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A DASHBOARD FOR BIODIVERSITY RISK METRICS

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INTRODUCTION

Biodiversity loss is a significant source of economic and financial risk (NGFS-INSPIRE, 2021). To monitor and mitigate biodiversity risks, central banks and financial supervisors must create a reporting framework that relies on a set of metrics which gives them an accurate picture of the location, acuteness, and severity of these risks in the economy and financial system. To properly assess these risks, it is crucial that actors within the financial system are cognizant of biodiversity risks and aware of the requirements to integrate the relevant risk reporting data over time. Within the reporting framework, the notion of double materiality should be accounted for, i.e., that both dependencies and impacts of economic activities on biodiversity are included. In this paper, the term "biodiversity risks" always refers to these doubly material interlinkages between economic activities and biodiversity loss (see Täger 2021).

Central banks, financial supervisors, as well as investors, asset managers, and other financial institutions need to better understand and measure biodiversity risks. Central banks need to assess these risks for the economy, the financial system, and their own balance sheets. Financial supervisors need to understand biodiversity risks to the financial system as well as to the individual institutions they oversee. Similarly, investors, asset managers, and other financial institutions need biodiversity risk metrics to direct their investments and mitigate risks. For financial governance, furthermore, biodiversity risk metrics are key to implement and adjust policies. Indeed, the question should not be whether but how best to guard against and reduce biodiversity risks to the financial system through monetary policy and financial regulation (NGFS-INSPIRE 2021; World Bank Group 2021a, 2021b; Abdelli et al. 2021).

Building capacity and assembling a dashboard based on existing biodiversity risk metrics are critical first steps for central banks and financial supervisors to engage with financial institutions. A metrics dashboard should include a set of biodiversity indicators which central banks and financial supervisors can and should use to better understand the prevalence of biodiversity risks and inform their policies. To that end, existing biodiversity risk metrics (such as the STAR metric and the Global Biodiversity Score) provide a solid starting point to create the first iteration of a dashboard. With more and better information and metrics becoming available, this dashboard should be regularly updated, on at least a biannual basis, and extended.

Now is the time for central banks and financial supervisors to highlight the magnitude and prevalence of biodiversity risks and lay clear foundations for biodiversity data and risk metrics—which are needed by financial markets and to mitigate systemic risks to both the economy and society at large. Accounting for biodiversity risks in investment decisions is an emerging practice, and the development of appropriate metrics is still ongoing. Yet, in order to address biodiversity-related economic and financial risks, financial market participants need to fully integrate them into their investment decisions. Central banks and financial supervisors can and should spur the emergence of an institutional reporting framework which provides investors and policy makers with the necessary boundaries and information to understand, quantify, report on, and manage biodiversity risks. Building on such a framework, central banks and financial supervisors should also model systemic biodiversity risks for the economy and society at large.

While a lot can be learned from the experience of including climate-related risks into financial governance, biodiversity risks also pose different challenges and need new forms of collaboration to be properly assessed. Central banks and financial supervisors are well advanced in the development of risk metrics and risk management frameworks for climate risks. The experience they accumulated in this domain can and should be applied to develop biodiversity risk dashboards. At the same time, biodiversity risks are more complex and diverse than climate-related risks and addressing them requires a broader set of stakeholders and experts to be involved.

This note proposes a set of characteristics for biodiversity risk metrics and guidelines to build up an institutional framework capable of addressing biodiversity risks. We first show that the main challenges which central banks and financial supervisors face in developing a dashboard to assess biodiversity risks, can be overcome. We then present the main characteristics that biodiversity risk metrics should satisfy to meet these challenges. With clear knowledge of what existing metrics are already capturing, central banks and financial supervisors can and should already start integrating biodiversity risks into their operations. At the same time, they should engage with a broad set of stakeholders to build up an institutional framework which enhances the metrics' validity and usability. Based on such enhanced metrics, central banks and financial supervisors should extend and update their dashboard to provide them with relevant indicators to assess and manage biodiversity risks.

BUILDING A DASHBOARD FOR BIODIVERSITY RISKS: CHALLENGES AND WAYS FORWARD

In this section, we show how and to what degree it is possible to address some of the main challenges arising when dealing with biodiversity risks. These challenges are related to defining, measuring, modelling, and communicating biodiversity risks.

