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**Article**

## What Justifies Sustainable Finance Measures? Financial-Economic Interactions and Possible Implications for Policymakers

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# Sustainable Finance: Current Needs, Measures and Impact

Greening the economy is high on the political agenda. As early as 2015, the Paris Agreement set ambitious targets to combat climate change. Efforts have since become broader and are now aimed at promoting sustainable development in general, as set out in the UN 2030 Agenda for Sustainable Development. The financial sector is expected to play an important role in the upcoming transition towards a more sustainable economy. Therefore, policy makers in different parts of the world are developing “sustainable finance” programs. The EU Commission has just released a renewed sustainable finance strategy. This issue of CESifo Forum explores why sustainable finance programs may be necessary and takes a closer look at investor and corporate behavior. The authors assess how important the objective of sustainability has been so far and examine how it affects the decisions of companies and those of their peers. They also propose measures to render the corporate sector more sustainable.

*William Oman and Romain Svartzman*

## What Justifies Sustainable Finance Measures? Financial-Economic Interactions and Possible Implications for Policymakers

Climate change looms increasingly large on the policy agenda. The evidence shows that climate change is accelerating and its effects are becoming ever more severe (Slater et al. 2021). Yet, according to the United Nations, countries’ updated climate pledges would result in emissions that are only 0.5 percent below 2010 levels by 2030—far below the 45 percent reduction that the Intergovernmental Panel on Climate Change (IPCC) views as necessary to limit global warming to 1.5°C (IPCC 2018). If policies remain unchanged, global temperatures could rise by a further 2–5°C by 2100 (levels not seen in millions of years), raising the risk of catastrophic outcomes (IMF 2020a). Patricia Espinosa, the executive secretary of the UN Framework Convention on Climate Change (UNFCCC), put it bluntly: “We are collectively walking into a minefield blindfolded. The next step could be disaster.”

At the same time, policymakers seem increasingly aware of the need to act with urgency and determination, although in practice the measures taken are still far from sufficient. Solving these challenges will require dramatic changes in production, consumption

and distribution patterns as well as lifestyles (IPCC 2018), and in some cases very large investments.

It is against this backdrop that work on climate-related financial risks and sustainable finance measures has been intensifying. Sustainable finance measures can be defined as policies that either seek to or can directly or indirectly help align the financial system with environmental goals. They include both financial-sector policies, notably financial supervision and regulation, and monetary policies, as both affect financial markets, financial actors and financial assets, and ultimately the allocation of capital. Following Mark Carney’s landmark speech on the “tragedy of the horizon” (Carney 2015), sustainable finance moved to center stage in the policymaking community, in particular with the creation in 2017 of the Net-



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work of Central Banks and Supervisors for Greening the Financial System (NGFS). Reflecting the growing consensus in the central banking community on the significance of climate change for financial stability, the NGFS comprises 87 members (as of the time of writing), including the world's main central banks.

While such developments are welcome, the rationale for promoting sustainable finance remains under debate. In particular, according to standard economic theory, in which the financial sector's role is to smooth income over time, pool savings and channel them to productive investment, process and share information, and diversify risk (Merton 1995), focusing on the financial sector would be inefficient and ineffective as long as measures are not taken in the real economy, most importantly a significant increase in carbon prices (IMF 2019). However, other theoretical and practical approaches, including some put forward by central banks and financial supervisors, suggest that the financial sector may have an important role to play in decarbonizing the economy.

This article provides an overview of the main justifications for sustainable finance measures that have been proposed to date, and their related theoretical and practical challenges. It does so by taking stock of the literature and recent policy developments, and by focusing on the role of central banks and financial regulators and supervisors. The next section summarizes the theoretical and practical justifications that have been given for sustainable finance measures. The following section considers barriers to the alignment of financial flows with sustainability goals and proposals to overcome these limitations. The concluding section discusses two ongoing debates and challenges related to the development of sustainable finance and the role of central banks.

### **JUSTIFICATIONS FOR SUSTAINABLE FINANCE MEASURES: FROM ECONOMIC THEORY TO PRACTICAL CONSIDERATIONS**

Justifications for sustainable finance measures can be divided into two broad categories: theoretical and practical. Theoretical justifications focus on externalities that hinder the low-carbon transition. Practical justifications highlight two potential threats to policy objectives posed by climate change: practical limitations to the concept of externalities, and the need for central banks and financial supervisors to manage the systemic risks generated by climate change and, potentially, other ecological crises. Below, we discuss each type of justification in turn, while acknowledging that they can be complementary rather than exclusive.

