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The value relevance of US firms' mandated financial risk disclosures attributable to the impact of climate change☆

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ABSTRACT

The impact of climate change on firms and, by extension, on economies is considered important for economic outcomes. This leads to the question of whether disclosures made by US firms concerning financial risks attributable to climate change, as mandated by general SEC regulations for reporting material financial risks during the period studied, have economic content. Our research explores the economic relevance of financial risk disclosures. attributable to climate change. We employ the level of analyst following as a measure of economic relevance and find that, all other things being equal, more disclosures of financial risk attributable to climate change are associated with higher levels of analyst followings in subsequent years. This suggests that such disclosures provide economically relevant information. Lastly, we outline the limitations of our study and suggest potential avenues for future research.

1. Introduction

The threat climate change poses to economic activity constitutes a significant concern for both individual businesses and the global economy at large. Furthermore, investors do appear to be interested in access to firm-specific information regarding the financial risk attributable to climate change (Amel-Zadeh, 2021; Krueger, Sautner & Starks, 2020). Issues then arise. Do US firms disclose information about the financial risks they face due to climate change? What regulations exist concerning the disclosure of this information, and how are they implemented? If they do disclose, do these disclosures contain economically relevant information? Note that such disclosures do not directly include the impact of a company on the environment, such as *via* carbon or toxic pollutant emissions. Instead, they pertain to the expected impact of climate change on a company, for example, how extreme weather might affect an agricultural company, framed in terms of financial risk.

In the US stock markets, the Securities and Exchange Commission (SEC) has traditionally held the view that firms have an obligation to disclose information on material financial risk attributable to climate change within their overall disclosure framework, which encompasses risk disclosures (Palmiter, 2015).[1] In 2010, however, the SEC issued specific interpretive guidance to assist companies in fulfilling their obligations to disclose information related to material financial risk attributable to climate change (Securities and Exchange Commission [SEC], 2010).[2] More recently, on March 6, 2024, the SEC announced the approval of a rule aimed at enhancing and standardising the

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[1] Similar requirements exist in jurisdictions covered by International Financial Reporting Standards (IFRS), under various IFRS regulations (see https://cdn.ifrs.org/-/media/feature/news/2019/november/in-brief-climate-change-nick-anderson.pdf?la=en).

[2] In terms of developments with respect to reporting on financial risks attributable to climate change, the Task Force on Climate-related to Financial Disclosures (TCFD) published recommendations on disclosing information related to financial risks attributable to climate change (Task Force on Climate-related Financial Disclosures [TCFD], 2017). In their recommendations, they provide a framework for these financial risk disclosures, which include the following core elements: governance, strategy, risk management, metrics, and targets. It is believed that the recommendations by the TCFD provide firms with more detailed guidance on how to disclose about the financial risks attributable to climate change than under SEC requirements. These recommendations are incorporated into the International Sustainability Standards Board (ISSB) standards, as well as the reporting rules of the UK and New Zealand.

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disclosures of financial risks attributable to climate change.[3] The rule builds on existing disclosure requirements by providing more detailed guidance on the necessary disclosures for firms reporting to the SEC. The implementation of this rule will be phased in gradually, initially applying to fiscal years from 2025 to 2028, with compliance assurance beginning for fiscal years 2026 to 2029.[4]

Historically, however, a tension has existed between the SEC's regulation for disclosing financial risk attributable to climate change and the actual disclosure practices of firms. Certainly, Hansen (2012) finds a modest increase in disclosures of financial risk related to climate change following the SEC's issuance of interpretive guidance. Nevertheless, he also points out that the increase in the provision of new information concerning the various categories of financial risks attributable to climate change is limited. This general lack of disclosure is a conclusion echoed by Palmiter (2015), Eccles and Krzus (2017) and Ilhan, Krueger, Sautner, and Starks (2022). For example, disclosures of financial risk attributable to climate change often employ boilerplate language which, in turn, may convey minimal economic information (Palmiter, 2015; Eccles & Krzus, 2017). Similarly, Ilhan et al. (2022) argue that disclosures of financial risk attributable to climate change are both imprecise and insufficient.

One potential explanation for the low (or low quality) disclosure levels made by firms is that many do not perceive themselves as being exposed to financial risks attributable to climate change (Amel-Zadeh, 2021). Other contributory factors might include the difficulties in forecasting and quantifying climate change's impacts, as Palmiter (2015) suggests. Further, some firms may perceive the obligation to disclose financial risk attributable to climate change as falling outside the SEC's regulatory realm (Burton, 2010).

Nonetheless, investors are indeed interested in information regarding financial risk attributable to climate change, although the extent and quality of such disclosures vary across firms (Amel-Zadeh, 2021; Krueger et al., 2020). Overall, this suggests that disclosures about financial risks attributable to climate change could have economic relevance. It remains uncertain, however, whether firms effectively communicate and convey this information in accordance with SEC risk disclosure regulations.

