Biodiversity Risk and Dividend Payouts

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Abstract: This study examines the impact of firm-level biodiversity risk on dividend payout policies. Using a dataset of 30,652 firm-year observations from 3,220 unique US-listed firms, we show that increased exposure to biodiversity risk leads to lower dividend payouts. Our results remain consistent after several robustness and endogeneity tests, including staggered adoption of state-level climate change action plans, 2-stage least squares (2SLS) with an instrumental variable, and entropy balancing. Cash flow and earnings volatility act as channels driving this association. We also find that firm life cycle, financial constraints, CEO age, and withdrawal from the Paris Agreement moderate this relationship. Our findings contribute to the literature on the increasing importance of climate change and biodiversity risk in corporate decision making.

Keywords: Biodiversity risk, dividend payouts, climate change, Paris agreement.

JEL Classification: G30, G35, Q54.

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1. Introduction

Biodiversity, short for "biological diversity," refers to the variability of life on Earth, including plants, animals, microorganisms and their ecosystems; it is the foundation of life on Earth. Biodiversity is essential for mitigating the effects of climate change and provides significant economic benefits in many industries, including agriculture, forestry, fisheries and tourism. According to the World Economic Forum's Global Risk Report (2020), biodiversity loss is the second most impactful and third most likely risk for the next decade and mentions that biodiversity loss has serious implications for humanity, ranging from the disruption of entire supply chains to the collapse of food and health systems. It is reported that an estimated $7.2 trillion of total enterprise value is exposed to unmanaged biodiversity risk (Carvalho et al., 2023), and that biodiversity and ecosystem degradation cause an estimated $4 trillion to $20 trillion in economic damages annually (Kapnick, 2022).

Biodiversity risk is related to potential losses of market participants due to natural deterioration. It can be divided into transition risk from regulatory actions and physical risk from actual biodiversity loss or losses related to nature (Giglio et al., 2023). Due to its economic implications, researchers have begun to examine the impact of biodiversity risk on firm-level outcomes such as stock returns (Giglio et al., 2023; Kalhoro & Kyaw, 2024), stock price crash risk (Liang et al., 2024) and firm operations (Ahmad & Karpuz, 2024; Giglio et al., 2023; Li et al., 2024; Salmi et al., 2023; Zu Ermgassen et al., 2022). Despite these emerging studies on the impact of biodiversity risk, there is a notable gap on the impact on firm’s dividend payout policies. Biodiversity reporting is currently at the same stage where climate change reporting was five to ten years ago (Agnew, 2022). Given the possible direct and indirect effects of biodiversity risk on firm’s financial performance, it is likely to affect dividend payouts. Therefore, this study investigates how, and through which channels biodiversity risk impacts firms' dividend payouts. We fill this gap and contribute to the limited climate finance research in this area as noted by Karolyi and Tobin-de la Puente (2023).

Dividend payout is one of the most important corporate decisions, playing a significant role in stock valuation and decisions on how companies allocate cash to shareholders (Brav et al., 2005; Faulkner & García-Feijóo, 2022). Consequently, dividends are a key element of corporate strategic planning (Allen & Michaely, 2003). Given the importance of corporate dividend payout policy to both shareholders and managers, the extant literature has been dedicated to identifying the key determinants of dividend decisions (Caliskan & Doukas, 2015; DeAngelo et al., 2006; Denis & Osobov, 2008; Fama & French, 2001; John et al., 2015; Koo et al., 2017; Michaely & Roberts, 2012). However, the impact of biodiversity risk is limited in this literature.

Biodiversity risk can impact dividend payments in two contrasting ways. According to signalling theory, dividend policy changes can provide insight into future cash flow changes (Bhattacharya, 1979; Miller & Rock, 1985). This suggests that companies may adjust their dividend policies in response to perceived cash flow risk stemming from biodiversity risk (Dionne & Ouederni, 2011). A negative correlation has been observed between corporate risk management strategies and dividend payouts, indicating that firms facing higher biodiversity-related risks may reduce dividends to preserve capital (Dionne & Ouederni, 2011). Indeed, Ahmad and Karpuz (2024) show that firms facing high biodiversity risk hold more cash for precautionary motives. Biodiversity risk exposure can negatively impact a company's future earnings by increasing the costs of corporate compliance, which will reduce profits and future cash flows (Jung et al., 2018; Zhu & Hou, 2022). Firm biodiversity risk is associated with lower sales and profitability and facing higher likelihood of bankruptcy (Adamolekun, 2024; Bach et al., 2024). Given that dividend policy is heavily influenced by earnings (Cheung et al., 2018; Gul, 1999; Michaely & Roberts, 2012), exposure to biodiversity risk would have a negative impact on dividends. Moreover, it has been documented that significant financial resources are needed for biodiversity risk management initiatives (Flammer et al., 2023; Panwar et al., 2023). While investing these financial resources to manage biodiversity risk can pay off in future stock prices, (Przychodzen & Przychodzen, 2013), it can negatively impact other aspects of firm operations, such as dividend payments, as resources are reallocated to manage biodiversity risk (Karolyi & Tobin-de la Puente, 2023; Nedopil, 2023).

On the other hand, earlier research has shown that companies with high biodiversity risk are more likely to experience stock price crashes (Liang et al., 2024) and investors require risk premium for firms exposed to higher biodiversity risk (Coqueret et al., 2025). In addition, investors may request a higher risk premium when they are uncertain about future regulation or litigation to protect biodiversity (Garel et al., 2024). We argue that companies with greater biodiversity risk pay out more dividends to investors in order to offset the risk they have created, based on the catering theory of dividends (Baker & Wurgler, 2004; Wang et al., 2022). Additionally, these large dividend payments assist companies in improving shareholder opinions regarding their capacity to control biodiversity risk exposure.

The two contrasting theoretical discussions suggest that the overall impact of biodiversity risk on dividend payment is ambiguous. We empirically investigate this puzzle using a sample of publicly listed US firms for the 2001-2020 period, with 30,652 firm-year observations. We use three related measures of biodiversity risk, constructed by Giglio et al. (2023), that are based on mentions of biodiversity risk exposure in the 10-Ks of the companies in our dataset. Our investigation comprises fixed effect regressions as well as further analyses to correct for possible endogeneity. To this end, we utilise a staggered difference-in-differences model considering the state-level enactment of Climate Change Adaption Plans (CCAP) and 2-stage least squares (2SLS) regressions using the Google biodiversity index as an instrumental variable, along with entropy balancing techniques. Overall, our results consistently show a negative significant relationship between biodiversity risk and dividend payout. This finding is both statistically significant and economically meaningful; a one standard deviation increase in biodiversity risk is associated with around 4 to 8 percent reduction in dividend payouts, depending on the measure used. Furthermore, we scrutinise the channels through which biodiversity risk impacts dividend payout. Our results show that cash flow and earnings volatility act as channels through which firm's biodiversity risk exposure leads to decrease in dividend payouts. Finally, further analysis shows that financial constraints, firm life cycle, CEO age and Paris agreement withdrawal decision moderate the negative relationship between biodiversity risk and dividend payout.

Though biodiversity risk and climate risk appear to be similar in concept, they are significantly different. While biodiversity risk arises from the threats to the variety of life on Earth and its consequences, climate risk is related with the potential negative outcomes from changes in the climate system. However, the adverse effects of changes in the climate system are closely linked to biodiversity loss, as climate change can accelerate biodiversity decline, while biodiversity loss can contribute to climate change by destroying carbon sinks (Giglio et al., 2023). However, given the growing focus on climate change and its economic impacts, it is crucial to distinguish between these risks and identify their impact on financial decision-making. In this aspect, this study contributes to the emerging finance literature on biodiversity risk in few distinct ways. First, we show that firms that are exposed to high biodiversity risk pay lower dividends. While previous studies have considered the impact of biodiversity risk on stock returns (Giglio et al., 2023; Kalhoro & Kyaw, 2024), stock price crash risk (Liang et al., 2024) and firm operations (Ahmad & Karpuz, 2024; Giglio et al., 2023; Li et al., 2024; Salmi et al., 2023; Zu Ermgassen et al., 2022), our unique contribution is that biodiversity risk negatively impacts how companies distribute cash to shareholders in the form of cash dividends. To this end we head to the call by Karolyi and Tobin-de la Puente (2023) and adds to the limited climate finance research in this area.

Second, the study provides possible channels through which biodiversity risk impacts dividend payout. Specifically, we show that biodiversity risk negatively impacts dividend payout through cash flow and earnings volatility channels (Gul, 1999; Jung et al., 2018; Michaely & Roberts, 2012; Zhu & Hou, 2022) and for financially constrained firms (Fan & Zhao, 2024; Trinh et al., 2024; Xu & Kim, 2021). Third we contribute to the literature on CEO attributes by showing that the negative impact on biodiversity risk on dividend is stronger for firms managed by younger CEOs. This findings aligns with the argument that younger CEOs are more proactive in allocating resources to mitigate biodiversity risks, thereby potentially reducing immediate financial returns to shareholders in favour of long-term sustainability (Desir et al., 2024). Finally, we contribute to the literature that employs signaling theory (Bhattacharya, 1979; Miller & Rock, 1985) to examine the determinants of dividends by considering ecological factor.