#### **Sustainable Finance: Auxiliary, Second Best or Essential Actor of the Low-Carbon Transition?**

The standard approach to environmental problems in economics has been to define the latter as negative

externalities, that is, activities that—if not corrected by policies—have a direct negative impact on others' production and consumption possibilities, including those of future generations. Taking this view, the emission of greenhouse gases (GHGs) imposes the externality of climate change (Stern 2015). As such, the role of the policymaker consists in ensuring that markets reinternalize the externality. To do so, the first-best solution consists in a carbon price, usually in the form of a Pigouvian tax on emissions that is equal to the external damage (Pigato et al. 2019). Other instruments exist, such as emission trading schemes (ETS), also known as cap-and-trade systems. Unlike a tax, which sets the price and allows the CO<sub>2</sub> level to vary, a cap-and-trade system sets the overall CO<sub>2</sub> level and allows the price to be determined in a decentralized way. In a first-best world, the financial sector does not play a role in decarbonizing the economy. The task of policy is to use carbon pricing to correct the GHG externality, which is assumed to be the only existing market failure, as laid out in Stern (2007). In such a world, sustainable finance can contribute to increasing the effectiveness of climate policies and help better manage environmental risks; aiming at greening the financial system without taking measures to green the 'real' economy can, though, lead to greenwashing (NGFS 2020a).

However, the view that carbon pricing alone will suffice suffers from serious limitations. The GHG externality is unique because climate change is global in its scope and impact, involves a high level of uncertainty, and is long-term and governed by a stock-flow process that makes it difficult to react quickly if mistakes are made, not least because its effects are potentially huge and irreversible. As a result, *The Stern Review* famously called climate change the "greatest market failure the world has ever seen" (Stern 2007). Empirical evidence shows that many economic sectors display a low elasticity of emissions to carbon prices (Rafaty et al. 2020), particularly in sectors with structural challenges such as urban systems, industrial supply chains and production networks (Hepburn et al. 2020). Stern and Stiglitz (2021) argue that climate change "involves radical change in all of the core systems of the economy (e.g. energy, land, cities, transportation)." This suggests that, while necessary, carbon pricing alone is insufficient to induce the necessary structural change to decarbonize the global economy in the required timeframe. Instead, achieving the objective of the Paris Agreement of limiting global warming to well below 2 degrees Celsius requires countries to implement policy packages that include policies beyond carbon pricing to address the multiple market failures that can undermine the low carbon transition (High-Level Commission on Carbon Prices 2017; Krogstrup and Oman 2019; Bhattacharya et al. forthcoming).

In this context, a second complementary theoretical justification for sustainable finance measures can

be envisioned, whereby measures aimed at promoting sustainable finance could be considered as second-best policies. According to Lipsey and Lancaster (1956), second-best policies are justified when there are multiple market failures that cannot be corrected independently, such that correcting one externality can reduce welfare. For instance, those on the losing side of climate change may not have the resources to make the productive investments needed, and/or imperfections in capital markets may mean that the latter will not provide the necessary low-carbon finance, meaning that sustainable financial measures become necessary (Stern and Stiglitz 2021; Bhattacharya et al. forthcoming).

However, the limitations to the pricing of externalities may be due to the fact that centuries of investment in fossil fuels have led to considerable institutional and technological inertia, cementing the structure of the global economy (Bhattacharya et al. forthcoming). Going further, it has been argued that market economies regularly generate new externalities, such that regulatory systems are overrun by externalities (Kapp 1950). According to this view, climate change should not be approached as a market failure (no matter how massive) but rather as a systemic challenge that calls for an unprecedented level of coordination among, and commitment from, multiple actors (private and public), involving multiple instruments (pricing, sectoral regulations, and so on), and with multiple consequences (on inequality, for instance).