This study investigates the economic relevance of disclosures on financial risk attributable to climate change made by US-listed firms. It specifically explores whether the information provided in these disclosures, as required by the general mandate to report material financial risks, influences the firms' information environments. This influence is measured by the extent of analyst followings the firms receive.

In employing the level of analyst followings as a way of capturing economic consequences, we follow Bernardi and Stark (2018), who study the relationship between environmental and social disclosures and analyst followings as a way to assess these disclosures' value relevance. On the one hand, Bernardi and Stark (2018) argue that if environmental and social disclosures lack value relevance, then no relationship should exist between their level and the level of analyst followings, once other determinants of analyst followings are controlled for. On the other hand, if these disclosures are value relevant, such a relationship becomes possible.

Following Berkman, Jona, and Soderstrom (2024), we utilise data on the levels of disclosure of financial risk attributable to climate change, as published by Ceres during the period from 2009 to 2017. This data was hand-collected directly from the Ceres website. Ceres, a US-based, non-profit organization dedicated to addressing sustainability issues such as global climate change, gathers data on disclosures concerning financial risk attributable to climate change from firm reports. The collected information is then categorized into four types of financial risk: physical risk, regulatory risk, renewable energy risk and non-specific risk. Additionally, Ceres evaluates these disclosures and assigns a score reflecting the comprehensiveness of financial risk disclosures each year, effectively ranking firms based on the extent of their disclosures.

In regressions using the level of analyst following as the dependent variable and the level of disclosure of financial risk attributable to climate change as our key experimental variable, we find a positive association between the extent of disclosures related to financial risk attributable to climate change in the prior year and the analyst following in the subsequent year, after controlling for many firm-specific characteristics found in previous studies that might affect the supply and demand for analyst services (including the level of environmental disclosures), as well as for firm and time effects. Our findings suggest that, despite the previously identified shortcomings in these disclosures, they can contain economically relevant information. Moreover, the greater the extent of these disclosures, the greater the amount of economically relevant information provided.

This research contributes to the literature on the economic consequences of *disclosures* related to financial risk attributable to climate change. Currently, there are only a limited number of papers in this domain. Specifically, this research examines how such disclosures influence firms' information environments, thereby shedding light on the utility of current financial risk disclosures associated with climate change for market participants, including investors and financial analysts, despite the documented challenges in their provision (Palmiter, 2015).

The remainder of this paper is organized as follows. Section 2 reviews relevant prior literature and develops the study's main hypothesis. Section 3 provides details of the research design and methods employed in the study. Section 4 outlines the data utilised. Section 5 presents the main results of the study. Finally, Section 6 summarizes the main conclusions drawn from the study, highlights some limitations, and suggests directions for future research.

2. Prior literature and hypothesis development

There are only a limited number of studies that directly investigate the economic relevance of firms' specific financial risk disclosures attributable to climate change, despite being mandated under the general requirements for disclosing material financial risks. For example, Schiemann and Sakhel (2019) explore the impact of voluntary disclosures on physical climate risks made by EU firms from 2011 to 2013 through the Carbon Disclosure Project (CDP). Their findings indicate that these disclosures provide economically relevant information, which either reduces information asymmetry if a firm is regulated under the EU Emissions Trading Scheme or increases it if a firm is not so regulated. Nonetheless, although their results offer valuable insights, the focus on voluntary disclosures by EU firms differs from our interest in the implications of mandatory disclosures in the US context. Painter (2020) investigates whether financial risks attributable to climate change affects municipal bond market prices, finding that such risks are related to the increase in issuance costs for long-term maturity bonds. Nevertheless, this study concentrates on municipal bonds, not securities, and addresses the impact of climate change-induced financial risk rather than the *disclosures* of financial risks attributable to climate change as such.

Two exceptions are the studies by Berkman et al. (2024) and Vestrelli, Colladon and Pisello (2024). Berkman et al. (2024) find that the level of mandatory disclosures of financial risk attributable to climate change is *negatively* related to firm valuation for US firms. They interpret these findings to suggest that higher levels of disclosure signal greater risk exposures, implying a negative relationship between disclosure levels and firm value due to the disclosures acting as proxies for

[3] https://www.sec.gov/news/press-release/2024–31.

[4] https://www.ceres.org/accelerator/regulating-climate-financial-risk/sec?utm_campaign=accelerator_climatedisclosure_cultivation_ecomm&utm_medium=email&utm_source=climatedisclosure_e2&utm_term=marketingcloud#FAQs.

adverse exposures to financial risks attributable to climate change. Conversely, Vestrelli et al. (2024) analyse measures of climate change disclosures made in SEC filings, using a methodology developed by the authors, and find a *positive* relationship between the extent of disclosures and firm value. They propose several explanations for this positive relationship which contrast with those put forward by Berkman et al. (2024) in explaining their results, such as the general idea that increased disclosures of value relevant information may reduce the cost of capital or that investors may inherently value transparency.

