Discussion of

"Biodiversity Risk"

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Broader Context

- The biodiversity crisis has received little attention in the literature. Yet, it is at least as severe as the climate crisis.
  - **"Code Red" alert for humanity**: global populations of mammals, fish, birds, reptiles, and amphibians declined by 69% since 1970 (WWF, 2022).
  - **Climate and biodiversity crises are deeply intertwined**: Meeting the Paris Climate Agreement goals depends on the successful conservation, restoration, and management of biodiversity (UN 2022).
  - **Existential threat to global economy**: over 50% of world's GDP is dependent on nature and the services it provides (UN 2022).
- The biodiversity crisis is likely to affect financial markets in important ways, but ways that are not (yet) well understood.

Summary

- The authors leverage **textual analysis techniques** to help understand how biodiversity risks affect equity prices.
- Authors construct several **measures** of **biodiversity risk:**
  - At the *aggregate level:* construct a **news-based** measure of aggregate biodiversity risk from the *New York Times.*
  - At the *firm level:* construct a biodiversity risk measure based on a **textual analysis** of firms' 10-K statements.
  - Also construct several variants/extensions of these measures.
  - All measures combine "physical biodiversity risks exposure" and "biodiversity footprint" (transition risks)
- Find **evidence** that **biodiversity risk affects equity prices**:
  - Returns of portfolios sorted on the authors' measures of biodiversity risk exposure covary positively with changes in aggregate biodiversity risk.

Summary

- There is a lot to like about this paper!
  - An insightful contribution.
  - I hope to see more work on 'biodiversity and finance' going forward!

- Focus of this discussion:
  - Comment 1: Measurement
  - Comment 2: Biodiversity vs climate risks
  - Comment 3: Disclosure of biodiversity information
  - Comment 4: Miscellaneous points

Comment 1: Measurement

- Authors put a lot of effort in constructing text-based measures of biodiversity risk (using 10-Ks and NYT articles, among others).
- I found the approach to be helpful. Moreover, the authors provide all their data online at www.biodiversityrisk.org.
  - Useful public goods for the profession!

Comment 1: Measurement

- The elephant in the room is the **measurement** of biodiversity risks.

a) Construction of **biodiversity dictionary** is somewhat ad hoc.

b) All measures of biodiversity risks are **indirect**.

c) Measures **blend** firms'
   - Biodiversity footprint (transition risks).
   - Physical biodiversity risk exposure.

Comment 1a: Measurement – Biodiversity Dictionary

a) Development of **Biodiversity Dictionary is somewhat ad hoc**

- Contains the following biodiversity-related terms (p. 53):

  "biodiversity, ecosystem(s), ecology (ecological), habitat(s), species, (rain)forest(s), deforestation, fauna, flora, marine, tropical, freshwater, wetland, wildlife, coral, aquatic, desertification, carbon sink(s), ecosphere, and biosphere."

- How was the dictionary **developed, defined, and validated**?

  For example:

  - Why are terms such as "**tropical**" and "**carbon sink**" included?
    - How much does this measure depend on the terms "tropical" and "carbon sink"?
    - Could it be that what you capture is a measure of climate change as opposed to biodiversity loss?
  - Why are **other terms excluded** (e.g., "genes")?
  - How does your definition **align with others** (e.g., by UN Convention on Biological Diversity (CBD), Taskforce on Nature-related Financial Disclosures (TNFD), Global Reporting Initiative (GRI))?

Comment 1a: Measurement – Biodiversity Dictionary

- **Suggestion 1a**
  - Provide more information about the development, definition, and validation of **Biodiversity Dictionary**.
  - For long-term impact and relevance of your measures and study's findings, **align your definition** of biodiversity with existing definitions and frameworks (by e.g., UN Convention on Biological Diversity (CBD), Taskforce on Nature-related Financial Disclosures (TNFD), Global Reporting Initiative (GRI)).

Comment 1b: Measurement – No Direct Measure

b) All measures of biodiversity risks are **indirect**

- The authors do **not use any direct measure** for the firms'
  - Biodiversity footprint (transition risks).
  - Physical biodiversity risk exposure.