These considerations point towards a third theoretical underpinning for sustainable finance, in which, more than being second best, sustainable finance could in fact have a central role to play in addressing climate change. Indeed, finance is critical for funding the new kinds of innovation and investments that are needed for deep decarbonization (Fay et al. 2015). Some estimates have found that low-carbon infrastructure investment gaps in developing countries could reach USD 15-30 trillion by 2040, and capital is not being allocated in a way that is consistent with the goals of the Paris Agreement (Bayat-Renoux et al. 2020, IPCC 2018). Significant public investment is key, but large-scale private investment is also needed to achieve the required structural transformation away from carbon-intensive economic systems towards a net zero economy (Villeroy de Galhau 2015). It is, in fact, notable that the role of the financial system has been explicitly acknowledged in climate negotiations, with the Paris Agreement calling for “making finance flows consistent with a pathway towards low greenhouse gas emissions and climate-resilient development” (UNFCCC 2016).

This need for sustainable finance is all the more urgent since, according to many observers, in its current form and without high carbon prices, the global financial system hinders rather than enables the deep decarbonization needed (IPCC 2018; Bayat-Renoux

et al. 2020).<sup>2</sup> Stern and Stiglitz (2021) outline four critical market failures and so-called government failures underpinning sustainable finance measures: (i) capital market imperfections, in particular highly imperfect climate risk markets, which lead to credit rationing for low-carbon investments; (ii) socialization of losses, which leads to collective moral hazard and excessive risk taking (such as fossil fuel investments that greatly risk becoming stranded assets); (iii) commitment problems, notably the lack of credibility of a ‘no bail-out’ rule for large fossil-fuel firms; (iv) systematic short-termism in managerial incentives due to imperfect and asymmetric information, which leads to managerial decisions that entail short-term benefits to managers and excessive climate risks, thereby leading to the famed “tragedy of the horizon” (Carney 2015). Some of these justifications are particularly relevant for developing countries, which have considerable long-term financing needs but limited access to climate finance (leading to higher hurdle rates), especially in the context of the current crisis (Bayat-Renoux et al. 2020; Svartzman and Althouse 2020).

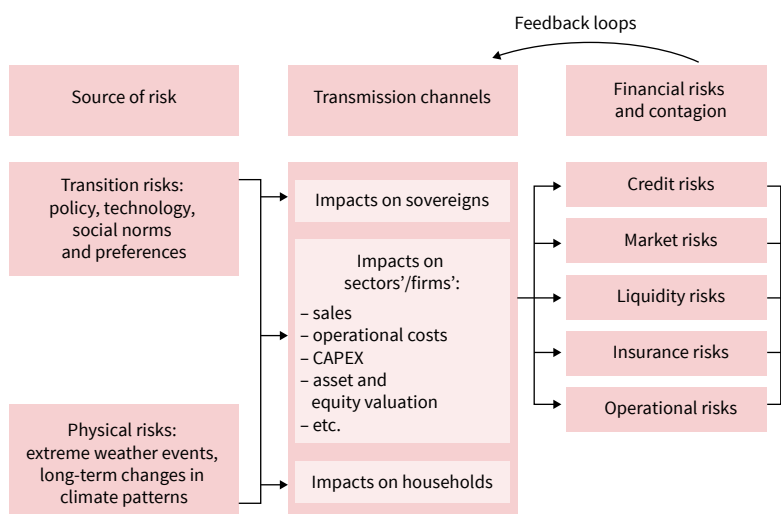
### **What Role for Central Banks and Financial Supervisors? The Risk-Based Approach**

This three-pronged conceptual framework helps us understand why central banks and financial supervisors have started to pay attention to climate change by collaborating through the NGFS, and how they rapidly became stakeholders of the low-carbon transition within the financial sector. The main contribution of the NGFS is to consider that, insofar as climate change poses a risk to financial stability, it “falls squarely within the mandates of central banks and supervisors to ensure the financial system is resilient to these risks” (NGFS 2019).

NGFS members focus on two types of climate-related financial risks: physical and transition risks (Banque de France, ACPR, and DG Trésor 2017; NGFS 2019; Grippa et al. 2019). Physical risks correspond to financial losses resulting from more frequent and severe weather and climate extremes (e.g., storms, wildfires) and long-term changes in climate patterns (e.g., rising sea levels). Transition risks correspond to financial losses resulting from a rapid or disorderly low-carbon transition. The latter could be triggered or accelerated by policy changes, technological disruptions, or behavioral changes. Such shifts could generate ‘stranded assets,’ especially in carbon-intensive sectors tied to fossil fuels (McGlade and Elkins 2015; Mercure et al. 2018). These stranded assets could in turn experience a sudden repricing, potentially causing a “climate Minsky moment” (Carney 2015). Physical and transition risks could interact with one another and materialize in many different manners while generat-

<sup>2</sup> According to estimates by the World Resources Institute, the world’s largest 33 banks allocated USD 654 billion to fossil fuel financing in 2019 (Avery 2019).

