Navigating the Storm: Evaluating Company's Expected Exposures and Disclosure to Climate Regulation using Generative AI

ABSTRACT

This study develops a novel AI-driven measure to quantify firms' exposure to climate regulatory risk, independent of voluntary disclosures. Using firms' 10K filings and regulations issued by EPA, we establish a systematic framework to assess the extent of regulatory exposure and its implications for corporate disclosure and asset pricing. We document a positive association between climate regulatory risk exposure and disclosure, with firms facing greater regulatory uncertainty exhibiting higher levels of climate risk disclosure. This effect is particularly pronounced in Republican-leaning states, suggesting that disclosure may serve as a strategic response to market-based incentives rather than regulatory mandates. Furthermore, we show that climate regulatory risk exposure is priced into stock returns, with higher-exposure firms earning a risk premium. We observe that while disclosure itself does not significantly affect valuations, implying that investors incorporate regulatory risk through alternative channels. Additionally, we exploit the 2016 U.S. presidential election as an exogenous shock to climate policy expectations, finding a significant decline in expected regulatory risk exposure post-election. Despite this shift, firms with high exposure continued to disclose climate risks, reinforcing the role of investor and stakeholder expectations in shaping disclosure behavior.

1.0 INTRODUCTION

Climate change has emerged as a defining challenge for financial markets, prompting a wave of regulatory interventions aimed at curbing corporate carbon emissions and mitigating environmental risks. In response, governments worldwide have introduced stringent policies, such as carbon pricing, sector-specific emissions limits, and mandatory climate risk disclosures. While these regulations are designed to facilitate the transition to a low-carbon economy, they also introduce climate regulatory risk—the uncertainty surrounding the timing, scope, and enforcement of these policies. This uncertainty creates significant financial and strategic challenges for firms, particularly those in carbon-intensive industries, as they navigate evolving regulatory requirements and market expectations.

A growing body of research has examined how firms disclose climate risks and how investors incorporate these risks into asset pricing(Sautner et al., 2023; Ilhan et al., 2021; Kim & Lyon, 2015; Bolton & Kacperczyk, 2021; Pastor & Veronesi, 2013). However, measuring firms' exposure to climate regulatory risk remains a key empirical challenge. Existing approaches rely heavily on voluntary disclosures, textual analysis of corporate earnings calls, or indirect market-based proxies such as carbon beta or policy uncertainty indices.(e.g. Sautner et al., 2023; Ilhan et al., 2021; Kim & Lyon., 2015). These methods suffer from some limitations. Voluntary disclosures are often incomplete and subject to managerial discretion, leading to concerns over greenwashing (Kim & Lyon, 2015; Sautner et al., 2023). Similarly, textual analysis of earnings calls may capture management sentiment rather than actual exposure to regulatory risk (Ilhan et al., 2021). Market-based measures, though informative, primarily reflect ex-post pricing effects rather than direct exposure to climate policies, potentially conflating regulatory risk with broader macroeconomic trends (Bolton & Kacperczyk, 2021).

This paper seeks to address these gaps by introducing a novel, AI-driven measure of expected climate regulatory risk exposure. We develop a systematic, forward-looking approach that does not rely on firms' discretionary disclosures by leveraging generative large language models (LLMs) to assess the impact of climate regulations on firms. Specifically, we apply state-of-the-art natural language processing techniques to compare firm-specific business descriptions in 10-K filings with Environmental Protection Agency regulations. This approach allows us to quantify the expected regulatory burden that firms face, independent of how they choose to disclose climate risks. We construct a firm-year-level measure of climate regulatory risk exposure by classifying each firm's business activities based on whether regulatory changes are expected to have a positive, negative, or neutral impact on operations. The AI-generated measure overcomes key limitations of existing approaches by systematically capturing firm-level exposure to climate policies without relying on subjective disclosure decisions or ex-post market reactions.

Using this measure, we examine three key research questions. First, does higher exposure to climate regulatory risk lead firms to increase climate-related disclosures? Economic theory suggests two competing hypotheses: The information asymmetry hypothesis posits that firms facing higher regulatory uncertainty should increase disclosure to reduce investor uncertainty and improve capital access (Healy & Palepu, 2001; Verrecchia, 1983, 2001; Lambert, Leuz, & Verrecchia, 2007; Clarkson, Li, Richardson, & Vasvari, 2008). Conversely, the risk perception hypothesis suggests that firms may limit disclosure to avoid signaling heightened exposure to costly regulations.(Kölbel, Leippold, Rillaerts, & Wang, 2023) , Our empirical analysis finds that firms with higher expected regulatory risk exposure are more likely to disclose climate risks in their 10-K filings, supporting the notion that disclosure serves as a strategic response to regulatory uncertainty. However, this relationship varies systematically with the political environment in which firms operate. Second, do investors price climate regulatory risk exposure into asset valuations, and is disclosure rewarded or penalized? While prior research finds that

firms with higher carbon risk tend to trade at a discount due to expected regulatory costs (Bolton & Kacperczyk, 2021; Ilhan et al., 2021; Sautner et al., 2023; Pastor & Veronesi, 2013), it remains unclear whether expected climate regulatory risk exposure—measured independently of firm disclosures—commands a return premium.

We find that firms with higher expected exposure to climate regulations earn significantly higher stock returns, consistent with investors requiring compensation for regulatory uncertainty. However, in contrast to the notion that greater transparency reduces the cost of capital, we find that climate risk disclosure itself is not significantly priced by the market, suggesting that investors may already incorporate expected regulatory exposure into asset valuations independent of firms' voluntary reporting. Additionally, the relationship between climate regulatory risk exposure and disclosure varies across political environments. While firms in both Republican- and Democrat-leaning states exhibit a positive association, the effect is stronger in Republican-leaning states.

To strengthen causal inference, we exploit the 2016 U.S. presidential election as an exogenous shock to climate policy expectations. The election of Donald Trump, who campaigned on a deregulatory platform, led to a sudden shift in anticipated climate policy enforcement. We document a significant decline in expected regulatory risk exposure post-election, consistent with firms reassessing the likelihood of stringent environmental regulations. However, firms with high exposure continued to disclose climate risks at similar levels, suggesting that disclosure decisions are influenced not only by regulatory expectations but also by long-term investor and stakeholder pressures.

Our findings contribute to the literature on climate regulatory risk, corporate disclosure, and asset pricing in several ways. First, we develop a novel, AI-driven measure of expected climate regulatory risk exposure, offering an objective and scalable alternative to traditional firm

disclosures and market-based proxies. By using large language models to assess impact based on firms' business and regulatory texts, we introduce a forward-looking approach that systematically quantifies climate regulatory risk without reliance on voluntary reporting. This extends prior research on climate risk measurement (Sautner et al., 2023; Ilhan, Sautner, & Vilkov, 2021) and addresses concerns over selective disclosure (Kim & Lyon, 2015). Second, we contribute to the corporate disclosure literature by providing new empirical evidence on the strategic determinants of climate risk disclosure. Our results show that firms with higher expected regulatory exposure are more likely to disclose climate regulatory risks, but this effect varies based on political and institutional factors. The response across different regulatory environments highlights how firms tailor disclosure strategies based on local enforcement expectations and investor sentiment (Healy & Palepu, 2001; Verrecchia, 1983, 2001). These findings align with prior work showing that firms use disclosure to manage information asymmetry while also considering potential regulatory and market penalties (Clarkson, Li, Richardson, & Vasvari, 2008; Li, 2010).

Third, we contribute to the market reaction literature by showing that climate regulatory risk exposure is priced by financial markets. Our findings indicate that investors assess regulatory risks independently of firms' voluntary disclosures, aligning with evidence that environmental risks are incorporated into the market (Hsu, Li, & Tsou, 2023). This challenges the assumption that greater disclosure lowers firms' cost of capital (Pastor & Veronesi, 2013), instead suggesting that markets price climate risk through broader regulatory signals and firm fundamentals rather than relying on voluntary reporting (Ilhan, Sautner, & Vilkov, 2021). Finally, we document how shifts in political leadership influence climate regulatory risk perceptions. By leveraging the 2016 U.S. presidential election as a natural experiment, we show that changes in political administration led to measurable shifts in firms expected regulatory risk, influencing both disclosure and market reactions (Ramelli & Wagner, 2021; Engle et al., 2020). This contributes to the broader literature on policy uncertainty and its effects on firm behavior, further

demonstrating that regulatory risk exposure is not static but evolves with political cycles and investor expectations.

