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Constructing forward-looking climate-related physical risk indicators – The use of private owned data for forward-looking aggregates at sector-country level for official statistics[1]

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[1] This presentation was prepared for the conference. The views expressed are those of the authors and do not necessarily reflect the views of the BIS, the IFC or the central banks and other institutions represented at the event.

Constructing forward-looking climate-related physical risk indicators

The use of private owned data for forward-looking aggregates at sector-country level for official statistics

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Abstract

Timely and consistent climate-related data are essential for analyses of trends and shifting patterns in financial markets and the economy as a whole. The NGFS Bridging Data Gaps report states that "given the importance of forward-looking assessments of both physical and transition risks, the current reliance on mostly backward-looking data is unsatisfactory".

With this paper, we aim at answering the question: How can we use existing climate data from private data providers to extract relevant forward-looking aggregates at a sector and country level? To do so, we use forward-looking data from a third-party data provider such as physical risk scores and the underlying financial risks.

One main issue we encountered is the limited coverage of company-level data. In addition, the variation between the different data providers is high, similar to other areas of sustainability data. Further, the hazards covered as well as their definitions are not consistent across data providers and therefore need to be considered when analyzing results. Finally, yet importantly, physical risk metrics should be comparable across years and scenarios and reflect financial damages.

Since results are likely to depend greatly on source data used, we focus on developing methods and concepts rather than on the actual results. These findings can contribute to planned work under the new G20 Data Gaps Initiative, specifically the recommendation on physical and transition risk indicators.

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1. Motivation

Why climate-related data?

Timely and consistent climate-related data are essential for analyses of trends and shifting patterns in financial markets and the economy as a whole. The availability of rich and up-to-date data is key to good policymaking. Many central banks, including the Eurosystem, are addressing climate-related risks on their balance sheets and in their supervisory roles.

High quality data sets are essential for any decision maker. Governments need them to decide on the future path of carbon taxes or to benchmark carbon emission reductions. Investors need detailed information on the climate footprint of companies to weigh up their investment decisions. Scattered data sources and cumbersome access further complicate the situation. It is essential to improve the coverage and consistency of data collections. Looking at various data pools helps to unmask measurement uncertainties and differences in the coverage from third-party data providers.

Why forward-looking indicators?

Reports such as from the Financial Stability Board (FSB)[1] and the Network on Greening the Financial System (NGFS)[2] have all highlighted the need to accelerate progress in making climate-related data available. In these reports, stakeholders report the need for more forward-looking data (for example targets or emissions pathways) and granular data (for example geo-spatial data at entity and asset levels). As an outcome of its monetary policy strategy review, the European Central Bank (ECB)[3] is developing new experimental indicators, covering relevant green financial instruments and the carbon footprint of financial institutions as well as their exposures to climate-related physical risks.

A survey of the Irving Fisher Committee on Central Banks Statistics (IFC)[4] in 2021 finds that indicators needed to properly support progress assessment, on sustainable financial instruments as well as environmental indicators related to physical risk, emission trading and energy use pricing, are of key importance. However, as many indicators are backward-looking, it is useful to complement them with forward-looking data to track commitments towards a greener economy. Still, forward-looking metrics seem to be a newer area of analysis for many central banks, with their actual use remaining limited so far.

The NGFS Bridging Data Gaps Progress Report states that "given the importance of forward-looking assessments of both physical and transition risks, the current reliance on mostly backward-looking data is unsatisfactory. Stakeholders reported that they need to understand the point-in-time performance of an exposure against a transition pathway – hence the need for firms to disclose their transition plans – as

[1] FSB, July 2021.

[2] NGFS, May 2021.

[3] ECB, July 2021(a); and ECB, July 2021(b).

[4] IFC, December 2021.

well as the impact of adaptation and mitigation measures on the evolution of the risks".