Conceptual challenges and ways forward

The definition of biodiversity includes various incommensurable components, yet the heterogeneity of metrics supports effective financial regulation. A key pillar for operationalizing a biodiversity risk dashboard is the Convention on Biological Diversity (CBD). It defines biodiversity as the

> "*variability among living organisms from all sources, including, inter alia, terrestrial, marine and other aquatic ecosystems, and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems*" (CBD 1992).

The conceptual challenge in this definition is that it combines three types of diversities: intra-species, inter-species, and inter-ecosystem diversity. Aggregation of risks across all three is not possible without loss of information. Yet it is possible to use several metrics side by side, which would allow to get an overall picture of biodiversity risks. There are also disagreements over what counts towards variability. For example, there are disagreements over where the line should be drawn between natural systems and humans: Should all living species count, or should varieties of (agricultural) crops be excluded on account of their use

and active development by humans? Different metrics deal differently with these questions. Effective financial regulation can make use of this heterogeneity.

While many questions remain unanswered, clear action targets exist. Any metric showing how "healthy" an ecosystem is or whether pressures are "too high," includes assumptions about what the "natural" state of a specific system is or ought to be and to what degree humans are seen as a species within or external to ecosystems (e.g., Williams 1980). This lack of a clear definition of "natural" complicates the calculation of a "biodiversity loss budget" (similar to the CO_2 emission budgets based on 1.5°, 2°, or 3°C scenarios). Yet a different path towards guided action exists: The first draft of the post-2020 global biodiversity framework already includes clear action targets framed around the main drivers of biodiversity loss. Implemented in this decade, they will allow to reach specified milestones by 2030 and clear goals by 2050. These action targets include, for instance, the protection of at least 30% of global land and sea areas and a two-thirds reduction in the usage of pesticides (CBD 2021). The private sector and financial supervisors can use these goals and milestones to set their own preliminary biodiversity targets. In addition, while the full guidance by the Science Based Targets Network (SBTN) is not available yet, the Initial Guidance (SBTN 2020) is an excellent start in explaining how businesses and financial institutions can start setting science-based targets for nature. The basis for action by central banks and financial supervisors is clear and given.

Practical challenges and ways forward

Assessing biodiversity risks rests on a multiplicity of scientific measurement methods which can be used in complementary ways. A variety of approaches is necessary to assess the genetic variability of species and to measure relevant pressures on and characteristics of ecosystems.[1] There are also many open questions on appropriate methodologies to attach economic value to biodiversity, as exemplified by the experiences of wetland banking in North America (see Robertson 2006). Crucially, existing valuation models deal poorly with threats that are potentially irreversible, marked by non-linear dynamics, or in a situation of limited substitutability of ecosystem services by human-made capital. While valuation thus should not be considered as a prerequisite for policy (see NGFS-INSPIRE 2021:17f; Nedopil 2021), it can nonetheless prove useful to animate biodiversity policy (see World Bank Group 2021b). Policy itself can be built on existing clear and scientific ways to measure biodiversity such as the STAR metric and Global Biodiversity Score (see Finance for Biodiversity (2021) for an overview of available measurement and approaches.) Since these have been developed with private financial institutions in mind, they may need to be adapted for governance purposes. Nonetheless, central banks and financial supervisors can and should move ahead with using them.

Assessing biodiversity risks often relies on complex modelling but while these are developed, proxies for major pressures are an appropriate choice. Measuring and comparing changes in natural and man-made capital stocks is complicated due to their incommensurability and complex dynamics (Treweek 2009:11). When faced with multiple incommensurate metrics, choices about their relative weight in policy-making have to be

[1] One of the reasons is what is called "emergent properties" or "emergence." This refers to the fact that not all characteristics of a system are measurable at the same scale. Properties emerge at different scales of analysis. For an introduction to dealing with this in biological systems see for example Allen et al. (1984).

made. And initial judgments on their relative weight may have to be updated due to new insights and unforeseen developments (Martinez-Alier et al. 1998). In addition, natural systems and processes are subject to complex, non-linear dynamics and potentially irreversible changes, and we have limited knowledge about where the tipping points might be (Kedward et al. 2020). This makes it difficult to model the repercussions of economic activities on habitats and ecosystem services, and vice versa. However, some major pressures can already be measured, and proxies can be used to assess biodiversity, so that action is possible while scientific developments continue. As an example, the ENCORE database allows to use dependencies of economic activities on biodiversity as a proxy for risk exposure and it has proven to be already usable by central banks. For instance, the Dutch central bank already used the database in 2020 to capture the dependencies and impacts on biodiversity of the Dutch financial system (DNB 2020). More recently, the Banque de France used ENCORE for a study on biodiversity-related financial risks in France (BdF 2021).