The paper is structured as follows. Section 2 provides details of the dataset and the research methodology. Section 3 presents basic regression results followed by analyses to control for potential endogeneity and model misspecification. In section 4, the focus is on the potential channels through which biodiversity risk impacts dividend payout. Section 5 comprises further analysis to capture the effect of firm differences and exogenous shocks. Lastly, section 6 concludes.

2. Data and Research Model

2.1. Data

Our firm-level biodiversity risk variable comes from the biodiversity risk exposure data constructed by Giglio et al. (2023). Making use of the 10-Ks of US listed firms, they created text-based measures of biodiversity risk. More specifically, they have three different measures: (1) Biodiversity count (*BioCount*) is equal to one if biodiversity risk is mentioned in the 10-K of a firm in a given year at least twice, and zero otherwise; (2) Biodiversity negative (*BioNegative*) is the difference between the number of negative-sentiment and positive-sentiment biodiversity related sentences in the 10-Ks; (3) Biodiversity regulation (*BioRegulation*) is equal to one if biodiversity risk is mentioned in the 10-K of a firm in a given year at least twice, out of which one of the mentions is related to regulation (i.e. containing words such as law(s), regulation, Act, ESA, etc.), and zero otherwise. Lastly, using principal component analysis (PCA), we transform the three biodiversity variables into one. This constructed variable (*BioPCA*) is a biodiversity index comprising most of the information and the variability of the three biodiversity risks and gives us a combined measure.

The outcome variable in our research is the dividend payments by the US listed companies. Firms usually make the strategic choice of distributing some (or all) of their profits as dividends. The rest is reinvested back in the business. We make use of Log of Dividend (*Ln(1+Dividend)*) and *Dividend per Share* to represent the magnitude of dividend payments. Our empirical analysis captures the nexus between biodiversity risk exposure and the choice of dividend payments at the firm level.

All the control variables we use in our analysis are sourced from the Compustat database. They comprise PPE to asset ratio (PPE), capital expenditure ratio (CAPEX Ratio), financial leverage (Leverage), return on assets (ROA), firm size (Ln (Total Assets)), market to book equity (MBE), cash flow ratio (CFR), and net working capital (NWC). Definitions of all variables in our dataset are presented in Table A1 in the Appendix.

Our dataset focuses on the 2001-2020 period since these are the years the firm-level biodiversity risk variables are available for. Firms in the utility and financial industries are excluded from our final sample due to their regulated nature, leading to a final dataset of 30,652 firm-year observations from 3,220 unique firms.

Table 1 presents the summary statistics. Not all firms pay out dividends every year. The mean value for Ln (1+Dividend) is 1.92, while the same figure for Dividend per Share is 0.57. Both measures have relatively high standard deviations which indicates that dividend payouts are highly dispersed among the firms. This dispersion may reflect varying profitability, dividend policies, or stages of corporate life cycles within the sample. As for the biodiversity measures, BioCount has a mean of 0.03 and a standard deviation of 0.16. The same figures for the BioRegulation variable are 0.02 and 0.13, respectively. This indicates that on average very few of the listed firms in the US mention biodiversity risk, related to regulation or not, in their 10-Ks. The higher standard deviation, however, points to some firms that might mention biodiversity risk multiple times, further supporting the idea of high variability in how firms disclose biodiversity risks. We observe a similar pattern for the BioNegative variable, with a mean of 0.02 and a standard deviation of 0.25. However, at the higher quantile, the difference between negative and positive biodiversity mentions is 2, hinting at the presence of a notable separation between the two sentiments. Lastly, BioPCA variable, which represents the aggregated measure of biodiversity risks, has a mean of 0.00 and a standard deviation of 1.00. The mean of 0 suggests that, on average, firms have a neutral exposure to biodiversity risk in this aggregated form, though the large standard deviation reflects significant variation across firms in terms of their overall biodiversity risk exposure.

[INSERT TABLE 1 ABOUT HERE]

2.2. Research Model

We use the following model to examine the link between firms' biodiversity risk and dividend payouts:

$$Dividend_{it} = Biodiversity_{it}\beta + X'_{it}\gamma + \mu_j + \delta_t + \epsilon_{it}, \tag{1}$$

where i denotes the firm, j represents the industry, and t denotes the year. The outcome variable, $Dividend_{it}$, is either Ln(1+Dividend) or Dividend per Share. $Biodiversity_{it}$ represents one of the following four measures: BioCount, BioNegative, BioRegulation, and BioPCA. X_{it} represents the firm-level control variables. μ_j denotes the industry fixed effects to account for industry-level time-invariant unobservable factors. δ_t denotes the year fixed effects and ϵ_{jt} is the error term. For all regressions, robust standard errors are clustered at the firm level.

3. Results

3.1. Baseline Regression Results

Table 2 presents the results of the baseline regressions, where Ln (1 + Dividend) is the dependent variable in specifications 1 to 4, and Dividend per Share is the dependent variable in specifications 5 to 8. The specifications represent different biodiversity risk variables. More precisely, specifications 1 and 5 highlight the impact of BioRegulation, while specifications 2 and 6 focus on BioNegative, and specifications 3 and 7 draw attention to BioCount. Lastly, specifications 4 and 8 make use of the BioPCA variable. The results consistently show a significant negative relationship between biodiversity risk and dividend payouts, suggesting that firms facing higher biodiversity risk tend to pay lower dividends. This finding is both statistically significant and economically meaningful. For instance, in specification 1, a one standard deviation increase in BioRegulation, is associated with a 6.03 percent reduction in dividend payouts.[1] The results for other biodiversity measures as well as the Dividend per Share outcome variable present similar results, both in sign and magnitude. Overall, our baseline regression findings support the hypothesis that firms facing higher biodiversity risk tend to pay lower dividends.

This negative relationship offers support for the signalling theory proposition discussed in Section 1. Exposure to biodiversity risks and related concerns can negatively impact a firm's future earnings, limiting its ability to distribute profits to shareholders. This aligns with the findings of Cheung et al. (2018), Gul (1999), and Michaely & Roberts (2012), who emphasize the role of earnings in dividend decisions. Additionally, our results reflect a broader understanding of corporate sustainability, where firms dealing with environmental risks, such as carbon and biodiversity, prioritize retaining earnings for risk management or sustainability efforts over dividend payouts. This is in accord with findings from Jung et al. (2018), Zhu & Hou (2022), and others who highlight the financial strain that environmental concerns impose on dividend policies.

In the case of control variables, PPE to Assets shows a consistent positive association with dividend payouts, suggesting that firms with more tangible assets may have a higher capacity to pay dividends due to more stable cash flows and reduced liquidity risks. Similarly, ROA is positively associated with dividends, indicating that more profitable firms are in a better position to distribute earnings. Firm Size also shows a positive association with dividend payouts, consistent with the idea that larger firms, with greater resources and financial stability, are more likely to distribute dividends. In contrast, the CAPEX Ratio is negatively associated with dividend payouts, suggesting that firms investing heavily in growth may retain earnings to fund capital projects rather than pay dividends. The Market to Book Equity ratio and Net Working Capital

[1] This figure is calculated by multiplying the related coefficient with the standard deviation of the BioRegulation variable (-0.4646 * 0.13).

similarly shows a negative relationship with dividends, as firms with higher market valuations tend to prioritize reinvestment over dividend distribution. Lastly, coefficients for Leverage and Cash Flow to Assets variables are negative and significant, as expected, but only when the outcome variable is Ln(1+Dividend).

[INSERT TABLE 2 ABOUT HERE]

Our baseline analysis includes only year and industry fixed effects. This is due to the lack of variation over time for our biodiversity risk measures. Limited within-variance can weaken statistical inference in fixed-effect models, lowering the likelihood of identifying significant effects for our variables of interest. However, to present a more robust set of findings, in this section we repeat our analysis after including the firm level fixed effects. A possible advantage is limiting the impact of unobserved heterogeneity between firms that could possibly influence both dividend payouts and biodiversity risk measures. Table 3 presents the results of the robustness exercise.[2] The results remain relatively consistent with the baseline model. The impact of BioRegulation on dividend payouts continues to be negative and significant. However, the magnitude of the coefficient is notably smaller when compared to results in Table 2. Overall, we believe this exercise offers further robustness to our general hypothesis that higher exposure to biodiversity risk leads to lower dividend payouts.

[INSERT TABLE 3 ABOUT HERE]

3.2. Endogeneity and Model Misspecification

Endogeneity and model misspecification are potential concerns when analysing the effect of biodiversity risk on dividend payouts. In our context, endogeneity may arise due to omitted variable bias or measurement error, leading to biased and inconsistent estimates. Similarly, another concern, model misspecification, could be due to imbalanced covariates or incorrect functional form, which might distort the estimates. To address these concerns, in this section we implement entropy balancing, ensuring that treated and control firms are well-matched on relevant covariates, and conduct a staggered difference-in-differences (DiD) analysis to account for variation in

[2] From this section onwards, the results for the BioRegulation variable are presented, given its potentially significant financial impact on firms (Li et al., 2025). For brevity, the findings for BioCount, BioNegative and BioPCA variables are omitted. They are qualitatively similar to the ones reported and are available upon request.

treatment timing. We also employ a two-stage least squares (2SLS) approach with an instrumental variable (IV) to isolate the exogenous variation in biodiversity risk. These techniques help enhance the robustness and reliability of the estimated relationship between biodiversity risk and dividend payouts.