Making use of available data

Several initiatives have sought to facilitate the availability of adequate data to support sustainable finance. While global initiatives on improving climate data are progressing, we need to leverage on readily available data sources and approaches in the short to medium-term. This is essential to fulfil the various pressing data needs in monetary policy, financial stability, and banking supervision. To this end, the IFC recommends for central banks to intensify the identification of sustainable finance data needs, cooperate with traditional and new stakeholders to close data gaps, and lead by example by improving the usage of the new data being collected.[5]

With this paper, we aim at answering the question: How can we use existing climate data from private data providers to extract relevant forward-looking aggregates at a sector and country level? To do so, we use data from a third-party data provider on forward-looking physical risk metrics, including the underlying financial risks.

The forward-looking metrics refer to physical risk in 2050, depending on various Representative Concentration Pathways (RCPs) that represent different levels of global warming and are defined by the Intergovernmental Panel on Climate Change (IPCC). The RCPs can be loosely translated into "low" (RCP 2.6), "medium" (RCP 4.5), and "high" (RCP 8.5) levels of global warming. While the impact of global warming is visible in financial damages, it is less visible in overall risk scores. We will base aggregation and analysis on financial damages data from ISS ESG (or, short, ISS).[6]

One main issue we encountered is the limited coverage of company-level data. In addition, the variation between the different data providers is high, similar to other areas of sustainability data. Further, the hazards covered as well as their definitions are not consistent across data providers and therefore need to be considered when analyzing results. Finally, yet importantly, physical risk metrics should be comparable across years and scenarios and reflect financial damages.

To account for these challenges, we will focus on sectors and regions with comparatively good coverage. Most promising in our sample are manufacturing sectors in the US, China, Japan, India, and the EU. Since results are likely to depend greatly on source data used, we focus on developing methods and concepts, rather than on the actual results. We hope these findings can contribute to planned work under the new G20 Data Gaps Initiative, specifically the recommendation on physical and transition risk indicators.[7]

[5] IFC, op. cit.

[6] https://www.issgovernance.com/

[7] FSB and IMF, October 2021.

2. Data, definitions, and methodology

Data and coverage

We performed our aggregation and analyses based on data from ISS, a commercial data provider, to which the Deutsche Bundesbank procured access. The data used here is part of the *Climate Core Impact* dataset and consists of multiple physical climate risk metrics at a company level. ISS also provides metadata on NACE[8] sector classification and country of incorporation for the companies in the dataset.

Data coverage is a key issue in aggregating company-level data. The physical risk dataset covers around 23 000, mostly large public, companies, many of which in large economies. Almost half of those are manufacturing companies (NACE C) while other large sectors in the dataset are logistics (NACE G–I) as well as financial and insurance activities (NACE K). The best country coverage can be found for the US and Japan with around 3 200 companies each, and for China with almost 2 500 companies. For the combination of country and sector, the dataset contains data on more than 1 000 companies each for the US, Chinese, and Japanese manufacturing sectors. There is also rather good coverage for the euro area, the United Kingdom, Canada, and India.

The number of companies in many sector-country combinations would be too low to conduct meaningful aggregation. Therefore, we look at the largest economies with the best ISS data coverage as well as the euro area separately while building regional aggregates for the other countries (see table 1).

Table 1. Number of companies by economy and sector

			of which:								
	A	B–E	C	F	G–I	J	K	L	M–N	O–Q	R–S
United States	8	1 430	1 200	41	375	387	639	202	167	64	32
Euro Area	20	758	666	60	199	203	220	103	110	19	31
Japan	10	1 456	1 415	137	668	330	160	137	202	43	40
United Kingdom	4	247	198	22	94	73	86	33	68	4	15
Canada	11	282	118	8	65	36	47	36	27	11	8
Other AEs	35	2 742	2 542	130	476	347	390	245	195	57	41
China	40	1 691	1 517	68	218	166	90	109	98	15	12
India	18	745	697	37	70	65	90	34	29	12	1
Other EMDEs Asia	63	818	684	115	296	57	233	206	67	30	14
EMDEs Europe	4	335	265	28	97	25	78	34	22	6	6
EMDEs Latin America and the Caribbean	20	227	154	18	86	16	92	31	13	11	6
EMDEs Middle East and Central Asia	11	295	272	8	70	13	165	36	9	14	2
EMDEs Sub-Saharan Africa	11	93	77	6	60	18	80	16	7	6	0
Rest of the World	13	569	456	34	206	99	147	125	52	36	17

Source: ISS ESG.