Figure 1  
Channels and Spillovers for the Materialization of Physical and Transition Risks



Source: Bolton et al. (2020a).

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ing feedback loops that can affect all economic agents (Figure 1). The implications of climate change for price stability are also being considered (e.g., Parker 2018), with some central banks exploring how their primary mandate of price stability could be impacted by climate change (Cœuré 2018; NGFS 2020b; Lagarde 2020; Schnabel 2021; Villeroy de Galhau 2021).

To identify and manage such climate-related financial risks, the emerging consensus among central banks is that it is necessary to rely on forward-looking, scenario-based analyses (Aufauvre and Bourgey 2019; Campiglio et al. 2018; NGFS 2020c). Unlike backward-looking risk management approaches, scenario analyses seek to examine plausible hypotheses for the future without assigning probabilities. Building on macrofinancial stress tests used to assess the resilience of banks in adverse scenarios (Borio et al. 2014), some central banks and the IMF are now developing adverse climate scenarios that will lead to “climate stress tests” (ACPR/Banque de France 2020; Vermeulen et al. 2019; Adrian et al. 2020)—that is, to estimating the resilience of the financial system to specific climate-related physical and transition developments (see Battiston and Monasterolo 2017).

These developments have triggered intense debates related to the theoretical considerations discussed above, revolving around whether and how central banks should play a role in combating climate change. Indeed, many have argued that central banks may end up overstepping their mandate by focusing on policy objectives that are within the purview of elected officials (see, e.g., Pisani-Ferry 2021). However, central banks’ position escapes this critique. The question being asked by NGFS members is not whether they should replace elected policymakers, most notably the fiscal authorities, in implementing climate policy (as noted by Weidmann 2021), but

rather how they should integrate climate-related financial risks into an appropriate risk management strategy that enables central banks to preserve both price and financial stability in the age of climate change (NGFS 2020b).

It thus appears that the NGFS’ position is mostly grounded in the third approach proposed above, while acknowledging its interactions with the first two approaches (as further discussed below), which considers that action from all actors will be needed to tackle climate change. Central banks and financial supervisors are part of the set of relevant actors, therefore they can and should act within the remit of their mandates. This position is informed by the view that assessing climate-related risks will itself contribute to decarbonizing the economy. As noted by Carney (2015), the approach of central bankers to both financial and price stability in the age of climate change has been similar so far: it is necessary to better measure climate-related risks so as to manage them. In other words, the impacts of climate change should be managed according to the “old adage [...] that which is measured can be managed.”

### CHALLENGES FOR THE ALIGNMENT OF FINANCIAL FLOWS WITH SOUND CLIMATE-RELATED RISK MANAGEMENT

While sustainable finance measures have focused on climate-related risks, some observers have warned that these risks may in fact be impossible to measure (even if one were able to fully bridge existing data and information gaps) and/or to manage from a pure risk-based approach. Below, we review these arguments and discuss some possible implications for central banks’ theoretical framework with respect to climate change.

#### Can Climate-Related Financial Risks be Measured and Managed?

The uncertainty around climate change poses a challenge to the measurement of climate-related financial risks. With regard to physical risks, tipping points are very likely to exist within Earth ecosystems, but remain difficult to estimate, and exceeding them could generate multiple cascade reactions (Lenton et al. 2019; Steffen et al. 2018) that make them particularly difficult to translate into financial metrics over uncertain time horizons. For example, while it is commonly agreed that climate change could generate mass migrations and conflicts (Abel et al. 2019), the probability of occurrence of such events and their translation into social, economic and then financial metrics are inherently difficult to measure with any degree of confidence.

