Manage biodiversity risk exposure?

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ABSTRACT

Using event study approach, we examine the investors' reactions to biodiversity-related policy events. We study firms that manage their biodiversity risk exposure as well as those that do not. We also study industries with varying level of biodiversity risk exposure. In the days leading up to *2021 Kunming Declaration*, firms that manage their biodiversity risk exposure experience positive abnormal returns, but not in the post-event period. The results show positive abnormal returns in both pre- and post- event in the case of 2022 *UN Biodiversity Conference*. Unclear economic implications ensuing the policy meetings leave firms that do not manage their biodiversity risk exposure unscathed. The market reaction at the industry level depends on how far-reaching the biodiversity risk discussions are.

1. Introduction

Biodiversity, i.e., diversity in geneses, species and ecosystems, is not only critical for well-being and prosperity of human race, but also is estimated to have contributed tens of trillions of dollars to the economy (Costanza et al, 1997). According to Anon., WWF (2022), wildlife populations of mammals, fish, birds, reptiles, and amphibians have declined by 69 % since the 1970. This alarming and deteriorating condition of biodiversity could result in grave consequences for life on our planet.

In the last decades, the attention to preserve biodiversity has shifted. Initially, the emphasis was on raising awareness as exemplified by the UN Biodiversity Conference held in 1992 (Rubino, 2000). It then shifted towards advocating for actions by certain actors such as the mining companies as outlined in the UN Declaration of 2010 (Adler et al, 2017). Despite those actions, destruction of the nature has reached alarming levels (Nedopil, 2023). The main driver of the biodiversity loss has been identified as economic activities (Dasgupta, 2021). For example, agricultural expansion and urban development for business purposes lead to destruction of natural surroundings, while overfishing results in a direct threat to marine diversity. The pollution and climate change arising from greenhouse gas emitted under industrial activities not only further deepens threats to biodiversity (Díaz et al, 2019), but also affect human life and economic activities, e.g., when natural disasters strike (Cardinale et al, 2012; Winn and Pogutz, 2013).

In the recent years, the attention has shifted towards drawing up concrete action plans to be carried out by all relevant parties (Sommerer and Lim, 2016). For instance, *Kunming Declaration of 2021* signed at the fifteenth meeting of the Conference of the Parties during the United Nations Biodiversity Conference held in Kunming on 12 and 13 October 2021 calls for immediate actions across all sectors of society and the economy to protect and conserve biodiversity sustainably. Meanwhile, *2022 UN Biodiversity Conference,* took place in Montréal, Canada, from December 7 to 19, 2022, resulted in an agreement to conserve 30 percent of lands and oceans by 2030. The events have formulated specific and tangible plans for businesses, as well as the wider society, to act on.

Studies have shown that biodiversity conservation actions require substantial financial resources (Flammer et al, 2023; Panwar et

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Table 1
The sample.

Firm category			
1	Firms that manage their biodiversity risk exposure		172
2	Firms that do not manage their biodiversity risk exposure		48
Total number of firms			220
Industry distribution			
	GICS Code	Industry	Number of firms
1	2510	Automobiles & Components	31
2	2520	Consumer Durables & Apparel	60
3	2530	Consumer Services	87
4	2550	Retailing	88
5	3010	Consumer Services and Retailing	11
6	3030	Auto Durables and Household Products	16
7	4010	Banks	412
8	4020	Diversified Financials	169
9	4510	Software & Services	152
10	4520	Technology Hardware & Equipment	74
11	4530	Semiconductors & Equipment	37
12	5010	Telecommunication Services	21
13	5020	Media & Entertainment	94
Total			1252

al, 2023). Hence, firms that are exposed to biodiversity risk inherently have potentially realizable significant financial setbacks. Consequently, the financial implications of biodiversity conservations underscore the recently growing literature (Flammer et al, 2023; Giglio et al, 2023; Phelps et al, 2011).

Moreover, firm's biodiversity risk exposure is intertwined with firm sustainability while sustainable finance needs to address a wide range of issues in addition to carbon and greenhouse gas emissions to be credible and meaningful (Carè and Weber, 2023; Singhania et al, 2023; Wilson, 2010). A dip in a firm's financial resource to address biodiversity conservation can eventually infringe into firm sustainability as resources are reallocated from sustainability efforts to preserving biodiversity (Karolyi and Tobin-de la Puente, 2023; Nedopil, 2023; Pandey et al, 2019). Carvalho et al (2023) studied the economic risk arising from biodiversity loss in the listed companies and found that 29 % of the firms that have adopted biodiversity policies by 2018 have approximately \$7.2 trillion in enterprise value exposed to unmanaged biodiversity risk. Hence, biodiversity risk management is crucial for economic sustainability and to align with as well as to promote sustainable finance.