Uncertainties and limitations of metrics remain but their clear documentation supports their use. Given the challenges mentioned above, the metrics' limitations and the urgency of action will need to be openly communicated. The uncertainty is partially due to the complexity of the dynamic changes related to pressure changes, such as the effects of increased pollution, invasive species, or the (local) extinction of species. To model such dynamics remains a challenge. However, large pressures are relatively well known, can be categorized relatively well, and the metrics' limitations are well documented (see for example Table 6.4 by Capitals Coalition and Cambridge Conservation Initiative (2020)). The same reference also provides a list of currently available metrics, which can be used to already integrate biodiversity considerations into monetary policy and financial supervision. Generally, multi-criteria evaluation methods offer themselves for decision-making regarding biodiversity, since they do not aggregate incommensurables into a single unit of account (Gunnarsdóttir et al. 2021; Martinez-Alier et al. 1998; Treweek et al. 2009).

A shared, scientific language able to combine the various specialized knowledge types is yet to arise, but experts can bridge this gap. To address biodiversity risks, bringing together different kinds of knowledge and expertise by different actors is crucial. This is a major reason for the inclusion of so-called "environmental justice" approaches into biodiversity management proposals, i.e., the inclusion of stakeholders like indigenous populations and peasant organizations. Their points of view have shown themselves to be crucial to understanding the challenges at hand (e.g., Nazarea 2006; Pörtner et al. 2021; World Bank Group 2021a). Such inclusive approaches to metric design are also used in similar stakeholder processes in areas beset by similar problems such as the development of sustainable energy indicators (see Gunnarsdóttir et al. 2021). Yet there are large differences in the ways in which insights and knowledge about biodiversity are communicated between scientists, businesses, agencies, indigenous and peasant communities, or governments. For central banks and financial supervisors, technical in-house expertise needs to be joined with outside expertise to parse the relevant input in order to expand their understanding of biodiversity risks.

THE FUNDAMENTAL CHARACTERISTICS OF BIODIVERSITY RISK METRICS

In this section, we propose a set of characteristics for biodiversity risk metrics for central banks and financial supervisors to consider[2]. We are drawing on existing work, such as the Finance for Biodiversity Pledge (2021) and the proposed Technical Scope by the Taskforce on Nature-related Financial Disclosures (TNFD 2021). The choice of these principles reflects our understanding of effective governance: it should guide the general direction but be broad enough to allow market participants to find specific ways to best implement it.

The metrics should allow central banks and financial supervisors to monitor biodiversity risks for both firms and households. This necessitates broader data disclosure. To understand the potential risks, metrics need to be built with recourse to data based on a strong conception of double materiality. This means that disclosures should go beyond the directly financially relevant data (such as liability or customer opinion) to include what "a reasonable person would consider [...] important" for biodiversity (see Täger 2021). A mere focus on the directly financially relevant disclosures does not allow to capture the main drivers of biodiversity loss and their relevant effects on firms and households. To exemplify: dependency on biodiversity either directly or through supply chains is not evenly distributed among firms and households. To include these aspects, disclosures should include data on supply chains, location, production systems, and more.[3] In addition, companies and households—including financial institutions through their investments—have various positive or negative impacts on biodiversity even if this footprint has no directly measurable financial or reputational impact. Some activities can be biodiversity-positive, such as ecologically integrated socio-economic systems (e.g., often of indigenous populations). Such "bio-cultural" aspects should be captured by disclosures just like other positive and negative effects (e.g., on land and water use, direct exploitation, pollution, or the introduction of invasive species). There is no perfect overlap between impacts and dependencies, also since the effects of an economic activity may arise in farther-off areas. This is why impacts and dependencies should be accounted for as is done by the ENCORE database at a sectoral level. A strong conception of double materiality for disclosures thus greatly enhances the ability to address biodiversity risks.