Taken together, our findings offer important insights for investors, regulators, and corporate managers seeking to understand the implications of climate regulatory risk. Investors evaluating firms' exposure to climate policy should look beyond voluntary disclosures, as these may not fully capture firms' regulatory risk profiles. Regulators aiming to improve climate-related financial reporting should consider how disclosure mandates interact with firms' strategic incentives and the broader political landscape. For corporate managers, our results highlight the importance of anticipating climate regulatory risks rather than reacting to policy changes ex-post. By developing an AI-based approach to measuring regulatory risk exposure, this paper contributes to the broader goal of improving transparency and risk assessment in financial markets as firms navigate the evolving climate policy landscape.

The remainder of this paper is organized as follows. Section 2 reviews the relevant literature on climate regulatory risk, disclosure behavior, and develops our hypotheses. Section 3 outlines the data sources, the construction of our novel AI-based regulatory risk exposure measure, and the empirical methodology. Section 4 presents our main findings; Section 5 explores the moderating role of political environment in shaping firms' disclosure responses. Section 6 concludes by discussing the broader implications for regulators, investors, and corporate decision-makers.

2. Literature Review and Hypothesis Development

2.1 Political Risk, Policy Uncertainty, and Market Outcomes

Political and regulatory risks play a crucial role in shaping corporate strategy, financial decision-making, and market behavior. Political risk arises from uncertainty regarding government actions, regulatory changes, and policy interventions that can alter the competitive landscape for businesses. These risks manifest in various ways, including changes in taxation, industry

regulations, environmental laws, and trade policies, all of which can influence firm behavior and asset pricing. Research shows that policy uncertainty influences corporate investment and stock market volatility, as firms delay capital expenditures in response to unclear regulatory signals (Baker, Bloom, & Davis, 2016; Gulen & Ion, 2016).

Climate policy uncertainty, in particular, affects investor sentiment and market outcomes. Prior studies indicate that investors demand a risk premium for firms exposed to regulatory uncertainty, leading to higher required returns and greater return volatility (Pastor & Veronesi, 2013). In the context of environmental regulations, studies have found that firms with high carbon risk trade at a discount due to anticipated compliance costs and potential restrictions on operations (Bolton & Kacperczyk, 2021). However, the extent to which firms manage these risks through disclosure and whether disclosure influences investor pricing decisions remain empirical questions.

2.2 Disclosure Response to Regulatory Risk Exposure

The escalating complexity of climate-related regulations forces firms to make nuanced disclosure decisions that are closely scrutinized by investors and regulators alike. While firms may seek to enhance transparency to build investor trust, disclosure also presents risks, as excessive reporting of climate-related exposure could lead to heightened regulatory scrutiny or market penalties (Clarkson, Li, Richardson, & Vasvari, 2008).

Building on established theories of information asymmetry (Healy & Palepu, 2001; Verrecchia, 2001) and market signaling (Lambert, Leuz, & Verrecchia, 2007), as well as recent empirical findings on regulatory risk (Sautner et al., 2023), we posit the following hypothesis:

H1: Firms with higher levels of expected climate regulatory risk will exhibit greater voluntary disclosure of climate-related information in their 10-K filings.

Enhanced disclosure is expected to serve as a mechanism to reduce information asymmetry between managers and investors, thereby mitigating adverse selection costs (Healy & Palepu, 2001; Verrecchia, 2001). Empirical research suggests that firms facing regulatory uncertainty often increase disclosure to address investor concerns, aligning with the idea that transparency can help manage investor expectations (Sautner et al., 2023). However, the extent to which disclosure effectively reduces perceived regulatory risk remains debated, as firms may strategically frame disclosures to minimize perceived exposure while maintaining compliance with reporting standards.

2.3 Market Consequences of Disclosure Under Regulatory Risk

Prior research suggests that climate regulatory risk exposure is priced into financial markets, with investors demanding compensation for the added uncertainty that firms face. Studies have found that firms operating in industries with greater regulatory scrutiny tend to experience higher expected returns due to increased risk perception (Pastor & Veronesi, 2013; Gulen & Ion, 2016). Furthermore, market-based measures of regulatory risk, such as carbon beta, indicate that firms with higher exposure to environmental regulations face more pronounced stock price fluctuations, reflecting investor uncertainty (Bolton & Kacperczyk, 2021).

While firms may attempt to mitigate these pricing effects through voluntary disclosure, the literature remains inconclusive on whether increased transparency reduces firms' cost of capital. Research suggests that while disclosure can improve investor confidence, it does not always offset the fundamental risks associated with regulatory exposure. For instance, Ilhan, Sautner, & Vilkov (2021) find that climate risk exposure is reflected in firm valuations regardless of disclosure, indicating that investors may assess regulatory risks through alternative signals rather than relying solely on self-reported data.

Building on these insights, we refine the second hypothesis into two distinct components:

H2a: Firms with higher climate regulatory risk exposure will command a risk premium in the capital markets.

Empirical results indicate that higher exposure is associated with significantly elevated stock returns, reflecting investors' demand for compensation for regulatory uncertainty (Pastor & Veronesi, 2013; Gulen & Ion, 2016). As climate-related regulations become more stringent, firms facing higher expected regulatory costs must offer increased returns to attract investors, further reinforcing the pricing of climate risk.

H2b: Climate risk disclosure does not mitigate the increase in the risk premium associated with exposure.

While increased transparency may alleviate some investor concerns, it does not fully offset the pricing of inherent regulatory risks. Prior studies suggest that climate risk disclosures are often viewed with skepticism due to concerns over greenwashing or selective reporting (Kim & Lyon, 2015; Sautner et al., 2023). Investors may discount disclosure-based measures due to the potential for managerial discretion in reporting, instead relying on broader regulatory signals and firm fundamentals when assessing climate risk exposure. Together, with these hypotheses we try to provide a comprehensive framework for understanding how firms adjust their disclosure practices in response to escalating climate regulatory challenges and how these practices influence market valuation.

3.0 METHODOLOGY

3.1 Existing Measures for Climate Regulatory Risk

The assessment of climate regulatory risk has evolved with the development of diverse quantitative and qualitative methodologies. These approaches help evaluate how firms adapt to climate-related regulatory challenges and how markets incorporate these risks into asset pricing and investment decisions.

One widely used framework is textual analysis of corporate disclosures. Sautner, van Lent, Vilkov, and Zhang (2023) developed a dictionary-based approach to measure firm-level climate risk exposure. Their methodology systematically extracts climate-related risk discussions from earnings calls and financial reports, allowing researchers and investors to quantify a firm's exposure to regulatory changes, carbon pricing, and emission reduction policies. This method has been useful in identifying firms that voluntarily disclose climate-related risks versus those that downplay regulatory concerns in their communications. However, its reliance on self-reported disclosures means it may be affected by greenwashing and selective reporting biases.

Another significant measure is carbon beta, introduced by Bolton and Kacperczyk (2021), which assesses a firm's exposure to climate transition risks based on its stock price sensitivity to carbon-related regulatory shocks. This market-based indicator helps investors assess the extent to which firms' valuations are influenced by carbon pricing mechanisms, regulatory shifts, and changes in environmental policies. Their findings indicate that firms with high carbon beta tend to face higher capital costs and lower long-term stock returns, reflecting market expectations of increased regulatory burden and transition risks for carbon-intensive firms.

Event studies have also been widely employed to measure climate regulatory risk. Krueger, Sautner, and Starks (2020) analyzed market reactions to climate policy announcements, showing that firms heavily exposed to carbon-intensive industries experience abnormal stock returns following policy shifts such as carbon tax implementations and emission reduction mandates. This approach provides real-time insights into how investors adjust expectations in response to

new climate regulations, although it is limited by the assumption that markets react efficiently to policy signals.