Meanwhile, on the reporting front, there is an increasing interest on biodiversity accounting and reporting calling for a systematic measurement and communication of a firm's effects on biodiversity and the strategies it has implemented for conservation, see for example, (Blanco-Zaitegi et al, 2022; Cuckston, 2013). The increased disclosure at the firm level together with clearly established targets set at the governmental levels that are exposing firms to economic consequences suggests an awakening of investors' attention to firms' exposure to biodiversity risk. Hence, this study investigates how the events that take steps towards engaging firms in biodiversity conservation influence investor perceptions and valuations of the firms, as well as across industries with varying level of biodiversity footprints.

This study contributes to the growing literature on biodiversity risk. First, through event study approach, we investigate how the market reacts to, and thus the valuation effect of, the events such as the *2021 Kunming Declaration*, and the *2022 UN Biodiversity Conference*, that take a step closer to engaging firms in actions towards biodiversity conservation. In the literature studies have focused on examining policies and strategies for biodiversity conservation, with particular emphasis on how financial investments form public and private sources can be mobilized to protect biodiversity (Panwar et al (2023), and the role of businesses in the movement (Anyango-van Zwieten, 2021; Flammer et al, 2023; Rubino, 2000). This study, however, aims to understand the nuanced relationship between biodiversity policy events and investors' valuation of the firms with regards to biodiversity risk exposure. Second, this study contributes broadly to the literature on sustainability not only through the preservation of biodiversity, but also through the financial implications inherent in the biodiversity risk exposure. Finally, we provide the valuation effect of biodiversity risk exposure across industries, which the literature to date has yet to address.

The next section describes the data and methodology. Section 3 presents results and Section 4 concludes.

2. Data and methodology

We collect daily stock returns on US firms and industries from WRDS. Using annual firm-level biodiversity score developed by Giglio et al (2023), we categorize the firms as either managing their biodiversity risk exposure or not. Using BERT model, Giglio et al (2023) have classified biodiversity sentences mentioned in the 10-K into positive, neutral, and negative sentiments. See Giglio et al (2023) for detailed description of the procedure and classifications. An advantage of Giglio et al (2023) data over biodiversity data available from other data sources such as Refinitiv or Bloomberg is that Giglio et al (2023) data focuses on biodiversity risk exposure while Refinitiv and Bloomberg data are on whether a firm discloses biodiversity risk exposure or policy.

Next, we categorize firms with positive sentiment (i.e., with a score between 1 and 8) as firms that are managing their biodiversity risk exposure, and those with negative sentiment (i.e., with a score between -1 to -6) as firms that do not manage their biodiversity risk

Table 2

Average abnormal returns (AR) across firms on the event day (*Kunming Declaration of 2021*).

	AR	t-Statistics
Firms that manage their biodiversity risk exposure	-0.46**	-2.48
Firms that do not manage their biodiversity risk exposure	-0.71***	-2.91

***, **, * represent significance at 1 %, 5 %, and 10 %, respectively.

exposure. We also investigate the impact across the industries identified by Giglio et al (2023) to have exposure to biodiversity risk.[a] Table 1 gives an overview of the sample across the groups and industries. There are 172 firms that are managing their biodiversity risk exposure compared to 48 firms that are not. Our industry sample is skewed towards banks with 412 firms, followed by diversified financials (169 firms) and software & services (152 firms).

For the event-study analyses, we choose the day of the conference as the event day, i.e., October 13, 2021 for *2021Kunming Declaration*, and December 19, 2022 for *2022 UN Biodiversity conference*. Furthermore, we use a 250-day estimation window, excluding the 41 days leading up to the event day to mitigate the potential impact of event-induced return variance on model estimation (Kamal et al, 2023; Yousaf and Goodell, 2023; Yousaf et al, 2023). The event window for the first event is 15 days (from t-7 to $t + 7$), and the event window for the second event is 7 days (from t-4 to $t + 4$).