Uncertainty is also pervasive when it comes to assessing transition risks. For instance, it remains highly uncertain which technologies will prevail in



a low carbon world (Svartzman et al. 2020). This makes any assessment of which countries, sectors and firms will win or lose from the low-carbon transition particularly difficult. The future trajectory of carbon prices is also highly uncertain, as is the future value of avoided emissions (Aglietta et al. 2015). Such difficulties can be compounded if one takes into account the increasingly acknowledged fact that a low-carbon transition could reshuffle trade flows (e.g., because of the new materials needed to power renewable technologies) and trigger new geopolitical alliances and tensions (Tänzler and Gordon 2020). In short, risk-management approaches may be particularly challenged when it comes to measuring risks that will impact all agents and interact with multiple other dynamic patterns.

These considerations have led some to argue that policymakers should instead embrace the concept of deep (Boissinot and Heller 2020) or radical (Chenet et al. 2021) uncertainty. A central idea in macroeconomics is that uncertainty about the future is ubiquitous (Knight 1921; Keynes 1936). With regard to climate change, this uncertainty is particularly deep, and as Stern and Stiglitz (2021) note, “there may be states of nature that we have never experienced or find hard to imagine or describe.”<sup>3</sup> Ultimately, this has led to the argument that the financial system and its robustness are “vulnerable not only to calculable risks but to ‘risks without a known distribution: so-called ‘Knightian’ or deep uncertainty or ‘unknown unknowns’” (Zenghelis and Stern 2016).<sup>4</sup>

Even if climate-related financial risks could be measured, it is not clear that it would be possible to manage them. The idea of relying on increased transparency on climate risks assumes that mandatory disclosure of climate risks will elicit an “efficient market reaction to climate change risks” (Carney 2015, see also FSB 2015).<sup>5</sup> According to this logic, climate risk disclosure, if introduced early enough and pertinent and internationally consistent, should induce transparency and market discipline, which should raise the cost of capital for climate-risky assets at the time the capital is deployed, in turn fostering financial stability by helping avoid a “climate Minsky moment.” It has been argued that this

approach implicitly assumes that financial markets are informationally efficient, a hypothesis that has been challenged in the literature.<sup>6</sup>

### A New Dilemma for Central Banks, and a Potential Way Forward Through the Concept of Double Materiality?

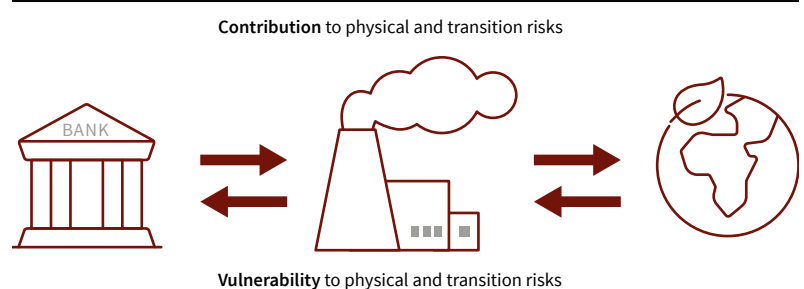
The existence of widespread and significant barriers to the measurement and management of climate-related financial risks poses a dilemma for central banks (Bolton et al. 2020a). On the one hand, for central banks to develop scenarios while waiting for other institutions or economic agents to take action (e.g., by imposing a carbon price) might expose them to the risk of not being able to deliver on their mandates of price and financial stability. On the other hand, central banks cannot substitute for other actors’ insufficient actions, as the latter pertain to areas that are not within the central bank’s remit (e.g., fiscal, industrial, urban planning, etc.).

To address this dilemma a new paradigmatic approach may be emerging through the concept of ‘double materiality,’ which is already supported by some policymakers, including financial supervisors (see, e.g., European Commission 2019 and ESMA 2020). Double materiality (see Figure 2) suggests that a comprehensive approach to climate-related financial risks calls for assessing two related phenomena: the fact that climate change can affect financial institutions (as captured by the risk-based approach), and the fact that financial institutions impact the climate system and therefore contribute to the risks they aim to measure. Some policymakers have hinted that the concept may apply to central banks, whose actions should not “reinforce market failures that threaten to slow down the decarbonization objectives of the global community” (Schnabel 2020). This idea appears to have support in the literature, in particular the notion that the more climate action is delayed, the more skewed the distribution of climate sensitiv-

<sup>6</sup> See Christophers (2017) for a more detailed discussion. See also Stern and Stiglitz (2021).