- There seems to be **more direct metrics** the authors **could use**.
  - Biodiversity footprint (transition risks):
    In a related paper, Garel, Romec, Sautner, and Wagner (2023, R&R at the *Review of Finance*) use **data from Iceberg Data Lab** (IDL) that provides firm-level data on the firms' biodiversity footprint.
  - Physical biodiversity risk exposure:
    - WWF's **Biodiversity Risk Filter** (https://riskfilter.org/biodiversity/home).
    - UNEP and S&P Global **Nature and Biodiversity Risk Data**.

- I do not know how good (or bad) these data are. But they are certainly worth considering, at least as a way to validate the text-based metrics.

Comment 1b: Measurement – No Direct Measure

- **Suggestion 1b**
  - Ideally, add proxies that **directly measure** firms' biodiversity footprint and physical biodiversity risk exposure.
    - The **Iceberg data, WWF's Biodiversity Risk Filter data,** and **UNEP-S&P Global's Nature and Biodiversity Risk data** could be a useful starting point, even if they only cover a subsample of the authors' dataset.

Comment 1c: Measurement – Blended Measure

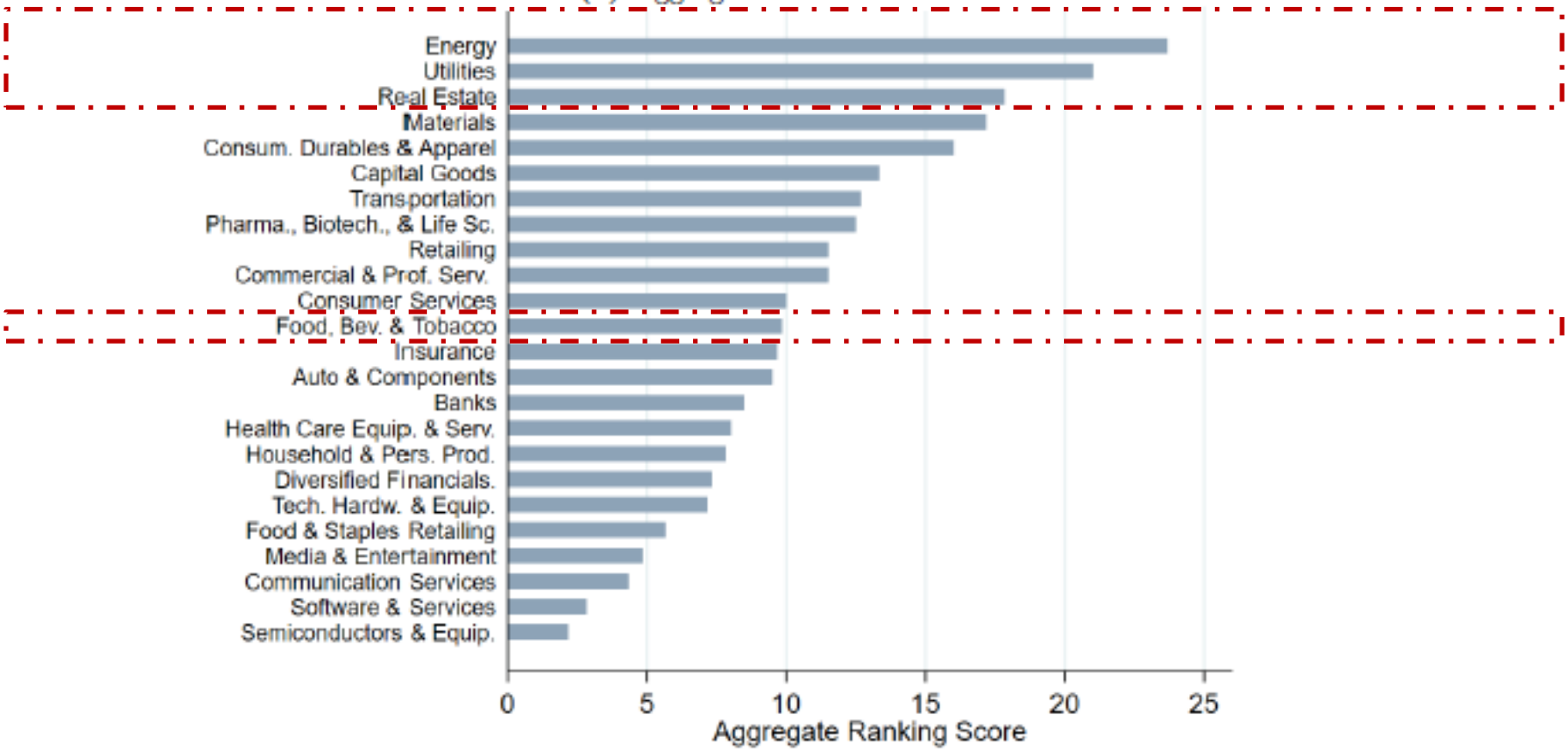
c) Measures of biodiversity risk **blend together** firms' biodiversity footprint (transition risks) and physical biodiversity risk exposure