Another emerging approach is climate policy uncertainty indices, such as the Climate Policy Uncertainty (CPU) Index developed as an extension of the Economic Policy Uncertainty (EPU) Index (Engle et al., 2020). By tracking climate-related news coverage and regulatory announcements, this index provides a macroeconomic perspective on climate risk. Studies have shown that higher levels of climate policy uncertainty correlate with lower corporate investment and increased market volatility, as firms delay capital-intensive projects in anticipation of future regulatory adjustments (Gulen & Ion, 2016).

Despite the advancements in measuring climate regulatory risks, each approach presents limitations. Textual analysis methods depend on firms' voluntary disclosures and can be subject to reporting biases. Market-based measures such as carbon beta capture investor sentiment but may not fully reflect long-term regulatory risk exposure. Event studies provide immediate market responses but do not always account for policy implementation lags. Similarly, media-based indices such as the CPU Index may be influenced by journalistic biases or incomplete coverage of climate policy events.

Recent advancements in machine learning and big data analytics aim to enhance the accuracy of climate risk measurement by integrating multiple sources, such as corporate filings, market data, regulatory announcements, and satellite imagery (Kölbel, Leippold, Rillaerts, & Wang, 2023). These innovations provide a more dynamic and forward-looking assessment of firms' climate regulatory risk exposure, improving investors' ability to anticipate and manage financial risks associated with environmental policies. While these methods such as textual analysis, event studies, and market-based indicators have significantly advanced the measurement of climate regulatory risk, they also present limitations. Many rely on self-reported corporate disclosures,

which can be selective or biased, while market-based measures capture only short-term investor sentiment.

3.2 Data and Sample Selection

To construct a novel measure of Climate Regulatory Risk Exposure (CRRE), we leverage state-of-the-art Large Language Models (LLMs) to analyze firm-level disclosures and regulatory texts. Specifically, we utilize the LLaMA-3-8B-Instruct model, a transformer-based neural network optimized for natural language processing (NLP) tasks. This model provides robust contextual understanding and semantic representation, enabling precise analysis of financial and regulatory text.

Our primary data sources include firm-specific textual disclosures from annual reports (10-K filings) obtained from the U.S. Securities and Exchange Commission's (SEC) EDGAR database. We extract Item 1 – Business Description. The processed 10-K filings are sourced from the University of Notre Dame's SRAF repository, ensuring data consistency and quality.

In parallel, we compile a comprehensive corpus of climate-related regulatory documents, encompassing all rules and regulations issued by the Environmental Protection Agency (EPA) and climate-related rules published in the Federal Register. These regulatory texts provide a foundational benchmark for assessing firms' climate regulatory risk exposure.

The final dataset spans publicly traded U.S. firms from 2001 to 2022, subject to data availability constraints. We impose standard selection criteria, retaining firms with complete 10-K filings and requisite financial data from Compustat and CRSP. Climate regulation documents are systematically sourced from the EPA's online repository, the Federal Register, and other government archives.

3.3 Data Processing for CRRE Measurement

We construct the CRRE measure by systematically assessing the impact of regulatory changes on firms' business operations using large language models (LLMs). This methodology builds upon prior research in textual analysis and machine learning applications in finance, such as the work of Loughran and McDonald (2011) on sentiment analysis in financial disclosures and Gentzkow, Kelly, and Taddy (2019) on text as data in economics. By integrating firm disclosures and regulatory text, our approach quantifies the extent to which firms' core business activities align with regulatory changes.

<INSERT FIGURE 1 HERE >

First, we extract firm-specific business descriptions from 10-K filings, which provide structured insights into a firm's primary operations and market positioning. These descriptions are processed using the BART summarization model, a transformer-based architecture known for its efficiency in abstractive summarization (Lewis et al., 2020), to generate concise summaries that retain key business activities and operational details. Parallel to this, we extract all regulations codified by the Environmental Protection Agency (EPA) in the Federal Register and parse them to derive structured summaries of each law, following methodologies similar to those used in legal and regulatory text mining. Figure 1 illustrates the complete process flow of data extraction, summarization, and classification. It visually represents how firm disclosures and regulatory summaries are processed through the LLM-based classification system, categorizing the impact of regulations on business descriptions into positive, negative, or no impact.

3.4 Climate Regulation Risk Exposure Classification and Computation

Next, we construct a structured query as shown in appendix where each regulatory summary is provided as a prompt to an LLM, along with the corresponding firm's business summary. This follows recent advancements in prompt engineering and LLM applications in economic forecasting (Bommasani et al., 2021). The LLM is tasked with assessing the impact of the

regulation on the firm's operations and classifies the response into three categories: P (positive impact), N (negative impact), or F (no impact). The full prompt structure and example queries are provided in the Appendix. Figure 1, referenced earlier, provides a visual representation of the data processing steps and classification methodology, reinforcing the structured approach used in this study.

Finally, we aggregate these classification outputs at the firm-year level to construct the CRRE measure using the following formula:

$$Exposure = \frac{N_i}{P_i + N_i + F_i}$$

where N_i represents the number of regulations classified as having a negative impact on firm I, P_i represents the number of regulations classified as having a positive impact, and F_i represents cases where no impact was identified. This firm-year-level metric provides a quantitative measure of the extent to which a firm is exposed to adverse climate regulatory influences over time, aligning with recent efforts to quantify environmental risk exposure in finance (Ilhan, Krueger, Sautner, and Starks, 2021).

To validate the CRRE measure, we employ a two-step approach. First, we conduct random sampling and manually review the explanations provided by the LLM to ensure interpretability and alignment with firm-specific operations. Second, we validate our results using an alternative LLM, Gemma, for a short timeframe to assess consistency across different models. Additionally, we compare the CRRE measure against external benchmarks, including climate litigation records, third-party climate risk ratings, and the climate regulatory exposure measure developed by Sautner et al. (2023). Prior studies have highlighted the importance of validation using independent risk assessments in financial research (Chava, 2014). Additionally, we conduct robustness checks by testing alternative classification thresholds and incorporating different

LLM architectures to assess the stability of the results, an approach consistent with best practices in machine learning for finance (Gu, Kelly, and Xiu, 2020).

3.5 Disclosure Measure

This study examines the extent to which firms disclose their exposure to climate-related regulations by assessing both the presence and depth of climate-related discussions within their financial reports. Specifically, we focus on Item 1A - Risk Factors from 10-K filings, as this section provides a structured avenue for firms to communicate regulatory risks. This methodology enables a systematic quantification of firms' transparency in acknowledging climate-related regulatory exposure. To determine whether a firm discloses climate-related risks, we employ Natural Language Processing (NLP) techniques in conjunction with a dictionary-based approach. Item 1A of the 10-K filings is analyzed for specific keywords and phrases indicative of climate-related disclosures.

We extract the full text of Item 1A - Risk Factors using automated NLP techniques and apply the climate risk dictionary developed by Sautner et al. (2023). Firms are classified based on the presence of these terms as follows:

- Disclosure Presence = 1 if climate-related terms are identified in Item 1A.
- Disclosure Presence = 0 if no relevant terms are detected.

This binary classification provides an initial assessment of whether firms acknowledge climate-related regulatory risks in their official filings, serving as a proxy for transparency.

3.6 Measuring Disclosure Depth

Beyond the presence of disclosure, we assess the extent to which firms discuss climate-related risks by quantifying the frequency of climate-related terms relative to the overall content of Item 1A.

The total word count of Item 1A is computed for each firm's filing, and the occurrences of climate-related terms are counted using the Sautner et al. (2023) dictionary. We define the disclosure depth metric as:

$$Disclosure\ Depth = \frac{Relevant\ Terms_{i,t}}{Total\ Words_{i,t}}$$

where:

- Relevant $Terms_{i,t}$ denotes the number of climate-related terms appearing in firm i's Item 1A at time t.
- $TotalWords_{i,t}$ represents the total word count in Item 1A.

A higher disclosure depth score reflects a greater emphasis on climate-related regulatory risks in firm disclosures. This measure enables a more granular evaluation of firms' engagement with climate-related regulatory discourse, complementing the binary disclosure presence indicator.