3.2.1. Difference-in-Difference Analysis

The Climate Change Adaptation Plans (CCAP) represents a critical response to the challenges posed by climate change, including biodiversity loss. CCAPs are designed to help the states mitigate and adapt to the adverse impacts of climate change by setting out sector-specific recommendations for action, such as in agriculture, biodiversity, coasts, water, and public health (Cao et al., 2024; Ray & Grannis, 2015). These plans are implemented gradually, with different states adopting them at different times, driven by local political factors, climate vulnerabilities, and governance capacity. Early adopters like Florida and Maryland finalised their CCAPs in 2008, and 19 states had passed their own adaptation plans by 2021 (Ray & Grannis, 2015).

The purpose of these plans is to address climate risks, including biodiversity loss, by identifying the challenges posed by climate change and planning appropriate responses. In states with CCAPs, firms face increased regulatory pressure and potential costs related to climate change adaptation, including stricter environmental regulations aimed at protecting biodiversity. Therefore, firms operating in these states are likely to perceive biodiversity risk as a more pressing issue and are expected to adjust their financial strategies, particularly their dividend policies, in response to the anticipated regulatory burden and long-term sustainability concerns. Equation (3) represents a staggered Difference-in-Differences (DiD) style analysis, which is formulated to scrutinise the exogeneous implementation of the staggered CCAP:

$$\begin{aligned}\text{Dividend Payout}_{i,t} &= \beta_0 + \beta_1 \text{Biodiversity Risk}_{i,t} + \beta_2 CCAP_{i,t} + \beta_3 \text{Biodiversity Risk}_{i,t} \times CCAP_{i,t} \\ &+ \sum \gamma_k Controls_{i,t} + \varepsilon_{i.t} \qquad (3)\end{aligned}$$

Where, $\text{Dividend Payout}_{i,t}$ denotes dividend payout policy for firm i, at year t. $\text{Biodiversity Risk}_{i,t}$ denotes firm level biodiversity risk measures. $CCAP_{i,t}$ is a dummy variable indicating if Climate Change Adoption Plans have been implemented at time t for the state that firm i has the headquarter in. $Controls_{i,t}$ denotes firm level control variables and $\varepsilon_{i.t}$ is the error term.

The results, presented in Table 4, reveal significant changes in how firms exposed to biodiversity risk adjust their dividend payouts. Following the enactment of the CCAP in a given state, firms headquartered in those states increase their focus on biodiversity risk, likely due to heightened regulatory concerns and greater environmental awareness. These firms that are exposed to higher levels of biodiversity risk further reduce their dividend payouts. This behaviour aligns with the expectation that firms in these states are increasingly prioritising long-term investments in sustainability and compliance with environmental regulations over short-term shareholder returns. Specifically, the negative relationship between biodiversity risk and dividend payouts becomes more pronounced in firms headquartered in CCAP states. This suggests that the regulatory environment established by the CCAPs not only intensified firms' awareness of biodiversity risks but also provided a strong incentive for them to retain earnings to meet the financial demands of climate adaptation efforts. Thus, the results from Table 5 support the hypothesis that the adoption of state-level CCAPs strengthens the negative impact of biodiversity risk on dividend payouts, highlighting how regulatory measures can shape corporate decision-making related to environmental risks and shareholder distributions.

[INSERT TABLE 4 ABOUT HERE]

3.2.2. Instrumental Variable Analysis

In this section we utilise Two-Stage Least Squares (2SLS) approach to mitigate potential endogeneity between biodiversity risk and firm performance by employing an instrumental variable (IV). Following Bach et al. (2024), we use the Google Biodiversity Attention Index as the instrumental variable for biodiversity regulation. The Google Biodiversity Attention Index measures public interest in biodiversity-related topics by counting the frequency of searches for biodiversity terms like "species loss" or "ecosystem services" on Google (Giglio et al., 2023). This index serves as an ideal instrument because it reflects societal concern for biodiversity issues, which is likely to influence firm-level biodiversity risk exposure, thus meeting the relevance criterion. Importantly, the Google Biodiversity Attention Index is exogenous to firm-level dividend payouts and does not have a direct impact on firms' outcomes, fulfilling the exclusion criterion necessary for a valid instrument. We make use of the following first and second stage estimations in the 2SLS regression:

First Stage:

$$\begin{aligned}\text{Biodiversity Risk}_{i,t} &= \beta_0 + \beta_1 Google\ Biodiversity\ Attention\ Index_t \\ &+ \sum \gamma_k Controls_{i,t} + \varepsilon_{i.t} \quad (4)\end{aligned}$$

Second Stage:

$$\text{Dividend Payout}_{i,t} = \beta_0 + \beta_1 \widehat{\text{Biodiversity}}\ \text{Risk}_{i,t} + \sum \gamma_k Controls_{i,t} + \varepsilon_{i.t} \quad (5)$$

Where, $\text{Dividend Payout}_{i,t}$ denotes dividend payout policy for firm i, at year t. $\text{Biodiversity Risk}_{i,t}$ denotes firm level biodiversity risk measure. $Google\ Biodiversity\ Attention\ Index_t$ is the instrumental variable. $\widehat{\text{Biodiversity}}\ \text{Risk}_{i,t}$ is the fitted biodiversity risk measure from the first stage regression. $Controls_{i,t}$ denotes firm level control variables and $\varepsilon_{i.t}$ is the error term.

First stage results, presented in Table 5, show that the Google Biodiversity Index is positively and significantly related to biodiversity regulation, suggesting that increased public attention to biodiversity concerns is associated with heightened regulatory attention. In the second stage, when biodiversity regulation is instrumented using the Google Biodiversity Index, the results in specifications 2 and 3 show that the instrumented biodiversity regulation variable is statistically significant and negatively associated with dividend payouts. This analysis, which controls for potential endogeneity, further corroborates the initial results, reinforcing the argument that firms exposed to higher biodiversity risk reduce their dividend payouts.

[INSERT TABLE 5 ABOUT HERE]

3.2.3. Entropy Balancing

In this section we employ entropy balancing (EB) to generate a matched sample in order to reduce the possibility of sample selection bias and account for any model misspecification. Entropy Balancing is used to address potential biases in observational studies by balancing the distribution of covariates between treatment and control groups. This technique ensures that the treatment group (firms exposed to biodiversity risk) and the control group (firms not exposed to biodiversity risk) are comparable across key characteristics. By minimising the differences in the distribution of covariates, Entropy Balancing helps to mitigate confounding variables that could distort the estimated treatment effects, making the results more reliable and robust. The method is considered doubly robust, meaning that it accounts for both the balance of covariates and the statistical significance of the treatment effect, leading to more accurate causal inferences (Hainmueller, 2012; Hossain et al., 2023). This is also preferred to propensity score matching technique, as it leads to significant loss of observations (McMullin & Schonberger, 2020).

Panel A of Table 6 demonstrates the convergence of the Entropy Balancing procedure in matching the treatment and control groups. It shows that, after applying the Entropy Balancing weights, the distribution of covariates between firms exposed to biodiversity risk and those not exposed is nearly identical, indicating successful matching. This balancing ensures that the treatment and control groups are comparable, eliminating the potential for confounding variables to bias the results. In Panel B of Table 6, the regression results using the Entropy Balanced matched sample further confirm the findings from the baseline models. The coefficient on biodiversity risk remains negative and statistically significant, reinforcing the conclusion that firms exposed to higher biodiversity risk tend to reduce their dividend payouts.

[INSERT TABLE 6 ABOUT HERE]

4. Channel Analysis

Understanding the channels through which biodiversity risk impacts dividend payouts is crucial for identifying the underlying mechanisms driving this relationship. Biodiversity risk may influence dividend policy by increasing cash flow volatility and earnings volatility, both of which affect firms’ ability to maintain stable payouts. By analysing these channels, in this section we aim to provide deeper insights into how biodiversity risk translates into financial decision-making and affects corporate payout policies.

4.1. Role of Cash Flow Volatility

In this section we examine the role of cash flow volatility on the association between biodiversity risk and firm dividend policy. We assume that firms exposed to greater biodiversity risks are likely to experience more volatile cash flows, which can significantly impact their dividend policies. The variability in cash flows arises from increased costs associated with regulatory compliance, potential fines, and the necessity for investment in biodiversity risk management initiatives (Ahmad & Karpuz, 2024; Flammer et al., 2023). These financial uncertainties compel firms to adopt more conservative dividend policies to ensure they retain sufficient capital to absorb shocks and manage risks effectively (Dionne & Ouederni, 2011). Consequently, the volatility in earnings due to biodiversity risks necessitates a reduction in dividend payouts, as firms prioritise financial stability over immediate shareholder returns (Bach et al., 2024; Gul, 1999). This strategic shift aligns with the signalling theory, where firms adjust dividends in response to anticipated changes in future cash flows to signal their financial health to investors (Bhattacharya, 1979; Miller & Rock, 1985). To examine the role of cash flow volatility, we create a dummy variable of high cash flow volatility, where the value is 1 if the three-year standard deviation of the cash flow ratio is higher than the median, and 0 otherwise.