- Yet, transition and physical risks are conceptually **fundamentally different**!
  - Biodiversity footprint (transition risks): impact of companies on biodiversity.
  - Physical biodiversity risk exposure: impact of biodiversity on companies.
- Ideally, these **should** not be mixed but **separately measured.**
- Otherwise, it is **unclear what is measured** and **how to interpret** the results and provide policy implications.
- Smell test:
  - Authors' measure suggest that energy, utilities, and real estate sectors are most exposed to biodiversity risks (see figure on next slide).
  - What is the intuition? Wouldn't one expect that agriculture, forestry, fishing, food and beverages are most exposed?

Comment 1c: Measurement – Blended Measure

Figure 5: Industry-Level Biodiversity Risk Exposure

(a) Aggregate Score



Comment 1c: Measurement – Blended Measure

- Also, whether companies are major contributors to biodiversity loss or are severely exposed to physical biodiversity risks has **very different implications** for firms, investors, biodiversity, and policy.

- **Suggestion 1c**
  - **Don't blend** together firms' biodiversity footprint and physical biodiversity risk exposure.
  - Ideally, would use **different measures** (see suggestion 1b).

Comment 2: Biodiversity vs. Climate Risks?

- The biodiversity crisis and climate crisis are **closely intertwined.**
- Relatedly,
  - Companies' biodiversity footprint and carbon footprint are closely intertwined (e.g., the conservation of biodiversity helps companies improve their biodiversity footprint and carbon footprint).
  - Companies' exposure to physical biodiversity risks and climate risks might be closely intertwined.
- We know from previous work (e.g., Bolton and Kacperczyk, JFE 2021) that companies' **carbon footprint affects stock returns**, as investors demand compensation for their exposure to carbon emission risk.
- For this reason, the authors are careful to explicitly **distinguish between climate risks vs. biodiversity risks**.

Comment 2: Biodiversity vs. Climate Risks?

- Interestingly, the authors find that biodiversity risks tend to be **negatively correlated** with climate risks.

Table 3: Industry-level Correlations of Biodiversity Scores

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
10k-based Biodiversity Scores								
(1) 10k:Negative	1.00							
(2) 10k:Count	0.74	1.00						
(3) 10k:Regulation	0.91	0.87	1.00					
Survey-based Biodiversity Scores								
(4) Survey: Transition	0.50	0.57	0.57	1.00				
(5) Survey: Physical	0.21	0.27	0.24	0.82	1.00			
(6) Survey: Average	0.37	0.44	0.42	0.95	0.96	1.00		
Holding-based Biodiversity Scores								
(7) Holding	0.49	0.23	0.32	0.29	0.00	0.15	1.00	
Climate Exposure Scores								
(8) Quantity-based Climate Exposure	−0.19	−0.12	−0.06	−0.33	−0.13	−0.23	−0.25	1.00

Note: Industry-level Pearson correlations of 10K-based Biodiversity Scores, Survey-based Biodiversity Scores, Holding-based Biodiversity Scores, and Quantity-based Climate Score. The 10K-based Biodiversity Scores and Quantity-based Climate Score are computed with data from 2019.

