First set of Euro Area indicators for green financial instruments, physical and transition risks[*]

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Abstract

Changes in climate and weather extremes as well as the transformation of a fossil-intense to a carbon-neutral economy are expected to strongly affect the financial system. Reliable data and meaningful statistical indicators are key to address these challenges and measure progress. This paper reports on the joint effort of the European System of Central Banks (ESCB) to develop and publish a first set of statistical climate change indicators for the financial sector, including transition risk/CO2 footprint indicators, physical risk indicators, and indicators on green and sustainable finance. The indicators are largely based on public and official ESCB data sources and use harmonised and fully transparent methodologies across euro area countries. The paper presents the first results and outlines the next steps that are planned for 2023-2024 for further methodological improvement.

Outline

[*] The indicators presented in this paper are based on the work of the ESCB STC Expert Group on Climate Change and Statistics and the STC Working Group on Securities Statisticcs. We are very grateful to all contributors of the three workstreams, and would like to thank explicitly the workstream leads Justin Dijk, Ville Tolkki and Nuno Silva.

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1. Introduction

Changes in climate and weather extremes as well as the transformation of a fossil-intense to a carbon-neutral economy are expected to strongly affect the financial system in manifold ways. At the same time, the financial sector will have to play a role in supporting the transition to a net-zero economy. Therefore, and in line with its mandate, the European Central Bank (ECB) is committed to addressing climate change. This includes managing climate-related risks to monetary policy and to the financial system, supporting the green transition, and enhancing transparency on climate-related matters.

The core ingredients to support this policy work of the ECB as well as other institutions, are reliable data and meaningful statistical indicators.

This paper reports on the joint effort of the European System of Central Banks (ESCB) to develop a first set of statistical climate change indicators for the financial sector. The indicators are largely based on public and official ESCB data sources which allow for replicability and high transparency of the methodology. Using harmonised methodologies across euro area countries[3] was one of the key principles of this exercise.

The development of climate change indicators entails a very high degree of complexity, including, among other things, matching various cross-country, micro-level datasets of different natures, developing appropriate imputation mechanisms for missing data, and inspecting data quality, taking into consideration aspects such as confidentiality, replicability and representativeness.

In line with the extensive stocktaking of user needs, three sets of statistical indicators were developed:

i) Experimental indicators on sustainable financial instruments, providing information on the proceeds raised to finance sustainable projects and hence the transition to a net-zero economy;

ii) Analytical indicators on the carbon footprint of financial institutions, providing information on banks' exposure to counterparties with a high dependence on carbon emission-intensive business models;

iii) and analytical indicators on financial institutions' exposure to climate related physical risks, providing information on the physical risks of loan and security portfolios assess risks stemming from the impact of climate change-induced natural hazards.

The methodology adopted, the empirical results and the relevant caveats as well as the future enhancements are outlined in this paper.

2. Sustainable Finance Indicators

The experimental indicators on sustainable finance provide time-series information on outstanding amounts and financial transactions related to issuances and holdings of sustainable debt instruments. This increases the market transparency, helps analysts understand both the funding needs of sustainable projects and the demand for these debt instruments as investment opportunities. Sustainable finance indicators are aligned with standard macroeconomic statistical concepts and methods and are broken down according to classical statistical dimensions, such as economic area, institutional sector, maturity, interest rate type, etc.

[3] This means, among other things, that datasets that are only available at national level were not used.

Data. The indicators on issuances and holdings of sustainable debt securities are compiled exclusively using official ESCB data sources, namely granular information from the Centralised Securities Database (CSDB) and Securities Holdings Statistics (SHS) (collected on the basis of the SHS Regulation[4]). The estimation process of the experimental indicators is fully embedded in existing official compilation frameworks: the indicators on issuances of sustainable debt securities are part of the existing CSDB Securities Issues Statistics (CSEC) dataset, whereas the indicators on the holdings of sustainable debt securities are released with the Securities Holdings Statistics by Sector (SHSS) dataset.

The CSDB attributes capture the three main dimensions of the sustainable debt securities, namely: (1) the sustainable classification, (2) the "assurance" level and (3) the standards to which each sustainable instrument is aligned to. As for the sustainable classification, debt securities are classified into the following four mutually exclusive categories: (1) green - GRE, (2) social - SCL, (3) sustainability - STN and (4) sustainability-linked - STL .[5] Furthermore, in order to better understand the reliability of the various sustainable products (e.g. to avoid "greenwashing"), the information about the sustainable category is complemented with its "assurance" level: (1) "self-labelled", (2) "with a second party opinion" and/or (3) "certified" .[6] Due to the lack of a common (internationally accepted) definition of the sustainable categories, information is also collect on the minimum requirements these products comply with. Therefore, the third and last CSDB ESG dimension captures the most globally recognised standards the sustainable classification of the debt securities can be aligned to. At this initial stage, the experimental sustainable finance indicators consider all sustainable debt securities classified as such in the CSDB, as long as they are at least labelled as sustainable by the respective issuer (i.e. self-labelled). Furthermore, the underlying standard the sustainable classification is aligned to is not considered.