The methodologies employed in the two papers only partially overlap, utilising different measures of disclosure and divergent control variable strategies. It would be difficult to assert that the methodology used in one of the papers is unequivocally superior to that used in the other. Further, it is not clear if the contrasting results stem from differences in disclosure measurement techniques, control variable strategies, or a combination of both. Additionally, the contrasting findings from both papers raise the possibility of endogeneity concerns arising from omitted variables that could simultaneously influence market value and disclosure levels, casting doubt on the existence of a direct relationship between disclosure levels and financial risks attributable to climate change. Notably, neither study models the firm characteristics linked to these disclosures, underscoring the value of exploring alternative methodologies to assess the economic relevance of these mandatory disclosures of financial risk attributable to climate change.

Much research on the consequences of firms' general information disclosures made by firms is anchored in information asymmetry theory (Akerlof, 1970). This theory states that insiders, possessing more information, can exploit outsiders, who have less information, leading to adverse selection and moral hazard problems. For example, according to Beyer, Cohen, Lys, and Walther (2010), an information asymmetry problem exists between entrepreneurs and investors (the valuation problem), and also between managers and owners (the stewardship problem). Previous research then suggests that higher disclosure levels of economically relevant information can reduce information asymmetries and increase firm value by lowering investors' monitoring costs and reducing the information disadvantage faced by less-informed investors (Verrecchia, 2001; Beyer et al., 2010).

An underlying assumption of information asymmetry theory is the uniform interpretation of information by all recipients. Nonetheless, in reality, investors vary in knowledge and sophistication levels, thus leading to disparate interpretations of firms' disclosures. In order to reduce their information asymmetry problems, investors have the option to engage analysts to interpret the information disclosed by firms. In this respect, Bhushan (1989) argues that the relationship between the level of firm disclosures and analyst followings will then depend upon how additional, economically relevant, information affects both the supply and the demand for analyst services. He contends that while increased disclosure should increase the supply of analyst services, its effect on the demand is context-dependent: complementary information boosts demand, whereas competing information reduces it. Hence, the overall effect on analyst followings could be either positive or negative, contingent upon the interplay between supply and demand forces.

In the context of these arguments, if firms disclose information lacking economic relevance, it should have no effect on the supply-demand dynamic that determines the level of analyst following. Therefore, establishing a relationship between the extent of financial risk disclosures attributable to climate change and enhanced analyst followings is suggestive that these disclosures provide economically relevant information. This viewpoint, introduced by Bernardi and Stark (2018), underpins our research approach.

Empirically, there are two main streams of papers about information disclosures and the level of analyst following. One stream focuses on financial information disclosures and analyst followings, while the other concentrates on non-financial information disclosures and analyst followings. For example, Bhushan (1989) investigates the determinants of analyst coverage, and finds that certain firm characteristics, such as size and ownership structure, are significantly related to the supply or the demand for economically relevant information, thereby impacting analyst following levels. Lang and Lundholm (1996) indicate that the disclosure level of economically relevant information is positively associated with the number of analysts following firms.[5] Tan, Wang, and Welker (2011) explore the effects of mandated IFRS adoption on analyst followings, arguing that it improves the comparability of accounting information across IFRS-adopting countries and increases the number of foreign analysts, particularly from those countries. Lehavy et al. (2011) examine the association between annual report readability and analyst followings, suggesting an inverse relationship - less readable reports, presumed to contain less economically relevant information, are associated with higher levels of analyst following. This presents an example of a negative correlation between financial disclosure quality and analyst attention.

Additionally, studies have examined the association between non-financial disclosures and analyst followings. For example, Bernardi and Stark (2018) find a positive relationship between environmental and social disclosures and analyst followings, consistent with the idea that such disclosures are of economic relevance. He, Marginson, and Dai (2019) investigate the relationship between voluntary disclosures of product and business expansion plans and analyst coverage. They find a positive association between the disclosure of such plans and analyst coverage.

Based on the discussion above, the association between the level of the disclosures concerning financial risks attributable to climate change and analyst followings can vary, depending on specific circumstances. Identifying these circumstances empirically would pose a significant challenge, however. Hence, we propose the following hypothesis in null form:

H_{0n}: All other things being equal, the level of disclosures of financial risk attributable to climate change is not related to the level of analyst following in subsequent years.

