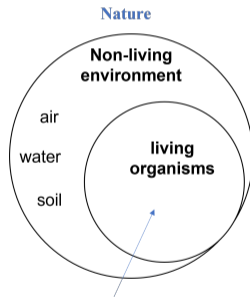
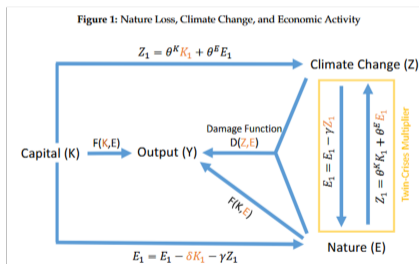


Theme: Pricing Biodiversity Risk

- What is biodiversity risk?
 - commonly understood as **the diversity of genes, species, and ecosystems.**
 - Nature and Biodiversity Loss:



Biodiversity: diversity of
Specie, Genes, ecosystems.



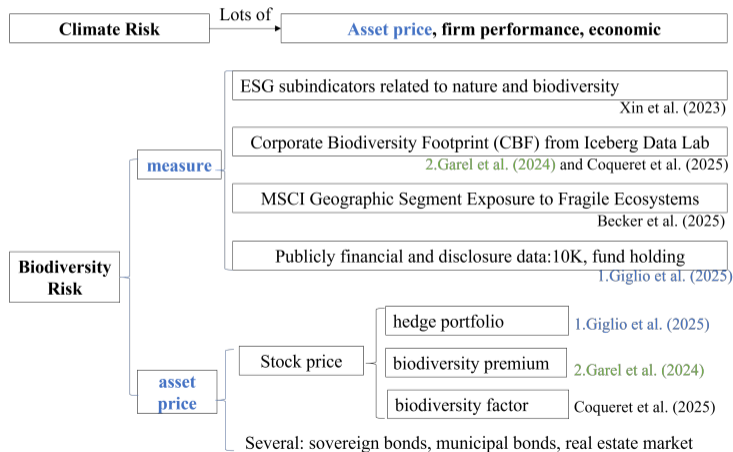
- ECB(2025): *ensuring that the Eurosystem, the implications of climate change and **nature degradation** for monetary policy and central banking*

Theme: Pricing Biodiversity Risk

- Physical Risk v.s. Transition Risk(OECD 2019, Giglio et al, 2025)
 - Physical risks encompass the financial and economic effects of the loss of biodiversity and the associated ecosystem services.
 - e.g.firms relying on specific natural resources, such as timber, may face scarcity or quality issues due to deforestation or habitat loss.
 - firms may also be affected by risks from an increased focus of regulators and consumers on the preservation of biodiversity.
 - e.g.policies aimed at protecting biodiversity, such as sustainable forestry requirements, may result in changes to asset values across a range of industries.

Theme: Pricing Biodiversity Risk

- literature review



Biodiversity Risk

Stefano Giglio, Theresa Kuchler, Johannes Stroebe, Xuran Zeng
(RF, 2025)

石宛青

(武汉大学金融系)

2025 年 11 月 14 日

What**Biodiversity Risk****Physical Risk****Transition Risk****How to
measure****Market:** NYT-Biodiversity News Index**Firm:** 10-K; CDP Questionnaire**Industry:** survey; fund holding**Is it
priced?**

Biodiversity Hedge Portfolio

Question

- How to measure biodiversity risk ?
 - market、firm、industry level
 - Consistent with reality; distinct from climate risk
- Is biodiversity risk priced in the stock market?
 - biodiversity risks already affect equity prices

Why interesting?

- academic side: climate finance has rapidly developed, yet climate change is **only one facet** of how the economy interacts with the natural world.
- another important and distinct dimension: the economic risks associated with biodiversity loss.
 - severe biodiversity loss: 10 to 100 times higher than the past 10 million years
 - large negative effect for the economy: an important factor of production alongside other factors like capital and labor (Dasgupta et al. 2013)
- Heterogeneous impacts: Different firms and sectors are affected differently (Giglio et al, 2026)
- **Research goal:** Quantify biodiversity risk in the cross-section of firms and industries, examine whether asset prices reflect it

Contribution

- literature on interaction between financial market, asset price, and health of our planet
 - prior:
 - Much recent paper has studied the physical and transition risks relate to climate (Alekseev et al. 2024)
 - extend: understand effect of biodiversity risks on economy –asset prices.
- literature on measure biodiversity risk dynamics and firms' exposures
 - prior:
 - rely on ESG subindicators related to nature and biodiversity (Xin et al. 2023)
 - MSCI Geographic Segment Exposure to Fragile Ecosystems (Becker et al.,2025))
 - extend: built from financial and disclosure data, and they are publicly available, replicable, and link directly to financial outcomes.