The market model by Dyckman et al (1984) is estimated to obtain the normal returns.

$$\widetilde{R}_{i,t} = \alpha_i + \beta_i R_{m,t} + \varepsilon_{i,t} \tag{1}$$

where $\widetilde{R}_{i,t}$ indicates expected normal return for stock i on the day t, $R_{m,t}$ is market returns (proxied by S&P 500) on same day. Abnormal returns (AR) are calculated as:

$$AR_{i,t} = R_{i,t} - \widetilde{R}_{i,t} \tag{2}$$

where $AR_{i,t}$ is abnormal return for stock i on the day t, $R_{i,t}$ denotes actual return of stock i on the day t. Then, Cumulative abnormal return (CAR) for stock i are calculated over the event window (τ_1, τ_2) as follows:

$$CAR_i(\tau_1 , \tau_2) = \sum_{t=\tau_1}^{\tau_2} AR_{i,t} \tag{3}$$

3. Empirical results

The first event – Kunming Declaration of 2021

Table 2 reports the average abnormal returns on the event day. All firms experience an abnormal drop in returns on the event day. However, the drop is larger at an event-day abnormal returns of -0.71 % for firms that do not manage their biodiversity risk exposure.

Table 3 summarizes the cumulative abnormal returns (CAR) around the event day. For firms that manage their biodiversity risk exposure, the CAR coefficients are positive and statistically significant in most of the days leading up to the event day (i.e., the day of the meeting). But post-event CARs, except for $t + 6$, are insignificant. However, firms that do not manage their biodiversity risk exposure do not exhibit any discernable pattern in the CARs around the event day.

The results in Tables 2 and 3 suggest that firms that manage their biodiversity risk exposure experience a gain in market value in anticipation of the upcoming meeting on biodiversity risk. On the day of the meeting when the discussions on biodiversity risk take place, firms that do not manage their biodiversity risk exposure are hit hardest, as indicated by a relatively highly negative event-day abnormal return. Despite that, the results suggest that the uncertainty surrounding how the discussions on biodiversity risk will translate into economic terms have left the market uncertain in their reaction, as indicated by the insignificant post-event CARs. As a robustness, we also conduct a similar study on firms that have explicitly discussed in their 10-K statements their exposure to biodiversity risk stemming from stricter regulations. Table A1 in Appendix shows that the results from this analysis are qualitatively similar to those in Table 3.

Fig. 1 demonstrates the progression of cumulative abnormal returns within the event window. In the days around the event day, the blue line that represents firms that manage their biodiversity risk exposure consistently stays above the orange line that represents firms that do not manage their biodiversity risk exposure.

Table 4 presents the CARs for various industries around the event day. The results show that except for Semiconductors and Equipment and Telecommunication Services all industries experience a significant drop in market value either in the days leading up to or after the meeting on biodiversity risk takes place. Thus, the results together with the low biodiversity risk score from Giglio et al (2023) reported in the second column suggest that the investors perceive the two sectors as having less exposure to biodiversity risk or more resilient to potential negative consequences that could arise from biodiversity-related challenges.

Table 4 also suggests that following the 2021 Kunming Declaration, when investors are increasingly recognizing the significance of

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[a] Giglio et al (2023) conducted a survey among finance academics, professionals, and regulators to rank industries that are most or least affected by (1) physical risks arising from biodiversity loss and (2) biodiversity-related transition risks.

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Table 3
Cumulative abnormal returns (CAR) of firms around *Kunming Declaration of 2021*.

Industry	t-7	t-6	t-5	t-4	t-3	t-2	t-1	$t+1$	$t+2$	$t+3$	$t+4$	$t+5$	$t+6$	$t+7$
Firms that manage their biodiversity risk exposure	3.11***	2.37***	0.26	0.57	1.68***	2.38***	2.21***	0.63	-0.66	-0.44	-1.53*	-0.60	-2.06**	-1.34
	(10.14)	(5.92)	(0.58)	(1.22)	(3.19)	(4.00)	(3.49)	(0.95)	(-0.89)	(-0.58)	(-1.92)	(-0.74)	(-2.45)	(-1.58)
Firms that do not manage their biodiversity risk exposure	1.01***	0.30	0.00	-0.20	0.11	0.64	0.69	-0.77	-2.17*	-2.41*	-3.33**	-2.86*	-2.92*	-2.17
	(3.82)	(0.62)	(-0.01)	(-0.28)	(0.13)	(0.63)	(0.64)	(-0.74)	(-1.69)	(-1.86)	(-2.37)	(-1.85)	(-1.81)	(-1.31)