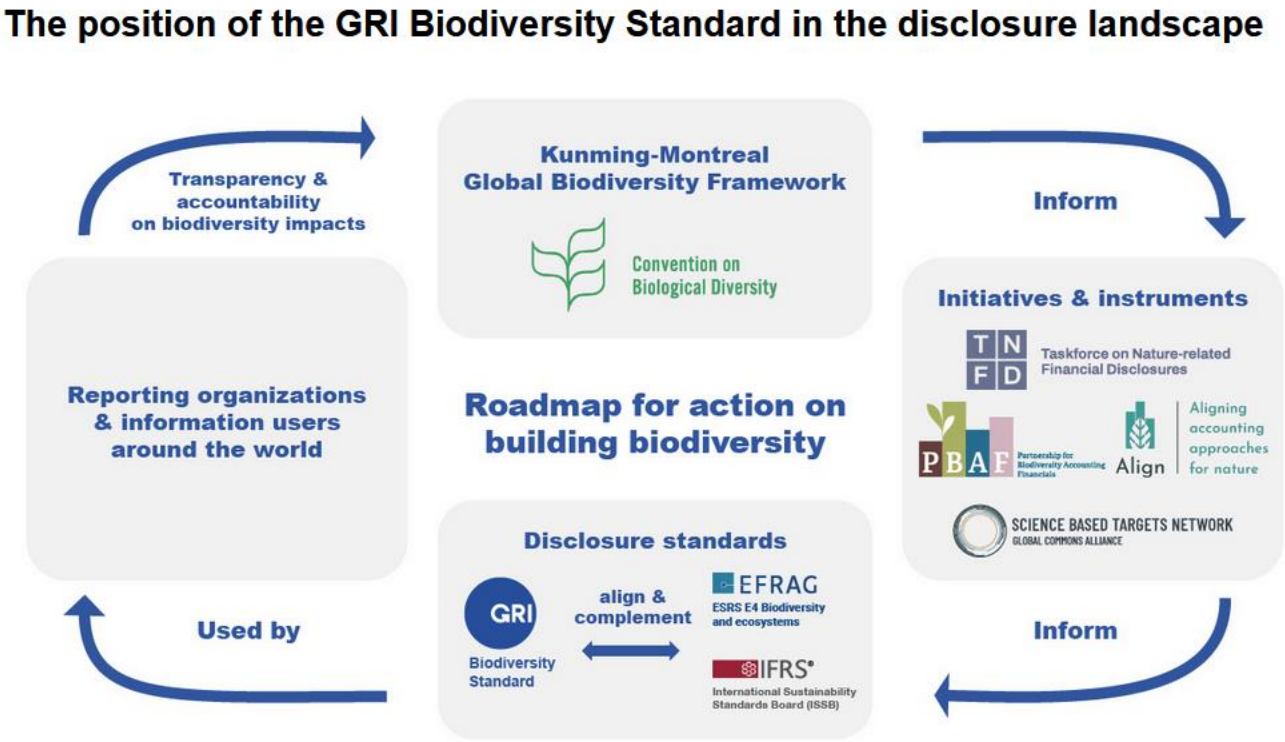
Comment 2: Biodiversity vs. Climate Risks?

- The **negative correlation** (up to -33%) is **somewhat surprising** given the intertwined nature of biodiversity and climate risks.
  - This is an interesting finding on its own, but it warrants **more discussion.**
  - Its **interpretation is complicated** due to the authors' use of blended measures for both "biodiversity risks" and "climate risks".

- **Suggestion 2**
  - Delve deeper into the negative correlation between climate risks and biodiversity risks.
  - This is an interesting and novel fact, which is worth highlighting, but it would be nice to understand the "why."
  - Related to Suggestion 1c, consider using separate measures for physical vs transition risks.

Comment 3: Disclosure of Biodiversity Information

- Recent efforts in pushing the voluntary **disclosure of biodiversity-related information**. (See related Comment 1a.)



Source: https://www.globalreporting.org/standards/standards-development/topic-standard-project-for-biodiversity/

Comment 3: Disclosure of Biodiversity Information

- In particular, the **Taskforce on Nature-related Financial Disclosures (TNFD)** was founded in 2021 and released its first disclosure framework in early 2022.
  - The TNFD, in turn, informs disclosure standards by IFRS, EFRAG, and GRI.
- Arguably, one may expect that the TNFD and the subsequent development of a disclosure framework have a **substantial effect** on firms, investors, and their attention to biodiversity.