Next to risks from gradual changes, the metrics should also cover the likelihood of reaching tipping points in ecosystems. Linear and non-linear dynamics necessitate

[2] For further proposed core characteristics, some of which overlap with the characteristics proposed here, we refer to the following: CISL (EU B@B Platform 2018: Table 3); the EU B@B Platform/Aligning Biodiversity Measures for Business collaboration (EU B@B Platform 2019: Table 2 , also included in the proposed Technical Scope for the TNFD 2021: page 35); and the Biological Diversity Protocol (UNEP 2020: Table 4).

[3] This is one side of the "double materiality" of biodiversity risk. The metrics suitable for this can capture dependencies on ecosystem services or the risk exposure to loss in ecosystem services. Such metrics can result in a financial indicator. Simpler versions will relate the state of ecosystems with risk exposure. With more complex modelling, such metrics may even translate pressures into impacts. In such a case, pressures on species and habitats (e.g., local extinctions of insects) are modelled for their potential economic consequences (e.g., loss of pollination services by insects leading to declines of fruit harvesting). Especially for potentially catastrophic declines in ecosystem services such as pollination, it is important to not rely on valuation in terms of modeled effects on GDP, since such models generally underestimate the economic and political effects of drastic shifts such as a famine. (The effects of Covid-19 are a case in point, in that the effects of the pandemic were much larger than would be captured by a mere shift in productivity due to more sick days.)

different modelling. In our current situation—where potentially large, even irreversible, non-linear dynamics are likely for some sub- and even global ecosystems—it is crucial that metrics inform their users also about the likelihood of tipping points. To assess financial risks, the possibility of non-linear dynamics (or "tipping points") should be included in the metrics. To exemplify this point: Poorer members of society generally depend more strongly on biodiversity, and in general, less diversified economic actors face higher risks even from smaller or more local perturbations. Therefore, household and business monitoring need to also include measures of inequality and diversification when assessing dependency risks related to biodiversity. Metrics covering the risks from gradual changes thus complement metrics which assess how likely radical, non-linear dynamics are at various systemic states.

The metrics should include micro and macro dimensions of biodiversity risks, including systemic societal risks (such as to public goods). For central banks and financial supervisors to properly undertake their activities, they should be able to assess both the risks faced by individual institutions, the financial system, and society in general. The reason for relying on both micro and macro metrics lies in the different tools for biodiversity risk management: overall biodiversity *risks* arise at various levels (micro, meso, and macro), while attempting to *mitigate impacts* depends on the ability to incentivize behavior of individual actors. The different levels at which these risks arise are also stressed by Dasgupta (2021) by stating that biodiversity loss affects both *direct* economic inputs for specific industries and companies (e.g., reduced soil quality for agricultural producers) and *indirect* inputs such as public goods (e.g., loss of food safety, air and water quality, or pest-management by ecosystems related to biodiversity loss). The metrics underpinning the dashboard should thus include the modelling of multiple connections between biodiversity and economic metrics across different layers to understand their relevance and impact for society, the economy, the financial sector, and individual firms. This is a foundation to understand and address the footprint of individual firms and industries.

The metrics should include spatially explicit information related to biodiversity risks. Biodiversity risks can be very specific to certain contexts or have effects over large areas. Policies should be able to reflect this. Regarding the first, for instance, ecosystems and what may be called a "healthy" state in the various areas of Brazil depend on very different local and regional factors. Central banks and financial supervisors should ensure that these heterogeneities between localities are reflected in the metric(s) they use to be able to provide locally adapted assessments. At the same time, biodiversity risks can also arise from cross-regional effects. To also address non-local issues, metrics should be built with an eye to cross-regional and cross-jurisdictional effects to reflect inter-regional and global connections (to also address such issues as telecoupling). To include supply chains, these spatially explicit metrics need to allow for sharing of information across jurisdictions where necessary.