Note: AE = advanced economy; EMDE = emerging market and developing economy.

[8] European classification of economic activities, from the French title: "**N**omenclature générale des **A**ctivités économiques dans les **C**ommunautés **E**uropéennes". NACE is derived from ISIC, the International Standard Industrial Classification of All Economic Activities.

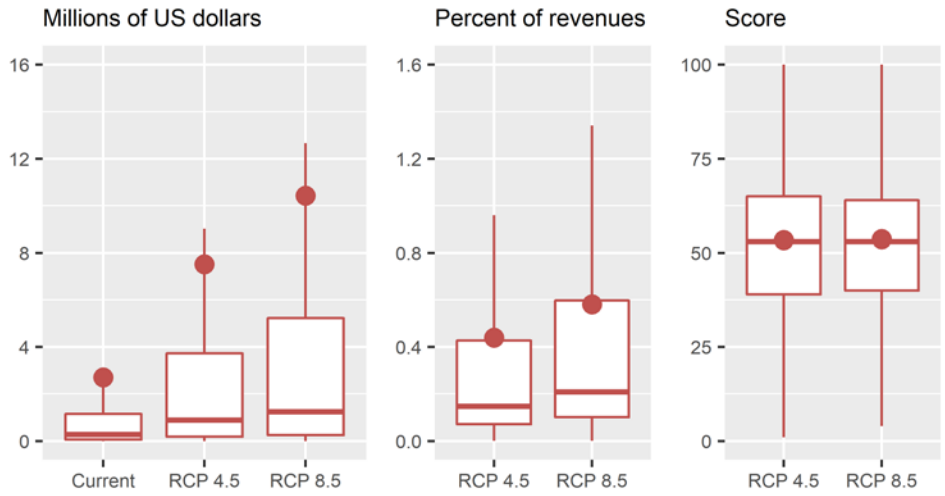
Methodology

The ISS physical risk metrics show climate-related physical risk both for the base year 2020 and forward-looking for the year 2050.[9] The forward-looking assessment is based on two scenarios: The "worst-case" scenario corresponds to the RCP 8.5 scenario of the IPCC Fifth Assessment Report[10], while the more moderate "likely" scenario corresponds to the RCP 4.5 scenario of said report.

For each of the scenarios and for the base year, absolute financial damages in 2020 US dollars are estimated for each of the hazards. The relative damages, i.e., damages as a percentage of the base year's revenues, are also made available by ISS for each company. The difference between the future relative damage and the base year relative damage forms the basis for the risk score. This score is bound to a range between 1 and 100 and measures the change in relative financial risk of each company compared to the base year and to their respective GICS sector[11]. It is normalized in a way that a score of 50 corresponds to the median risk of the issuer's sector in the respective scenario. It is therefore neither comparable across sectors nor across scenarios. This is shown in figure 1 for the full sample of companies.

While the expected financial damage is generally higher for the RCP 8.5 scenario than for the RCP 4.5 scenario, this does not translate into higher physical risk scores in RCP 8.5, due to the normalization process. This limits the usefulness of the risk score for our purposes, and we thus focus on the actual financial risks from here on.

Figure 1. Distribution of overall physical risk by climate scenario



Source: ISS ESG.

[9] ISS, April 2021.

[10] IPCC, 2014.

[11] GICS is short for Global Industry Classification Standard, a classification system that categorizes companies into 11 sectors, 24 industry groups, 69 industries, and 158 sub-industries. See also: https://www.msci.com/our-solutions/indexes/gics

ISS conducts the analysis of physical climate risk by distinguishing operational risks and market risks.

