Zooming in on Biodiversity Risk: The Pricing of Deforestation Risk on International Financial Markets

Marc Bohnet*, Philip Fliegel*, Tycho Tax†

* Humboldt Universität zu Berlin, Junior research group PECan; † Climate & Company

Introduction: Paper in a nutshell

- Biodiversity risk becomes more recognized by investors and policymakers
  => More stringent policies
  => Shifting investor expectations
- Reduction of complexity of biodiversity risk by focussing on deforestation

How to measure deforestation risk of a company?
- Introduction of novel Corporate Deforestation Exposure (CDE) metric
- Assessing companies' deforestation exposure that are in the MSCI ACWI
- Deploying a short- and long-term analysis to examine whether deforestation risks are priced in financial markets

Financial data
- Compustat: stock returns, closing prices, capex, assets, sales,…
- Refinitiv: ESG scores, emission data
- News shock indicators (Giglio et al., 2023)

CDE data
- Orbis; Refinitiv; Exiobase; Forest 500; Climate Trace
- Deforestation attribution (per Country-Sector) – Pendrill et al. (2020)

Table 1: Spearman rank correlation of the CDE metric to E, S, and G scores as well as total and scope 1-2 emission intensities

Variables	(1)	(2)	(3)	(4)	(5)	(6)
(1) dt1_score	1.000					
(2) E Score	0.244	1.000				
(3) S Score	0.126	0.126	1.000			
(4) G Score	0.069	0.069	0.069	1.000		
(5) Total Emission Intensity	0.424	0.424	0.424	0.424	1.000	
(6) Scope 1-2 Emission Intensity	0.359	0.359	0.359	0.359	0.359	1.000

Results: Long- and short-term analysis

- Overall, the BMG portfolio underperforms the market (2010-2022)
- We do not find any significant effect for neither the climate nor the biodiversity news shock index, indicating the uniqueness of the CDE
- Plotting the 30-months alpha coefficient over time, we only observe significance for certain periods while a clear trend emerges
- Over time the negative point estimates for the BMG portfolio's alpha diminish and turn positive. Even though they are not significant a clear trend seems to emerge after the EUDR's first discussion at the end of 2019
- Stocks of companies with a very high CDE metric (top 10%) experience on average CAARs of 1.5% on the adoption date of the EUDR

Figure 1: 30-months rolling alpha

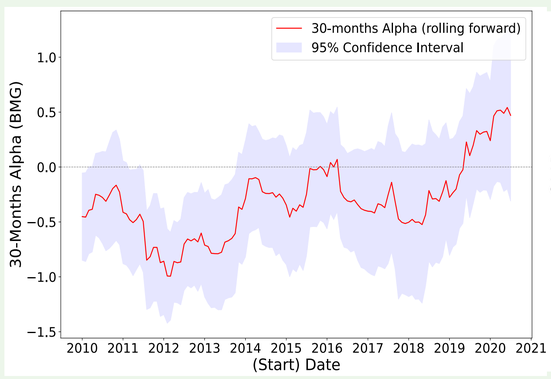
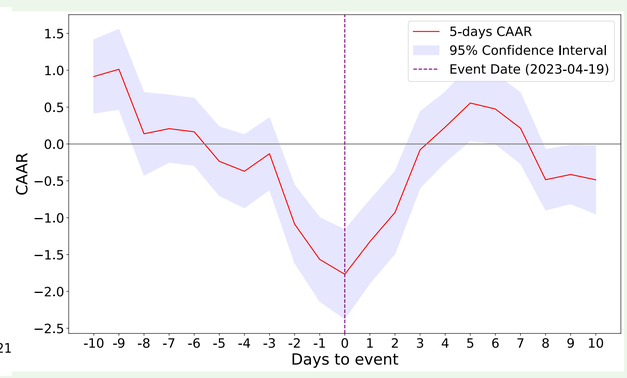


Figure 2: CAARs of highest 10th percentile



- **In recent year investors' expectations seem to change and adapt to a more stringent policy environment regarding deforestation confirmed by their reaction during the adoption of the EUDR**

LinkedIn

Website

PECan

marc-philipp.bohnet@hu-berlin.de

philip.fliegel@hu-berlin.de

tycho@climcom.org

Construction of the CDE metric:

- Developed in corporation with Climate & Company
- Collect data on companies' business activities (country-sector pairs) including subsidiaries, assets and disaggregated revenue information
- Collect date on deforestation risk to either company, subsidiary, sector, geographic location or country-sector pair
- Make sure to not double count and attribute this information to the company in any portfolio (here MSCI ACWI)

Figure 3: Number of observations per company and data source

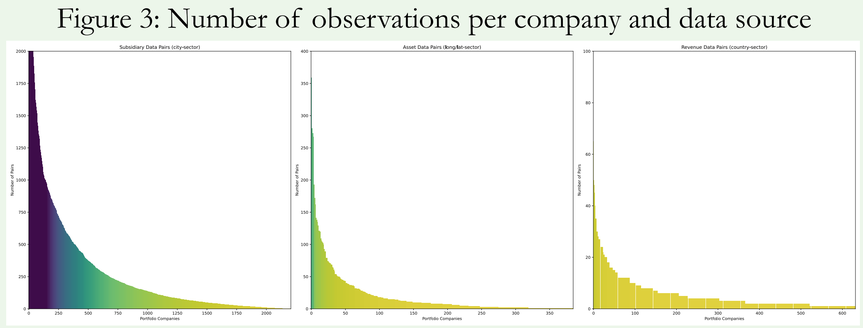


Figure 4: CDE metric per sector (GICS level 2)

