**Article:**
Ahmad, M.F. and Karpuz, A. orcid.org/0000-0003-2746-6428 (2024) Beyond climate change risk: Biodiversity and corporate cash holdings. Economics Letters, 236. 111608. ISSN: 0165-1765

https://doi.org/10.1016/j.econlet.2024.111608

# Beyond Climate Change Risk: Biodiversity and Corporate Cash Holdings

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First version: May 1, 2023

This version: February 12, 2024

**Abstract**

We document that firms' exposure to biodiversity risk is positively associated with corporate cash holdings. The positive effect is distinct from the influence of firm's exposure to climate change risk. Further, our findings are more pronounced for firms in industries highly exposed to biodiversity risks, facing large financial constraints or exposed to high competition. Overall, the results support the precautionary motives of corporate cash holdings.

JEL classification: G30; G31; Q54

Keywords: Biodiversity, Climate risk; Corporate Cash Holdings

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## 1. Introduction

A prominent focus in the literature has centered on examining the relationship between economic activities and our planet (e.g., Stroebel and Wurgler, 2021). This literature shows that climate change substantially affects firm value and corporate decisions, and for managers, it stands among the top five threats to their business (Ginglinger, 2020). In this study, we focus on an equally important theme: biodiversity. Defined as the total of genes, species, and ecosystems, biodiversity-related services generate tens of trillions of dollars (Costanza et al., 1997) and recent degradations in biodiversity services have been estimated to cause damages between $4trn to $20trn per year. Despite its importance for business activities, the impact of biodiversity risk on corporate decisions is unexplored. Motivated by this gap in the literature, we investigate how firms' exposure to biodiversity risks affects their cash holding decision.

Cash holding is an important corporate liquidity management tool, and a large body of existing research evaluates the determinants of corporate cash holdings (Opler et al., 1999). As liquidity management is a first-order important decision for firms (Graham and Harvey, 2001), an analysis of cash holdings in conjunction with biodiversity risks is an important gap to fill in the literature.

While climate and biodiversity risks are interconnected to some extent, they are substantially different. Giglio et al. (2023) measure this disparity using media analysis, concluding that the temporal patterns of biodiversity risk substantially differ from those of climate risk. Their findings from the media analysis and several anecdotal evidence underscore that biodiversity related risks differ from climate change related risks.

Firms' exposure to biodiversity risks can be either physical (e.g., loss of services such as the supply of raw materials) or transition risks stemming from regulatory and consumer responses to reduce biodiversity loss (Giglio et al., 2023). Considering these risks and drawing from the precautionary motives of cash holding (e.g., Bates et al., 2019), we hypothesize that firms exposed to biodiversity risks should have substantially higher precautionary demand for cash to respond to the biodiversity risks. Bates et al. (2009) document a substantial rise in US firms' cash reserves over time, attributing this growth to cash flow risk and precautionary motives of cash holdings. Opler et al. (1999) document that the underlying reasons for keeping the precautionary cash are capital market frictions and future investment opportunities.

For biodiversity risks, we use a measure developed by Giglio et al. (2023), who use the textual analysis of US firms' 10-K statements to capture their biodiversity risks. We find that firms significantly increase their precautionary cash holdings in response to biodiversity risks. Additionally, this increase is more pronounced for firms in industries with higher biodiversity risk, financially constrained firms, and firms operating in a competitive environment. Since cash is more important for financially vulnerable firms amid increased risks or uncertainties (Faulkender and Wang, 2006; Alimov, 2014), results from these tests provide support for our precautionary motive argument.

Our study contributes to the literature that investigates the relationship between environmental changes and corporate decisions (Ahmad et al., 2023). Our research fills an important gap in this literature by investigating how biodiversity related risks affect corporate cash holdings. Our paper also contributes to a newly growing body of literature examining the effect of biodiversity risk on corporate policies (Karolyi and Tobin-de la Puente; Giglio et al., 2023). Additionally, our study adds to the extensive body of literature focused on corporate cash holding policy (Opler et al., 1999; Bates et al., 2009).

## 2. Data and empirical strategy

We obtain the data on firms' biodiversity risk exposure, created based on 10-K statements, from Giglio et al. (2023). The climate change risk exposure scores and firm characteristics are from Sautner et al. (2022) and Compustat, respectively. We exclude firms in financial (SIC 6000-6999) and regulated (SIC 4900-4999) industries. We winsorize the continuous variables at their 1st and 99$^{th}$ percentiles. Our final sample contains 23,296 firm-year observations for 2,765 US public firms between 2002 and 2020.