- Operational risks materialize at the level of the individual physical asset, either in the form of direct damage through business interruptions and repair cost or through reduced labor productivity. They are estimated by linking asset locations (if available) to multiple climate hazard maps depending on the type of hazard. Where no individual asset locations are available (as most companies report them only at the country level), country level information on the facilities is combined with exposure maps derived from satellite imagery and population data.
- Market risks materialize at the level of national GDP. It therefore depends on in which countries the company generate its revenue and the physical climate risks of those countries.

Six types of climate-related hazards are considered: coastal floods, droughts, heat stress, river floods, tropical cyclones, and wildfires. The last three are considered to cause only operational risks through direct damage, while coastal floods impact operational risks through the same channel and at the same time impact market risks through GDP. Heat stress decreases labor productivity which affects both operational risks and market risks. Droughts exclusively affect market risk through its impact on agriculture and therefore GDP.

Comparison ISS – Carbon4 Finance

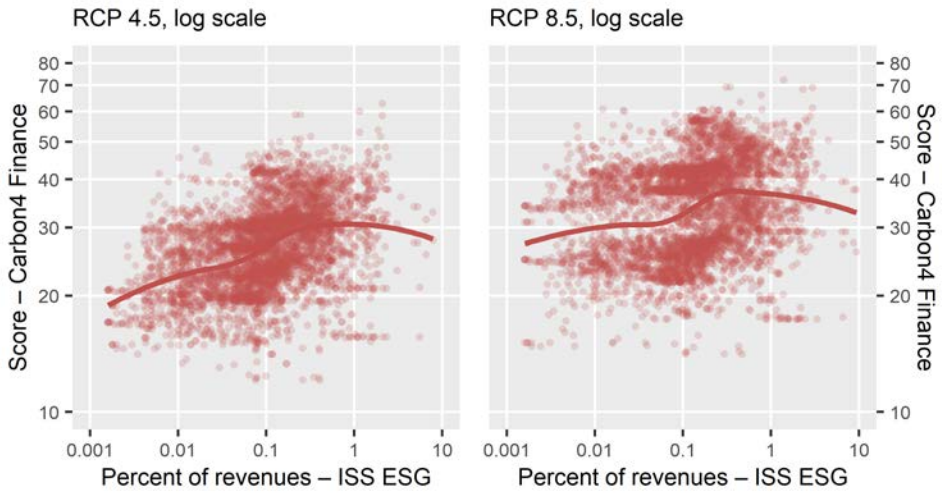
Besides ISS, the Bundesbank has access to physical risk scores from another data provider: Carbon4 Finance (C4F)[12]. This data provider covers physical risk scores but not financial metrics. Furthermore, the number of companies that are covered by the dataset amounts to only about a quarter of that of ISS. Given how critical an issue the coverage of the dataset is for aggregation, we continue to use ISS data for the analysis. However, an important issue becomes visible when we compare the physical risk metrics of ISS of C4F for all the companies in the common sample.

To this end, we compare forward-looking physical risk metrics for the same year (2050) and for the same two scenarios (RCP 4.5 and RCP 8.5). The C4F physical risk score is not normalized for each scenario, so it is comparable to the financial physical risk metric from ISS, expected annual losses from climate-related damage in percent of revenues. The comparison shows some correlation but first and foremost high variation (see figure 2). If there was agreement on how exposed companies are to physical risk, the points would all be arranged on a straight line. This variation between data from different providers is a common theme in sustainability data.[13] In the specific case of physical risk data, this can be explained, among other things, by the aforementioned fact that different hazards are covered and their definitions are not consistent across data providers.

[12] https://www.carbon4finance.com/

[13] Berg et al., 2019.

Figure 2. Comparison of overall physical risk by climate scenario



Sources: ISS ESG, Carbon4 Finance.

3. Preliminary indicators and main findings

Aggregation

We construct aggregate indicators by economic sector and by country or region using the metadata provided by ISS. In sectoral terms, we use the NACE framework. For the country and region breakdown we use the IMF classification of "advanced economies" (AE) and "emerging market and developing economies" (EMDE) as well as the latter's regional breakdown.[14]

A metric used by ISS to show the physical climate risk of a company is the expected annual loss from climate-related damages in percent of the company's baseline revenue. To derive sectoral and regional aggregate indicators, we calculate the weighted average of this metric in the respective country or region and sector, using baseline revenue as the weight. For each sector-region combination, we derive two aggregate indicators, one for the "likely" (RCP 4.5) and one for the "worst-case" (RCP 8.5) scenario.