Note: t-statistics are in parenthesis. ***, **, * represent significance at 1 %, 5 %, and 10 %, respectively.
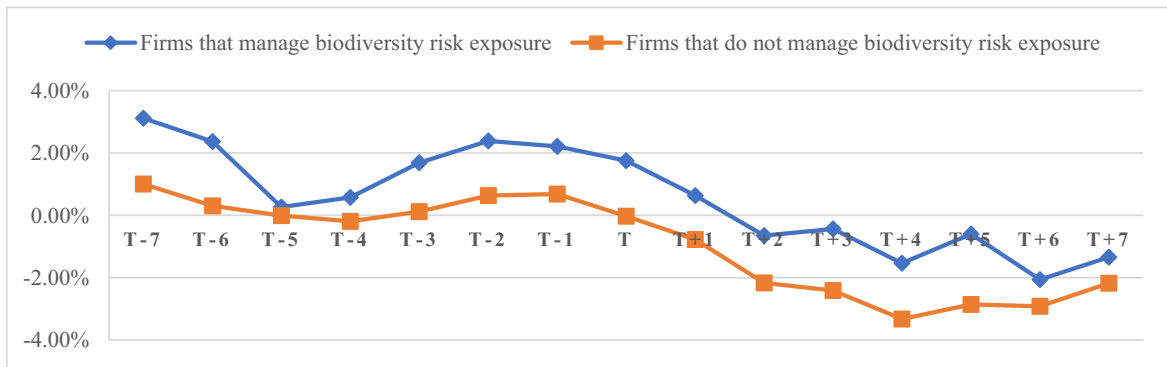
Fig. 1. Cumulative abnormal returns (CAR) of firms that manage versus firms that do not manage biodiversity risk exposure.

biodiversity risk, they demand a risk premium on stocks of companies that belong to an industry that has a high dependence on natural resources but do not manage their biodiversity risk exposure. This finding aligns with existing literature, for instance, Pastor and Veronesi (2012) that stock prices tend to decline after regulatory announcements, especially when the consequence from the regulation is highly uncertain (see also Garel et al, 2023; Cherief et al, 2022; Bolton and Kacperczyk, 2021).

The second event – 2022 UN Biodiversity Conference in Montreal

UN Biodiversity conference was held in Montreal on 19th December 2022. The event day abnormal returns in Table 5 show a negative event-day return for firms that manage their biodiversity risk exposure.

CAR reported in Table 6 shows that firms that manage their biodiversity risk exposure experience a significant positive CARs in days leading up to the event day. Moreover, the positive CARs continue in the post-event period. Firms that do not manage their biodiversity risk exposure do not experience any discernible pattern in the CAR around the event day. Table A2 in Appendix shows that the results from re-run of the event study analyses on firms that explicitly (or not explicitly) discuss their exposure to biodiversity risks stemming from stricter regulations. The results are qualitatively similar to those in Table 6.

Fig. 2 plots the CARs of firms that manage their biodiversity risk exposure (the blue line) around the event day against those that do not manage their biodiversity risk exposure (the orange line). Throughout the whole event window period the blue line consistently stays above the orange line, indicating higher cumulative abnormal returns for firms that manage their biodiversity risk exposure. These results are consistent with Choi et al (2020), who observed that companies with high carbon intensity perform poorly in stock markets during warmer-than-usual months, prompting retail investors to shift away from environmentally-unfriendly stocks. Pástor et al (2022) find that German green bonds and US green stocks outperform their counterparts, non-green bonds, and brown stocks, respectively, particularly as the concerns for climate increased. Additionally, Flammer (2021), through event study, finds that investors respond positively to the issuance of green bonds, leading to significantly positive cumulative abnormal returns.

Table 7 presents the CARs during the days surrounding *2022 UN Biodiversity Conference*. The results show that only banks experience a positive CARs around the event day, showing a favorable market responsive. All the other industries experience no discernible CARs around the event day. The *2022 UN Biodiversity Conference* resulted in an agreement to conserve 30 percent of lands and oceans by 2030. Banks are minimally exposed to biodiversity risks associated with lands and oceans and thus have exhibit a positively significant CARs around the conference. In contrast, there are no discernible CARs for the rest of industries, showing uncertainty about the economic implications of the conference outcomes in those sectors. Given that the conference proposed a clearly defined target, the market should exhibit a more pronounced reaction. The mixed results suggest that the market is uncertain regarding the economic consequences of the biodiversity policies. These results are consistent with Graziano et al. (2023) who showed that clarity and credibility of economic policy interventions drive the market reactions.