Design-Perceptions of the Importance of Biodiversity Risks

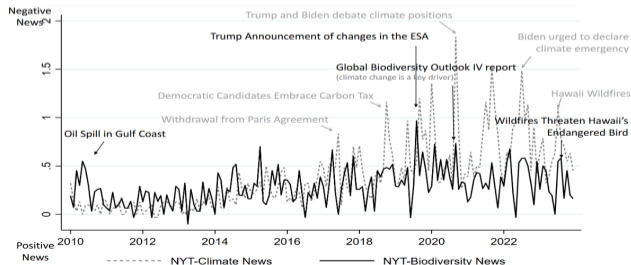
- survey: 668 response: 48% academic researchers, 34% financial professionals, and 18% financial regulators or public-sector

	Pooled	Role			Location				Biodiversity Concern			
		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

- About 70% rated both 2 risks as at least moderately financially material.
- Roughly 20% believe these risks are already materializing,
- with transition risks generally expected to emerge earlier than physical risks.

Design-Measuring Aggregate Biodiversity Risk

- The NYT Biodiversity News Index(Engle et al., 2020)
 - ① Build a 'Biodiversity Dictionary' from New York Times(NYT) articles
 - Use Google word2vec to select 100 terms highly similar to "biodiversity"
 - Exclude irrelevant words and "climate change" to separate from climate news
 - ② Identify biodiversity article:an article must contain at least 2 related sentences
 - ③ Classify Sentiment using BERT: 8.4% positive, 72.0% neutral, 19.6% negative
 - ④ Construct the Daily Index: Negative Articles – Positive Articles



corr on 4 climate indices:

International Summit	−0.11
Global Warming	0.10
Natural Disaster	0.21
Climate Policy	0.20

Design-measure firms' biodiversity risk exposures

- ① firms' 10-K statements
 - 10K-Biodiversity-Count Score:
 - same as news,a 10-K contains ≥ 2 sentences related to biodiversity,assign "1"
 - 10K-Biodiversity-Negative Score: negative – positive sentences
 - 27.6% negative, 5.6% positive .
 - 10K-Biodiversity-Regulation Score:
 - Regulation: "law(s)," "regulation," "Act," "ESA," "discharge," "restriction."
 - Count Score = 1 & at least sentence contain regulation words,assign "1"
- ② opinions elicited in our survey of financial professionals, academics, regulators;
- ③ portfolio holdings of funds focused on biodiversity
- ④ firms' responses to the CDP Climate Change Questionnaire

Design-measure firms' biodiversity risk exposures

- ① firms' 10-K statements
- ② opinions elicited in our survey of financial professionals, academics, regulators;
 - choose industries that most negatively affected by biodiversity phy、trans risks
- ③ portfolio holdings of funds focused on biodiversity
 - 5 biodiversity-related funds: AXA IM ACT Biodiversity Equity ETF...

$$\text{HoldingScore}_{l,t,f} = \frac{w_{l,t,M} - w_{l,t,f}}{w_{l,t,M}},$$

- $w_{l,t,M}$ is the weight of industry l in the market portfolio at time t , and $w_{l,t,f}$ is the weight of industry l in fund f 's portfolio.
- ④ firms' responses to the CDP Climate Change Questionnaire
 - assign “1” if firm has activities in biodiversity-sensitive areas and could negatively affect biodiversity

Design-The Pricing of Biodiversity Risk

- If biodiversity risk is priced, the biodiversity-sorted portfolios should move with biodiversity news——hedge portfolio.
 - ① BiodiversityNews: NYT Biodiversity News Index——monthly——AR(1)
 - ② Long-short: industry level, weight by bio-risk rank, go long low-risk industries
 - 8 bio-risk measure(3-10k, 3-survey, fund, CDP)
 - ③ cal correlation: Long-short portfolio & Bio-News
 - ④ Really reflect exposure to biodiversity risk, rather than other like size or bm?

$$\text{BiodiversityNews}_t = \mathbf{w}\mathbf{R}_t + \varepsilon_{c,t}$$

- R_t : characteristic-sorted return(Fama-French、HML、other 212 characteristic)

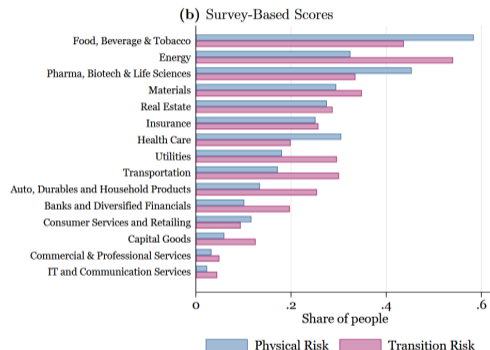
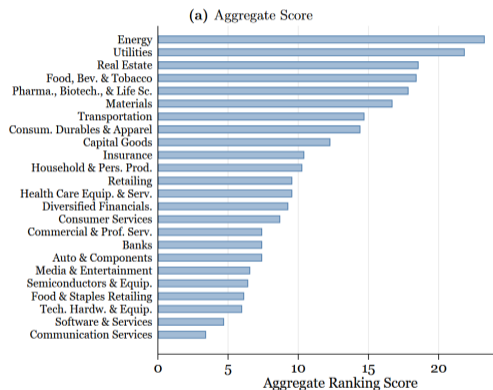
Result-Q1