Results

1. Results by country

In terms of how damages are distributed between companies located in different countries, we arrive at similar results as many other publications on the topic such as the ND-GAIN indicator on climate change vulnerability and readiness.[15] We find that companies in emerging market and developing economies generally face higher physical risk than those located in advanced economies (see table 2). Within the EMDE group, India and other Asian countries stick out as being subject to particularly high

[14] IMF, October 2022.

[15] University of Notre Dame, 2022; and NGFS, October 2022.

physical risk. Although this is not too unexpected, the gap to e.g., Middle Eastern and Sub-Saharan countries seem a bit large given that those regions are expected to suffer immensely from drought and heat stress respectively.

A possible explanation is that some climate hazards are better researched than others, e.g., floods vs. droughts. It is also important to keep in mind that the physical risk of companies is not necessarily representative of the physical risk of countries in which they are based for, at least, two reasons. First, (large) companies usually have production facilities outside their country of incorporation. Second, physical risk varies strongly within a country and a company's facilities might be located in particularly favorable or unfavorable areas. Not surprisingly, the physical risk is consistently higher for the RCP 8.5 scenario than for the RCP 4.5 scenario.

Table 2. Total annual physical risk as a percentage of revenues by scenario

	RCP 4.5	RCP 8.5
United States	0.14	0.18
Euro Area	0.09	0.12
Japan	0.17	0.25
United Kingdom	0.14	0.19
Canada	0.14	0.17
Other AEs	0.28	0.39
China	0.00	0.00
India	0.43	0.59
Other EMDEs Asia	0.90	1.23
EMDEs Europe	1.23	1.73
EMDEs Latin America and the Caribbean	0.08	0.10
EMDEs Middle East and Central Asia	0.31	0.48
EMDEs Sub-Saharan Africa	0.53	0.75
Rest of the World	0.51	0.72

Source: ISS ESG.
Note: AE = advanced economy; EMDE = emerging market and developing economy.

2. Results by sector

The sectors most affected by physical climate risk according to the ISS data are NACE A (Agriculture, forestry and fishing), B, D and E (Mining and quarrying and other industry) and L (Real estate activities). While the NACE sectors A, B and E directly deal with natural resources, the sectors D and L have a large dependency on physical assets such as electricity grids, pipelines, and buildings. On the other end, many services sectors face relatively low physical risk, while sector C (manufacturing), which is the largest sector in terms of ISS data coverage, is roughly in the middle. Table 3 shows the aggregation of ISS data by the NACE sector for the two scenarios.

Table 3. Global annual physical risk as a percentage of revenues by sector

	RCP 4.5	RCP 8.5
A – Agriculture, forestry and fishing	0.49	0.70
B, D, E – Mining and quarrying and other industry	0.47	0.62
C – Manufacturing	0.24	0.33

Table 3. Global annual physical risk as a percentage of revenues by sector (continued)

	RCP 4.5	RCP 8.5
F – Construction	0.18	0.25
G–I – Wholesale and retail trade, transportation and storage, accommodation and food service activities	0.17	0.24
J – Information and communication	0.20	0.28
K – Financial and insurance activities	0.23	0.33
L – Real estate activities	0.39	0.55
M–N – Professional, scientific, technical, administration and support service activities	0.17	0.25
O–Q – Public administration, defence, education, human health and social work activities	0.21	0.28
R–U – Other services	0.22	0.30

Source: ISS ESG.