4. Conclusion

We investigate the impact of policy events related to biodiversity on the US firms that manage their biodiversity risk exposure compared to those that do not manage their biodiversity risk exposure. Additionally, we examine the impact at the industry level, comparing those that are expected to rely highly on natural resources (i.e., high biodiversity risk exposure) with those that rely less (i.e., low biodiversity risk exposure) as identified by Giglio et al (2023). Firms that manage their biodiversity risk exposure experience an increase in firm value in days leading up to the day where worldwide discussions on biodiversity risks take place. However, the unclear economic implications of the outcomes from the discussions leave the valuation of the firms that do not manage their biodiversity risk exposure unscathed. At the industry level, all industries except Semiconductors & Equipment, and Telecommunication Services experience a significant drop in market value either in the days leading up to or after the meeting on biodiversity risk as a wider concern (i.e., around *2021 Kunming Declaration*). However, *2022 UN Biodiversity conference* where biodiversity risk on land and oceans are under the spotlight, only banking industry experience a positive market valuation in the period around the event day.

Overall, our study shows that investors are recognizing the importance of biodiversity risk at the time of the *2021 Kunming Declaration*. They demand a risk premium on stocks of firms that belongs to an industry that rely much on natural resources but do not

Table 4
Industry-wise cumulative abnormal returns (CAR) around *Kunming Declaration of 2021*.

Industry	Level of Biodiversity risk (Giglio et al., 2023)	t − 7	t − 6	t − 5	t − 4	t − 3	t − 2	t − 1	t + 1	t + 2	t + 3	t + 4	t + 5	t + 6	t + 7
Automobiles & Components	0.195	0.36	-0.41	-1.47**	-2.07**	-3.29**	-2.87**	-2.07*	-1.91	-2.57	-2.57*	-3.03*	-3.52**	-4.01**	-3.77**
		(0.72)	(-0.61)	(-2.09)	(-2.78)	(-3.31)	(-2.63)	(-1.74)	(-1.35)	(-1.65)	(-1.78)	(-2.07)	(-2.17)	(-2.36)	(-2.09)
Auto Durables and Household Products	0.195	-0.31	-0.97	-1.87*	-2.47**	-2.54**	-2.36**	-2.22**	-2.64**	-3.98***	-5.61***	-5.51***	-5.14***	-5.95***	-5.83**
		(-0.42)	(-1.30)	(-2.00)	(-2.15)	(-2.40)	(-2.65)	(-2.20)	(-2.23)	(-3.66)	(-4.21)	(-4.29)	(-3.50)	(-3.41)	(-2.70)
Consumer Durables & Apparel	0.195	-0.02	-0.39	-1.28**	-0.55	-1.23	-1.62*	-0.81	-1.17	-2.14**	-2.82***	-3.19***	-3.40***	-3.57***	-3.85***
		(-0.07)	(-0.96)	(-2.09)	(-0.80)	(-1.52)	(-1.74)	(-0.85)	(-1.26)	(-2.34)	(-2.89)	(-3.04)	(-3.24)	(-3.35)	(-3.22)
Banks	0.150	0.15	-0.58***	-1.72***	-1.53***	-1.80***	-1.37***	-0.72*	-2.04***	-3.32***	-4.24***	-4.50***	-4.49***	-4.81***	-5.10***
		(1.01)	(-8.02)	(-5.91)	(-5.82)	(-4.30)	(-2.24)	(-1.19)	(-6.07)	(-9.22)	(-10.18)	(-10.55)	(-10.02)	(-10.10)	(-9.91)
Diversified Financials	0.150	0.36	-0.58*	-1.62***	-1.16**	-1.66***	-1.57***	-1.20**	-1.97***	-2.97***	-3.84***	-4.15***	-3.74***	-3.99***	-4.10***
		(1.53)	(-1.95)	(-4.16)	(-2.72)	(-3.25)	(-2.88)	(-2.26)	(-3.23)	(-4.47)	(-5.53)	(-5.98)	(-4.94)	(-5.19)	(-4.93)
Consumer Services	0.105	-0.09	-0.59	-1.43***	-1.31**	-1.41**	-1.19*	-0.19	-0.49	-1.53	-2.11**	-2.54**	-2.40**	-2.83***	-3.30***
		(-0.28)	(-1.61)	(-3.16)	(-2.49)	(-2.18)	(-1.71)	(-0.25)	(-0.55)	(-1.90)	(-2.45)	(-2.68)	(-2.54)	(-2.91)	(-3.36)
Consumer Services and Retailing	0.105	-0.17	-1.48*	-2.09*	-2.69**	-3.45**	-2.51	-2.16	-2.84	-4.15**	-4.65**	-4.96**	-3.92**	-3.73**	-3.33*
		(-0.26)	(-1.96)	(-2.00)	(-2.65)	(-2.37)	(-1.39)	(-1.11)	(-1.56)	(-2.25)	(-2.40)	(-2.45)	(-2.14)	(-2.14)	(-2.07)
Retailing	0.105	0.47	-0.12	-0.85**	-0.16	-0.25	-0.49	0.26	-0.92	-1.77**	-2.19***	-2.29***	-2.03**	-2.52***	-2.24**
		(1.60)	(-0.40)	(-2.11)	(-0.28)	(-0.41)	(-0.69)	(0.38)	(-1.19)	(-2.21)	(-2.57)	(-2.70)	(-2.41)	(-2.88)	(-2.35)
Media & Entertainment	0.034	0.43	-0.46	-1.83***	-1.48**	-2.09***	-1.85**	-1.34	-2.29**	-3.74***	-4.79***	-5.01***	-4.81***	-5.01***	-5.43***
		(1.14)	(-1.00)	(-3.20)	(-2.40)	(-2.81)	(-2.35)	(-1.59)	(-2.32)	(-3.52)	(-4.13)	(-4.44)	(-4.15)	(-4.01)	(-4.01)
Semiconductors & Equipment	0.034	1.46**	1.08	0.49	0.95	1.76	1.87	2.10*	0.68	0.58	0.32	-0.54	-0.34	-0.76	-0.76
		(2.42)	(1.44)	(0.57)	(1.14)	(1.60)	(1.54)	(1.90)	(0.71)	(0.49)	(0.25)	(-0.43)	(-0.24)	(-0.51)	(-0.52)
Software & Services	0.034	0.11	-0.60	-2.06***	-1.82***	-2.27***	-2.12***	-1.78**	-2.38***	-3.44***	-4.42***	-4.70***	-4.59***	-5.17***	-5.42***
		(0.32)	(-1.54)	(-4.70)	(-3.64)	(-3.30)	(-2.94)	(-2.50)	(-3.22)	(-4.33)	(-5.10)	(-4.65)	(-4.30)	(-4.76)	(-4.74)
Technology Hardware & Equipment	0.034	0.24	-0.93*	-2.07***	-2.13***	-2.82***	-2.48***	-1.71*	-2.65**	-3.68***	-4.38***	-4.94***	-4.81***	-5.19***	-5.41***
		(0.57)	(-2.06)	(-3.86)	(-3.33)	(-3.29)	(-2.78)	(-1.85)	(-2.32)	(-2.96)	(-3.45)	(-3.81)	(-3.54)	(-3.76)	(-3.58)
Telecommunication Services	0.034	0.61*	0.03	-0.89	-0.37	-0.58	-0.47	0.11	-0.64	-1.35	-1.67	-2.09	-1.80	-1.93	-1.67
		(1.72)	(0.08)	(-1.32)	(-0.50)	(-0.65)	(-0.43)	(0.09)	(-0.41)	(-0.82)	(-1.06)	(-1.28)	(-1.09)	(-1.09)	(-0.97)