To investigate the effect of firms' biodiversity risk exposures on corporate cash holdings, we estimate the following model:

$$Cash_{i,t} = a_1 BiodiversityRisk_{i,t} + a_2 CCExposure_{i,t} + \Phi X_{i,t} + f_i + d_t + e_{i,t} \quad (1)$$

where subscripts *i* and *t* denote firm and year, respectively.[1] *Cash* is the ratio of cash holdings to total assets. Our main variable of interest is the variable *Biodiversity Risk*, which is a firm-year binary variable equals to one if a firm is exposed to biodiversity risks (i.e., if a company

[1] Our results are robust when using lagged values of the right-hand side variables.

mentions biodiversity in at least two sentences on its 10-K file and at least one of these sentences is about regulation) (Giglio et al., 2023). *CCExposure* is a standardized measure of climate change risk exposure (Sautner et al., 2022) and we control it in all of the analyses. The vector of covariates *X* is for commonly used firm-level determinants of *Cash,* which are *Firm size, Tobin's Q, Leverage, Tangibility, NWC* (net working capital), *Cash flow, Capex, R&D intensity*, and *Dividends* (Opler et al., 1999). We also control for firm (*f*) and year (*d*) fixed effects. *e* is for the error term. Standard errors are corrected for heteroscedasticity at the firm level. The summary statistics are presented in Table 1.

## 3. Results

Table 2 reports the coefficient estimates calculated from equation 1. In column 1 of Panel A, the coefficient on *Biodiversity Risk* is positive and significant at the 1% level. In terms of economic significance, the firms exposed to biodiversity risk increase their cash holdings by 3.8 percentage points, which translates into an annual increase in their cash holdings of 15% from their unconditional sample average of 24.8%[2]. In column 2, we use an alternative proxy for biodiversity risk, *Biodiversity Risk - Negative* which is measured as the number of negative biodiversity sentences minus the number of positive biodiversity sentences in 10-K files annually (Giglio et al., 2023). Our results remain robust[3]. Consistent with our hypothesis, results suggest that firms increase their precautionary cash holdings in response to the biodiversity risks and this response is distinct from firms' exposure to climate change risks.

In panel B of Table 2, we perform various identification tests. In column 1, we drop all the industries from the analyses that have less than 5 firms exposed to biodiversity risk (intensive margin). This test addresses a potential concern that our results might be driven by only a small group of firms with high biodiversity risks. In column 2, we employ the system-GMM estimation method to address potential endogeneity problems. In column 3, we use the propensity score matching (PSM) with the nearest neighbor based on the control variables. Importantly, our treated and non-treated firms have similar levels of climate change exposure, and they only differ based on biodiversity risks. As the PSM works with the reduced sample, in column 4 we use the entropy balancing approach, that considers the full sample. Across all these tests, we consistently find robust evidence. Lastly, we perform a placebo test in column 5

[2] The economic impact is calculated as follows: the coefficient estimate (3.8%) divided by the mean Cash (24.8%).
[3] We also use alternative definitions of our dependent variable (i.e., industry adjusted cash ratio and ln(1+Cash)) and our results remain robust [unreported].

and the statistical insignificance of the independent variable confirms the robustness of the main results.

In Table 3, we test cross-sectional heterogeneity of our baseline results by focusing on three dimensions: (i) industries exposed to biodiversity risks (Giglio et al. 2023) in columns 1-2, (ii) financially constrained firms wherein liquidity management is important (Faulkender and Wang, 2006) in columns 3-4, and (iii) firms operating in a competitive environment (Alimov, 2014) in columns 5-6. In all the columns, the variable of interest is the interaction between *Biodiversity Risk* and *corresponding interaction variable,* a dummy variable distinguishing firms/industries based on the dimension studied. Consistent with our expectation, the positive effect of Biodiversity Risk is amplified in (i) firms operating in High-Risk Industries, (ii) financially constrained firms, and (iii) firms operating in competitive environments. Our results remain robust irrespective of the definition that we use to identify High-Risk Industries, financially constrained firms, and competition. As cash is more important for financially vulnerable firms when there are more risks or uncertainties (Faulkender and Wang, 2006), these results provide support for our precautionary motive argument.

## 4. Conclusion

We provide novel and robust evidence that biodiversity risk has a significantly positive effect on corporate cash policy. This effect is more pronounced for industries highly exposed to such risks, for firms that are financially constrained, or operating in competitive environments. Collectively, these results support the precautionary motives of corporate cash holdings.

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**Table 1 - Descriptive Statistics**