3. Results by country group and sector

When looking at physical risk by sector for each of the country groups separately, we see that the overarching theme of emerging market and developing economies being more affected by physical climate risk than advanced economies is reflected in each of the sectors (see table 4). However, the large difference we see in physical risk between sectors with more physical assets (A, B, D, E, L) and e.g., the services sectors, can be attributed mostly to the advanced economies. In developing economies, the different sectors are more similarly affected by climate change damages and the ranking order of sectors changes. For example, in EMDEs, the R–S sectors are most affected by physical risk, while showing relatively low risk in AEs. However, the data coverage for these sectors is generally low (see table 1) so the results might not be reliable. On the other hand, the real estate sector (L) does not stand out in EMDEs as in AEs. The latter results are somewhat surprising and warrant further research. It should also be kept in mind, that the data coverage for EMDEs is generally lower than for AEs and the amount of information the data provider has on the company's facilities might vary between the country groups.

Table 4. Total annual physical risk as a percentage of revenues by country group

	Advanced Economies		Emerging market and developing economies	
	RCP 4.5	RCP 8.5	RCP 4.5	RCP 8.5
A	0.37	0.53	0.69	0.98
B, D, E	0.31	0.40	0.75	1.02
C	0.17	0.24	0.46	0.64
F	0.08	0.12	0.26	0.37
G–I	0.10	0.15	0.44	0.64
J	0.12	0.16	0.63	0.86
K	0.12	0.17	0.48	0.68
L	0.35	0.47	0.47	0.68
M–N	0.11	0.16	0.48	0.68
O–Q	0.11	0.15	0.76	1.09
R–S	0.15	0.20	0.81	1.14

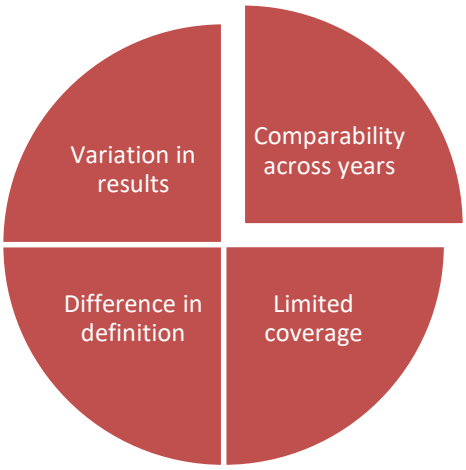
Source: ISS ESG.

Challenges

Our findings point to four main challenges when constructing forward-looking physical risk indicators (see figure 3):

1. Forward-looking indicators on physical climate risk are not standardized. They can differ in terms of the year they focus on, the scenarios they consider, the hazards they cover, the way they define the hazards, the methodology for risk calculation, and the way the results are presented (scores or expected annual losses, for example).
2. The most common form of forward-looking physical risk indicators is some sort of score. Besides not having a direct financial interpretation, scores might not be comparable across years, sectors, or climate scenarios. This may not be a big problem when comparing individual companies' physical risk exposure but should be considered carefully when creating aggregate indicators.
3. While our aggregate indicators show a distribution of physical climate risks between regions and sectors that is roughly as expected, the overall magnitude of physical risk is significantly different from what for example the NGFS finds for comparable scenarios.[16] It requires further research to see where these differences come from.
4. The coverage for company-level physical risk data is relatively low. This is a major challenge when calculating sector and country aggregates. Furthermore, the proprietary methodology for calculating the risk metrics is not completely transparent.

Figure 3. Challenges in constructing forward-looking indicators



[16] NGFS, September 2022.

4. Way forward

This paper aims at calculating forward-looking physical risk indicators using third-party data. Results show that source data plays an important role when comparing results. Going forward, we want to contrast the findings using third-party data with other forward-looking indicators.

One important source are the climate scenarios of the NGFS, which are now in Phase III of their development pipeline. As such, the latest release reflects the new country-level commitments made at COP26 in November 2021. The scenarios also include latest trends in renewable energy and key mitigation technologies.[17] Notably, the modelling of physical risks has been improved; including a first estimate of acute physical risks. Moreover, transition risks are represented with increased granularity in certain sectors. Robustness checks with those results can give additional insights on the importance of source data and methodologies applied.

In addition, aspects of the work carried out here could also be applied to forward-looking transition risk indicators. As the Bundesbank has this data available from other third-party data providers, we want to look at how to calculate sector and country aggregates from the data available to us.