Biodiversity risk metrics should be forward-looking. Current scenarios and models are only partially able to describe future biodiversity risks. For the time being, ad-hoc scenarios should be developed to (1) assess the resilience of the financial system to specific biodiversity-related risks, and (2) to predict future impacts on biodiversity. The usage of scenarios is particularly relevant for financial institutions, because it can support future decisions, e.g., concerning portfolio rebalancing. Such scenarios could describe land use change (such as the amount of hectares devoted to a given plantation, or the protection of at least 30% of global land and sea areas) and could also account for the time a given pressure persists in ecosystems (e.g., toxic substances, or fertilizers). Moreover, scenarios

should be able to account for adaptation strategies of companies and to capture the interaction between biodiversity loss and climate change to avoid underestimation and/or double counting. Next to the time dimension, scenarios need to include a spatial dimension to capture, for instance, how easily pressures can spread (as in the case of pollution and toxicities) and including whether their effect is mainly local at the source or potentially far away (as in the case of telecouplings). For this, metrics relying on spatial approaches and GIS data will play a crucial role. Moreover, scenarios should account for the endogeneity of biodiversity risks, as well as their complexity and non-linearities and move away from point estimates to provide a probability distribution of the estimated risks. Finally, scenarios should overcome the limitation of many integrated assessment models (IAMs), which underestimate the risks through cascading and contagion effects by not including the financial system (Battiston et al. 2021).

Macro-approaches complement micro-founded scenarios. Ideally, scenarios should be micro founded (or bottom-up) in order to address specific biodiversity risks and identifying the most relevant actors. Yet the foreseeable lack of data to account for all the relevant micro and macro connections between biodiversity risks and economic activities, will place practical limits to purely micro-founded scenarios. This is why macro-founded approaches will play an important role in guiding the work on biodiversity risks. They may for instance prove valuable to capture aspects which are not visible at the micro level or to assess drastic declines or even collapses in key ecosystem services. In addition, such scenarios can support the (even just preliminary) capturing of feedback effects such as with climate change.

The metrics should cover sectoral and specific firm-level indicators, including from non-listed firms. A sectoral approach should be used for a broader understanding of biodiversity impacts and dependencies in the wider economy, and an even more macro-approach should be used to assess biodiversity risks including those of a public good nature due to their weak substitutability. At the same time, company, asset, or project/site data are required to capture differences within a sector or across regions and to connect the risks from different levels of aggregation (see above) to specific sites. Moreover, metrics should move away from an exclusive focus on listed firms to allow for a more comprehensive assessment of biodiversity risks and impacts in the economy.

Metrics related to firms should also include their exposure to and impact on the spatially explicit biodiversity risks through their supply chain. Focusing solely on the activities undertaken by a specific company will lead in many cases to a large underestimation of the overall risks related to the production process of that company. Policy-actionable metrics should thus be able to go beyond the direct activities of a company and include biodiversity risks of the entire supply chain (equivalently to scope 1, 2 and 3 for emissions). This is also where “leakages” from biodiversity policies should be captured, to assess the degree to which a reduction of biodiversity-negative activities was solely achieved by its dislocation to a place where rules or their enforcement are weaker. The world input-output table (WIOD) or environmentally extended input-output databases such as the EEMRIO may support such an inclusion of supply chain effects.

Exposure metrics should reflect the dependency of firms and households on biodiversity. Calculating value-at–risk metrics (or similar forward-looking financial metrics) for biodiversity risks is highly complex. Central banks and financial supervisors can use simpler dependency metrics as a first step. These can serve as a proxy for biodiversity risks

at the firm and household level for marginal and drastic changes in ecosystem services. These dependency metrics should also be made available to firms to understand their exposure across their supply chains. Value-at-risk metrics should be built up over time to give supervisors, firms, and financial actors clearer guidance on where exactly their risks and the risks of in their supply chains lie.

Impact metrics should be able to differentiate between loss and gain in biodiversity, both in gross and net terms. Metrics should support policy which minimizes the negative and maximizes the positive impacts of different assets and projects on biodiversity. To effectively do this, metrics should differentiate between the extent to which biodiversity concerns have been and are included in the development of projects and ongoing production. In the very least, they should record the different stages in the mitigation hierarchy (avoidance, minimization, rehabilitation, offsetting). And if a project in fact exhibits a biodiversity gain, this should also be included in metrics (see BBOP 2018). Such differentiation would allow to also measure positive bio-cultural livelihoods and economic activities or changes towards or away from them. To reduce double-counting through aggregation, loss and gain should be differentiated into gross and net factors in impact metrics.

Biodiversity risk metrics are attempts at capturing risk relations between multiple complex systems. As such, a variety of different techniques and methodologies should be used to address limitations of data and modelling. Scenarios are crucial for understanding the different scopes of biodiversity risks for individual actors, since loss of habitats and biodiversity is marked by uncertainties and encompasses multiple interconnected yet sometimes still incommensurable threats (such as soil erosion, groundwater depletion, pollinator loss, or even climatic changes). At the same time, biodiversity loss has implications also for the world economy. And interactions of biodiversity risks with climate change should also be accounted for to capture feedback effects (see Pörtner et al. 2021).