Issuances of sustainable debt securities. Indicators on issuances of sustainable debt securities are released by issuer area at face, nominal and market value. The breakdown by sustainability classification (green, social, sustainability, and sustainability-linked) is only available for the euro area and the EU as a whole. Breakdowns by issuer sector and individual euro area country are only available for green bonds; the same applies for net issuances (financial transactions), which are available for the euro area only. Securities are considered to fulfil the sustainable criteria if labelled as such by the issuer (i.e. a weak level of assurance is accepted). The new aggregates are available at a monthly frequency around ten working days after the end of the reference period (t+10).

Holdings of sustainable debt securities. Indicators on holdings of sustainable debt securities comprise a breakdown by sustainability classification for the euro area aggregate (at face and market value), including a breakdown by issuing counterparty area (euro area, EU, rest of the world). Breakdowns by holding sector and individual euro area country are only available for green bonds; the same applies for financial transactions, which are available for the euro area only. In line with the indicators on issuances, a weak level of assurance is accepted. The new aggregates are disseminated at quarterly frequency at around t+2 months.

Results. The outstanding amount of sustainable debt securities issued in the euro area has more than doubled in the last two years. Securities designed to finance green and social projects, which account for the majority of the market (Chart 1), have seen a particularly strong increase. Over the same period, sustainability-linked bonds recorded the highest growth rate. However, despite the relatively broad

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4 Regulation (EU) No 1011/2012 of the European Central Bank of 17 October 2012 concerning statistics on holdings of securities (ECB/2012/24) (OJ L 305, 1.11.2012, p. 6).

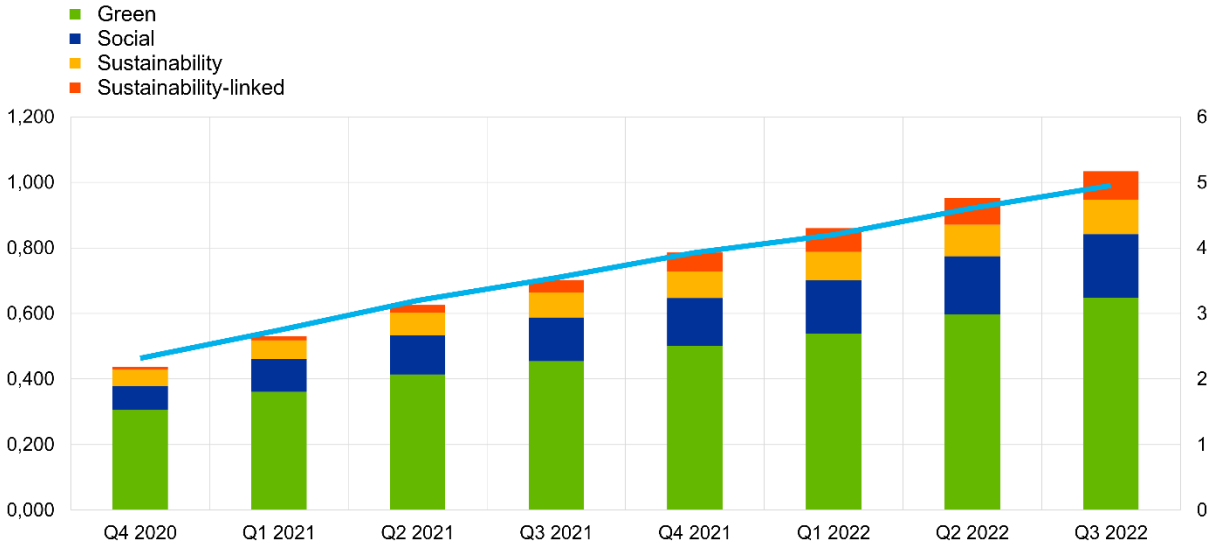
5 In all these categories, the issuer commits, as a minimum, to "use the proceeds" of the issuance for a specific sustainable project with the exception of sustainability-linked debt securities, where the proceeds are not necessarily used in sustainable project but instead that the issuer has specific sustainability targets.

6 In other words, this flag provides information on whether the sustainability classification is only "self-imposed", whether it is verified by an external counterpart or whether it is ultimately (legally) certified by an independent and certified third party.

definition (all levels of assurance are considered, and no restrictions are imposed on the underlying sustainability standard or taxonomy), the relevance of these instruments in the overall debt securities market remains minor (Chart 1).