Table 7 presents result for the role of cash flow volatility. Supporting our conjecture, the results in specification 1 indicate that high biodiversity risk significantly increases cash flow volatility, underscoring the financial instability associated with environmental risks. Firms exposed to greater biodiversity risks experience more volatile cash flows, which directly affect their financial planning and operational stability. This heightened volatility introduces uncertainty in the firm's ability to generate consistent earnings, a critical factor in determining dividend policies. In specifications 2 and 3, the interaction term *Regulation × High Cash Flow Volatility* exhibits a statistically significant negative impact on dividend payouts. This finding suggests that regulatory pressures, when coupled with elevated cash flow volatility, amplify the adverse impact on dividend distribution. In essence, regulatory compliance costs, combined with unstable cash flows driven by biodiversity risks, constrain the firm's ability to distribute dividends, as more resources are diverted toward managing financial and environmental uncertainties.

[INSERT TABLE 7 ABOUT HERE]

4.2. Role of Earnings Volatility

Next, we examine the role of earnings volatility. We expect high biodiversity risk to lead to more earnings volatility, which, in turn, significantly affects dividend policies. This expectation is based on the premise that biodiversity risk can escalate compliance costs and disrupt business operations, thereby reducing profitability and future cash flows (Zhu & Hou, 2022). As firms face heightened earnings uncertainty due to biodiversity-related challenges, they might adopt more conservative dividend policies to preserve cash and buffer against potential financial instability (Dionne & Ouederni, 2011). Ahmad and Karpuz (2024) demonstrate that companies exposed to high biodiversity risk tend to hold more cash for precautionary reasons, indicating a strategic shift towards liquidity management over dividend distribution. Consequently, we anticipate that firms with significant biodiversity risk will exhibit lower and more volatile dividend payouts, reflecting their need to mitigate the financial impact of biodiversity-related uncertainties on their earnings. We proxy high earnings volatility by a dummy variable, where the value is 1 if the three-year standard deviation of the ROA is higher than the median, and 0 otherwise.

Table 8 shows result for the role of earnings volatility. In accord with our expectation, the results in specification 1 reveal that high biodiversity risk significantly increases earnings volatility, indicating that firms exposed to environmental risks experience greater fluctuations in their profitability. This heightened volatility reflects the unpredictability of earnings streams, which can be attributed to factors such as increased operational costs, disruptions in supply chains, and compliance with environmental regulations. Such volatility poses a challenge for firms in maintaining stable financial performance, making it difficult to forecast and allocate resources effectively. Specifications 2 and 3 further emphasise the role of earnings volatility in shaping dividend policies. The interaction term *Regulation × High Earnings Volatility* demonstrates a statistically significant and negative impact on dividend payouts. This suggests that regulatory pressures exacerbate the negative influence of earnings volatility on dividend decisions. In other words, firms facing both stringent regulations and unpredictable earnings are more likely to reduce dividend distributions to preserve financial flexibility and meet regulatory compliance costs. These findings indicate high biodiversity risk, by increasing earnings volatility, erodes a firm's ability to maintain consistent dividend payments. As a result, firms may opt to retain earnings as a buffer against future uncertainties rather than distributing them to shareholders.

[INSERT TABLE 8 ABOUT HERE]

5. Additional Analysis

In addition to examining the direct effects of biodiversity risk on dividend payouts, we also explore potential moderating factors that may influence this relationship. Specifically, in this section we analyse how financial constraints, firm life cycle stages, CEO age, and the US decision to withdraw from the Paris Agreement shape the impact of biodiversity risk on dividend policy. This analysis provides a more nuanced understanding of the factors that condition the biodiversity risk–dividend payout relationship.

5.1. Financial Constraints

First, we examine the moderating effect of financial constraints. Existing literature indicates that under heightened financial constraints, firms are likely to reduce spending on environmental initiatives, leading to poorer environmental performance (Fan & Zhao, 2024; Trinh et al., 2024; Xu & Kim, 2021). This prioritisation can lead to reduced spending on biodiversity conservation and climate risk mitigation, deteriorating their overall environmental performance (Fan & Zhao, 2024; Xu & Kim, 2021). Financial constraints are associated with higher financing costs, which increase the marginal costs of environmental remediation efforts and limit the firm's capacity to invest in sustainable practices (Feng et al., 2024; Trinh et al., 2024). As a result, firms under financial strain may find it challenging to allocate resources towards mitigating biodiversity risks effectively. In the context of dividend payouts, this could mean that financially constrained firms facing greater biodiversity risks are likely to pay less in dividends. The necessity to conserve cash for essential operations and immediate financial obligations takes precedence over dividend distributions. This behaviour aligns with the prospect theory, where decision-makers prioritise losses over potential gains, leading to conservative financial strategies under uncertainty (Kahneman & Tversky, 2013).

To capture the presence of financial constraints, we introduce two variables: *High Financial Constraint* and *High WW Index*, as proposed in earlier studies (Hoberg & Maksimovic, 2015; Whited & Wu, 2006). We define them as dummy variables taking the values of 1 if the financial constraint and the WW index values are greater than their median and 0 otherwise. We interact them with BioRegulation in our regression analysis. Table 9 presents the results of the effect of financial constraints on dividend payouts for firms with higher biodiversity risk. The findings indicate that firms facing higher financial constraints and greater biodiversity risk pay less in dividends. This behaviour aligns with the argument that financially constrained firms prioritise liquidity and the retention of earnings over dividend payouts to manage the increased costs and risks associated with environmental compliance and remediation (Fan & Zhao, 2024; Trinh et al., 2024; Xu & Kim, 2021). The negative relationship between financial constraints and dividend payouts indicates the challenges these firms face in balancing financial stability with environmental responsibility (Feng et al., 2024).

[INSERT TABLE 9 ABOUT HERE]

5.2. Firm Life Cycle

Next, we explore the role of firm's life cycle on the relationship between biodiversity risk and dividend payments. Firm life cycle plays a significant role in shaping a company's environmental strategies and dividend policies. During the growth stage, firms are often characterised by high innovation and proactive environmental strategies. These companies tend to invest heavily in addressing biodiversity risks and complying with environmental regulations to capitalise on growth opportunities and respond to public scrutiny, especially in high-emission sectors (Primc & Čater, 2016; Tascón et al., 2021). As firms transition into the maturity stage, they benefit from stability and a strong reputation built through consistent environmental performance, which helps them maintain competitive advantages and sustain stakeholder relationships (Al-Hadi et al., 2019). In the context of biodiversity risk, mature firms are likely to face greater expectations for environmental stewardship. This is because they have the resources and established processes to manage such risks effectively. Consequently, older and more mature firms facing higher biodiversity risks may exhibit a tendency to pay more dividends. This behaviour can be attributed to their need to signal financial stability and maintain investor confidence.

Following DeAngelo et al. (2006), we use the ratio of retained earnings to total assets (*RE/TA*) and the ratio of retained earnings to total equity (*RE/TE*) as proxies for firm cycle and interact them with BioRegulation in our regression analysis. Table 10 presents the results using both variables. The findings show that older and more mature firms with higher biodiversity risk indeed pay higher dividends. The result supports the argument that mature firms, despite facing significant environmental challenges, use dividend payouts as a strategy to reassure investors and demonstrate robust financial health. This aligns with the understanding that while younger firms focus on growth and innovation in managing biodiversity risks, mature firms leverage their established capabilities and financial resources to balance environmental responsibilities with shareholder returns (Al-Hadi et al., 2019; Primc & Čater, 2016; Tascón et al., 2021).

[INSERT TABLE 10 ABOUT HERE]

5.3. CEO Age

We further examine how the relationship varies based on the CEO age. Earlier studies show that older CEOs tend to engage in less corporate risk-taking (Ferris et al., 2017). Given that CEOs are responsible for major decisions and directing firm strategy, their cognitive abilities and knowledge base are crucial for navigating complex and evolving competitive, political, and economic environments (Rajagopalan & Datta, 1996). However, cognitive abilities decline with age, which can diminish a CEO's effectiveness in managing environmental risks, including biodiversity risks (Desir et al., 2024; Wilson et al., 2010). In line with this, Wali Ullah et al. (2023) found that managerial ability negatively impacts climate change exposure, indicating that more skilled managers can reduce firm-level climate risks. Younger CEOs, who generally possess sharper cognitive skills, greater risk-taking propensity and managerial ability, are likely to be more proactive in addressing biodiversity risks (Desir et al., 2024). Consequently, younger CEOs might be more effective in mitigating these risks compared to their older counterparts. To examine the effect of CEO age, we split our sample into two groups: *Older CEOs* and *Younger CEOs*, based on the median CEO age.

Table 11 presents the results for the effect of CEO age on the relationship between biodiversity risk and dividend payouts. The findings reveal that the negative effect of biodiversity risk on dividend payouts is stronger for younger CEOs. This suggests that younger CEOs, who are more attuned to environmental concerns and more willing to take strategic risks, might reduce dividend payouts more significantly when faced with higher biodiversity risks. This behaviour aligns with the argument that younger CEOs are more proactive in allocating resources to mitigate biodiversity risks, thereby potentially reducing immediate financial returns to shareholders in favour of long-term sustainability (Desir et al., 2024).