Should our tests reject this hypothesis, we will interpret these results as evidence that an increase in the extent of financial risk disclosures attributable to climate change is associated with greater economic consequences (as reflected in the size of analyst followings, whether they increase or decrease). This, in turn, indicates that higher levels of such disclosures provide more economically relevant information.[6]

3. Research design and methods

We use conventional regression analyses to investigate the association between the extent of disclosures of financial risk attributable to climate change and analyst followings in subsequent years. We estimate our models on the full sample of firm-years, as well as specifically focusing on those firm-years for which the relevant disclosure levels are

[5] Lang and Lundholm (1996) also point out, however, that the level of analyst following may affect the level of information disclosures. Therefore, analyst following may increase due to more value-relevant information disclosures, or alternatively, information disclosures may increase because of more analysts following the firm demanding the information. Nonetheless, Liu, Bernardi, Stark, and Rouis (2021) find that analyst following is not associated with the level of disclosures of financial risk attributable to climate change, once a comprehensive set of other firm characteristics are controlled for.

[6] Technically, although it is reasonable to argue that the rejection of the null hypothesis indicates that increases in the levels of disclosures of information on financial risks attributable to climate change produce higher quantities of value relevant information, not rejecting the null could occur for two reasons: (i) the information provided is economically meaningless; or (ii) given the arguments of Bhushan (1989), the way supply of, and demand for, analysts works out is such that supply and demand effects cancel out for each possible level of disclosure. Put another way, failure to reject the null hypothesis does not indicate unambiguously that the disclosures of information about financial risk attributable to climate change are value irrelevant.

positive. We also use two model specifications, one including the lagged dependent variable, one not. Including the lagged dependent variable allows for persistence in the levels of analyst followings.

We first estimate the following model (1) to test H_{0a}:

$$AF_{i,t+1} = a_0 + a_1 CCRD_{i,t-1} + a_2 ED_{i,t} + \sum_{j=1}^{J} b_j CV_{i,j,t} + \sum_{t=1}^{T} c_t Year_t + \varepsilon_{i,t} \quad (1)$$

where $AF_{i,t+1}$ is the number of analysts following firm i at the first date following the release of the annual report for year t, when the analysts provide forecasts for the next fiscal year, $t + 1$. $CCRD_{i,t-1}$ is the disclosure level score for financial risks attributable to climate change score for firm i in year t-1. We use the value for year t-1 to allow the information time to have any effect, if any, on the level of analyst following. ED_t is the level of environmental disclosures (*e.g.*, levels of disclosure about carbon emissions, pollution, the impact of the firm on the environment in general, *etc.*) in year t. We include it as an explanatory variable not only because of the results in Bernardi and Stark (2018), but also to provide reassurance that our measure of the level of financial risk disclosures attributable to climate change is not environmental disclosures in disguise and is, instead, a distinct construct. The $CV_{i,j,t}$, $j = 1$ to J, are a set of J control variables, and the $Year_t$'s, $t = 1$ to T, are a set of calendar year time dummy variables, of which only T-1 are included in the regression. We include firm fixed effects by using the fixed effects 'within' estimator. By including firm and time fixed effects and a broad ranging set of control variables, we intend to reduce the impact of correlated omitted variables on our results, thereby improving identification. The control variables are derived from those employed in Bhushan (1989), Lang and Lundhom (1993), Tan et al. (2011), Lehavy et al. (2011) and Bernardi and Stark (2018), and are described more fully in the next section.

Our second specification estimates:

$$AF_{i,t+1} = a_0 + a_1 CCRD_{i,t-1} + a_2 ED_{i,t} + a_3 AF_{i,t} + \sum_{j=1}^{J} b_j CV_{i,j,t} + \sum_{t=1}^{T} c_t Year_t + \varepsilon_{i,t} \quad (2)$$

in which we include the level of analyst following at the start of year t ($AF_{i,t}$) as an additional explanatory variable to control for persistence in this variable.

For our hypothesis tests, under hypothesis H_0n, the coefficients of a_1 are not expected to be significantly different from 0. If they are, whether positive or negative, we reject the null hypothesis.

4. Data

4.1. Measuring the level of financial risk disclosures attributable to climate change

According to the SEC guidance on disclosures related to financial risks attributable to climate change, US firms are advised to report on four distinct types of risk information. The first is *regulatory risk*, defined as the impact from legislation and regulation enacted in response to climate change concerns. This includes, for example, the costs of purchasing allowances under the 'cap and trade' carbon trading system, which could necessitate disclosure. Also, firms need to disclose potential impacts in other areas to comply with the disclosure regulations. The second type is *renewable risk*, which results from technological developments related to climate change that could affect the demand for existing products or services. For example, those industries relying on oil as their source of energy may be required to shift towards clean and renewable energy sources, reducing the demand for oil. The third type is *physical risk*, which represents the risk of physical consequences arising as a result of climate change on the firm's plant, property, and equipment. For instance, firms located near the coastline need to consider the risk of sea-level rise damaging their infrastructure, and provide relevant information about this risk to investors. The last type of climate risk is *non-specific risk*, which includes other risks not included in the first three types.