A similar increasing trend can be observed for the holdings of sustainable securities. While euro area investors seem to prefer sustainable debt securities issued in the euro area, the euro area as a whole is a net buyer of these instruments – that is, its holdings outperform its issuances.

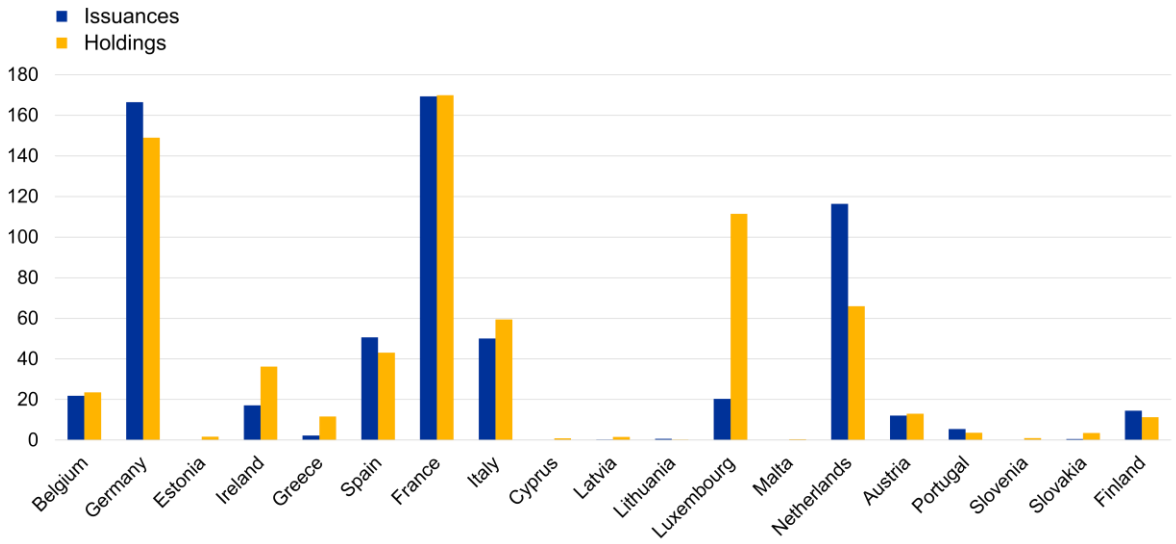
Figure 1: Euro area issuances of sustainable debt securities



Note: Observed amounts refer to the last day of the reference period. The share of total issuances represents the amount of all sustainable securities as a share of the outstanding amounts of all debt securities issued in the euro area.

Splitting issuances and holdings of green debt securities by country, France and Germany are the top issuers and holders of green debt securities in the euro area, accounting for more than half of the market. The Netherlands is the third-largest issuer and Luxembourg is the third-largest holder. The remaining euro area countries represent a small share of both the issuances and holdings of the green bond market. Some countries have only residually entered the market or are yet to enter it.

Figure 2: Issuances and holdings of green debt securities by country



Note: Observed amounts refer to the last day of the reference period. Sources:

Challenges. The indicators presented here are deemed to be quite robust in terms of data quality and coverage, and are therefore designated as experimental statistics. However, as with other similar initiatives on sustainable finance, a key limitation is that the classifications currently rely only on the most loose level of assurance (i.e. "self-labelling"). Once sufficient information is available, data breakdowns regarding the level of assurance (with a second-party opinion and/or certified) will be made available.

3. Carbon Footprint Indicators

Carbon emission indicators of financial institutions provide information on the carbon intensity of the securities and loan portfolios of those financial institutions and thus help to assess the sector's exposure to transition risks as well as its role in financing the transition to a net-zero economy. Carbon emission indicators have been developed to cover two perspectives: the total emissions financed by the financial sector and the exposure of the financial sector to emission-intensive counterparties. These indicators will be useful when analysing the role of the financial sector in financing carbon-related activities and hence assessing the associated transition risks vis-à-vis sectors with carbon-intensive operations. The four indicators are broadly in line with those under prior initiatives[7].

Data. To analyse the financial sector perspective at a single entity level, individual loan-level data from the Eurosystem's AnaCredit dataset are matched with publicly available emissions data from the European Emissions Trading System (EU ETS)[8]. Loans to entities located in non-euro area countries are excluded. For all AnaCredit-based indicators, Scope 1 emissions from debtors which do not report in the EU ETS are imputed using aggregate data from Eurostat air emissions accounts (AEA).