While this paper highlights some of the challenges of working with forward-looking physical risk data, it is important to gain experience with this data and learn how to work with imperfect climate data for the time being. In addition to the forward-looking nature, the data used here were highly granular, at company level with economic sector information. The natural next step to support policy analysis would be to link forward-looking geo-spatial data to the granular and sectoral dimensions.

[17] However, the current data do not yet account for Russia's invasion of Ukraine.

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DEUTSCHE BUNDESBANK EUROSYSTEM

Constructing forward-looking climate-related data

Maurice Fehr and Elena Triebskorn, Sustainable Finance Data Hub, Directorate General Statistics

Introduction
Constructing forward-looking climate data

1. Why forward-looking data? – Excerpts and results from relevant publications

2. Results from work on the constructing of forward-looking climate-related physical risk indicators

3. Challenges and way forward

1. Why forward-looking data?
Excerpts and results from relevant publications

The Network on Greening the Financial System (NGFS) published a progress report on its Bridging Data Gaps Workstream in May 2021:

- Persistent gaps in climate-related data hinder the achievement of these objectives. Stakeholders report the **need for more forward-looking data** (for example targets or emissions pathways) and granular data (for example geographical data at entity and asset-levels).
- Given the importance of forward-looking assessments of both physical and transition risks, the **current reliance on mostly backward-looking data is unsatisfactory**. Stakeholders reported that they need to understand the point-in-time performance of an exposure against a transition pathway – hence the need for firms to disclose their transition plans – as well as the impact of adaptation and mitigation measures on the evolution of the risks.

The Irving Fisher Committee on Central Bank Statistics (IFC) released a report on Sustainable finance data for Central Banks in December 2021:

- **Many indicators are backward-looking**, it is useful to **complement them with forward-looking data to track commitments towards a greener economy**.
- In general, forward-looking metrics seem to be a **newer area of analysis** for many central banks, with their actual use remaining limited so far.

2. Constructing forward-looking climate-related physical risk indicators
Underlying data and research question

- Bundesbank acquired **a variety of climate-related indicators**. From the same two data providers, we have **physical risk data at the company level** available for internal analysis.

- In one case, the data set consists only of **physical risk scores**; in the other case, it also includes the **underlying financial risks**.

- Both data sets are **forward-looking** and use the IPCC's **Representative Concentration Pathways (RCPs)** that represent different levels of global warming. They can be loosely translated into: **low** (RCP 2.6), **medium** (RCP 4.5) and **high** (RCP 8.5) **levels of global warming.**

- Bundesbank Sustainable Finance Data Hub (Maurice Fehr and Elena Triebskorn) together with Jens Mehrhoff (IMF) are exploring the question:

How can we use existing climate data from private data providers to extract relevant forward-looking aggregates at a sector and/or country level?

2. Constructing forward-looking climate-related physical risk indicators
Coverage Physical Risk from ISS ESG

Number of companies in the ISS physical risk dataset by country* and NACE sector	A	B-E	including: C	F	G-I	J	K	L	M-N	O-Q	R-S
United States											
Euro Area											
Japan											
United Kingdom											
Canada											
Other AE											
China											
India											
Other EMDE Asia											
EMDE Europe											
EMDE Latin America Caribbean											
EMDE Middle East and Central Asia											
EMDE Sub-Sahara Africa											
Rest of the World											

*Regional aggregates based on the classification from the IMFs World Economic Outlook April 2022

= not enough issueres for aggregation
= not enough issuers for statistical analysis
= barely enough issuers for statistical analysis
= enough issuers for statistical analysis

2. Constructing forward-looking climate-related physical risk indicators Preliminary results

- The **coverage for many sector-country-combinations is too low** to construct aggregate indicators.

- Therefore, we **further aggregate the countries and regions** into an AE (Advanced Economies) group and an EMDE (Emerging Markets and Developing Economies) group.