Ceres gathers data on disclosures concerning financial risks attributable to climate change, made by both US-based and international firms. Through content analysis, Ceres collects and categorizes these disclosures into the four aforementioned types of financial risk. Specifically, for each firm-year, Ceres reviews SEC filings, searching for keywords related to each risk category, to assign an overall, relative, score reflecting the total amount of disclosure. Additionally, it calculates the percentages of the total disclosures of information on financial risk attributable to climate change for each of the four types of risk mentioned above. We utilise the data made publicly available by Ceres

Table 1
Variable Descriptions and Sources.

Dependent variables	
Variables	*Variable Description*
AF	The first record of the number of the analyst following for the next fiscal year after the release of the year t annual report, from I/B/E/S - in year t + 1
Independent variables	
Variables	*Variable Description*
CCRD	The level of climate change-related financial risk disclosures for the year, from Ceres – measured in year t-1
ED	The environmental disclosure score in year t from Bloomberg.
Size	Log of market value in year t, from Compustat
BM	Book-to-market ratio, equal to the ratio of the book value of equity to the market value of the equity in year t, from Compustat
SG	Sales growth – the ratio of the change in sales revenue in the current year to sales revenue in year t, from Compustat
RD	The ratio of research and development expense to market value in year t, from Compustat
ROA	Return on assets, equal to the ratio of net income to total assets in year t, from Compustat
Loss	A dummy variable, equal to 1 if net income is smaller than 0 in year t, otherwise 0, from Compustat
CapEx	The ratio of capital expenditure to total assets in year t, from Compustat
PPE Age	The ratio of net property, plant, and equipment to gross property, plant, and equipment in year t, from Compustat
Lev	Leverage, equal to the ratio of total liabilities to total assets in year t, from Compustat
Debt Issued	Long-term debt issuance to total assets in year t, from Compustat
Equity Issued	The sale of common and preferred stock to total assets in year t, from Compustat
AQ	Accounting quality, equal to the absolute value of abnormal accruals in year t, from Compustat
Volatility	The standard deviation of the daily return over one year after the annual report release date, from CRSP - measured in year t
Beta	Beta coefficient from CAPM model, from Beta Suite in WRDS
Volatility	The standard deviation of daily returns in year t, from CRSP
Strategic Ownership	Beginning year blockholder ownership percentage, from WRDS TR 13-F Stock Ownership database
Board Independence	The ratio of the number of non-executive directors to total board size in year t, from Boardex

Table 2
Sample Derivation.

Steps	*Observations*
Ceres data for US-listed firms from 2009 to 2017	11574
After dropping firms in financial industries	9423
Observations with non-missing Compustat data in year t	7701
After merging with Boardex data	7199
After merging with analyst following data from I/B/E/S	7074
After merging with volatility measures from CRSP	6833
After merging with environmental disclosure scores from Bloomberg	6260

Table 3
Sample Industry Classifications.

Industry	*Observations*
Aerospace & Defence	109
Apparel & Textiles	152
Automotive	35
Chemicals	205
Consumer Goods	301
Electric Power & Gas Utilities	350
Electronics	398
Entertainment & Recreation	46
Food & Beverages	265
Hospitality & Tourism	58
Information Technology	519
Manufacturing & Industrial Materials	798
Media	66
Medical Equipment Manufacturing	334
Mining	70
Oil & Gas	411
Pharmaceuticals/Health Care	606
Real Estate Finance/Property Development.	219
Retail	301
Services - Business-Related	266
Services - Educational	35
Services - Other	155
Telecommunications	157
Transportation	205
Waste Management	43
Water Utility/Services	44
Wholesale	112
Total	6260

from 2009 to 2017 to measure the extent of total financial risk disclosures of financial risk attributable to climate change for a firm in a given year.

4.2. Other variable definitions

As mentioned above, we use control variables that are employed in Bhushan (1989), Lang and Lundholm (1993), Tan et al. (2011), Lehavy et al. (2011), and Bernardi and Stark (2018). The variables used as control variables are intended to capture proxies for the supply and/or demand for analyst services, including proxies that capture firms' general information environments. The set of control variables includes firm size (*Size*); the book-to-market ratio (*BM*); sales growth (*SG*); research and development expenditures (*RD*); property, plant, and equipment (*PPE*); capital expenditures (*CapEx*); the relative age of property, plant, and equipment (*PPE Age*); return on assets (*ROA*); whether a firm makes a loss (*Loss*); leverage (*Lev*); debt raised (*Debt Issued*); equity raised (*Equity Issued*); equity repurchased (*Equity Repurchased*); cash holdings (*Cash Holdings*); accounting quality (*AQ*); Beta (*Beta*); volatility (*Vol*); board independence (*Board Independence*); and strategic ownership (*Strategic Ownership*).