For consolidated group level indicators, data from the Eurosystems' Securities Holdings Sector Statistics (SHSS) are matched to emissions data primarily from Institutional Shareholder Services (ISS), supplemented by data from Refinitiv. For these indicators, all global Scope 1 or 2 emissions are accounted

[7] For instance, the Task Force on Climate-related Financial Disclosures (TCFD), the Partnership for Carbon Accounting Financials (PCAF) and the ECB/ESRB Project Team on climate risk monitoring. However, methodologies and specific implementation assumptions differ widely between compilers.

[8] More information on the EU ETS is available on the European Commission's website.

for when measuring the finances and risk implied in emissions. All indicators are compiled by country of the creditor/holder and cover the years 2018 to 2020 at an annual frequency.

Indicators. The first two indicators on carbon emissions financed by financial institutions aim to provide information on how the financial sector contributes to the financing of high-emitting economic activities. This is done by looking at the amount (share) of total carbon emissions from non-financial enterprises that can be linked to financial institutions based on the set of identifiable securities and loan portfolios.

a) Financed emissions (FE): Total greenhouse gas (GHG) emissions of a debtor/issuer weighted by the investment as a share of the company's total value.

b) Carbon intensity (CI): FE divided by the production value of the company weighted by the investment in the company's activities as a share of the company's total value.

The indicators on FE help users to monitor reduction targets for economic activities, both over time and across sectors, and how these coincide with certain levels of financing. However, because emissions are not normalised, it is not yet possible to disentangle differences due to bank/portfolio size from differences deriving from the emissions themselves.

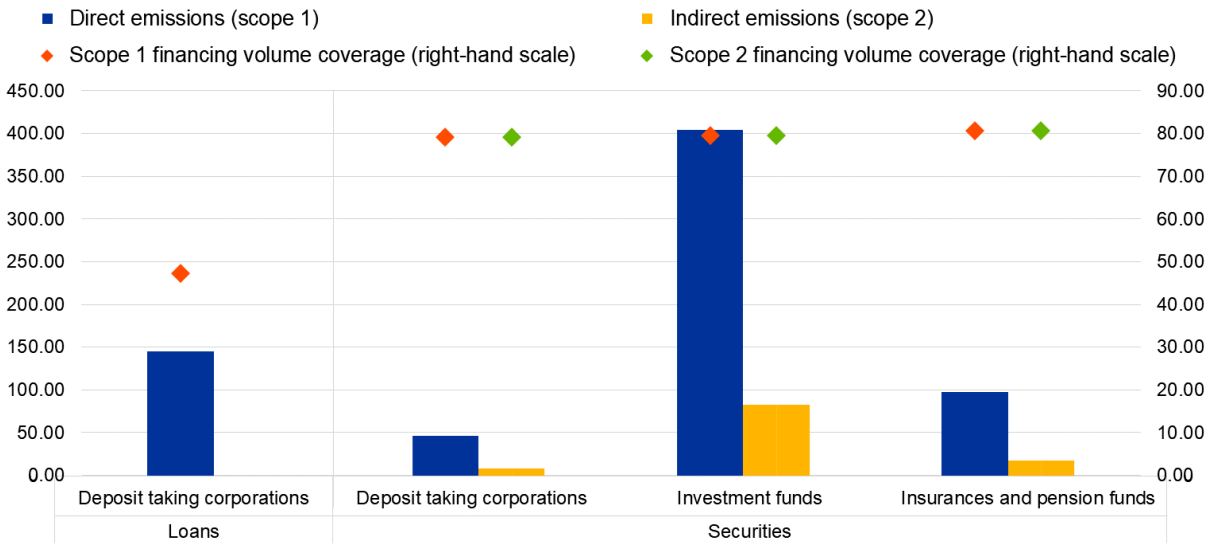
The third and fourth indicators consider the transition risks for the financial sector stemming from the exposure of loans and securities portfolios to economic activities with elevated risks (emissions). The exposure is assessed by capturing the relative amount of financing of economic activities that may be affected by the transition to net zero. Unlike the indicators related to the financing of carbon-intensive activities, these indicators use the creditors' portfolio value as a standardisation variable, i.e. they take the investor perspective.

c) Weighted average carbon intensity (WACI): Total GHG emissions of a debtor/issuer standardised by a measure of company production value, weighted by the investment in these activities as a share of the total investment portfolio value.

d) Carbon footprint (CFP): FE standardised by the total investment portfolio value.

Results. The financed emissions (FE) indicator suggests that most funding of direct and indirect global emissions by euro area financial institutions occurs via investment funds (Figure 3), which also mirrors their absolute portfolio size in financial markets.