	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
10k-based Scores									
(1) 10k: Negative	1.00								
(2) 10k: Count	0.70	1.00							
(3) 10k: Regulation	0.80	0.96	1.00						
Survey-based Scores									
(4) Survey: Transit.	0.53	0.42	0.42	1.00					
(5) Survey: Physical	0.26	0.20	0.18	0.82	1.00				
(6) Survey: Average	0.41	0.32	0.31	0.95	0.96	1.00			
Holding-based Scores									
(7) Holding	0.39	0.03	0.22	0.27	0.08	0.18	1.00		
CDP-based Scores									
(8) CDP-based	0.89	0.87	0.91	0.58	0.30	0.46	0.29	1.00	
Climate Exposure Scores									
(9) Quantity-based	0.05	0.01	0.05	-0.15	0.16	0.01	-0.01	-0.10	1.00

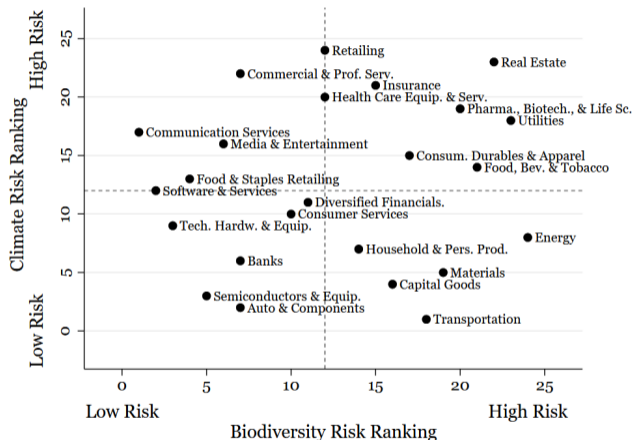
- self-reported bio-risk exposures have generally been growing over time; measures substantially correlated

Result-Q1



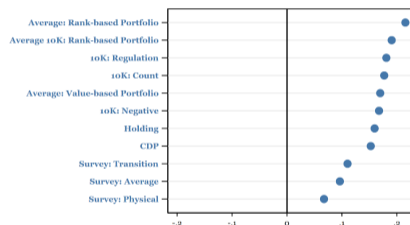
- ranking aligns with economic intuition
- participants perceive distinct heterogeneities: phy,trans

Result-Q1



- firm- and industry-level exposures to biodiversity risk are distinct from climate risk exposures

Result-Q2

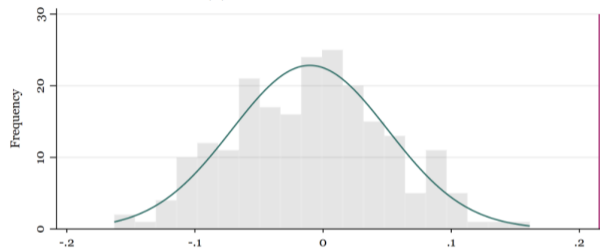


	Hedge Target	
	NYT-Biodiversity News	NYT-Climate News
Average: Rank-based Portfolio	0.22*** (0.08)	0.03 (0.10)
10K: Regulation	0.18** (0.08)	0.09 (0.08)
10K: Count	0.18** (0.07)	0.13* (0.07)
Average: Value-based Portfolio	0.17** (0.08)	0.06 (0.09)
10K: Negative	0.17** (0.07)	0.09 (0.08)
Holding	0.16** (0.07)	0.04 (0.09)
CDP	0.15* (0.08)	0.08 (0.09)
Survey: Transition	0.11 (0.07)	-0.02 (0.09)
Survey: Average	0.10 (0.07)	-0.03 (0.09)
Survey: Physical	0.07 (0.07)	-0.02 (0.08)
Average	0.15*** (0.05)	0.05 (0.06)

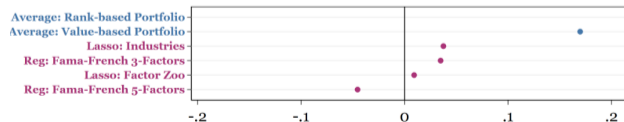
- All correlations are positive, with magnitudes from around 0.07 to 0.22.

Result-Q2

(a) Correlation Distribution



(b) Hedging Performance



- mimicking portfolios:but none performs as well as our bio-measure

Thanks!
Question & idea?

Idea

- 进一步研究？类似气候风险的一系列研究：
 - 文本分析区分物理、转型风险
 - 可以考虑对其他资产的影响，如基金、公司债
 - 生物多样性风险与供应链风险、行业传染
 - 生物多样性尾部风险
 - 生物多样性与企业违约风险
 - 金融体系的生物多样性敞口
 - 投资者生物多样性风险信念定价研究
- 度量方法？
 - 生物多样性风险的“政策不确定性”指数
 - 用卫星数据评估企业设施附近生境退化程度：植被指数等
- 其他？
 - 生物多样性、气候风险交互对经济、金融的影响
 - 央行/政策的生物多样性情绪

Appendix-Q1