[INSERT TABLE 11 ABOUT HERE]

5.4. Paris Agreement Withdrawal

Under the Paris Agreement, countries, including the U.S. at the time, were expected to meet specific environmental targets to reduce greenhouse gas emissions, a move that also encompassed the protection of ecosystems and biodiversity (Smith et al., 2022; Wali Ullah et al., 2024). For firms, this international framework created a heightened sense of responsibility toward mitigating environmental impacts, including biodiversity risks. Companies faced increasing regulatory pressures and expectations from stakeholders to reduce their carbon footprints and address biodiversity loss, often resulting in increased costs, compliance efforts, and more conservative dividend policies to manage these risks. Trump's decision to withdraw from the Paris Agreement marked a dramatic shift in U.S. climate policy, signalling a move away from these global commitments and regulatory pressures (Faccini et al., 2021). This decision was also relatively unexpected. Such an exogenous shock enables us to measure the combined effect of an environmental agreement and biodiversity risk on dividend payouts.

The withdrawal, along with the broader environmental deregulation that followed, led to a less stringent regulatory environment. Firms that had been concerned about biodiversity risks, motivated by global agreements and regulatory expectations, now found themselves in a more relaxed environment where biodiversity concerns were no longer seen as a priority (Giglio et al., 2023; Hoepner et al., 2023). As a result, firms began to reassess the relevance of biodiversity risks in their strategic planning and financial decisions. We expect this shift to influence firm behaviour, leading to changes in dividend payouts. Companies no longer need to allocate as much capital toward mitigating biodiversity-related risks as before, and instead increase shareholder returns. To capture the moderating effect of the Paris agreement withdrawal, in equation (2) we interact BioRegulation with the Paris agreement withdrawal dummy variable.

$$\text{Dividend Payout}_{i,t} = \beta_0 + \beta_1 \text{Biodiversity Risk}_{i,t} + \beta_2 Paris\ Agreement\ Withdrawal + \beta_3 \text{Biodiversity Risk}_{i,t} \times Paris\ Agreement\ Withdrawal + \sum \gamma_k Controls_{i,t} + \varepsilon_{i.t} \quad (2)$$

$\text{Dividend Payout}_{i,t}$ denotes dividend payout policy for firm i, at year t. $\text{Biodiversity Risk}_{i,t}$ denotes firm level biodiversity risk measures. Paris Agreement Withdrawal is a dummy variable that is equal to 1 for year 2017 and onwards, and 0 otherwise. $Controls_{i,t}$ are firm level control variables, which are identical to those in equation (1). $\varepsilon_{i.t}$ denotes the error term.

To capture the direct effect of Trump's decision, we restrict the sample to two years before and after the withdrawal, excluding year 2017. Table 12 shows that the regression results provide valuable insights into how firms adjusted to this exogenous shock. We observe a shift in dividend payout behaviour. Specifically, the negative impact of biodiversity risk on dividend payouts disappears. In the years following the withdrawal, firms that were previously exposed to higher biodiversity risk begin to increase their dividend payouts. This change suggests that the environmental deregulation associated with the Paris Agreement withdrawal diminished the perceived urgency of biodiversity risk for these firms. As a result, firms that were once focused on mitigating biodiversity risks, potentially at the cost of dividends, began to prioritise returning profits to shareholders through higher dividends. The deregulation appears to have reduced the incentive for firms to retain earnings for sustainability efforts, leading to an increase in dividend payouts as firms recalibrated their strategies in response to the altered regulatory landscape.

[INSERT TABLE 12 ABOUT HERE]

6. Conclusion

This study examines the impact of biodiversity risk on corporate dividend payouts, addressing a critical but underexplored aspect of sustainability and financial decision-making. As environmental risks, including biodiversity loss, become increasingly relevant for firms and investors, understanding their implications for corporate policies is essential. To ensure robust and reliable results, this study employs a comprehensive empirical approach. Our findings reveal that increased biodiversity risk has a negative and significant effect on dividend payouts, suggesting that firms facing greater exposure to biodiversity-related risks are more likely to adopt conservative dividend policies. This result is consistent with the idea that biodiversity risk increases financial uncertainty, leading firms to hold earnings for precautionary motives and reducing their willingness to distribute cash to shareholders. The effect is particularly pronounced in firms with higher cash flow and earnings volatility, indicating that financial instability amplifies the impact of biodiversity risk on dividend decisions. Additionally, the moderating analysis highlights that the response to biodiversity risk varies based on firms' financial constraints, life cycle stages, CEO age, and the US withdrawal from the Paris Agreement.

The findings of this study contribute to the growing literature on environmental risk and corporate finance by providing new insights into how firms adjust their financial policies in response to biodiversity threats. The results have important implications for investors, policymakers, and corporate managers, underscoring the need to integrate biodiversity considerations into financial planning and regulatory frameworks. By offering a rigorous empirical analysis and shedding light on both the direct and conditional effects of biodiversity risk, our research advances the understanding of how environmental challenges influence corporate financial behaviour and dividend policies.

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Appendix

Appendix A.1: Variable specification

Variables	Description	Data Source
Ln (1 + Dividend)	Natural logarithm of 1 plus the amount of dividend declared on common shares	Compustat
Dividend Per Share	Ratio of dividends declared on common shares to the total number of shares outstanding	Compustat
Biodiversity_ Regulation	The 10K-Biodiversity-Regulation Score measures firm exposure to biodiversity risks related to regulations. It assigns a score of "1" if a firm's 10-K statement contains at least two sentences mentioning biodiversity risks and at least one of these sentences references regulatory terms such as laws, regulations, or restrictions; otherwise, it assigns a score of "0".	Giglio et al. (2023)
Biodiversity_ Negative	The 10K-Biodiversity-Negative Score assesses the sentiment of biodiversity mentions in firms' 10-K statements. Using the BERT model for sentiment analysis, this score specifically counts biodiversity-related sentences with negative sentiment, indicating perceived risks rather than opportunities.	Giglio et al. (2023)
Biodiversity_ Count	10K-Biodiversity-Count Score quantifies biodiversity risk exposure based on textual analysis of firms' 10-K statements. A score of "1" is assigned if a statement includes at least two sentences related to biodiversity; otherwise, a score of "0" is given.	Giglio et al. (2023)
Biodiversity_ PCA	Biodiversity_PCA is a composite measure derived from principal component analysis (PCA) of Biodiversity_Regulation, Biodiversity_Negative, and Biodiversity_Count into a single score, providing a comprehensive assessment of a firm's overall exposure to biodiversity risks.	Author Constructed
PPE to Assets	Ratio of Property, Plants and Equipment to total assets	Compustat
CAPEX Ratio	Ratio of capital expenditure to total assets	Compustat
Leverage	Sum of current and long-term liabilities divided by total assets	Compustat
ROA	Ratio of net income to total assets	Compustat
Firm Size (Ln (Total Assets))	Natural logarithm of total assets	Compustat

Market to Book Equity	Ratio of market to book value of total equity	Compustat
Cash Flow Ratio	Ratio of operating income before depreciation minus interest expenses, taxes, and common dividends, all divided by the book value of assets	Compustat
Net Working Capital	Difference between current operating assets and current operating liabilities divided by total assets	Compustat
High Financial Constraint	Dummy variable taking the value of 1 if the firm has higher than median values of the "delaycon" measure – facing risk of delaying their investments due to issues with liquidity	(Hoberg & Maksimovic, 2015)
High WW Index	Dummy variable taking the value of 1 if the firm has higher than median values of the Whited-Wu index. $$WW_{i,t} = -0.091 \times \frac{CF_{i,t}}{BA_{i,t-1}} - 0.062 \times DIVPOS_{i,t} + 0.021 \times \frac{LD_{i,t}}{ASSETS_{i,t-1}} - 0.044 \times SIZE_{i,t} - 0.035 \times SG_{i,t} + 0.102 \times ISG_{i,t}$$ where BA is the book value of total assets, DIVPOS is a dummy variable, equal to 1 if the dividend is positive. LD denotes long-term debt, Size is the logarithm of total assets, SG is sales growth and ISG means industrial sales growth.	Author Constructed
RE/TE	Ratio of earned equity to total common equity	Compustat
RE/TA	Ratio of earned equity to total assets	Compustat
CEO Age	Age of the CEO of the firm	Execucomp

Tables

Table 1: Summary Statistics

Variable		Mean	SD	Quantiles 25th Percentile	 Median	 75th Percentile
Ln (1 + Dividend)	30,652	1.92	2.13	0.00	1.31	3.62
Dividend Per Share	30,652	0.57	8.55	0.00	0.00	0.66
BioRegulation	30,652	0.02	0.13	0.00	0.00	0.01
BioNegative	30,652	0.02	0.25	0.00	0.00	2.00
BioCount	30,652	0.03	0.16	0.00	0.00	0.00
BioPCA	30,652	0.00	1.00	-0.16	-0.02	0.12
PPE to Assets	30,652	0.21	0.25	0.03	0.10	0.30
CAPEX Ratio	30,652	0.13	0.16	0.06	0.10	0.16
Leverage	30,652	0.21	0.22	0.04	0.16	0.32
ROA	30,652	0.09	0.10	0.03	0.08	0.14
Firm Size (Ln (Total Assets))	30,652	7.28	1.50	6.18	7.43	8.67
Market to Book Equity	30,652	-4.89	17.64	1.39	2.19	3.70
Cash Flow Ratio	30,652	0.05	0.19	0.01	0.06	0.12
Net Working Capital	30,652	0.03	0.15	-0.06	0.01	0.12