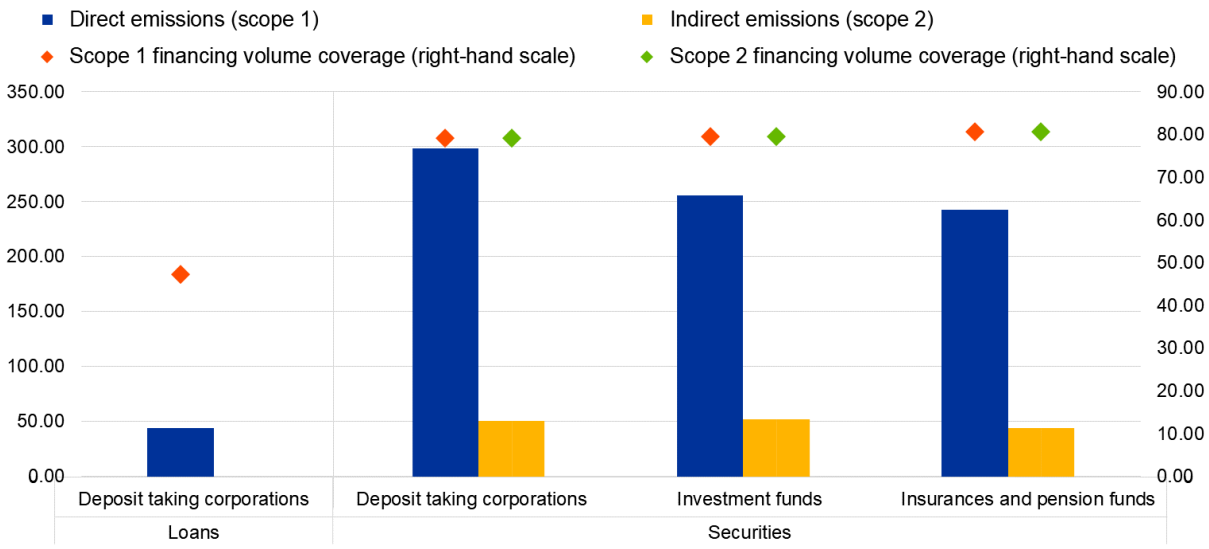
Figure 3: Direct and indirect emissions financed, broken down by type of financial institution



Note: Euro area, left-hand scale: million tonnes of CO2; right-hand scale: percentage of total financing volume covered, 2018-2020 averages. Securities include listed shares and debt securities and are computed at group level. Loans are computed at single entity level. "Deposit-taking corporations" does not include central banks. "Direct emissions" and "Indirect emissions" refer to the covered financing volume only and will be higher once coverage is increased.

However, this conclusion does not take into account the intensity of the emissions produced by NFCs in their provision of goods and services. This is achieved by looking at the carbon intensity indicator, which suggests that, when comparing the carbon intensity of securities portfolios, the most carbon-intensive activities are financed via the banking sector (Figure 4), but that the carbon intensity of banks' loan portfolio is far lower.

Figure 4:Intensity of direct and indirect emissions financed, broken down by type of financial institution



Note: Euro area, left-hand scale: tonnes of CO2 emissions per EUR million of revenue; right-hand scale: percentage of total financing volume covered, 2018-2020 averages. Securities include listed shares and debt securities and are computed at group level. Loans are computed at individual entity level. "Deposit-taking corporations" does not include central banks. Underlying emissions refer to the covered financing volume only and will be higher once coverage is increased.

Challenges. One major challenge of the compilation of carbon emissions is the general lack of consolidated and unconsolidated corporate emissions data, as well as missing balance sheet information at the same level of detail as the granular loans and securities data. This implies reduced coverage, potential biases and a need for imputation. Specifically, in AnaCredit, on average across all jurisdictions, emissions and balance sheet information are jointly available for only about 47% of outstanding debt, and this coverage varies widely from country to country. Overall, coverage is higher for SHSS indicators but still varies widely across countries.

Further complications are due to a compositional bias, which leads to the conclusion that the FE indicator needs to be understood as the lower bound of actual financed emissions. Relative indicators, such as the WACI, can be biased either upwards or downwards and also over time, depending on whether the numerator or denominator of the indicator is more strongly affected by a temporal effect. Other challenges are encountered when comparing data over time. This is due to different data coverage rates and because corrections for price movements (due to exchange rates and inflation) are not yet considered in the current indicator compilations. Finally, a decomposition of changes over time to disentangle changes in carbon footprints arising from changes in the portfolio composition (e.g. due to divestment from high-emission sectors) or from 'greening' of underlying assets. .

4. Physical Risk Indicators

Global warming is associated with an increase in extreme weather conditions, which in turn are likely to result in more frequent and intense natural hazards. Damage caused by these events can also have an impact on the financial system: companies affected by these hazards might find it difficult to service their debts, or collateral might lose its value. Ultimately, these changes may also have an impact on financial stability. All indicators in this dataset are classified as analytical.