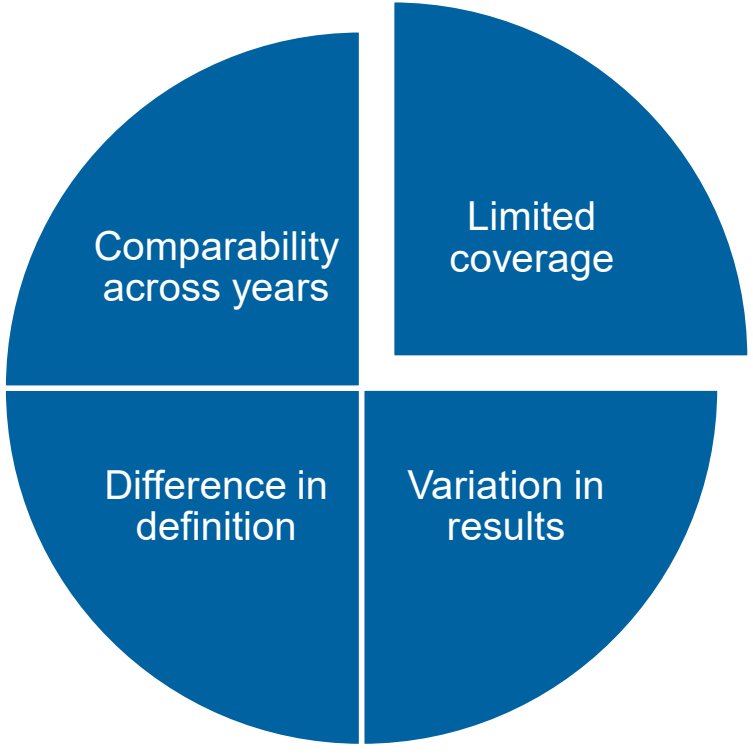
- The next slide shows **physical risk indicators for sector-group combinations** and for **two climate scenarios** from the IPCC 5th Assessment Report, RCP4.5 being the more optimistic scenario, RCP8.5 the more pessimistic one.

2. Constructing forward-looking climate-related physical risk indicators Preliminary results

Total annual physical risk in % of revenue by sector and country group	Advanced Economies		Emerging Markets & Developing Economies	
	RCP 4.5	RCP 8.5	RCP 4.5	RCP 8.5
A	0.37%	0.53%	0.69%	0.98%
B, D, E	0.31%	0.40%	0.75%	1.02%
C	0.17%	0.24%	0.46%	0.64%
F	0.08%	0.12%	0.26%	0.37%
G-I	0.10%	0.15%	0.44%	0.64%
J	0.12%	0.16%	0.63%	0.86%
K	0.12%	0.17%	0.48%	0.68%
L	0.35%	0.47%	0.47%	0.68%
M-N	0.11%	0.16%	0.48%	0.68%
O-Q	0.11%	0.15%	0.76%	1.09%
R-S	0.15%	0.20%	0.81%	1.14%

3. Constructing forward-looking climate-related physical risk indicators Challenges

- One main issue is **limited coverage** in company level data.
- The **variation** between the data of different providers is high, similar to other composite indicators.
- The hazard types covered and their **definitions are not consistent** across data providers and therefore need to be taken into account when analysing results.
- Physical risk metrics should be comparable across years and scenarios and **reflect financial damages**.



3. Constructing forward-looking climate-related physical risk indicators Way forward

- Central banks could be a good place to construct physical risk indicators by **combining climate-related with financial data**, which is available in central banks (in the Eurosystem: Analytical Credit Datasets, Security Holding Statistics, Centralised Securities Database).

- In the **short to medium-term**: Making use of existing **enterprise-level data from private sources. Combining them with public data** can bridge data gaps.

- In the **longer-term**: To **be more precise** on detailed physical risks and their financial implications we would need:
  - **New skills:** GIS (Geographic Information System) knowledge required to work with climate-related data on a granular level and close cooperation with climate experts.
  - **Granular financial data:** Exact locations of collateral, counterparties and their branches / facilities as well as their valuation. In addition, data on households is limited.

Thank you for your attention!

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