<sup>3</sup> Some observers have argued that assessing climate futures requires an assessment of the socio-political and socio-economic futures entailed by climate change, which requires engaging with ‘deep,’ ‘fundamental,’ or ‘radical’ uncertainty (Kandlikar et al. 2005).  
<sup>4</sup> A risk minimization approach (Krogstrup and Oman 2019) stresses the asymmetry of the costs of policy mistakes. The cost of acting too slowly to combat climate change is much greater than the cost of mitigating climate change ‘too fast’ – policymakers can reverse mitigation actions, but they cannot reverse climate overshoot.  
<sup>5</sup> Schnabel (2020) thus argues that the empirical evidence suggests a mispricing of climate risks “as a result of informational market failures that stem primarily from the absence of a clear, consistent and transparent globally agreed taxonomy accompanied by disclosure requirements.” There is evidence that equity valuations do not reflect the projected incidence of climate risks (IMF 2020b). Bolton and Kacperczyk (forthcoming) document that stocks of firms with higher emissions earn higher returns. ESRB (2020) find evidence that financial market pricing of climate risks seems “heterogeneous at best, and absent at worst.”

Figure 2  
Double Materiality



Source: Authors’ illustration, based on European Commission (2019).

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ity values, and the higher the probability of extreme values (Weitzman 2012; Aglietta and Espagne 2016).<sup>7</sup>

In fact, the concept of double materiality seems also to be implicitly present in the purpose of the NGFS, as the latter seeks to “contribute to the development of environmental and climate risk management in the financial sector and to mobilize the mainstream finance to support the transition toward a sustainable economy.”<sup>8</sup> While the first part of the NGFS mission statement corresponds to identifying how climate change could impact the financial system, the second part corresponds to reducing the contribution of the financial system to climate change.

The implementation of the concept of double materiality could have diverse implications for prudential and monetary policy (e.g., Schoemaker 2021, Van ‘t Klooster and Van Tilburg 2020). Monetary policy could be decarbonized in a gradual and targeted manner (Villeroy de Galhau 2021), for instance, by ensuring that the collateral pledged by the central bank’s counterparties is aligned (or consistent) with the objectives of the Paris Agreement based on credible third parties’ opinions (see Oustry et al. 2020). A related proposal is to use taxonomies of activities to determine whether to exclude certain bonds, based on clear and transparent rules that are used to finance projects that conflict with decarbonization objectives (Schnabel 2020). In this approach, central banks and financial supervisors would seek to steer markets in a low-carbon direction, not because they are acting beyond their mandate, but because the nature of climate-related financial risks requires them to broaden their approach to risks. This means that the double materiality perspective may lead to the need to consider whether reducing the impact of the financial system on the climate system could be part of a robust risk-management strategy.

### SOME DEBATES AHEAD

While the above arguments may provide central banks with a theoretical and operational framework of action with regard to climate change, they would leave several questions unaddressed. We briefly discuss two of these below. First, given that central banks’ actions would remain inefficient in a world that does not act on climate change, what role, if any, is there for coordinating their actions with other actors (notably fiscal authorities) and what are the potential implications for central banks? Second, how do they account for environmental risks beyond climate change? Our aim is merely to present these debates, as they are likely to shape future discussions.

### Policy Coordination Challenges and Potential Implications for Central Banks

In order to overcome the above dilemma (i.e., the need for central banks to act and the impossibility of solving the climate challenge on their own), one existing proposal consists in emphasizing policy coordination. As noted by the OECD (2015), it is necessary to make all policies consistent with climate objectives, and the role of central banks and sustainable finance policies should be assessed in this light. Stern and Stiglitz (2021) argue that climate change mitigation requires radical change in all of the core systems of the economy, which in turn requires “complex coordination of a kind that goes beyond standard pricing, especially in the presence of multiple market failures.”

As an example of this approach, Aglietta and Valla (2021) call for a transformation of the growth regime in which fiscal, financial and monetary policies are complementary and cooperative. They, among others (e.g., Gabor 2021), propose new thinking and a new organization of monetary policy, in which the latter is integrated with macroprudential policy and coordinated with fiscal policy. More broadly, Bolton et al. (2020a) identify four areas (fiscal policy, responsible investment, international coordination, and accounting norms) that do not fall within the remit of central banks, but with which central banks may need to interact in order to manage climate-related financial risks.