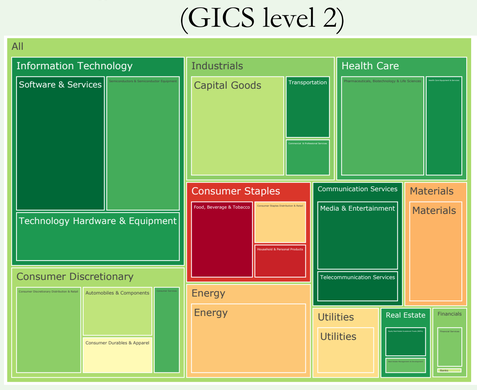
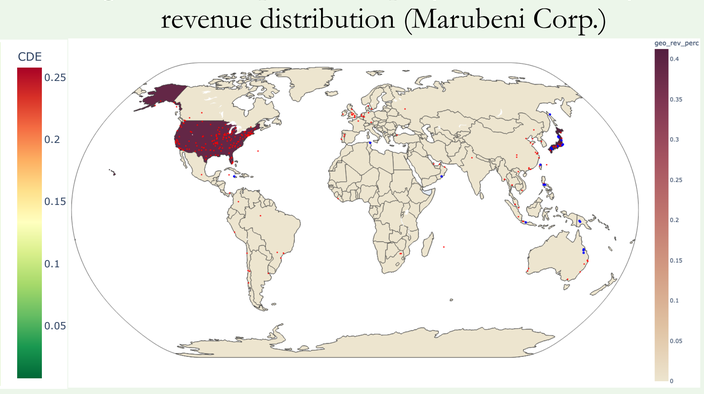


Figure 5: Example of company asset, subsidiary and revenue distribution (Marubeni Corp.)



Methods:

- We deploy a Fama-French five factor model (Fama and French, 2015), including two extra specifications with new shock indices by Giglio et al. (2023):

$$R_{it} - RF_t = \alpha_i + \beta_{i1}(RM_{kt} - RF_t) + \beta_{i2}SMB_t + \beta_{i3}HML_t + \beta_{i4}RMW_t + \beta_{i5}CMA_t + \epsilon_{it}, \quad (1)$$

$$R_{it} - RF_t = \alpha_i + \beta_{i1}(RM_{kt} - RF_t) + \beta_{i2}SMB_t + \beta_{i3}HML_t + \beta_{i4}RMW_t + \beta_{i5}CMA_t + \beta_{i6}ClimateShocks_t + \epsilon_{it}, \quad (2)$$

$$R_{it} - RF_t = \alpha_i + \beta_{i1}(RM_{kt} - RF_t) + \beta_{i2}SMB_t + \beta_{i3}HML_t + \beta_{i4}RMW_t + \beta_{i5}CMA_t + \beta_{i6}BiodiversityShocks_t + \epsilon_{it}, \quad (3)$$

Note: *Rit* is the monthly return of the Brown Minus Green portfolio. RF is the risk- free rate of return. RM denotes the return of the market portfolio k. Moreover, the model also features the High Minus Low (HML) value, Small Minus Big (SMB) size, Robust Minus Weak (RMW) profitability as well as the Conservative Minus Aggressive (CMA) investment factor. The constant alpha indicates whether a portfolio outperforms the market, even when controlling for all other risk factors.

- Our short-term event study adopts this approach, incorporating the methodologies of Oberndorfer et al. (2013) and Engle (2001) as detailed below:

$$r_{it}^e = \alpha_i + \beta_{i1}(RM_{kt} - RF_t) + \beta_{i2}SMB_t + \beta_{i3}HML_t + \beta_{i4}RMW_t + \beta_{i5}CMA_t + \sqrt{h_{it}}\epsilon_{it} \quad (4)$$

$$h_{it} = a_i + b_i h_{it-1} + c_i h_{it-1}\epsilon_{it-1}^2 \quad (5)$$

$$\widehat{AR_{it}} = r_{it}^e - \widehat{r_{it}^e} \quad (6)$$

$$\widehat{AAR_t} = \frac{1}{N}\sum_{i=1}^{N}\widehat{AR_{it}} \quad (7)$$

$$\widehat{CAAR_{t1,t2}} = \sum_{t=t1}^{t2}\widehat{AAR_t} \quad (8)$$

References:

Fama, Eugene F, and Kenneth R French. 2015. "A five-factor asset pricing model." Journal of financial economics, 116(1): 1–22.

Giglio, Stefano, Theresa Kuchler, Johannes Stroebel, and Xuran Zeng. 2023. "Biodiversity Risk." National Bureau of Economic Research Working Paper 31137. http://www.nber.org/papers/w31137.

Pendrill, F., Persson, F. & Kastner, T. (2020). 'Deforestation risk embodied in production and consumption of agricultural and forestry commodities 2005-2017'. Chalmers University of Technology, Senckenberg Society for Nature Research, SEI, and Ceres Inc. DOI: 10.5281/zenodo.4250532

Oberndorfer, Ulrich, Peter Schmidt, Marcus Wagner, and Andreas Ziegler. 2013. "Does the stock market value the inclusion in a sustainability stock index? An event study analysis for German firms." Journal of Environmental Economics and Management, 66(3): 497–509.

Engle, Robert. 2001. "GARCH 101: The use of ARCH/GARCH models in applied econometrics." Journal of economic perspectives, 15(4): 157–168.