BUILDING AND USING A COMMON FRAMEWORK FOR BIODIVERSITY RISK METRICS

In this section, we identify recommendations for central banks and financial supervisors for their engagement with other institutions, actors, and communities. The establishment of a whole institutional ecosystem is necessary to properly measure and understand biodiversity risks, and to implement appropriate policies. These recommendations will support them in building globally responsive and spatially explicit dashboards underpinned by metrics which can serve both local and cross-jurisdictional purposes. They lay the groundwork for effective policy towards a biodiversity net gain economy.

Building an ecosystem to support a common framework for biodiversity risk metrics

An open development process for biodiversity risk metrics will ensure that outside specialized expertise can complement central banks' and financial supervisors' in-house expertise. Central banks and financial supervisors provide and depend on specialized expertise in the development of biodiversity risk metrics. In that context, they

need to understand what role they ought to play in defining these tools, the goals, and the policies. Clarity is also needed as to what central banks and financial supervisors should prescribe and what should be left to banks, companies, or agencies which all bring their own specific expertise. Financial authorities should play an important role in facilitating data availability to support decision-making of these different actors, for instance through mandatory and harmonized disclosure or supporting the building up of international databases. Moreover, central banks and financial supervisors can assess the dependencies and impact of the domestic financial system on biodiversity, as shown by central banks in the Netherlands and France. More generally, central banks and financial supervisors need to establish a process that brings together specialists in biodiversity, modelling, data collection, etc. to raise awareness, educate, and build consensus on the type of data that could help reduce risks and identify investment opportunities in the field of biodiversity. They should also consider creating working groups on specific biodiversity topics, convening investors, companies, academics, data providers, agencies, indigenous organizations, and others. Openness of the development process is also crucial to ensure replicability of the analysis, which is a key characteristic which biodiversity risk metrics ought to exhibit (see, for instance, EU B@B Platform, 2019).

Creating local and global metrics requires the development of a policy ecosystem including non-traditional stakeholders. For concerns such as biodiversity or sustainable development in general, there exists "no standardized approach to indicator selection" (Gunnarsdóttir et al. 2021). Yet through the inclusion of different stakeholders in the design of measurement tools and in the definition of goals for biodiversity, the lack of consensus within the scientific community can be addressed: Choosing appropriate indicators needs to address the variability of local socio-economic-ecological conditions in accordance with the principle of "context based" metrics highlighted by CISL (EU B@B Platform, 2018). To capture the various aspects, it is important to draw on the expertise and specialized knowledge from companies, scientists of various fields, governments, agencies, indigenous peoples, local communities and farmers (see Nazarea 2006, Pörtner et al. 2021, World Bank Group 2021a). The iterative design process by Gunnarsdóttir et al. (2021) might be well suited for the development of a dashboard in this field: Various stakeholders' knowledge is included through semi-structured interviews and focus groups. Their input is used to build a Delphi survey, the results of which are then connected with preliminary indicators, which can be continuously refined. Such a process can be repeated also for periodic reviews. We propose that multiple jurisdictions with various socio-economic-ecological conditions embark on such a process in order to learn from each other how these different conditions may impact indicator choice.

Diverse stakeholders must be convened quickly in a process to building a global framework for measuring, reporting, and communicating biodiversity risks, and to address global and cross-regional biodiversity risks. Robust sharing of knowledge between different jurisdictions is crucial but does not suffice to address the globalized nature of finance and biodiversity risks. The process for individual central banks and financial supervisors laid out above will struggle in the inclusion of cross-jurisdictional risks, regarding both biodiversity and financial stability. We thus propose that the more local process above should be accompanied by a process of building up a biodiversity policy ecosystem with various stakeholders of global purview, such as the UN, global indigenous and environmental organizations, the WTO, and others. This process should provide (1) metrics which take into consideration telecoupling of both biodiversity pressures, risks, radical

uncertainties and the possibility of financial contagion, and (2) data formats and global prerequisites of data disclosure. This process could itself again be modeled after the process proposed by Gunnarsdóttir et al. (2021) and informed by the learnings from the Taskforce on Climate-Related Financial Disclosures (TCFD 2021) -- given the caveats about the difference between measuring biodiversity risks versus climate risks. Short-, medium- and long-term goals, as proposed further above, should be defined in this process as well. The local dashboards should then be able to also include these global and cross-jurisdictional indicators as they pertain to their local situation.