3.7 Summary Statistics

<INSERT TABLE 1 HERE>

Table 1 presents the descriptive statistics for the key variables in this study, offering an overview of firms' climate regulatory risk exposure and disclosure behavior. The results reveal substantial heterogeneity in both climate risk exposure and disclosure practices.The Exposure variable, which quantifies firms' climate regulatory risk as a percentage, has a mean of 1.215% with a standard deviation of 2.798%. While some firms have no recorded exposure (minimum = 0%),

others face significantly higher regulatory risk, with a maximum value of 36%, suggesting that regulatory pressures vary widely across firms.The Disclosure variable, measuring the percentage of total firm disclosures dedicated to climate regulatory risks, has a mean of 0.006% with a standard deviation of 0.026%. This indicates that, on average, firms allocate only a small fraction of their disclosure efforts to climate regulatory risks. The maximum observed disclosure is 0.78%, meaning that even the most transparent firms dedicate less than 1% of their total disclosures to climate regulatory matters.

The low levels of voluntary disclosure suggest that firms may either lack incentives to report on climate regulatory risks or strategically withhold information due to regulatory uncertainty or competitive concerns. Overall, these statistics suggest that firms experience unequal exposure to climate regulatory risks and respond with highly varied disclosure strategies. The fact that climate regulatory disclosures remain at low levels across firms highlights a potential gap in climate-related transparency. The next section empirically examines the relationship between regulatory risk exposure and disclosure behavior, assessing whether firms with greater exposure tend to increase transparency or strategically withhold information.

3.8 Pairwise Correlation Between Climate Regulatory Risk Exposure and Disclosure

<INSERT TABLE 2 HERE>

Table 2 presents the pairwise correlation between climate regulatory risk exposure (Exposure) and climate risk disclosure (Disclosure)**,** providing preliminary insights into the relationship between firms' regulatory risk exposure and their transparency regarding climate-related risks. The correlation between Exposure and Disclosure is 0.224 moderate positive association**.** This suggests that firms with greater exposure to climate regulatory risk tend to disclose more information regarding these risks. This finding aligns with the information asymmetry

perspective (Healy & Palepu, 2001; Verrecchia, 2001), which posits that firms facing higher uncertainty and regulatory scrutiny may engage in greater disclosure to mitigate adverse selection concerns and reduce information asymmetry with investors.

However, the magnitude of the correlation suggests that exposure alone does not fully explain firms' disclosure decisions. While the correlation analysis provides initial evidence of a positive relationship between climate regulatory risk exposure and disclosure**,** it does not account for firm heterogeneity or establish causal directionality. To further examine this relationship, next we perform various test to assess the likelihood of disclosure as a function of regulatory risk exposure and to analyze the extent of disclosure as a continuous variable.

4.0 EMPIRICAL RESULTS

This section presents the empirical findings on the relationship between climate regulatory risk exposure and firms' disclosure behavior**.** We begin by estimating a logit model to examine whether firms with higher regulatory risk exposure are more likely to disclose climate-related risks.

4.1 Climate Regulatory Risk Exposure and the Likelihood of Disclosure

For initial analysis we run a logit regression, where the dependent variable is an indicator for whether a firm discloses information related to climate regulatory risk. The key independent variable, Exposure, measures the firm's climate regulatory risk, with a higher value indicating greater negative regulatory exposure.

Across all model specifications, Exposure is positively and significantly associated with the likelihood of disclosure at the 1 percent level. The estimated coefficients range from 0.0404 to 0.0863, suggesting that firms facing greater regulatory risk exposure are more likely to disclose climate-related information. This result supports Hypothesis 1, which predicts that firms with higher regulatory exposure exhibit greater voluntary disclosure of climate-regulatory risks as a

response to regulatory uncertainty**.** The finding is consistent with the information asymmetry hypothesis (Healy & Palepu, 2001; Verrecchia, 2001), which suggests that firms disclose more when regulatory uncertainty is high to reduce adverse selection concerns.

<INSERT TABLE 3 HERE>

Column (1) presents the baseline regression without fixed effects. Column (2) incorporates industry fixed effects, controlling for sector-specific disclosure norms and regulatory pressures. Column (3) further includes year fixed effects, accounting for macroeconomic and policy-driven variations over time. The significance and magnitude of Exposure remain stable across these specifications, suggesting that the relationship between regulatory risk exposure and disclosure is not driven by industry composition or time trends. These findings indicate that firms with greater climate regulatory risk exposure are more likely to disclose.

4.2 Climate Regulatory Risk Exposure and the Extent of Disclosure

<INSERT TABLE 4 HERE>

Following this we run an OLS regression estimating the extent of firms' climate risk disclosure as a function of climate regulatory risk exposure. The dependent variable, Disclosure, represents the percentage of climate-related information voluntarily reported by firms. The key independent variable, Exposure, captures the degree of climate regulatory risk a firm faces.

We find that across all model specifications, Exposure is positively and significantly associated with the extent of disclosure at the 1 percent level indicating that firms with greater regulatory risk exposure allocate a larger proportion of their disclosure efforts to climate regulatory risks. This result further supports Hypothesis 1, as it suggests that firms not only initiate disclosure but also adjust the extent of disclosure in response to regulatory risk.

Columns (1) through (5) progressively introduce industry fixed effects, year fixed effects, and industry-year interactions. Across all specifications, the coefficient on Exposure remains positive

and statistically significant, suggesting that the relationship between climate regulatory risk and disclosure is not driven by industry composition or time trends.

4.3 Climate Regulatory Risk Exposure, Disclosure, and Stock Returns

<INSERT TABLE 5 HERE>

To understand the relationship between climate regulatory risk exposure, disclosure, and firms' stock returns we run an OLS regression with the dependent variable, Returns, represents firm-level stock returns. The key independent variables are Exposure, which captures the percentage of a firm's climate regulatory risk exposure, and Disclosure.

We can observe in Table 5 across all specifications, Exposure is positively and significantly associated with stock returns at the 5 percent level or better. The estimated coefficients range from 0.130 to 0.147, indicating that firms with higher climate regulatory risk exposure tend to experience higher stock returns. This result supports Hypothesis 2a, which predicts that firms facing higher regulatory risk exposure command a risk premium in capital markets, as investors demand compensation for policy uncertainty. This finding is in line with prior research showing that firms exposed to regulatory uncertainty may earn higher expected returns due to the risks associated with future policy changes (Pastor & Veronesi, 2013; Gulen & Ion, 2016).

The coefficient on Disclosure is positive but statistically insignificant, suggesting that the extent of firms' climate-related disclosure does not have a direct impact on stock returns. This result supports Hypothesis 2b, which posits that disclosure does not mitigate the risk premium associated with exposure. These findings are consistent with Christensen, Hail, and Leuz (2021), who argue that voluntary disclosure may not always be perceived as fully credible by investors. Similarly, Li (2010) suggests that the economic impact of risk-related disclosures depends on the perceived reliability of the information.

Overall, the results suggest that while firms' exposure to regulatory risk influences investor expectations and pricing, disclosure alone does not necessarily translate into higher or lower

returns, possibly due to concerns over selective reporting or greenwashing. The next section explores additional robustness checks and alternative empirical tests to further validate these findings.

4.4 Addressing Endogeneity: The 2016 U.S. Presidential Election as an Exogenous Shock

To address potential endogeneity concerns in the relationship between climate regulatory risk exposure and firm behavior, we employ the 2016 U.S. presidential election as an exogenous shock. Donald Trump's unexpected victory led to a substantial shift in expected climate policies, with a clear deregulatory stance that included efforts to roll back environmental regulations and withdraw from international climate agreements (Krueger, Sautner, and Starks, 2020). This event provides a natural experiment to assess whether the relationship between climate regulatory risk exposure and disclosure, as well as stock returns, changed before and after the election.

We first estimate a regression of exposure on post, where post is an indicator variable that takes the value of 1 for observations from 2016 onward and 0 otherwise. This allows us to assess whether firms' climate regulatory risk exposure declined following the election, reflecting a change in perceived regulatory risk due to shifting policy expectations.