Such avenues nevertheless pose at least three significant challenges. First, they require central banks’ to know what other actors will do, to enable them to adjust their own actions. For instance, knowing how climate policy will affect the economic outlook, and its implications for monetary policy (NGFS 2020b). Another example relates to the path and speed of the transition induced by climate policy, which may also have financial stability implications (NGFS 2020c).

Second, some of the measures mentioned above may be considered to impinge on the principle of market neutrality, according to which monetary policy should be asset neutral. Weidmann (2020) argues that it is not the task of the central bank to “penalize or promote certain industries.” Other senior central bankers have nevertheless questioned whether the principle itself should be reassessed in the light of climate change. For instance, Schnabel (2020) argues that “market neutrality may not be the appropriate benchmark for a central bank when the market by itself is not achieving efficient outcomes” and Lagarde wonders “whether market neutrality should be the actual principle that drives our monetary-policy portfolio management.”<sup>9</sup> Villeroy de Galhau (2021) suggests that “market neutrality – which guides the execution

<sup>7</sup> A related idea is that climate change is uninsurable (see Chichilnisky and Heal 1993).

<sup>8</sup> See [www.ngfs.net](http://www.ngfs.net).

<sup>9</sup> See Arnold (2020). Further, Schnabel (2021) notes that large firms in emission-intensive sectors are more likely to enter the bond market as they have a high level of fixed assets that can serve as collateral.

of our market operations – should not put a brake on carbon neutrality.”

Third, certain forms of policy coordination (e.g., fiscal-monetary) to achieve climate-related goals raise questions about central bank independence. Cochrane (2020) argues that by engaging in climate policy, central banks will lose their independence and ability to fulfill their main missions of controlling inflation and stemming financial crises. By contrast, Honohan (2019) argues that failing to green central bank interventions will over the longer term pose a threat to central bank independence, while Bernanke (2003) has argued that, under some circumstances, “greater cooperation for a time between the central bank and the fiscal authorities is in no way inconsistent with the independence of the central bank.” More broadly, such questions relate to that of determining whether central banks should act within their primary or secondary mandate (in the case of the ECB), and the extent to which climate risks and mitigation goals fit into current central bank mandates (see Cœuré 2018, Dikau and Volz 2019; Fischer 2019; Van Tilburg and Simic 2021).

### Beyond Climate-Related Financial Risks, A New Era of Ecological Risks?

While sustainable finance has mainly focused on climate change, it has been argued that the latter is only the “tip of the iceberg” (Steffen et al, 2011). Other biogeochemical cycles that are as essential for life on Earth as a stable climate are also increasingly affected by human activity (e.g., biodiversity loss and soil erosion – IPBES 2019; IPCC 2019). Rockström et al. (2009) and Steffen et al. (2015) identify nine critical Earth systems with environmental boundaries that have already been crossed or could be crossed in the near future. Crossing these boundaries could lead to catastrophic outcomes for ecosystems and human systems (Lenton et al. 2019), let alone for economic and financial systems. For instance, a growing body of literature (Johnson et al. 2020) and international organizations (IPBES 2020) indicate that because of ongoing biodiversity loss, we may have entered an era of biodiversity-related financial risks (including pandemics triggered by zoonotic diseases), which could make the occurrence of systemic and irreversible financial risks more likely (Bolton et al. 2020b; Dasgupta 2021). Kedward et al. (2020) suggest capturing these large, interconnected risks under the notion of “nature-related financial risks.”

Some central banks have begun acknowledging some of these risks (Schnabel 2021; Schellekens and Van Toor 2019), in particular with regard to biodiversity (DNB 2020). However, measuring biodiversity-related financial risks is more complex than climate-related risks, as the former relies on multiple local indicators related to the functioning of diverse ecosystems (Kedward et al. 2020). Central banks

may also be more constrained in their ability to address some of these issues than they are with climate change. For instance, a rapidly growing literature suggests that protecting ecosystems calls for large-scale transformations of socio-ecological systems, requiring the need for new tools to measure welfare (e.g., by moving beyond GDP and considering the limits to its growth) (Dasgupta 2021; IMF 2021). Although the literature on such risks is in its infancy, it is conceivable that the above considerations could ultimately reinforce the need for new institutional arrangements among policy areas. While central banks are likely to be exposed to risks from the systematic degradation of ecosystems and should therefore pay increasing attention to them, their margin of action will remain limited if they act on their own.

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