***, **, * denote significance at 1 %, 5 %, and 10 %, respectively. In column 2, biodiversity risk score is based on a survey conduct by (Giglio et al, 2023). A higher score indicates a higher level of biodiversity risk.

Table 5

Abnormal returns (AR) of firms on event day (*2022 UN Biodiversity Conference*).

	AAR	t-Statistics
Firms with positive biodiversity risk sentiments	-0.63**	-2.15
Firms with negative biodiversity risk sentiments	-0.44	-1.10

***, **, * denote significance at 1 %, 5 %, and 10 %, respectively.

Table 6

Cumulative abnormal returns (CAR) of firms around *2022 UN Biodiversity Conference*.

	t-4	t-3	t-2	t-1	$t+1$	$t+2$	$t+3$	$t+4$
Firms that manage their biodiversity risk exposure	0.79***	0.71**	1.97***	1.54***	1.59***	1.97***	1.39*	2.74***
	(4.28)	(2.80)	(4.66)	(3.41)	(3.04)	(3.21)	(1.92)	(3.80)
Firms that do not manage their biodiversity risk exposure	0.01	-0.02	-0.10	0.26	0.37	0.53	0.44	0.82
	(0.03)	(-0.05)	(-0.16)	(0.38)	(0.48)	(0.63)	(0.51)	(0.81)