| Variable Name | Mean | St. Dev. | Q1 | Median | Q3 |
|---|---|---|---|---|---|
| ***Dependent Variables*** | | | | | |
| Cash | 0.248 | 0.351 | 0.044 | 0.124 | 0.312 |
| ***Variables of Interests*** | | | | | |
| Biodiversity Risk | 0.022 | 0.145 | 0.000 | 0.000 | 0.000 |
| Biodiversity Risk - Negative | 0.027 | 0.314 | 0.000 | 0.000 | 0.000 |
| ***Control Variables*** | | | | | |
| Firm Size | 7.192 | 1.703 | 5.970 | 7.082 | 8.291 |
| Tobin's Q | 2.808 | 2.719 | 1.371 | 1.946 | 3.065 |
| Leverage | 0.279 | 0.270 | 0.067 | 0.233 | 0.399 |
| Tangibility | 0.268 | 0.252 | 0.086 | 0.182 | 0.369 |
| NWC | 0.048 | 0.174 | -0.045 | 0.045 | 0.148 |
| Cash Flow | 0.058 | 0.174 | 0.046 | 0.085 | 0.127 |
| CAPEX | 0.054 | 0.066 | 0.018 | 0.034 | 0.063 |
| R&D Intensity | 0.059 | 0.116 | 0.000 | 0.008 | 0.069 |
| Dividend | 0.430 | 0.495 | 0.000 | 0.000 | 1.000 |
| CCExposure | -0.107 | 0.628 | -0.357 | -0.286 | -0.124 |

**Table 2 - Biodiversity Risk and Corporate Cash Holdings**
Impact of Biodiversity risk on cash holdings. The p-value is reported within brackets and *** indicates significance at 1% level.

Panel A: Baseline results

| | 1 | 2 |
|---|---|---|
| *Variables of Interest* | | |
| Biodiversity Risk | 0.038*** | |
| | [0.000] | |
| Biodiversity Risk - Negative | | 0.011*** |
| | | [0.002] |
| Controls | | |
| CCExposure | 0.001 | 0.001 |
| | [0.702] | [0.720] |
| Firm Size | -0.076*** | -0.076*** |
| | [0.000] | [0.000] |
| Tobin's Q | 0.053*** | 0.053*** |
| | [0.000] | [0.000] |
| Leverage | 0.038*** | 0.039*** |
| | [0.008] | [0.008] |
| Tangibility | -0.215*** | -0.217*** |
| | [0.000] | [0.000] |
| NWC | -0.256*** | -0.256*** |
| | [0.000] | [0.000] |
| Cash Flow | -0.119*** | -0.119*** |
| | [0.000] | [0.001] |
| CAPEX | 0.045 | 0.044 |
| | [0.356] | [0.364] |
| R&D Intensity | 0.640*** | 0.640*** |
| | [0.000] | [0.000] |
| Dividend | -0.004 | -0.004 |
| | [0.437] | [0.441] |
| Firm and Year FE | Yes | Yes |
| # of Observations | 23,296 | 23,296 |
| Adjusted $R^2$ | 0.817 | 0.817 |

Panel B. Identification Tests

| | Intensive Margin | GMM | PSM | Entropy Balancing | Placebo |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 |
| *Variables of Interest* | | | | | |
| Biodiversity Risk | 0.043*** | 0.139*** | 0.029*** | 0.121*** | |
| | [0.011] | [0.043] | [0.004] | [0.000] | |
| Biodiversity Risk - Shuffled | | | | | -0.011 |
| | | | | | [0.479] |
| Controls | Yes | Yes | Yes | Yes | Yes |
| Firm and Year FE | Yes | Yes | Yes | Yes | Yes |
| # of Observations | 10,400 | 23,296 | 886 | 23,296 | 23,296 |
| Adjusted $R^2$ | 0.828 | 0.817 | 0.677 | 0.685 | 0.817 |
| m1 | | 0.000 | | | |
| m2 | | 0.000 | | | |
| m3 | | 0.318 | | | |
| Hansen-J | | 0.279 | | | |
| Difference-in-Hansen | | 0.479 | | | |
| Lag limits | | (3 5) | | | |

**Table 3 – Cross-sectional Heterogeneity Tests**

Cross sectional tests for the impact of Biodiversity risk on cash holdings. The p-value is reported within brackets and *** indicates significance at 1% level.

| | High Risk Industry | | Financial Constraints | | Competition | |
|---|---|---|---|---|---|---|
| | GICS based | Survey Based | KZ Index | Altman's Z-score | Fluidity | HHI |
| | 1 | 2 | 3 | 4 | 6 | 7 |
| *Variables of Interest* | | | | | | |
| Biodiversity Risk | -0.008 | -0.025 | 0.010 | 0.007 | 0.012 | 0.017 |
| | [0.619] | [0.147] | [0.512] | [0.554] | [0.218] | [0.142] |
| **Biodiversity Risk x Interaction Variable** | **0.054*** ** | **0.070*** ** | **0.045*** ** | **0.069*** ** | **0.040*** ** | **0.040** ** |
| | **[0.005]** | **[0.000]** | **[0.003]** | **[0.000]** | **[0.004]** | **[0.010]** |
| | | | 0.000 | 0.001 | 0.001 | 0.001 |
| | | | [0.887] | [0.739] | [0.705] | [0.675] |
| Controls | Yes | Yes | Yes | Yes | Yes | Yes |
| Firm and Year FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 23296 | 23296 | 23296 | 23296 | 23296 | 23296 |
| Adjusted R2 | 0.817 | 0.817 | 0.821 | 0.819 | 0.817 | 0.817 |