Using biodiversity risk metrics in policy implementation

Given the uncertainty over and lack of estimates for biodiversity risks, central banks should adopt a precautionary approach and rely on most severe estimates in the available range. Central banks and financial supervisors should anticipate, assess and mitigate risks to the financial system. Due to the globally unprecedented scale of biodiversity loss, they should assume that environmental degradation poses macroeconomic and financial risks in their jurisdictions unless it can be shown otherwise. The early stage of metrics development to assess the state of biodiversity and associated risks also speaks in favor of the adoption of a precautionary approach, relying on the most extreme values in the available range (Abdelli et al. 2021, Kedward et al. 2020).

Central banks and financial supervisors need to monitor and enhance the ability of financial institutions to understand and account for biodiversity risks. They should support the development of expertise and skills of the different economic and non-economics actors who (1) need to create, provide, and work with data, and who (2) need to coordinate, implement, and provide feedback on policy. Central banks and financial supervisors can directly engage to contribute to the creation of the necessary data. For financial institutions, data providers, and others, central banks and financial supervisors need to understand and address their ability to actually make sense of and react appropriately to policy, as they do already in relation to macroeconomic developments.

Start with the better known and significant biodiversity risks and then extend to others. The rate and extent of biodiversity decline is fast and large, and the threats from biodiversity loss and extinction rates are large and potentially catastrophic (Abdelli et al. 2021, Nedopil 2021, NGFS-INSPIRE 2021, World Bank Group 2021a, 2021b). Given the high complexity of measuring biodiversity risks, it is both reasonable and critical to address specific biodiversity threats with higher priority. This is in line with the “relevance” principle identified, amongst others, by the EU B@B Platform and in turn requires a deeper understanding of what the main drivers of biodiversity loss are and the relative impact of threats stemming from biodiversity loss. One example is provided by the mitigation hierarchy as developed by the Business and Biodiversity Offsets Programme (BBOP 2018:3).

CONCLUSION

Central banks and financial supervisors play a vital role in addressing biodiversity risks to the financial system and the economy as well as societies as a whole. With their engagement on climate change they have already moved one of the big drivers of biodiversity loss onto their agendas. It is now crucial and possible to build on this and move towards a more multi-faceted approach to accounting for biodiversity risks in financial governance.

Through an appropriate convening of a diverse set of stakeholders, and with a clear set of characteristics for appropriate metrics, related analytical challenges can be met. While metrics will necessarily encompass trade-offs such as in terms of precision versus scalability and data collection, the overarching goal of the process is to focus on the main drivers of biodiversity loss first. This means finding a balance between the demand for forward looking information and high standard and precise datasets.

The inclusion of different stakeholders is vital to address the challenges of biodiversity risks. Different kinds of knowledge are essential to reduce the gaps in the ability to measure and address the systemic, non-linear, complex, and spatially explicit effects of biodiversity loss. Central banks and financial supervisors can and should play an important role in facilitating such a framework's development and in supporting its proper functioning. Such an open, inclusive framework is crucial to help identify major threats, to reduce biases in the development of metrics, and to strengthen the move towards a biodiversity net gain economy.

We first call on financial authorities to build and use a dashboard of biodiversity metrics to assess the state of biodiversity risks, both in terms of dependencies and impacts. The dashboard consists of a set of metrics that rely on financial institutions' disclosure of impacts and dependencies (irrespective of their direct relation to risks). With such a dashboard, central banks and financial supervisors will be able to ever more aptly track and support the implementation of specific policies.

Secondly, we argue for central banks and financial supervisors to take a leading role in establishing an appropriate framework to further develop these metrics. To that end, the collaboration with various actors is crucial for the overall institutional ecosystem. Such an inclusive, open approach will also build up the ability of the different actors to provide the data for the dashboard and to build up their own implementation capabilities and improve the dashboards. This approach also provides oversight over these actors and their ability to implement biodiversity related policy. Finally, the highlighted principles also help assess the state of and necessary adjustments to the development of accounting for biodiversity risks in financial governance overall.

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