Next, we divide the sample into pre-election and post-election periods and estimate separate regressions of exposure on disclosure before and after the election. This analysis tests whether firms' disclosure practices changed in response to the anticipated deregulatory environment. If disclosure is primarily driven by firms' regulatory risk assessments, we expect a weakening of the relationship between exposure and disclosure after the election, as firms may perceive less pressure to voluntarily report climate risks.

Finally, we examine the relationship between exposure and returns in the pre-election and post-election periods to assess whether investors' valuation of climate regulatory risk changed following the election. If investors incorporate changing regulatory expectations into asset prices, we expect a shift in the relationship between exposure and stock returns, potentially reducing the risk premium assigned to firms with high climate risk exposure in the post-election period.

By sequentially estimating these regressions, we evaluate whether firms' disclosure decisions and market responses are primarily shaped by changing regulatory expectations or whether climate regulatory risk remains a persistent determinant of firm behavior, independent of political cycles. The next section presents the empirical results of this analysis, highlighting how the 2016 election influenced firms' climate risk exposure, disclosure, and stock returns.

<INSERT TABLE 6 HERE>

Table 6 presents the results of the OLS regression examining whether expected climate regulatory risk exposure changed following the 2016 U.S. presidential election. The key independent variable, post, is an indicator that takes the value of 1 for observations from 2016 onward and 0 otherwise. This specification allows us to assess whether the expected level of climate regulatory risk exposure shifted after the election, reflecting changes in anticipated regulatory enforcement rather than firms' direct responses.

Across all specifications, the coefficient on post is negative and statistically significant, suggesting that expected climate regulatory risk exposure declined after the election. This result indicates that, following the Trump administration's deregulatory stance, the projected level of regulatory scrutiny facing firms decreased. The decline remains robust across alternative specifications, including models with industry and year fixed effects, reinforcing that the shift was not driven by industry-specific trends or broader economic conditions.

The magnitude of the post-election decline in expected exposure suggests that regulatory risk assessments are highly sensitive to political transitions and policy uncertainty. The results are consistent with prior literature demonstrating that changes in political leadership can lead to reductions in anticipated regulatory oversight, particularly in industries subject to environmental regulations (Pastor and Veronesi, 2013; Gulen and Ion, 2016).

The next section examines whether this change in expected climate regulatory risk exposure influenced firms' disclosure behavior and stock returns, further assessing the broader market implications of the 2016 election on climate risk management.

4.5 Impact of Expected Climate Regulatory Risk Exposure on Disclosure Before and After the 2016 U.S. Presidential Election

<INSERT TABLE 7 HERE>

Table 7 presents the results of the OLS regression examining the relationship between expected climate regulatory risk exposure and disclosure before and after the 2016 U.S. presidential election. The dependent variable, disclosure, represents the percentage of climate-related information voluntarily reported by firms. The key independent variable, exposure, measures the expected level of climate regulatory risk faced by firms. Column (1) reports the results for the post-election period (2016 and later), while column (2) presents results for the pre-election period.

The coefficient on exposure is positive and statistically significant in both periods, suggesting that firms with higher expected regulatory risk exposure are more likely to disclose climate-related risks regardless of the political environment. However, the magnitude of the coefficient on exposure is larger in the post-election period (0.138) compared to the pre-election period (0.0659), indicating that the relationship between expected regulatory risk and disclosure

strengthened after the election. This suggests that despite the anticipated regulatory rollback, firms facing high expected exposure continued to increase their disclosure, possibly due to investor pressure or growing awareness of climate-related financial risks.

The stability of this relationship across periods suggests that firms' disclosure decisions are not solely driven by short-term regulatory expectations but may also reflect long-term risk management strategies and market expectations. These findings align with prior research showing that firms with significant environmental exposure tend to maintain disclosure practices even amid regulatory uncertainty (Christensen, Hail, and Leuz, 2021).

Overall, the results indicate that firms with greater expected climate regulatory risk exposure are more likely to engage in disclosure, with this relationship persisting and even strengthening after the election. The next section explores whether this shift in disclosure patterns translated into changes in market valuation and stock returns

4.6 Expected Climate Regulatory Risk Exposure and Stock Returns Before and After the 2016 U.S. Presidential Election

<INSERT TABLE 8 HERE>

Table 8 presents the results of the OLS regression examining the relationship between expected climate regulatory risk exposure and stock returns before and after the 2016 U.S. presidential election. The dependent variable, returns, represents firm-level stock returns. The key independent variable, exposure, measures the expected level of climate regulatory risk faced by firms. Column (1) reports results for the pre-election period, while column (2) presents results for the post-election period.

The coefficient on exposure is positive and statistically significant in both periods, suggesting that firms with higher expected climate regulatory risk exposure are associated with higher stock

returns. However, the magnitude of the coefficient increases from 0.099 in the pre-election period to 0.392 in the post-election period, indicating that the relationship between expected exposure and stock returns strengthened after the election. This suggests that investors may have adjusted their pricing of regulatory risk following the shift in policy expectations, potentially assigning a higher risk premium to firms with greater expected exposure in a deregulated environment.

The increase in the coefficient after the election is consistent with literature on political uncertainty and asset pricing, which suggests that changes in regulatory expectations can lead to shifts in how investors assess risk and return (Pastor and Veronesi, 2013; Gulen and Ion, 2016). These findings indicate that while regulatory risk exposure has always been a factor in asset pricing, its perceived impact on returns intensified in response to changing policy expectations following the 2016 election.

4.7 Validation of Expected Climate Regulatory Risk Exposure Measure

<INSERT TABLE 9 HERE>

Table 9 presents the results of the OLS regression examining the relationship between our measure of expected climate regulatory risk exposure and the dictionary-based regulatory exposure measure developed by Sautner et al. (2023). The dependent variable, dictionary regulatory exposure, quantifies firms' exposure to climate regulation based on textual analysis of corporate disclosures, while the key independent variable, exposure, represents our measure of expected climate regulatory risk.

The coefficient on exposure is positive and statistically significant across specifications, suggesting a strong alignment between the two measures. This indicates that our approach effectively captures meaningful variation in firms' climate regulatory risk exposure, consistent

with an alternative textual analysis method. The relationship remains robust when controlling for firm characteristics and including industry fixed effects, reinforcing the validity of our measure as a reliable proxy for firms' expected climate regulatory risk.

These findings provide further support for the construct validity of our measure, showing that it aligns with established approaches while incorporating additional information on expected regulatory risk. The next section explores the implications of these results for understanding firms' climate risk management and disclosure practices

5.0 Additional Analysis: Political Environment and Climate Risk Disclosure

Regulatory and political environments play a critical role in shaping firms' disclosure decisions, particularly in the context of climate-related risks. Prior research suggests that firms respond not only to direct regulatory pressures but also to broader political and institutional factors that influence corporate transparency and sustainability practices (Dyck, Lins, Roth, and Wagner, 2019; Christensen, Floyd, Liu, and Maffett, 2017). To examine whether the relationship between expected climate regulatory risk exposure and disclosure varies by political environment, we classify firms based on whether their headquarters is located in a Republican- or Democrat-leaning state. Given the well-documented differences in climate policy preferences across party lines, firms in these two groups may face distinct regulatory expectations and stakeholder pressures.

<INSERT TABLE 10 HERE>

Table 10 presents the results in a single table with two panels. Panel A reports the regression results for firms headquartered in Republican-leaning states, while Panel B presents results for firms headquartered in Democrat-leaning states.

In Panel A, the coefficient on exposure is positive and statistically significant at the 1 percent level across all specifications, indicating that firms with higher expected climate regulatory risk exposure disclose more climate-related information. The magnitude of the coefficient ranges from 0.078 to 0.167, with higher values in specifications that do not include industry or year fixed effects. The inclusion of industry and year fixed effects in columns (2) and (4) reduces the coefficient magnitude but retains statistical significance, suggesting that the positive association between exposure and disclosure in Republican states is not driven by industry composition or time trends. These findings align with prior studies showing that firms in less regulated environments rely more on voluntary disclosure mechanisms to address investor concerns (Grewal, Riedl, and Serafeim, 2019).