- **Suggestion 3**
  - These disclosure efforts **matter for the interpretation** as well: changes over time **could reflect improvements in disclosure** as opposed to increased physical biodiversity risk exposure or/and increased biodiversity-related transition risks (e.g., due to anticipated subsequent regulations).
  - Could examine whether the results are stronger following these events.

Comment 4a: Miscellaneous Points

a) For the news-based measure of aggregate biodiversity risk, the authors use articles from **one single newspaper** (the *New York Times)*.

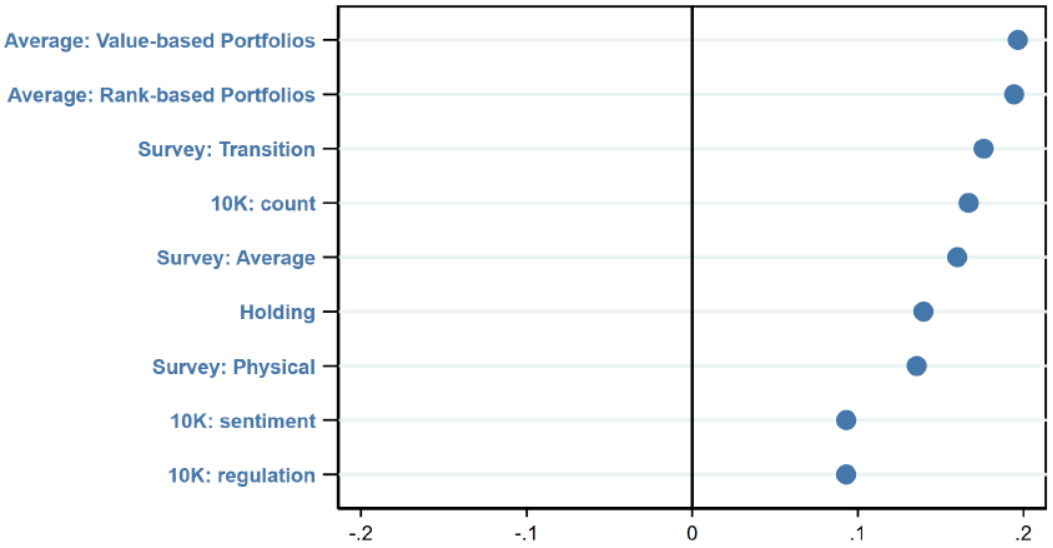
- While this is reasonable, **other newspapers** (e.g., the *Wall Street Journal*) may be a more natural source given their closer focus on business and economics.

- **Suggestion 4a**
  - Add a robustness check with the WSJ and ideally a larger selection of newspapers.

Comment 4b: Miscellaneous Points

b) When reporting the sensitivity of the hedge portfolio to innovations in aggregate biodiversity risk, the authors report the **correlations but without confidence intervals**.

Figure 7: Biodiversity Hedge Performance of Various Portfolios



- **Suggestion 4b**
  - Add confidence intervals to the figures. (This is discussed in Appendix A.4.3; but would be nice to have the stats in the figures as well.)

Comment 4c: Miscellaneous Points

c) Authors conduct a **survey** on the perceptions of biodiversity risks among finance academics, professionals, public sector regulators, and policy economists.

- Great idea to add qualitative survey-based information.
- Yet, the **informativeness might be limited** if the surveyed population has limited knowledge/expertise about biodiversity-related physical and transition risks).
  - Note, about 35% of respondents had no opinion (Table 4).
  - Respondents might simply "guess" the answer and check the most likely box (Table 1).