Note: t-statistics are in parenthesis. ***, **, * represent significance at 1 %, 5 %, and 10 %, respectively.
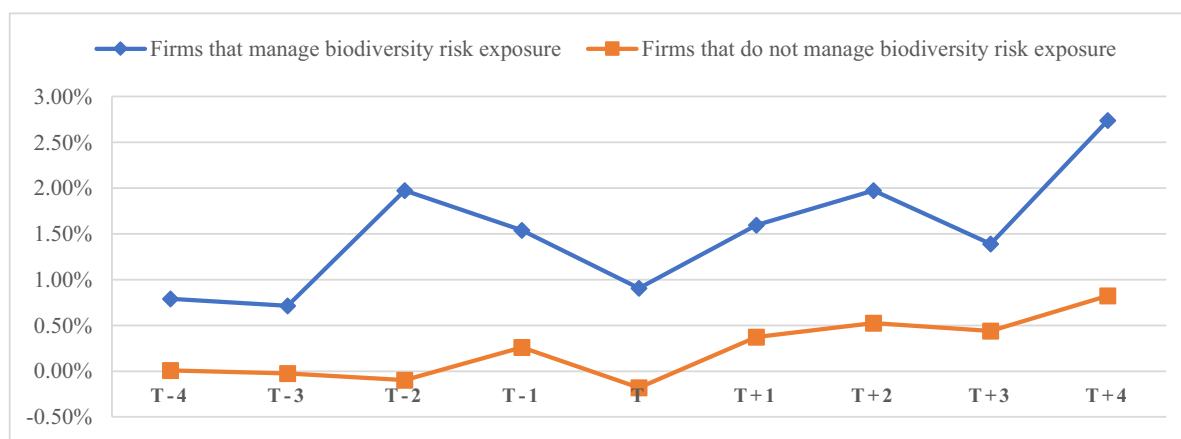
Fig. 2. Cumulative abnormal returns (CAR) of firms that manage versus firms that do not manage biodiversity risk exposure.

manage biodiversity risk exposure. These results support previous studies on carbon risk that showed that stock price declines after regulatory announcements and investors demand for risk premium for their exposure to carbon risk. After the *2022 UN Biodiversity Conference*, firms managing biodiversity risk show higher cumulative abnormal returns. However, at the industry level, only banks receive positive market response, with no discernable response for other industries. This contrast suggests market being uncertain about the future economic implications of biodiversity policies, despite the well-defined targets.

In this study we have employed biodiversity risk exposure data by Giglio et al (2023), developed through BERT NLP model. According to Fang et al (2022), there are several limitations to using NLP in text analysis in social science research as it may not fully capture the subtle meanings or intentions someone writes or says in text. Thus, one future line of research could be to employ biodiversity risk exposure generated through other approaches, such as surveys.

CRediT authorship contribution statement

Muhammad Ramzan Kalhoro: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Writing – original draft, Writing – review & editing. **Khine Kyaw:** Supervision, Writing – original draft, Writing – review & editing.

Data availability

Data is obtainable from data provider with subscription

Table 7

Industry-wise cumulative abnormal returns (CAR) around *2022 UN Biodiversity Conference*.