In Panel B, the coefficient on exposure remains positive and statistically significant across all specifications, with values ranging from 0.0567 to 0.135. While the overall pattern is similar to that in Republican states, the coefficients are slightly smaller in magnitude, suggesting that firms in Democrat-leaning states may already face stronger regulatory expectations, reducing the marginal impact of exposure on disclosure.

Overall, the results suggest that the relationship between expected climate regulatory risk exposure and disclosure is positive and significant in both political environments but slightly stronger in Republican-leaning states. This may indicate that firms in states with less regulatory pressure are more responsive to market-based incentives for disclosure, whereas firms in Democrat-leaning states already operate under higher baseline disclosure expectations. These findings contribute to the broader literature on political economy and corporate disclosure, reinforcing the idea that firms' strategic disclosure decisions are shaped not only by their regulatory risk exposure but also by the broader political and institutional environment in which they operate.

6.0 Conclusion

This study examines the relationship between expected climate regulatory risk exposure and firms' disclosure behavior, as well as the financial market implications of regulatory risk. The findings indicate that firms with higher expected exposure to climate regulatory risk are more likely to disclose climate-related information, supporting the argument that disclosure serves as a strategic response to regulatory uncertainty. However, the strength of this relationship varies across political environments, with firms headquartered in Republican-leaning states exhibiting a stronger association between exposure and disclosure compared to those in Democrat-leaning states. This suggests that firms in less regulated environments may use disclosure as a tool to manage investor expectations, while those in states with stricter climate policies already operate under higher baseline disclosure expectations.

Furthermore, the study finds that climate regulatory risk exposure is positively associated with stock returns, indicating that investors price in regulatory uncertainty as a component of firm risk. The 2016 U.S. presidential election provides an exogenous shock that allows for further analysis, showing that expected regulatory exposure declined after the election, but firms with high exposure continued to disclose climate-related risks. These findings contribute to the growing literature on climate regulatory risk by providing a novel measure of expected regulatory exposure and highlighting the role of political and market factors in shaping disclosure behavior. Our AI-driven measure of expected climate regulatory risk exposure improves upon existing methods that rely on voluntary disclosures or market-based proxies, which can be biased or backward-looking. By using large language models (LLMs) we provide a forward-looking, and granular assessment of regulatory impact. Future research could further explore the long-term financial consequences of climate risk disclosure and the evolving role of regulatory oversight in corporate transparency.

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Figure 1: Use of LLM to create the measure

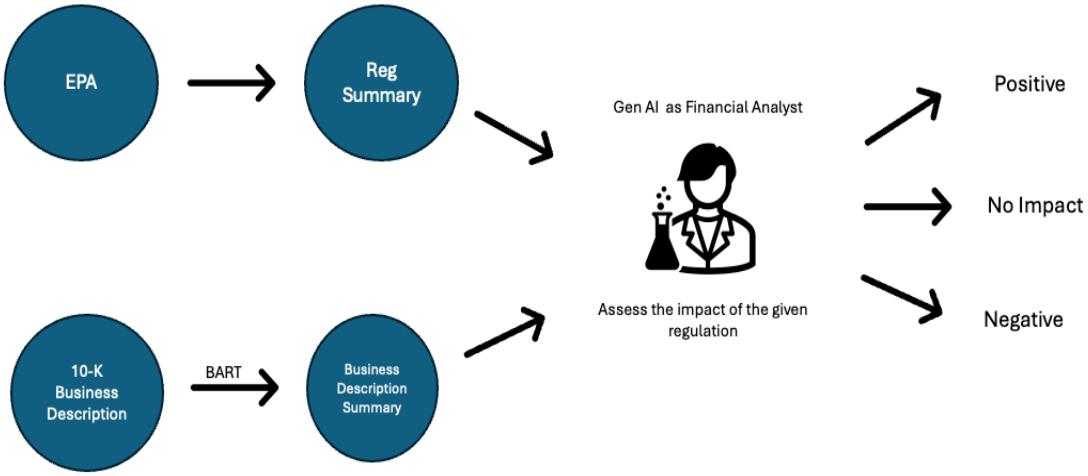


Table 1: Summary Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Exposure	48473	1.215	2.798	0	36
Disclosure	50208	.006	.026	0	.787
at	50160	7927.365	63197.272	0	2573126
capx	39054	194.576	1049.114	-330	34271
ch	49602	362.144	2858.863	-18.993	236166
dltt	50008	1376.348	10037.967	0	486876
ebit	39376	338.367	1795.013	-8167	71230
ppent	49213	1108.662	6874.258	0	259651

The table presents summary statistics for the key variables used in the analysis. *Exposure* measures a percentage of a firm's climate regulatory risk exposure. *Disclosure* represents the extent of firms' voluntary reporting on climate regulatory risk, *at* (total assets, in millions), *capx* (capital expenditures), *ch* (cash holdings), *dltt* (long-term debt), *ebit* (earnings before interest and taxes), and *ppent* (net property, plant, and equipment). All financial variables are reported in millions of U.S. dollars and all continuous financial variables are winsorized at the 1st and 99th percentiles.

Table 2: Pairwise correlations

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
(1) Exposure	1.000							
(2) Disclosure	0.224	1.000						
(3) at	-0.015	0.013	1.000					
(4) capx	0.076	0.082	0.852	1.000				
(5) ch	-0.008	0.024	0.721	0.547	1.000			
(6) dltt	0.003	0.033	0.817	0.676	0.653	1.000		
(7) ebit	0.040	0.027	0.801	0.725	0.676	0.586	1.000	
(8) ppent	0.090	0.097	0.293	0.907	0.295	0.336	0.638	1.000

Table 2 presents pairwise correlations between climate regulatory risk exposure (Exposure) and climate risk disclosure (Disclosure) and the firms characteristics.

Table 3: Logit Regression Results

VARIABLES	(1) Disclose	(2) Disclose	(3) Disclose
Exposure	0.0509***	0.0863***	0.0404***
	(0.0110)	(0.0126)	(0.0129)
log_at	-0.523***	-0.867***	-0.449***
	(0.118)	(0.123)	(0.134)
log_capx	-0.0927	-0.0530	-0.0494
	(0.0750)	(0.0784)	(0.0819)
log_ch	0.124***	0.00396	0.0730
	(0.0409)	(0.0425)	(0.0444)
log_dltt	0.0957***	0.120***	0.121***
	(0.0303)	(0.0316)	(0.0331)
log_ebit	-0.0389	-0.0356	-0.0271
	(0.0533)	(0.0542)	(0.0564)
log_ppent	1.287***	1.357***	0.731***
	(0.100)	(0.102)	(0.113)
Constant	-9.728***	-9.057***	-9.002***
	(0.416)	(0.447)	(1.445)
Industry FE	No	Yes	Yes
Year FE	No	No	Yes
Observations	28,076	28,076	27,737
Number of gvkey	4,706	4,706	4,612

The table presents the results of the logit regression estimating the likelihood of firms disclosing climate regulatory risk information. The dependent variable, Disclose, is an indicator for whether a firm voluntarily reports climate-related risks and takes value of 0 or 1. Exposure measures the percentage of a firm's climate regulatory risk exposure. The regressions include log-transformed financial variables: at (total assets), capx (capital expenditures), ch (cash holdings), dltt (long-term debt), ebit (earnings before interest and taxes), and ppent (net property, plant, and equipment). Standard errors are reported in parentheses. Statistical significance is denoted as *** $p < 0.01$, ** $p < 0.05$, and * $p < 0.1$.