Table 2: Baseline Result

Dependent Variable	(1) Ln (1 + Dividend)	(2) Ln (1 + Dividend)	(3) Ln (1 + Dividend)	(4) Ln (1 + Dividend)	(5) Dividend Per Share	(6) Dividend Per Share	(7) Dividend Per Share	(8) Dividend Per Share
BioRegulation	-0.4646***				-0.1384***			
	(0.0753)				(0.0349)			
BioNegative		-0.1885***				-0.0741***		
		(0.0391)				(0.0186)		
BioCount			-0.5189***				-0.1795***	
			(0.0617)				(0.0254)	
BioPCA				-0.0818***				-0.0283***
				(0.0097)				(0.0040)
PPE to Assets	1.6474***	1.6224***	1.6621***	1.6621***	0.3236***	0.3167***	0.3302***	0.3302***
	(0.0702)	(0.0700)	(0.0702)	(0.0702)	(0.0322)	(0.0321)	(0.0322)	(0.0322)
CAPEX Ratio	-0.6483***	-0.6492***	-0.6492***	-0.6492***	-0.1307*	-0.1311*	-0.1310*	-0.1310*
	(0.1731)	(0.1734)	(0.1732)	(0.1732)	(0.0744)	(0.0745)	(0.0744)	(0.0744)
Leverage	-0.6458***	-0.6446***	-0.6427***	-0.6427***	-0.0127	-0.0124	-0.0117	-0.0117
	(0.0645)	(0.0645)	(0.0644)	(0.0644)	(0.0390)	(0.0390)	(0.0390)	(0.0390)
ROA	1.9457***	1.9367***	1.9441***	1.9441***	0.7631***	0.7600***	0.7628***	0.7628***
	(0.1520)	(0.1523)	(0.1517)	(0.1517)	(0.1098)	(0.1099)	(0.1097)	(0.1097)
Firm Size	0.6884***	0.6885***	0.6886***	0.6886***	0.1156***	0.1156***	0.1157***	0.1157***
	(0.0091)	(0.0091)	(0.0091)	(0.0091)	(0.0049)	(0.0049)	(0.0049)	(0.0049)
Market to Book Equity	-0.0004***	-0.0004***	-0.0004***	-0.0004***	-0.0001**	-0.0001**	-0.0001**	-0.0001**
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Cash Flow to Assets	-0.2751***	-0.2720***	-0.2795***	-0.2795***	0.0738	0.0748	0.0722	0.0722
	(0.0812)	(0.0815)	(0.0808)	(0.0808)	(0.0633)	(0.0634)	(0.0632)	(0.0632)
Net Working Capital	-0.6103***	-0.6033***	-0.6083***	-0.6083***	-0.1840***	-0.1813***	-0.1833***	-0.1833***
	(0.0758)	(0.0759)	(0.0758)	(0.0758)	(0.0498)	(0.0498)	(0.0498)	(0.0498)
Constant	-3.5190***	-3.5179***	-3.5185***	-3.5318***	-0.5428***	-0.5420***	-0.5424***	-0.5470***
	(0.0674)	(0.0674)	(0.0673)	(0.0673)	(0.0417)	(0.0417)	(0.0417)	(0.0416)

Observations	30,652	30,652	30,652	30,652	30,652	30,652	30,652	30,652
Adjusted R-squared	0.4341	0.4339	0.4347	0.4347	0.1348	0.1349	0.1354	0.1354
Year FE	YES	YES	YES	YES	YES	YES	YES	YES
Industry FE	YES	YES	YES	YES	YES	YES	YES	YES

Note: The baseline regression model between biodiversity risk and dividend payout is shown in this table. Ln(1 + Dividend) is the dependent variable in specifications 1 through 4, and Dividend Per Share is the dependent variable in specifications 5 through 8. Year and industry fixed effects are taken into account in all specifications. Appendix A.1 provides a thorough explanation of every variable. Robust standard errors, clustered at the firm level, are in parentheses. Significance at the 1%, 5%, and 10% levels is denoted by the symbols ***, **, and *, respectively.

Table 3: Baseline Results with Firm Fixed Effects

Dependent Variable	(1) Ln (1 + Dividend)	(2) Dividend Per Share
BioRegulation	-0.0210*	-0.0651**
	(0.0074)	(0.0047)
PPE to Assets	0.1978*	-0.0255
	(0.1127)	(0.0801)
CAPEX Ratio	0.1231***	0.0985*
	(0.0424)	(0.0576)
Leverage	-0.0033	0.1352***
	(0.0569)	(0.0460)
ROA	0.5139***	0.3031***
	(0.1257)	(0.1078)
Firm Size	0.0286*	-0.0648***
	(0.0159)	(0.0116)
Market to Book Equity	0.0000	0.0000
	(0.0001)	(0.0000)
Cash Flow to Assets	0.0479	0.1002*
	(0.0624)	(0.0572)
Net Working Capital	-0.3922***	-0.2899***
	(0.0817)	(0.0822)
Constant	1.3310***	0.7914***
	(0.1160)	(0.0849)
Observations	30,126	30,126
Adjusted R-squared	0.8466	0.4818
Year FE	YES	YES
Firm FE	YES	YES

Note: The regression model between biodiversity risk and dividend payout using firm fixed effects is shown in this table. Ln(1 + Dividend) is the dependent variable in specification 1, and Dividend Per Share is the dependent variable in specification 2. Year and industry fixed effects are taken into account in both specifications. Appendix A.1 provides an explanation of each variable. Robust standard errors, clustered at the firm level, are in parentheses. Significance at the 1%, 5%, and 10% levels is denoted by the symbols ***, **, and *, respectively.

Table 4: The Staggered Passing of Climate Change Adoption Plans (CCAP)

	(1)	(2)
Dependent Variable	Ln (1 + Dividend)	Dividend Per Share
CCAP × BioRegulation	-0.4398**	-0.3267***
	(0.2161)	(0.1209)
CCAP	0.1204***	0.1194***
	(0.0354)	(0.0198)
BioRegulation	-0.4184***	-0.1044**
	(0.0733)	(0.0410)
PPE to Assets	1.6487***	0.3253***
	(0.0593)	(0.0332)
CAPEX Ratio	-0.6444***	-0.1269***
	(0.0613)	(0.0343)
Leverage	-0.6477***	-0.0145
	(0.0474)	(0.0265)
ROA	1.9349***	0.7524***
	(0.1382)	(0.0773)
Firm Size	0.6878***	0.1151***
	(0.0081)	(0.0046)
Market to Book Equity	-0.0004***	-0.0008***
	(0.0006)	(0.0000)
Cash Flow to Assets	-0.2669***	0.0820
	(0.0934)	(0.0522)
Net Working Capital	-0.6182***	-0.1920***
	(0.0774)	(0.0433)
Constant	-3.5255***	-0.5493***
	(0.0585)	(0.0327)
Observations	30,652	30,652
Adjusted R-squared	0.4325	0.1332
Year FE	YES	YES
Industry FE	YES	YES

Note: This table shows result for exogeneous shock of the staggered state-level passing of Climate Change Adoption Plans (CCAP). Ln (1 + Dividend) is the dependent variable in specification 1, and Dividend Per Share is the dependent variable in specification 2. Year and industry fixed effects are taken into account in both specifications. Appendix A.1 provides an explanation of each variable. Robust standard errors, clustered at the firm level, are in parentheses. Significance at the 1%, 5%, and 10% levels is denoted by the symbols ***, **, and *, respectively.

Table 5: Two-stage Least Squares Analysis

Dependent Variable	(1) Regulation	(2) Ln (1 + Dividend)	(3) Dividend Per Share
Google Biodiversity Index	0.0004***		
	(0.0001)		
BioRegulation		-1.7737***	-0.3059**
		(0.2436)	(0.1394)
PPE to Assets	0.0701***	1.7453***	0.3945***
	(0.0061)	(0.0644)	(0.0324)
CAPEX Ratio	-0.0049	-0.8089***	-0.1874**
	(0.0038)	(0.1991)	(0.0857)
Leverage	-0.0017	-0.7315***	0.0533
	(0.0038)	(0.0690)	(0.0407)
ROA	0.0195	2.8628***	0.9980***
	(0.0123)	(0.1660)	(0.1271)
Firm Size	-0.0008	0.7760***	0.1495***
	(0.0006)	(0.0098)	(0.0057)
Market to Book Equity	0.0007*	-0.0005***	-0.0001**
	(0.0003)	(0.0002)	(0.0000)
Cash Flow to Assets	-0.0088	-0.9052***	-0.1259*
	(0.0069)	(0.0785)	(0.0701)
Net Working Capital	-0.0037	-0.1960***	-0.0462
	(0.0049)	(0.0725)	(0.0427)
Constant	0.2003***	-4.1418***	-0.8058***
	(0.0671)	(0.0738)	(0.0465)
Underidentification test			
Anderson Canon. LM Statistic	96.81		
p-value	0.000		
Weak identification test			
Cragg-Donald Wald F Statistic	106.88		
Observations	26,499	26,499	26,499
R-squared	0.1568	0.3581	0.0872
Year FE	YES	YES	YES
Industry FE	YES	YES	YES

Note: This table shows result for 2-stage Least Squares using Instrumental Variable. Specification 1 shows result for first stage regression using Google Biodiversity Index as instrumental variable. Ln(1 + Dividend) is the dependent variable in specification 2, and Dividend Per Share is the dependent variable in specification 3. Year and industry fixed effects are taken into account in all specifications. Appendix A.1 provides an explanation of each variable. Robust standard errors, clustered at the firm level, are in parentheses. Significance at the 1%, 5%, and 10% levels is denoted by the symbols ***, **, and *, respectively.

