vehicles. All regressions include a constant, industry and year fixed effects, and control for the logarithm of total assets (AssetTotal_log), fixed assets to total assets (Asset_fixed), return on assets (ROA), working capital to assets (WC), and Tobin's Q. Standard errors, clustered at the firm level, are reported in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

	Debt_total		Debt_LT		Debt_ST	
	(1)	(2)	(3)	(4)	(5)	(6)
CCSN_alter	-0.0069***		-0.0088***		0.0034***	
	(0.0027)		(0.0026)		(0.0009)	
Reg_risk	-0.0122**		-0.0104*		-0.0051**	
	(0.0060)		(0.0061)		(0.0021)	
CCSN_alter_reg_risk	-0.0036		-0.0044		-0.0018	
	(0.0045)		(0.0046)		(0.0020)	
EV_register		-0.0056		-0.00998*		0.00896***
		(0.0056)		(0.0053)		(0.002)
Reg_risk		-0.0118*		-0.0090		-0.0017
		(0.0063)		(0.0065)		(0.0020)
CCSN_alter_reg_risk		0.0019		-0.0030		-0.0181
		(0.0219)		(0.0205)		(0.0142)
Adj. R-squared	0.354	0.353	0.340	0.339	0.214	0.216
Firm controls	Y	Y	Y	Y	Y	Y
Industry fixed effect	Y	Y	Y	Y	Y	Y
Year fixed effect	Y	Y	Y	Y	Y	Y
Observations	26,221	26,221	26,221	26,221	26,221	26,221