Table 1 provides details the definitions of variables, the respective dates of measurement, and the sources of data.

4.3. Sample construction

Overall, our sample consists of US-domiciled firms covered by the Ceres database with the necessary data for conducting our tests. The sample derivation process is described in Table 2. Our final dataset incudes 6260 firm-year observations spanning from 2009 to 2017. Ceres made the data on disclosures of financial risk attributable to climate change publicly available, *via* their website, until 2018. At the time of our data collection, however, the complete dataset for 2018 was not fully available, leading to the exclusion of 2018 data from our analysis.

4.4. Sample characteristics

Table 3 provides the industry breakdown, Table 4 provides the summary statistics, and Table 5 provides the correlations between variables for our sample.

Table 4
Sample Descriptive Statistics.

Variable	*N*	*Mean*	Std. Dev	*Min*	*P10*	*Median*	*P90*	*Max*
AF	6260	11.596	8.220	1	3	9	23	49
CCRD	6260	27.733	33.927	0	0	4	85	100
ED	6260	9.253	15.601	0	0	0	34.884	84.298
Size	6260	7.758	1.581	4.370	5.873	7.596	9.909	11.991
BM	6260	0.409	0.294	-0.313	0.094	0.367	0.795	1.401
SG	6260	0.090	0.257	-0.499	-0.130	0.059	0.307	1.465
RD	6260	0.020	0.037	0	0	0.002	0.059	0.243
ROA	6260	0.032	0.119	-0.597	-0.059	0.047	0.131	0.269
Loss	6260	0.189	0.392	0	0	0	1	1
Capex	6260	0.049	0.050	0.001	0.009	0.033	0.104	0.281
PPE age	6260	0.487	0.166	0.114	0.289	0.470	0.714	0.971
Lev	6260	0.541	0.235	0.084	0.227	0.541	0.822	1.289
Debt Issued	6260	0.115	0.202	0	0	0.029	0.340	1.248
Equity Issued	6260	0.025	0.089	0	0	0.003	0.038	0.949
AQ	6260	1.045	3.203	0.001	0.012	0.109	2.072	21.859
Volatility	6260	0.023	0.011	0.008	0.012	0.021	0.037	0.064
Beta	6260	1.210	0.447	0.228	0.679	1.169	1.802	2.513
Strategic Ownership	6260	0.220	0.124	0	0.058	0.212	0.385	0.559
Board Independence	6260	0.944	0.094	0.364	0.8	1	1	1

Notes: Variable definitions can be found in Table 1.

Table 5
Variable Correlations.

Variables	*AF*	*CCRD*	*ED*	*Size*	*BM*	*SG*	*RD*	*ROA*	*Loss*	*Capex*
CCRD	0.209									
ED	0.454	0.279								
Size	0.728	0.240	0.630							
BM	-0.114	0.191	-0.058	-0.167						
SG	-0.024	-0.083	-0.119	-0.049	-0.155					
RD	-0.089	-0.268	-0.054	-0.179	-0.071	0.056				
ROA	0.097	0.009	0.116	0.249	-0.057	0.021	-0.413			
Loss	-0.068	-0.04	-0.129	-0.246	0.041	-0.016	0.321	-0.689		
Capex	0.201	0.403	0.035	0.085	0.049	0.006	-0.201	0.047	-0.025	
PPE age	0.151	0.362	0.074	0.206	0.139	0.109	-0.243	0.058	-0.046	0.34
Lev	0.111	0.186	0.215	0.208	-0.282	-0.067	-0.117	-0.08	0.031	0.039
Debt Issued	-0.052	0.034	-0.05	-0.046	-0.062	0.029	-0.096	-0.027	0.016	0.069
Equity Issued	-0.075	-0.099	-0.103	-0.164	-0.152	0.156	0.264	-0.499	0.32	-0.055
AQ	-0.044	-0.023	0.002	-0.044	-0.028	0.048	0.083	0.019	-0.009	0.014
Volatility	-0.254	-0.162	-0.335	-0.545	0.12	0.047	0.282	-0.425	0.458	-0.007
Beta	-0.15	-0.071	-0.24	-0.323	0.077	0.085	0.171	-0.253	0.295	0.007
Strategic Ownership	-0.104	-0.116	-0.187	-0.181	0.007	0.013	0.077	-0.108	0.114	-0.096
Board Independence	-0.064	-0.041	-0.09	-0.108	-0.043	0.031	0.029	-0.038	0.035	-0.008

Variables	*PPE Age*	*Lev*	*Debt Issued*	*Equity Issued*	*AQ*	*Volatility*	*Beta*	*Strategic Ownership*
Lev	0.058							
Debt Issued	0.051	0.304						
Equity Issued	-0.035	-0.137	-0.044					
AQ	-0.048	-0.013	0.016	0.039				
Volatility	-0.091	-0.089	0.028	0.292	0.049			
Beta	-0.085	-0.047	0.075	0.125	0.088	0.605		
Strategic Ownership	-0.098	-0.039	0.053	0.041	-0.05	0.034	0.123	
Board Independence	-0.034	-0.033	-0.027	0.057	-0.003	0.058	0.048	0.086

Notes: Variable definitions can be found in Table 1.