Industry	Level of Biodiversity risk (Giglio et al, 2023)	t-4	t-3	t-2	t-1	$t+1$	$t+2$	$t+3$	$t+4$
Auto Durables and Household Products	0.195	-0.29	-3.28	-4.09	-1.59	-0.84	-1.20	-0.93	-2.29
		(-0.42)	(-0.91)	(-0.89)	(-0.43)	(-0.23)	(-0.32)	(-0.23)	(-0.54)
Automobiles & Components	0.195	0.15	0.22	0.74	1.34*	-0.51	-0.64	-0.21	-0.51
		(0.22)	(0.27)	(1.01)	(1.75)	(-0.67)	(-0.64)	(-0.23)	(-0.50)
Consumer Durables & Apparel	0.195	-0.09	0.03	0.02	1.14	0.93	1.34	1.81*	1.28
		(-0.23)	(0.06)	(0.03)	(1.35)	(1.08)	(1.53)	(1.85)	(1.32)
Banks	0.150	0.34	0.63**	1.17***	1.53***	0.81**	0.42	1.19**	1.03*
		(1.50)	(2.34)	(4.04)	(4.49)	(2.02)	(0.96)	(2.45)	(1.95)
Diversified Financials	0.150	0.20	0.27	0.78*	1.20**	0.10	0.18	0.72	0.49
		(0.88)	(0.78)	(1.74)	(2.28)	(0.13)	(0.23)	(0.75)	(0.45)
Consumer Services	0.105	-0.50	-0.20	0.70	1.05	1.79	1.91	2.17	1.84
		(-1.52)	(-0.48)	(1.46)	(1.71)	(1.35)	(1.33)	(1.39)	(1.14)
Consumer Services and Retailing	0.105	1.90	1.82	2.75	2.58	2.26	1.57	4.17	2.76
		(1.23)	(0.51)	(0.83)	(0.65)	(0.61)	(0.41)	(1.20)	(0.63)
Retailing	0.105	-0.19	0.00	0.52	0.26	-1.08	-0.82	-0.80	-1.16
		(-0.55)	(0.00)	(0.74)	(0.31)	(-1.10)	(-0.92)	(-0.80)	(-1.07)
Media & Entertainment	0.034	-0.66	-0.17	0.82	1.29*	0.63	0.15	1.73	1.70
		(-1.58)	(-0.31)	(1.27)	(1.84)	(0.78)	(0.15)	(1.24)	(1.13)
Semiconductors & Equipment	0.034	0.12	0.77	1.16	1.92*	2.18	3.22	4.77	4.08
		(0.25)	(0.87)	(1.06)	(1.68)	(1.34)	(1.62)	(1.61)	(1.53)
Software & Services	0.034	0.40	0.37	0.86	1.33	0.12	-0.07	0.46	-0.51
		(0.88)	(0.60)	(1.18)	(1.61)	(0.13)	(-0.06)	(0.43)	(-0.46)
Technology Hardware & Equipment	0.034	-0.05	-0.14	0.50	0.40	-0.80	-1.20	-0.86	-1.67
		(-0.11)	(-0.32)	(0.88)	(0.60)	(-0.93)	(-1.34)	(-0.89)	(-1.64)
Telecommunication Services	0.034	1.73	0.39	0.46	0.79	0.75	2.01	2.20	2.07
		(0.92)	(0.32)	(0.26)	(0.40)	(0.32)	(0.82)	(0.90)	(0.93)

***, **, * denote significance at 1 %, 5 %, and 10 %, respectively. In column 2, biodiversity risk score is based on a survey conduct by (Giglio et al, 2023). A higher score indicates a higher biodiversity risk rank.

Appendix 1

Table A1

Cumulative abnormal returns (CAR) of firms to *2021 Kunming Declaration*.

	t-7	t-6	t-5	t-4	t-3	t-2	t-1	$t+1$	$t+2$	$t+3$	$t+4$	$t+5$	$t+6$	$t+7$
Firms that explicitly discuss biodiversity risk stemming from regulations	3,65***	2,84***	0,12	0,71	2,04***	3,07***	2,86***	0,67	-0,74	-0,39	-1,75*	-0,92	-2,69***	-1,66
	(9,85)	(5,78)	(0,21)	(1,22)	(3,17)	(4,25)	(3,73)	0,82	-0,80	-0,41	(-1,73)	-0,89	(-2,55)	-1,59
Firms that do not explicitly discuss biodiversity risk stemming from regulations	1,66***	0,79**	0,07	-0,11	0,45	0,78	0,91	-0,03	-1,32*	-1,57*	-2,33***	-1,65*	-2,09**	-1,62
	(6,41)	(2,19)	(0,15)	(-0,22)	(0,78)	(1,18)	(1,25)	(-0,04)	(-1,67)	(-1,89)	(-2,66)	(-1,78)	(-2,19)	(-1,58)

Note: t-statistics are in parenthesis. ***, **, * represent significance at 1 %, 5 %, and 10 %, respectively.

Table A2

Cumulative abnormal returns (CAR) of firms to *2022 UN Biodiversity Conference*.

	t-4	t-3	t-2	t-1	$t+1$	$t+2$	$t+3$	$t+4$
Firms that explicitly discuss biodiversity risk stemming from regulations	0,93***	0,81***	2,28***	1,73***	1,76***	2,19***	1,06	2,86***
	(4,68)	(2,65)	(5,34)	(3,64)	(2,80)	(2,97)	(1,42)	(3,31)
Firms that do not explicitly discuss biodiversity risk stemming from regulations	0,27	0,20	0,48	0,49	0,63	0,77	0,81	1,11
	(1,12)	(0,59)	(0,89)	(0,86)	(1,06)	(1,23)	(0,95)	(1,44)

Note: t-statistics are in parenthesis. ***, **, * represent significance at 1 %, 5 %, and 10 %, respectively.

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