Table 6: Entropy Balancing

Panel A: Proof of Convergence

Before Balancing

	Treatment			Control		
	Mean	Variance	Skewness	Mean	Variance	Skewness
PPE to Assets	0.6597	0.0475	-0.9317	0.2663	0.0606	1.0851
CAPEX Ratio	0.1101	0.0087	2.1421	0.1313	0.0259	20.4201
Leverage	0.3119	0.0328	0.7827	0.2267	0.0536	2.5971
ROA	0.1016	0.0068	1.4561	0.1017	0.0117	0.1312
Firm Size	7.8310	1.5001	-0.7597	6.9010	2.3141	-0.1941
Market to Book Equity	-4.6810	8748.0000	-14.6701	-7.3681	24446.0000	-23.4202
Cash Flow to Assets	0.0890	0.0084	-0.4297	0.0531	0.0304	-5.5451
Net Working Capital	0.0045	0.0099	1.0662	0.0312	0.0231	-0.1363

After Balancing

	Treatment			Control		
	Mean	Variance	Skewness	Mean	Variance	Skewness
PPE to Assets	0.6597	0.0475	-0.9317	0.6593	0.0525	-1.2462
CAPEX Ratio	0.1101	0.0087	2.1421	0.1102	0.0347	34.8012
Leverage	0.3119	0.0328	0.7827	0.3118	0.0416	1.8320
ROA	0.1016	0.0068	1.4561	0.1015	0.0067	-2.2612
Firm Size	7.8310	1.5001	-0.7597	7.8291	2.0041	-0.9768
Market to Book Equity	-4.6810	8748.0000	-14.6701	-4.6811	52108.0000	14.6902
Cash Flow to Assets	0.0890	0.0084	-0.4297	0.0889	0.0257	-21.7112
Net Working Capital	0.0045	0.0099	1.0662	0.0042	0.0126	0.8335

Panel B: Regression with Entropy Balanced Matched Sample

	(1)	(2)
Dependent Variable	Ln (1 + Dividend)	Dividend Per Share
BioRegulation	-0.5469***	-0.1525***
	(0.0872)	(0.0376)
PPE to Assets	0.2497	-0.3099**
	(0.1907)	(0.1210)
CAPEX Ratio	-0.6885	-0.1267
	(0.6554)	(0.1435)
Leverage	-1.9216***	-0.3875***
	(0.1953)	(0.0918)
ROA	1.5656***	0.9048***
	(0.5674)	(0.3054)
Firm Size	0.9169***	0.1748***
	(0.0297)	(0.0117)
Market to Book Equity	0.0007	0.0002
	(0.0001)	(0.0003)
Cash Flow to Assets	0.1983	0.3004
	(0.3736)	(0.2098)
Net Working Capital	-3.5083***	-0.8744***
	(0.3462)	(0.1585)
Constant	-3.9898***	-0.4669***
	(0.2589)	(0.0927)
Observations	30,652	30,652
Adjusted R-squared	0.5368	0.2962
Year FE	YES	YES
Industry FE	YES	YES

Note: This table shows result for Entropy Balancing. Panel A present results for proof of entropy balancing convergence and Panel B present results for regression using entropy balanced matched sample. In Panel B, Ln (1 + Dividend) is the dependent variable in specification 1, and Dividend Per Share is the dependent variable in specification 2. Year and industry fixed effects are taken into account in both specifications. Appendix A.1 provides an explanation of each variable. Robust standard errors, clustered at the firm level, are in parentheses. Significance at the 1%, 5%, and 10% levels is denoted by the symbols ***, **, and *, respectively.

Table 7: Channel Analysis – Cash Flow Volatility

VARIABLES	(1) High Cash Flow volatility	(3) Ln (1 + Dividend)	(3) Dividend Per Share
BioRegulation	0.1267***	-0.2431*	-0.0055
	(0.0194)	(0.1277)	(0.0628)
High Cash Flow Volatility		-0.3701***	-0.1125***
		(0.0234)	(0.0115)
BioRegulation × High Cash Flow Volatility		-0.2838*	-0.1695**
		(0.1511)	(0.0744)
PPE to Assets	-0.2592***	1.5376***	0.2725***
	(0.0170)	(0.0648)	(0.0319)
CAPEX Ratio	0.0112	-0.8848***	-0.1667***
	(0.0197)	(0.0749)	(0.0368)
Leverage	0.1218***	-0.6397***	-0.0006
	(0.0136)	(0.0518)	(0.0255)
ROA	0.0686	2.6160***	0.9133***
	(0.0420)	(0.1594)	(0.0784)
Firm Size	-0.0952***	0.6943***	0.1107***
	(0.0024)	(0.0095)	(0.0047)
Market to Book Equity	0.0000	-0.0004***	-0.0001***
	(0.0000)	(0.0001)	(0.0000)
Cash Flow to Assets	-0.1132***	-0.3024***	0.1247**
	(0.0287)	(0.1091)	(0.0537)
Net Working Capital	-0.0828***	-0.6902***	-0.2076***
	(0.0227)	(0.0861)	(0.0424)
Constant	1.3582***	-3.3227***	-0.4348***
	(0.0178)	(0.0747)	(0.0368)
Observations	26,736	26,703	26,703
R-squared	0.1750	0.4397	0.1740
Controls	YES	YES	YES
Industry FE	YES	YES	YES
Year FE	YES	YES	YES

Note: This table presents the results of the effect of high cash flow volatility. High cash flow volatility is represented by a dummy variable, where the value is 1 if the three-year standard deviation of the cash flow ratio is higher than the median, and 0 otherwise. Ln (1 + Dividend) is the dependent variable in specification 2, and Dividend Per Share is the dependent variable in specification 3. Year and industry fixed effects are taken into account in both specifications. Appendix A.1 provides an explanation of each variable. Robust standard errors, clustered at the firm level, are in parentheses. Significance at the 1%, 5%, and 10% levels is denoted by the symbols ***, **, and *, respectively.

Table 8: Channel Analysis - Earnings Volatility

VARIABLES	(1) High Earnings Volatility	(2) Ln (1 + Dividend)	(3) Dividend Per Share
BioRegulation	0.1074***	-0.0802	-0.0543
	(0.0190)	(0.1140)	(0.0559)
High Earnings Volatility		-0.4796***	-0.1293***
		(0.0239)	(0.0117)
BioRegulation × High Earnings Volatility		-0.5783***	-0.1126***
		(0.1423)	(0.0098)
PPE to Assets	-0.2367***	1.5196***	0.2717***
	(0.0167)	(0.0646)	(0.0317)
CAPEX Ratio	-0.0496**	-0.9170***	-0.1783***
	(0.0194)	(0.0748)	(0.0367)
Leverage	0.0847***	-0.6414***	-0.0063
	(0.0134)	(0.0516)	(0.0253)
ROA	0.8305***	2.9821***	1.0008***
	(0.0413)	(0.1606)	(0.0787)
Firm Size	-0.1164***	0.6723***	0.1069***
	(0.0024)	(0.0096)	(0.0047)
Market to Book Equity	0.0000	-0.0004***	-0.0001***
	(0.0000)	(0.0001)	(0.0000)
Cash Flow to Assets	-0.1066***	-0.3031***	0.1231**
	(0.0282)	(0.1089)	(0.0534)
Net Working Capital	0.2153***	-0.5599***	-0.1617***
	(0.0222)	(0.0861)	(0.0422)
Constant	1.4028***	-3.1431***	-0.4088***
	(0.0175)	(0.0754)	(0.0369)
Observations	26,685	26,653	26,653
R-squared	0.2310	0.4435	0.1762
Controls	YES	YES	YES
Industry FE	YES	YES	YES
Year FE	YES	YES	YES

Note: This table presents the results of the effect of high earnings volatility. High earnings volatility is represented by a dummy variable, where the value is 1 if the three-year standard deviation of the ROA is higher than the median, and 0 otherwise. Ln (1 + Dividend) is the dependent variable in specification 2, and Dividend Per Share is the dependent variable in specification 3. Year and industry fixed effects are taken into account in both specifications. Appendix A.1 provides an explanation of each variable. Robust standard errors, clustered at the firm level, are in parentheses. Significance at the 1%, 5%, and 10% levels is denoted by the symbols ***, **, and *, respectively.