Table 6
The Impact of the Level of Financial Risk Disclosures Related to Climate Change on Subsequent Analyst Followings.

Variables	Full Sample		Positive CCRD Sub-Sample	
CCRD	0.012 * **	0.006 * **	0.013 * **	0.009 * *
	(0.003)	(0.002)	(0.005)	(0.004)
ED	0.053 * **	0.026 * **	0.040 * **	0.023 * **
	(0.006)	(0.005)	(0.009)	(0.007)
AF	-	0.573 * **	-	0.543 * **
		(0.010)		(0.014)
Size	1.834 * **	0.772 * **	2.006 * **	0.843 * **
	(0.098)	(0.079)	(0.162)	(0.132)
BM	0.564 * *	0.542 * **	0.650 * *	0.624 * *
	(0.229)	(0.179)	(0.321)	(0.254)
SG	-0.330 * *	-0.321 * **	-0.730 * **	-0.622 * **
	(0.156)	(0.122)	(0.261)	(0.207)
RD	4.239 * *	2.542	8.840 *	1.219
	(2.091)	(1.638)	(5.303)	(4.209)
ROA	-2.132 * **	-0.819 *	-2.142 * *	-0.334
	(0.617)	(0.484)	(1.045)	(0.830)
Loss	0.330 * *	0.190 *	0.353 *	0.290 *
	(0.142)	(0.111)	(0.210)	(0.167)
Capex	-1.509	-1.503	-2.797	-1.216
	(1.540)	(1.206)	(2.028)	(1.609)
PPE Age	-0.124	0.121	-1.044	0.198
	(0.527)	(0.413)	(0.943)	(0.748)
Lev	-0.683	-0.341	-1.672 * *	-0.445
	(0.423)	(0.331)	(0.762)	(0.605)
Debt Raised	-0.458 *	-0.093	-0.396	-0.255
	(0.263)	(0.206)	(0.393)	(0.311)
Equity Raised	-0.488	-0.442	0.599	-0.354
	(0.579)	(0.454)	(1.474)	(1.169)
AQ	-0.025 * *	-0.009	-0.033 * *	-0.013
	(0.012)	(0.009)	(0.017)	(0.013)
Volatility	40.116 * **	21.393 * **	67.409 * **	29.064 * **
	(7.731)	(6.065)	(13.147)	(10.468)
Beta	-0.823 * **	-0.567 * **	-1.314 * **	-0.905 * **
	(0.139)	(0.109)	(0.222)	(0.176)
Strategic Ownership	2.599 * **	1.598 * **	4.788 * **	2.985 * **
	(0.483)	(0.379)	(0.751)	(0.597)
Board Independence	0.250	-0.021	-1.532	-0.784
	(0.735)	(0.576)	(1.122)	(0.890)
Firm Fixed Effects	Y			
Time Fixed Effects	Y			
R-squared	0.201	0.510	0.216	0.508
Observations	6260		3266	

Notes: This table presents the results for the association between the climate change risk disclosure level and analyst following next year. There are three sets of results. All regressions are estimated with firm fixed effect, and time dummies are included in the analyses but are not reported for space reasons. The standard errors in parentheses are clustered by industry. Variable definitions can be found in Table 1.

Table 4 reveals that a significant number of firms disclose little to no information on financial risks attributable to climate change, as evidenced by a median *CCRD* score of 4, relative to a maximum possible score of 100. In fact, just over half the firm-years in the sample feature disclosures on financial risk attributable to climate change. The median value for *ED* is zero, suggesting that less than half the firm-years in our sample feature any environmental disclosures.

Table 5 suggests a positive and significant correlation between *CCRD* and *ED* (for a sample size of 6260 observations, a significant correlation is defined as greater than (less than) approximately.0247 (−.0247)). Further, both *CCRD* and *ED* are positively and significantly correlated with *AF*. Nonetheless, *AF* is significantly correlated with all other potential explanatory variables but one (*SG*). Further, *CCRD* also has significant correlations, even if of moderate size, with all but two of the other potential explanatory variables (*ROA* and *AQ*). Based on these findings, we now turn to our multivariate analyses.

5. Results

Table 6 presents the results for the association between the level of disclosure of financial risk attributable to climate change and analyst followings in a multivariate context. The first two columns of results present the results of estimating our two specifications on the full sample. The third and fourth columns of results provide the results of estimating our two specifications on a sub-sample of firm-years for which *CCRD* is positive.