Data. The hazard data for the physical risk indicators are solely obtained from publicly availed data sources, most of them from the European Commission's Disaster Risk Management Knowledge Centre, which is part of the Joint Research Centre (JRC). The indicators comprehend seven acute natural hazards for which physical risk indicators are constructed: coastal flooding (JRC), river flooding (JRC), wildfires (Copernicus, NASA, own calculations, landslides (JRC), subsidence (JRC), windstorms (Copernicus, own calculations), water stress (World Research Institute). For five of the seven indicators only current hazard profiles are available. For water stress and wildfires, projected data are available for 2030 and 2030-2050 respectively. In contrast to other providers of physical risk indicators, the focus here lies on acute natural hazards rather than on chronic changes in weather extremes. While data availability is better and data processing is easier for chronic hazards, acute hazards can be linked to physical damage in a more intuitive and exact way. To cover balance sheet information of debtors, data from Bureau van Dijk's commercial database Orbis are used and any missing data are imputed. The indicators are calculated on a consolidated group level.

Indicators. Physical risk is a result of an interaction of three elements: physical hazards, exposures of assets and assets' vulnerability to those hazards. Correspondingly, the underlying data and the analysis were arranged in three layers.

First, the *hazards* layer describes natural disasters or extreme weather events (e.g. the frequency, severity and probability of such an event at a specific location and under a specific climate scenario). Second, the *exposure* layer provides information on how financial institutions are exposed to risks through their investments (e.g. equity, corporate bonds, loans) and the underlying collateral/physical asset (e.g. the value and location of residential real estate that is mortgaged or the machinery and inventories of corporations). Third, a *vulnerability* assessment is necessary to translate hazard data into expected losses by analysing the potential damage power of a hazard to to a certain asset.

Against this background, three sets of indicators have been developed:

a) Normalised exposure at risk (NEAR): the percentage of the portfolio at risk[9] – where each debtor/issuer's exposure is weighted by a financial risk ratio. This relates the expected annual losses (EAL) to measures of financial performance (revenue) or company size (total assets).[10] The EAL provides a risk estimate that is explicitly based on monetary damages and allows aggregations across hazards, which is not the case for score indicators. At the current stage, underlying data quality and availability are not always sufficient to calculate EAL-based indicators for all hazards. However, EAL-based indicators are available for coastal flooding, river flooding and windstorms.

[9] This assumes that expected annual losses (EAL) as a share of revenue or total assets equates to the same proportion of the exposure at risk. To construct the indicator: first, the EAL of the debtor/issuer is normalised by using either revenues or total assets to determine a financial risk ratio (FRR); then the FRR is multiplied by the exposure to determine what share of the exposure in a portfolio is at risk for each debtor/issuer. The FRR has a value between 0 and 1. It is bounded at 1 if the EAL exceeds the value of the normalisation variable (revenue or total assets), so the exposure at risk cannot exceed total exposure.

[10] Admittedly, a relation between a financial risk ratio and the total exposure might be non-linear and more complex – at lower levels of damages, a company may be able to replace the lost assets, while the translation of the EAL to repayment ability might also depend on many other factors, such as the debt repayment schedule.

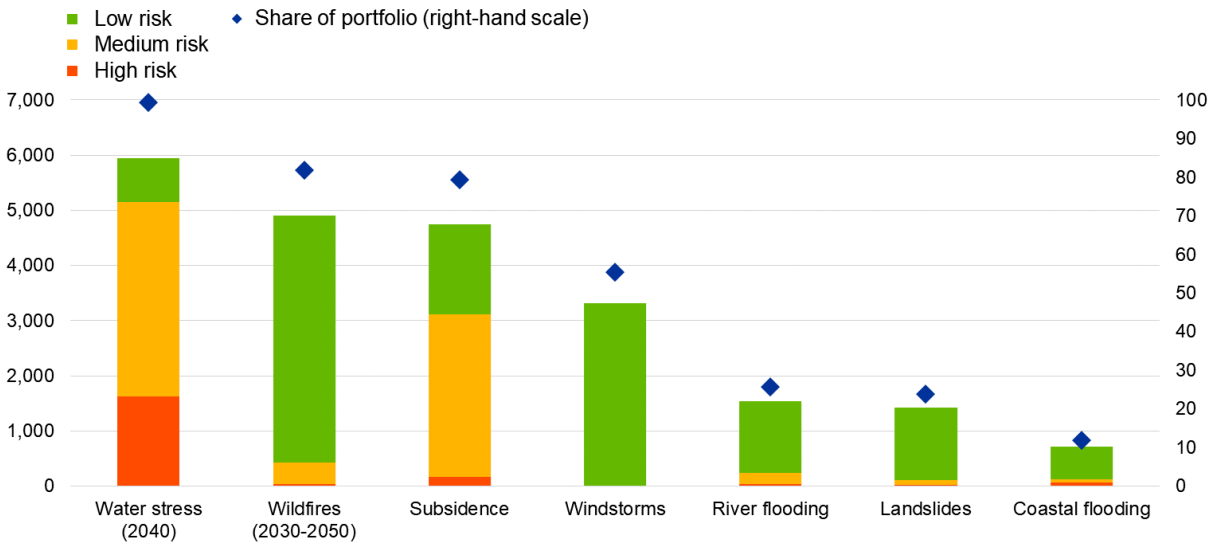
b) Potential exposure at risk (PEAR): the percentage of the portfolio that is exposed to physical hazards, based on the total financial exposure for all entities that have a risk score above zero. PEAR offers a potential ("maximum") value to complement the specific value provided by NEAR. Indicators based on total exposures are easy to interpret and less demanding to calculate, as vulnerability data are not needed for their computation (similar to the risk scores below).