Comment 4c: Miscellaneous Points

Table 4: Current pricing of biodiversity risks in asset markets

		Role			Location				Biodiversity Concern			
	Pooled	Academic Institution	Private Sector	Public Sector	North America	Europe	Asia	ROW	Very High	High	Low	No Concern
Stock Market (%)												
Not enough	48	43	53	61	45	53	60	69	71	53	30	6
Correct	17	23	11	15	18	17	13	23	11	26	33	23
Too much	3	3	5	3	5	1	2	0	2	2	8	29
No opinion	32	31	32	21	33	28	25	9	16	19	29	42
Commodity Market (%)												
Not enough	43	39	46	55	39	47	57	63	65	45	24	3
Correct	19	25	14	17	20	21	15	20	13	29	39	23
Too much	3	2	5	5	5	1	0	6	1	2	8	29
No opinion	35	35	35	22	36	30	28	11	20	24	29	45
Sovereign Debt Market (%)												
Not enough	43	39	44	58	41	48	50	60	65	45	29	3
Correct	14	20	10	8	16	13	12	9	6	23	33	19
Too much	2	2	2	4	2	1	2	6	0	2	3	26
No opinion	41	39	44	30	41	38	37	26	29	30	35	52
Real Estate Market(%)												
Not enough	46	42	48	61	45	51	53	54	66	51	32	3
Correct	16	22	12	9	17	15	13	20	10	23	32	29
Too much	2	1	3	3	2	2	0	3	0	1	5	26
No opinion	37	35	38	27	37	32	33	23	24	25	32	42

Comment 4c: Miscellaneous Points

Table 1: Biodiversity Risk Perceptions

		Role			Location				Biodiversity Concern			
	Pooled	Academic Institution	Private Sector	Public Sector	North America	Europe	Asia	ROW	Very High	High	Low	No Concern
Physical Risk Importance (%)												
Not at all important	8	9	9	5	9	6	9	6	1	3	9	100
Slightly important	24	26	23	20	26	20	26	14	6	27	91	0
Moderately important	35	37	28	40	34	36	38	26	19	69	0	0
Very important	34	28	40	35	31	38	28	54	73	0	0	0
Transition Risk Importance (%)												
Not at all important	7	7	6	11	8	6	7	9	1	1	9	100
Slightly important	20	22	19	18	22	19	19	11	8	17	91	0
Moderately important	42	46	34	46	40	50	36	40	26	82	0	0
Very important	30	25	41	25	30	25	38	40	66	0	0	0
Physical Risk Materialization (%)												
Already today	23	18	29	24	24	18	19	29	32	15	12	13
1 to 5 years	10	8	10	14	9	9	5	23	11	9	8	7
5 to 30 years	46	51	43	41	45	52	43	43	45	57	36	7
More than 30 years	17	18	14	19	17	17	22	3	10	17	35	30
Never	5	6	4	1	4	4	10	3	1	2	9	43
Transition Risk Materialization (%)												
Already today	20	16	27	17	23	14	16	23	27	14	15	10
1 to 5 years	26	28	25	24	25	29	22	34	33	23	15	7
5 to 30 years	41	44	34	47	40	44	43	34	33	54	41	13
More than 30 years	8	7	10	7	9	7	9	3	4	7	20	27
Never	5	5	4	6	3	7	10	6	2	2	9	43

Note: For the first two blocks, participants were asked: "Biodiversity risks for investors and firms are often divided into (i) physical risks coming from actual changes in biodiversity (e.g., reduced pollinators, freshwater scarcity) and (ii) transition risks coming from changes in the regulatory environment to combat biodiversity loss (e.g., the Clean Water Act). Please rate the financial materiality of these risks for corporations in the United States. 1- Physical Risk; 2- Transition Risk". For the last two blocks, participants were are: "Over what time horizon, if any, do you expect these biodiversity risks to materialize?", where biodiversity risk is either the physical risk or transition risk.

Comment 4c: Miscellaneous Points

- **Suggestion 4c**
  - Add an **auxiliary analysis** that i) only considers respondents with **relevant expertise,** and/or ii) weighs the responses based on the level of expertise.
  - Consider using time windows of **similar length** for the survey.

Concluding Remarks

- Focus of this discussion:
  - Comment 1: Measurement
  - Comment 2: Biodiversity vs climate risks
  - Comment 3: Disclosure of biodiversity information
  - Comment 4: Miscellaneous points

- There is a lot to like about this paper!
  - An insightful contribution.
  - I hope to see more work on 'biodiversity and finance' going forward!

Thank You!