Table 4: OLS Regression Results for Climate Risk Disclosure

VARIABLES	(1) Disclosure	(2) Disclosure	(3) Disclosure	(4) Disclosure	(5) Disclosure
Exposure	0.136***	0.0723***	0.157***	0.0917***	0.111***
	(0.00538)	(0.0263)	(0.0301)	(0.0287)	(0.0303)
log_at	0.00917	-0.0588	-0.0344	-0.0953*	-0.0636
	(0.0320)	(0.0551)	(0.0800)	(0.0533)	(0.0516)
log_capx	-0.0426	-0.125	0.00589	-0.0925	-0.124
	(0.0292)	(0.0906)	(0.118)	(0.0917)	(0.0911)
log_ch	-0.0849***	0.00127	-0.118*	-0.0300	-0.0249
	(0.0146)	(0.0483)	(0.0677)	(0.0502)	(0.0493)
log_dltt	0.0187*	0.0205	0.0126	0.0180	0.0201
	(0.00976)	(0.0131)	(0.0158)	(0.0133)	(0.0146)
log_ebit	-0.140***	-0.0809*	-0.132**	-0.0750*	-0.0689
	(0.0191)	(0.0428)	(0.0562)	(0.0409)	(0.0421)
log_ppent	0.347***	0.308***	0.332***	0.307***	0.291***
	(0.0254)	(0.0979)	(0.100)	(0.0960)	(0.0966)
Constant	-0.317***	0.122	-1.027***	-0.335	0.211
	(0.102)	(0.214)	(0.361)	(0.260)	(0.219)
Industry FE	No	Yes	No	Yes	No
Year FE	No	No	Yes	Yes	No
(Industry *Year) FE	No	No	No	No	Yes
Observations	28,076	27,737	27,737	27,737	27,704
R-squared	0.069	0.148	0.085	0.159	0.203

The table presents the results of the following OLS regression estimating the extent of firms' climate risk disclosure.

$$\textit{Climate Reg Risk Disclosure} = \alpha + \beta 0 \cdot \textit{Climate Reg Risk Exposure} + \beta k \cdot \textit{Controls} + \varepsilon$$

.

The dependent variable, Disclosure, represents the percentage of climate-related information voluntarily reported by firms. Exposure measures the percentage of a firm's climate regulatory risk exposure. The regressions include log-transformed financial variables: at (total assets), capx (capital expenditures), ch (cash holdings), dltt (long-term debt), ebit (earnings before interest and taxes), and ppent (net property, plant, and equipment). Columns (1) through (5) present different model specifications, incorporating industry and year fixed effects, as well as an industry-year interaction fixed effect in column (5). Standard errors are reported in parentheses. Statistical significance is denoted as *** $p < 0.01$, ** $p < 0.05$, and * $p < 0.1$

Table 5: OLS Regression Results for Exposure, Disclosure, and Returns

VARIABLES	(1) Returns	(2) Returns	(3) Returns	(4) Returns
Disclosure			0.0144	0.0405
			(0.0378)	(0.0289)
Exposure	0.147**	0.135***	0.146**	0.130***
	(0.0617)	(0.0396)	(0.0632)	(0.0399)
log_at	-3.771***	-3.728***	-3.769***	-3.726***
	(0.383)	(0.371)	(0.382)	(0.371)
log_capx	-1.221**	-1.141**	-1.220**	-1.137**
	(0.485)	(0.467)	(0.485)	(0.466)
log_ch	0.860***	0.778***	0.861***	0.779***
	(0.138)	(0.129)	(0.138)	(0.130)
log_dltt	0.282***	0.255***	0.282***	0.254***
	(0.0737)	(0.0693)	(0.0738)	(0.0693)
log_ebit	2.050***	2.023***	2.051***	2.025***
	(0.229)	(0.221)	(0.229)	(0.222)
log_ppent	0.449	0.474	0.445	0.462
	(0.317)	(0.301)	(0.317)	(0.300)
Constant	19.52***	22.17***	19.52***	22.16***
	(1.771)	(1.372)	(1.768)	(1.370)
Industry FE	Yes	No	Yes	No
Year FE	Yes	No	Yes	No
(Industry * Year) FE	No	Yes	No	Yes
Observations	27,368	27,335	27,368	27,335
R-squared	0.185	0.251	0.185	0.251

The table presents the results of the OLS regression estimating the relationship between climate regulatory risk exposure, disclosure, and firms' stock returns. The dependent variable, returns, represents firm-level stock returns. The key independent variable, exposure, measures the percentage of a firm's climate regulatory risk exposure. Disclosure represents the percentage of climate-related information voluntarily reported by firms. The regressions include log-transformed financial variables: at (total assets), capx (capital expenditures), ch (cash holdings), dltt (long-term debt), ebit (earnings before interest and taxes), and ppent (net property, plant, and equipment). Columns (1) through (4) present different model specifications, incorporating industry and year fixed effects, as well as an industry-year interaction fixed effect in column (3). Standard errors are reported in parentheses. Statistical significance is denoted as *** $p < 0.01$, ** $p < 0.05$, and * $p < 0.1$.

Table 6: Expected Climate Regulatory Risk Exposure and 2016 U.S. Presidential Election

VARIABLES	(1) Exposure	(2) Exposure	(3) Exposure	(4) Exposure
Post	-0.639***	-0.669***	-2.724***	-2.835***
	(0.0515)	(0.102)	(0.414)	(0.395)
log_at	-0.330***	-0.164**	-0.295*	-0.0794
	(0.0354)	(0.0686)	(0.154)	(0.0604)
log_capx	-0.236***	-0.0713	-0.323	-0.159**
	(0.0324)	(0.0677)	(0.193)	(0.0650)
log_ch	-0.285***	-0.233***	-0.211***	-0.156***
	(0.0161)	(0.0414)	(0.0567)	(0.0357)
log_dltt	0.0722***	0.0402**	0.0679*	0.0325**
	(0.0109)	(0.0181)	(0.0353)	(0.0158)
log_ebit	0.0557***	0.0324	0.0396	0.0172
	(0.0212)	(0.0291)	(0.0516)	(0.0272)
log_ppent	0.745***	0.378***	0.795***	0.381***
	(0.0278)	(0.0732)	(0.148)	(0.0739)
Constant	1.781***	1.936***	4.471***	4.579***
	(0.112)	(0.183)	(0.823)	(0.508)
Industry FE	Yes	No	Yes	No
Year FE	No	Yes	Yes	No
(Industry * Year) FE	No	No	No	Yes
Observations	28,076	27,737	27,737	27,737
R-squared	0.090	0.291	0.152	0.357

The table presents the results of the OLS regression estimating the change in expected climate regulatory risk exposure following the 2016 U.S. presidential election. The key independent variable, post, is an indicator variable that takes the value of 1 for observations from 2016 onward and 0 otherwise. The regressions include log-transformed financial variables: at (total assets), capx (capital expenditures), ch (cash holdings), dltt (long-term debt), ebit (earnings before interest and taxes), and ppent (net property, plant, and equipment). Columns (1) through (4) present different model specifications, incorporating industry and year fixed effects, as well as industry-year interaction fixed effects in column (4). Standard errors are reported in parentheses. Statistical significance is denoted as *** $p < 0.01$, ** $p < 0.05$, and * $p < 0.1$.

Table 7: Expected Climate Regulatory Risk Exposure and Disclosure Before and After the 2016 U.S. Presidential Election

VARIABLES	(1) Disclosure (Before)	(2) Disclosure (After)
Exposure	0.0869***	0.138***
	(0.0313)	(0.0379)
log_at	-0.0728	-0.114
	(0.0640)	(0.0837)
log_capx	-0.0475	-0.254
	(0.0575)	(0.304)
log_ch	-0.0579	0.0701
	(0.0550)	(0.0779)
log_dltt	0.0131	0.0366
	(0.0124)	(0.0350)
log_ebit	-0.0767*	-0.0919
	(0.0417)	(0.0860)
log_ppent	0.274***	0.390*
	(0.0936)	(0.221)
Constant	-0.338	0.271
	(0.278)	(0.487)
Industry FE	No	No
Year FE	No	No
(Industry * Year) FE	Yes	Yes
Observations	23,398	4,339
R-squared	0.161	0.202

The table presents the results of the OLS regression estimating the relationship between expected climate regulatory risk exposure and firms' disclosure before and after the 2016 U.S. presidential election. The dependent variable, Disclosure, represents the percentage of climate-related information voluntarily reported by firms. The key independent variable, Exposure, measures the expected level of climate regulatory risk faced by firms. Column (1) reports results for the post-election period (2016 and later), while column (2) presents results for the pre-election period. The regressions include industry fixed effects and industry-year interactions. Standard errors are reported in parentheses. Statistical significance is denoted as *** $p < 0.01$, ** $p < 0.05$, and * $p < 0.1$.