c) Risk scores (RS): these complement PEAR by splitting exposures into risk level categories and indicate the percentage of the portfolio that is associated with a specific risk class from 0 (no risk) to 3 (high risk). The scores at group head level (when multiple entities belong to the same group) are calculated using simple averages.[11]

Results. Figure 5 illustrates that the highest potential exposures at risk are associated with water stress, wildfires, subsidence and windstorms. These hazards are more prevalent, as they are not limited to specific geographical regions such as river, coastal or mountain areas. The RS provides insight into how widespread the hazard's effects could be within the financial system.

For most of the hazards assessed, a very large share of the potential risk exposure is allocated to the lowest risk category. But for water stress or subsidence, medium and high-risk scores have a larger share than for the other hazards analysed. Windstorm risks are estimated to be low for the entire exposure at risk, owing to relatively low hazard intensity and the solidity of buildings and construction materials used in the euro area.

Figure 5: Hazard-specific risk scores



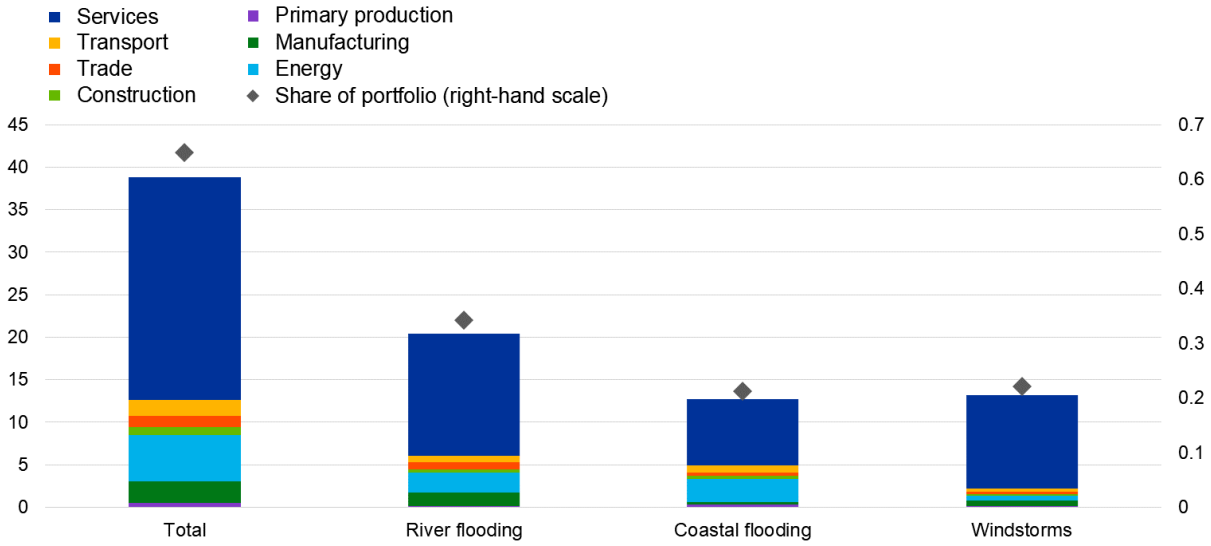
Note: Euro area, left-hand scale: EUR billions; right-hand scale: percentage of portfolio. Risk scores are not comparable across hazard types because the scores rely on different methodologies and sources. Indicators for water stress and wildfires are based on projected data for 2040 and 2030-2050 respectively. AnaCredit and SHS data are for December 2020.