Table 9: The Effect of Financial Constraints

Dependent Variable	(1) Ln (1 + Dividend)	(2) Dividend Per Share	(3) Ln (1 + Dividend)	(4) Dividend Per Share
High Financial Constraint × BioRegulation	-0.6279***	-0.1023*		
	(0.1649)	(0.1387)		
High Financial Constraint	-0.0586***	-0.0172		
	(0.0222)	(0.0159)		
High WW Index × BioRegulation			-0.3155**	-0.0413**
			(0.1420)	(0.0038)
High WW Index			0.2497***	0.0574***
			(0.0200)	(0.0118)
BioRegulation	-0.0744	-0.0504	-0.1891***	-0.0170***
	(0.1472)	(0.0660)	(0.0923)	(0.0444)
PPE to Assets	1.6426***	0.3229***	1.6284***	0.3192***
	(0.0703)	(0.0322)	(0.0701)	(0.0321)
CAPEX Ratio	-0.6393***	-0.1281*	-0.6689***	-0.1353*
	(0.1723)	(0.0742)	(0.1731)	(0.0747)
Leverage	-0.6446***	-0.0122	-0.6459***	-0.0130
	(0.0645)	(0.0390)	(0.0640)	(0.0390)
ROA	1.9361***	0.7597***	1.9186***	0.7565***
	(0.1520)	(0.1082)	(0.1529)	(0.1097)
Firm Size	0.6889***	0.1158***	0.6720***	0.1121***
	(0.0091)	(0.0049)	(0.0090)	(0.0049)
Market to Book Equity	-0.0004***	-0.0001**	-0.0004***	-0.0001**
	(0.0001)	(0.0000)	(0.0001)	(0.0000)
Cash Flow to Assets	-0.2799***	0.0727	-0.1763**	0.0962
	(0.0808)	(0.0634)	(0.0853)	(0.0630)
Net Working Capital	-0.6212***	-0.1875***	-0.5901***	-0.1792***
	(0.0759)	(0.0503)	(0.0755)	(0.0496)
Constant	-3.4800***	-0.5315***	-3.5482***	-0.5509***
	(0.0680)	(0.0419)	(0.0674)	(0.0418)
Observations	30,652	30,652	30,652	30,652
Adjusted R-squared	0.4344	0.1349	0.4372	0.1356
Year FE	YES	YES	YES	YES
Industry FE	YES	YES	YES	YES

Note: This table shows result for effect of financial constraints. Ln (1 + Dividend) is the dependent variable in specifications 1 and 3, and Dividend Per Share is the dependent variable in specifications 2 and 4. Year and industry fixed effects are taken into account in all specifications. Appendix A.1 provides an explanation of each variable. Robust standard errors, clustered at the firm level, are in parentheses. Significance at the 1%, 5%, and 10% levels is denoted by the symbols ***, **, and *, respectively.

Table 10: The Effect of Firm Life Cycle

Dependent Variable	(1) Ln (1 + Dividend)	(2) Dividend Per Share	(3) Ln (1 + Dividend)	(4) Dividend Per Share
RE/TA × BioRegulation	1.1997***	0.2941***		
	(0.2412)	(0.0686)		
RE/TA	0.1202***	0.0434***		
	(0.0172)	(0.0068)		
RE/TE × BioRegulation			0.0797***	0.0238***
			(0.0210)	(0.0073)
RE/TE			0.0180***	0.0048***
			(0.0021)	(0.0008)
Regulation	-0.5567***	-0.1560***	-0.5009***	-0.1361***
	(0.0783)	(0.0342)	(0.0793)	(0.0370)
PPE to Assets	1.6082***	0.3109***	1.5826***	0.3161***
	(0.0706)	(0.0323)	(0.0792)	(0.0342)
CAPEX Ratio	-0.6738***	-0.1430*	-0.6444***	-0.1139
	(0.1785)	(0.0760)	(0.1892)	(0.0794)
Leverage	-0.5539***	0.0142	-0.5826***	0.0048
	(0.0656)	(0.0394)	(0.0700)	(0.0424)
ROA	1.8670***	0.7412***	2.6222***	1.0795***
	(0.1556)	(0.1105)	(0.1748)	(0.1110)
Firm Size	0.6582***	0.1055***	0.7243***	0.1295***
	(0.0099)	(0.0051)	(0.0105)	(0.0048)
Market to Book Equity	-0.0004***	-0.0001**	-0.0001	-0.0000
	(0.0001)	(0.0000)	(0.0001)	(0.0000)
Cash Flow to Assets	-0.6100***	-0.0509	-0.4586***	-0.0125
	(0.0971)	(0.0678)	(0.0941)	(0.0508)
Net Working Capital	-0.7702***	-0.2396***	-0.7136***	-0.2195***
	(0.0798)	(0.0516)	(0.0859)	(0.0600)
Constant	-3.2805***	-0.4625***	-3.7994***	-0.6597***
	(0.0763)	(0.0442)	(0.0776)	(0.0387)
Observations	30,602	30,602	25,280	25,280
Adjusted R-squared	0.4361	0.1347	0.4210	0.1425
Year FE	YES	YES	YES	YES
Industry FE	YES	YES	YES	YES

Note: This table shows result for effect of firm life cycle. Ln (1 + Dividend) is the dependent variable in specifications 1 and 3, and Dividend Per Share is the dependent variable in specifications 2 and 4. Year and industry fixed effects are taken into account in all specifications. Appendix A.1 provides an explanation of each variable. Robust standard errors, clustered at the firm level, are in parentheses. Significance at the 1%, 5%, and 10% levels is denoted by the symbols ***, **, and *, respectively.

Table 11: The Effect of CEO Age

Dependent Variable	(1) Ln (1 + Dividend)	(2)	(3) Dividend Per Share	(4)
	Older CEOs	Younger CEOs	Older CEOs	Younger CEOs
BioRegulation	-0.4304***	-0.7463***	-0.1174***	-0.1807**
	(0.1130)	(0.1742)	(0.0450)	(0.0861)
PPE to Assets	1.4698***	1.3168***	0.2086***	0.2838***
	(0.1329)	(0.1360)	(0.0535)	(0.0504)
CAPEX Ratio	-4.5629***	-2.3179***	-1.1902***	-0.5760***
	(0.3400)	(0.1863)	(0.1222)	(0.0812)
Leverage	-0.8623***	-0.4630***	-0.0672	0.1651*
	(0.1266)	(0.1295)	(0.0657)	(0.0894)
ROA	0.4518	2.3762***	0.3190	0.9764***
	(0.5061)	(0.3699)	(0.2447)	(0.1865)
Firm Size	0.8666***	0.7671***	0.1561***	0.1280***
	(0.0205)	(0.0186)	(0.0108)	(0.0080)
Market to Book Equity	-0.0004***	-0.0006***	-0.0001**	-0.0001
	(0.0001)	(0.0002)	(0.0000)	(0.0000)
Cash Flow to Assets	3.3157***	1.5731***	1.1294***	0.6268***
	(0.6463)	(0.3827)	(0.2173)	(0.1502)
Net Working Capital	-0.6924***	-0.7009***	-0.1475*	-0.1152
	(0.1712)	(0.1568)	(0.0875)	(0.0902)
Constant	-4.2665***	-4.1096***	-0.6602***	-0.7167***
	(0.1543)	(0.1302)	(0.0811)	(0.0553)
Observations	9,614	10,101	9,614	10,101
Adjusted R-squared	0.4618	0.4241	0.1310	0.2017
Year FE	YES	YES	YES	YES
Industry FE	YES	YES	YES	YES
Chow-test P-value	0.0012		0.0041	

Note: This table shows result for the effect of CEO age. The sub samples of older and younger CEOs are developed based on the median CEO Age. Ln (1 + Dividend) is the dependent variable in specifications 1 and 2, and Dividend Per Share is the dependent variable in specifications 3 and 4. Year and industry fixed effects are taken into account in all specifications. Appendix A.1 provides an explanation of each variable. Robust standard errors, clustered at the firm level, are in parentheses. Significance at the 1%, 5%, and 10% levels is denoted by the symbols ***, **, and *, respectively.

Table 12: The Effect of Paris Agreement Withdrawal

Dependent Variable	(1) Ln (1 + Dividend)	(2) Dividend Per Share
Paris Agreement Withdrawal × Regulation	0.4153**	0.1382*
	(0.1629)	(0.0750)
Paris Agreement Withdrawal	0.1359***	0.0773***
	(0.0224)	(0.0274)
Regulation	-0.0478	-0.0928
	(0.1992)	(0.0746)
PPE to Assets	-0.1297	0.2039
	(0.1694)	(0.3481)
CAPEX Ratio	0.0374	-0.0019
	(0.0618)	(0.0735)
Leverage	-0.1508	0.0286
	(0.1002)	(0.1286)
ROA	0.7225**	0.3551
	(0.3535)	(0.2961)
Firm Size	0.0715	-0.0790
	(0.0499)	(0.0710)
Market to Book Equity	0.0001**	0.0001
	(0.0000)	(0.0000)
Cash Flow to Assets	-0.1822	0.1041
	(0.1405)	(0.1747)
Net Working Capital	-0.2307	-0.3292*
	(0.1696)	(0.1759)
Constant	1.4276***	0.9990**
	(0.3560)	(0.4738)
Observations	6,085	6,085
Adjusted R-squared	0.4264	0.0980
Year FE	NO	NO
Industry FE	YES	YES

Note: This table shows result for exogeneous shock of Donald Trump's 2017 Paris Agreement Withdrawal. The Paris Agreement Withdrawal is a dummy variable for years 2017 onwards. Ln (1 + Dividend) is the dependent variable in specification 1, and Dividend Per Share is the dependent variable in specification 2. Year and industry fixed effects are taken into account in both specifications. Appendix A.1 provides an explanation of each variable. Robust standard errors, clustered at the firm level, are in parentheses. Significance at the 1%, 5%, and 10% levels is denoted by the symbols ***, **, and *, respectively.