Table 8: Expected Climate Regulatory Risk Exposure and Stock Returns Before and After the 2016 U.S. Presidential Election

VARIABLES	(1) Return (Before)	(2) Returns (After)
Exposure	0.0991**	0.392***
	(0.0443)	(0.135)
log_at	-3.815***	-3.038***
	(0.370)	(0.946)
log_capx	-1.207**	-0.825
	(0.462)	(0.824)
log_ch	0.736***	1.004***
	(0.135)	(0.289)
log_dltt	0.306***	-0.171
	(0.0759)	(0.382)
log_ebit	2.069***	1.844***
	(0.249)	(0.397)
log_ppent	0.451	0.504
	(0.326)	(0.472)
Constant	22.86***	17.83***
	(1.306)	(3.289)
Industry * Year FE	Yes	Yes
Observations	23,095	4,240
R-squared	0.264	0.196

The table presents the results of the OLS regression estimating the relationship between expected climate regulatory risk exposure and firm-level stock returns before and after the 2016 U.S. presidential election. The dependent variable, returns, represents firm-level stock returns. The key independent variable, exposure, measures the expected level of climate regulatory risk faced by firms. Column (1) reports results for the pre-election period, while column (2) presents results for the post-election period. Standard errors are reported in parentheses. Statistical significance is denoted as *** $p < 0.01$, ** $p < 0.05$, and * $p < 0.1$.

Table 9: Validation of Expected Climate Regulatory Risk Exposure Measure

VARIABLES	(1) Dictionary Reg Exposure	(2) Dictionary Reg Exposure
Exposure	0.00457***	0.00494*
	(0.000382)	(0.00283)
log_at	0.0131***	0.00435
	(0.00227)	(0.00470)
log_capx	-0.00204	0.00216
	(0.00207)	(0.00445)
log_ch	-0.00431***	0.00205
	(0.00104)	(0.00205)
log_dltt	-0.00125*	-0.000435
	(0.000693)	(0.000818)
log_ebit	-0.00681***	-0.00399*
	(0.00136)	(0.00207)
log_ppent	0.0116***	0.00172
	(0.00181)	(0.00330)
Constant	-0.0594***	-0.00844
	(0.00723)	(0.0229)
Industry FE	No	No
Year FE	No	No
Industry * Year FE	No	Yes
Observations	28,076	27,704
R-squared	0.027	0.142

The table presents the results of the OLS regression estimating the relationship between our measure of expected climate regulatory risk exposure and the dictionary-based regulatory exposure measure from Sautner et al. (2023). The dependent variable, dictionary regulatory exposure, quantifies firms' exposure to climate regulation based on textual analysis of earnings call, while the key independent variable, exposure, represents our measure of expected climate regulatory risk. The regressions include interaction of industry and year fixed effects. Standard errors are reported in parentheses. Statistical significance is denoted as *** $p < 0.01$, ** $p < 0.05$, and * $p < 0.1$.

Table 10: Political Environment and Climate Risk Disclosure

The table presents the results of the OLS regression estimating the relationship between expected climate regulatory risk exposure and firms' disclosure, separated by the political affiliation of the state where the firm is headquartered. The dependent variable, disclosure, represents the percentage of climate-related information voluntarily reported by firms. The key independent variable, exposure, measures the expected level of climate regulatory risk faced by firms. The regressions include controls for firm characteristics. Standard errors are reported in parentheses. Statistical significance is denoted as *** p < 0.01, ** p < 0.05, and * p < 0.1.

Panel A: Republican-Leaning States

Panel A presents the results for firms headquartered in Republican-leaning states.

VARIABLES	(1) Disclosure (Republican)	(2) Disclosure (Republican)	(3) Disclosure (Republican)	(4) Disclosure (Republican)
Exposure	0.143***	0.0780***	0.167***	0.102***
	(0.00819)	(0.0287)	(0.0321)	(0.0316)
Controls	Yes	Yes	Yes	Yes
Industry FE	No	Yes	No	Yes
Year FE	No	No	Yes	Yes
Observations	13,346	13,227	13,227	13,227
R-squared	0.071	0.145	0.094	0.162

Panel B: Democrat-Leaning States

Panel B presents the results for firms headquartered in Democrat-leaning states.

VARIABLES	(1) Disclosure (Democrat)	(2) Disclosure (Democrat)	(3) Disclosure (Democrat)	(4) Disclosure (Democrat)
Exposure	0.117***	0.0567**	0.135***	0.0703***
	(0.00688)	(0.0226)	(0.0306)	(0.0247)
Controls	Yes	Yes	Yes	Yes
Industry FE	No	Yes	No	Yes
Year FE	No	No	Yes	Yes
Observations	14,730	14,510	14,510	14,510
R-squared	0.065	0.180	0.077	0.187

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Appendix 1: **Prompt Used for Assessing the Impact of EPA Regulations on Firms**

System Instruction

You are a financial analyst called Jack, skilled in understanding the potential impact of regulation by the Environmental Protection Agency (EPA) on companies' business prospects.

Prompt

"As of the knowledge cutoff date at the end of year [YEAR], and based on the relevant details (business information and description, and regulation summary) provided below, assess the direction of the potential impact of passing the following regulation by the EPA on the firm's future operations."

Business and Regulation Details:

- **[Business Description]**: {Insert summarized firm business description here}
- **[Regulation Summary]**: {Insert summarized regulation details here}

Assessment Criteria:
Be very strict in your assessment and only consider direct impacts. Assign one of the following classifications:

- **P**: If the regulation is expected to have a **positive** impact on the firm.
- **N**: If the regulation is expected to have a **negative** impact on the firm.
- **F**: If the regulation is **not related** to or **not expected to affect** the firm described.

Your response must **always** begin with one of the letters (**P, N, or F**), followed by a brief explanation of your assessment.

Appendix 2: Variable Description

Variable	Description	Measurement	Source
Exposure	Expected climate regulatory risk exposure	Proportion of firm-year instances where regulations are classified as having a negative impact on operations	Constructed using LLM-based classification of regulatory texts and firm disclosures
Disclosure	Climate regulatory risk disclosure	Percentage of total firm disclosures in 10-K filings dedicated to climate regulatory risks	SEC EDGAR (10-K Item 1A)
Returns	Firm-level stock returns	Annual stock return	CRSP
Post	Indicator for post-2016 period	Equals 1 for years 2016 and onward, 0 otherwise	Election-based event classification
Dictionary Regulatory Exposure	Sautner et al. (2023) climate risk measure	Text-based measure capturing climate risk exposure from earnings calls and reports	Sautner et al. (2023) dataset
Republican HQ	Firm headquartered in a Republican-leaning state, based on presidential election results from 2000 to 2020	Equals 1 if firm HQ is in a state that voted Republican in a given presidential election year; 0 otherwise	State-level election results (National Archives Electoral College)
Democrat HQ	Firm headquartered in a Democrat-leaning state, based on presidential election results from 2000 to 2020	Equals 1 if firm HQ is in a state that voted Democrat in a given presidential election year; 0 otherwise	State-level election results (National Archives Electoral College)
Firm Size	Logarithm of total assets	Natural log of total assets (at)	Compustat
Leverage	Capital structure measure	Long-term debt (dltt) divided by total assets (at)	Compustat
Profitability	Firm earnings performance	Earnings before interest and taxes (ebit) divided by total assets (at)	Compustat
Capital Expenditures (CapEx)	Firm investment level	Capital expenditures (capx) divided by total assets (at)	Compustat
Cash Holdings	Firm liquidity measure	Cash and short-term investments (ch)	Compustat

		divided by total assets (at)	
Property, Plant, and Equipment (PP&E)	Firm's fixed assets	Net property, plant, and equipment (ppent) divided by total assets (at)	Compustat
Market-to-Book Ratio	Growth opportunities	Market value of equity divided by book value of equity	Compustat
ROA (Return on Assets)	Profitability ratio	Net income divided by total assets	Compustat
Industry FE	Industry fixed effects based on SIC codes	Dummy variables for SIC code-based industry classification	SIC codes from Compustat
Year FE	Year fixed effects for each year in the panel dataset (2000–2022)	Dummy variables for each year in the panel dataset	