Figure 6 shows normalised exposure at risk for three different hazards broken down into economic sectors. The distribution across sectors broadly reflects the share of each sector in terms of total financial assets, with the highest share of services at around 67%. Comparing Figure 6 with Figure 5 reveals that the potential exposure of a hazard does not necessarily reflect the expected loss a hazard could cause. While

[11] The simple average assumes that the risk classes assigned to multiple entities within a group have identical weights. Simple averages are rounded up (e.g. an average score of 4.3 is rounded up to 5). The score-based indicators provided in this paper are very similar to those found in the literature (see, for example, ECB/ESRB Project Team on climate risk monitoring, "Climate-related risk and financial stability", ECB/ESRB, July 2021). Calculations using a weighted average RS – with revenue as a proxy for the size of individual entities within a group – yielded very similar results (not depicted in this paper).

windstorms have a higher potential exposure than river and coastal flooding, the expected losses are lower.

Figure 6: Normalised exposure at risk by sector



Note: Euro area, left-hand scale: EUR billions; right-hand scale: percentage of portfolio. Information in this chart is based on expected annual damages caused to physical company assets by each hazard. AnaCredit and SHS data are for December 2020.

Challenges. The comparability between countries may be limited by a lack of information on existing mitigation measures. For instance, while the Netherlands shows the highest potential exposure to coastal flooding, flood protection measures are widespread in the country, which lowers the risk significantly.

The current indicators do not take these kinds of adaptation measures into account, which implies that the data overestimate the risk for countries with a well-established protection infrastructure. In the current calculations of the indicators, the total value of fixed assets is used as a benchmark for estimated losses. In the case of larger companies, the fixed assets might be distributed across various locations with different exposure to physical hazards.

Individual hazards and their related damages are currently considered separately. However, the co-occurrence of events, such as windstorms and coastal flooding, can intensify their impact, leading to greater damage than implied by adding together the individual hazards.

5. Conclusion and Way forward

While these first set of indicators are not yet official statistics (work in this direction will continue at least until 2024), they expand and improve upon existing measures used by research and policy areas in a variety of ways. For example, physical risk indicators have been calculated for 7 risks including storms, floods, and water stress, including exposures of portfolios to all risks, as well as expected annual losses for three of these risks. In addition, the indicators are internationally comparable and fully consistent at different levels of aggregation (e.g. sector, country and euro-area). The fact that the work is embedded within the ESCB statistical function implies that the data will also be regularly updated, and methodologies continuously reviewed. For example, the green or sustainable nature of debt instruments has already become an integrated part of the regular European securities statistics and underlying granular data.

Comparison to other initiatives. The ESCB statistical work presented in this paper complements other climate-related activities currently ongoing at international and EU level. This includes work by the International Monetary Fund on estimates of similar indicators based on macroeconomic statistics and by the ECB and the European Systemic Risk Board (ESRB) using exclusively commercial data. In addition, several groups (e.g. the G20, the Financial Stability Board, the Basel Committee on Banking Supervision, the Network for Greening the Financial System) have undertaken or are planning efforts to increase the availability and quality of climate-related data. The indicators presented here benefited from that work and their quality will further improve as more and better data sources become available. Several regulatory initiatives[12] in the EU are anticipated to generate new data as a result of new reporting requirements for financial and non-financial institutions concerning sustainability and climate information, which should lower the need for imputations.

Next steps. The climate and sustainability related indicators described here reflect the results of intensive but time-constrained ESCB-wide work. This is however only the first step towards the development of comprehensive and robust climate related statistical indicators. Further work and enhancements are planned based on issues that were identified in the development process.

Sustainable Finance: Despite the greenwashing concerns, currently users consider sustainable instruments only on the basis of "the use of proceeds" principle arising from a simple self-labelling approach. In the next enhancements of the sustainable finance indicators, further levels of assurance will be considered, subject of course to data availability and quality. The expectation is that as the sustainable debt market evolves (i.e. gains depth) and the demand for reliability of the sustainable products increases.

Carbon emissions: Future improvements to the indicators on carbon emissions will be focused on imputations for missing data. Given the scarcity of raw data, imputations have an important role in estimating carbon emissions that can be attributed to financial sector portfolios. Improvements to the current methodology will be investigated by, amongst others, accounting for the non-linearity of emissions and firm size, by developing imputation approaches for scope 2, and for group level (as opposed to single entity) indicators.

Physical risks: Future work intends to focus on few key areas. First, while the location of the physical assets (e.g. factories of the non-financial companies in which financial institutions invest) is the main determinant of physical risk, the data sources are the weakest. Improving address information reported in the ESCB register of institutions and affiliates data (RIAD) and complementing it with either nationally available data or public data sources.

12 These include the Sustainable Finance Disclosure Regulation (SFDR), the entry into force of the EU Taxonomy Regulation and future reporting requirements linked to the Corporate Sustainability Reporting Directive (CSRD) and European Sustainability Reporting Standards (ESRS).