Starting with the control variables, a number of them are robustly significant across all specifications and estimation samples – *ED*, *Size*, *BM*, *SG*, *Volatility*, *Beta* and *Strategic Ownership*. When the lag of the dependent variable is included, it is highly significant and adds substantially to explanatory power. Nonetheless, our experimental variable, *CCRD*, is highly significant across all specifications. This is despite the presence of firm and time fixed effects and a comprehensive set of firm-specific control variables.

Thus, we feel comfortable rejecting our null hypothesis and concluding that the level of disclosures of financial risk attributable to climate change is associated with the level of analyst following. Our results also reinforce those of Bernardi and Stark (2018), demonstrating an association between levels of environmental disclosure and analyst followings. That effect is distinct from the one we observe for the extent of disclosures concerning financial risk attributable to climate change.

As additional tests, considering the uncertain timing of analyst responses to changes in the disclosure level of information on financial

risks attributable to climate change we substitute $CCRD_{i,t}$ for $CCRD_{i,t-1}$ in Eqs. (1) and (2), leaving other aspects of our testing equations unchanged. Essentially, these tests assume that changes will occur very quickly, contrasting with the assumption of a lag of just over a year used in the previously reported tests. The reports are qualitatively similar to those reported in Table 6, other than when the full sample is used and also lagged analyst following is included as an independent variable. In this case, the coefficient of $CCRD_{i,t}$ is insignificant. Overall, we do not view the results of these additional tests as negating our overall conclusions.[7]

6. Conclusions

In sum, we conclude that, all other things being equal, more disclosures of financial risk attributable to climate change, as mandated by the SEC's requirement for disclosing material financial risks, are associated with higher analyst followings in subsequent years. We interpret this as indicative of the economically relevant information contained within these disclosures. Further, our results suggest that disclosing economically relevant information on financial risks attributable to climate change is feasible for firms, notwithstanding the forecasting and quantification challenges inherent in so doing identified by Palmiter (2015).

We acknowledge, however, that there are several limitations of this study. First, despite employing a comprehensive set of firm characteristics and implementing both firm and time fixed effects to mitigate endogeneity concerns, there may still be omitted variables influencing the level of climate risk disclosure that could also affect the dependent variable. Second, our research does not necessarily establish a clearly causal relationship but, rather, identifies associations between disclosures of financial risk attributable to climate change and a specific economic consequence - analyst followings. Third, our analysis is limited to exploring the effect on one economic consequence, namely the level of analyst following. The literature suggests other possible outcome variables such as analyst forecast accuracy, forecast dispersion, target price forecast accuracy, target price forecast dispersion, bid-ask spreads, volatility, liquidity, and trading volumes. Investigating the impact of disclosure levels related to financial risk associated with climate change on these varied economic consequences represents a possible avenue for future research.

Fourth, whilst the evidence presented in this paper does suggest that the mandated disclosures under examination, stemming from the SEC's broad-based financial risk reporting mandate, can contain economically relevant information, it does not determine whether firms are disclosing the 'appropriate' amount of information. Presumably, the SEC's recent new rule approval requiring detailed and specific firm disclosures on financial risks attributable to climate change suggests that the SEC perceives current disclosures as lacking.

Fifth, a critical assumption underpinning our study's theoretical framework is that analysts can rationally comprehend the characteristics of information disclosed regarding financial risks attributable to climate change, including its economic relevance. Nonetheless, Stocken (2000) suggests that information disclosed by firms may not always be truthful and verifiable, particularly when the costs of false reporting are minimal. Under these circumstances, firm disclosures may not be genuinely informative. Consequently, a distinct theoretical framework relating observable disclosure levels to analyst followings is necessary for this setting. This framework could facilitate alternative interpretations of our empirical results, focusing on how analysts and market participants respond to the disclosed information and its impact on market outcomes.

As for other future research directions, the relationship between disclosures of financial risk attributable to climate change and economic outcomes could be explored in different ways, such as different textual analysis techniques beyond those employed by Ceres, as exemplified, for example, by Vestrelli et al. (2024). Additionally, conducting analogous studies in other countries, such as the UK or New Zealand, where specific firms are now required to explicitly and mandatorily disclose information on financial risks attributable to climate change, could yield valuable insights. With time, data emerging from the SEC's new disclosure requirement will provide a wealth of data for assessing the rule's impact. Pursuing these research avenues could elucidate whether diverse types of financial risk disclosures indeed provide economic insights.

CRediT authorship contribution statement

Cristiana Bernardi: Supervision, Resources, Investigation. **Andrew William Stark:** Supervision, Methodology, Conceptualization. **Siqi Liu:** Writing – original draft, Formal analysis, Data curation.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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[7] Results are available from the authors by request.

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