

Greening collateral frameworks

Summary

Central bank collateral frameworks play a powerful role in contemporary market-based financial systems. Collateral rules and practices affect the demand for financial assets by financial institutions, with significant implications for governments' and non-financial corporations' access to finance. However, existing collateral frameworks lack environmental considerations and suffer from a carbon bias: i.e. they create disproportionately better financing conditions for carbon-intensive activities.

Environmental issues can be incorporated into collateral frameworks in a number of ways, notwithstanding various methodological and data challenges. We distinguish between (i) the *environmental risk exposure* approach, whereby credit assessments in collateral frameworks are modified to capture the exposure of financial institutions and central banks to climate-related financial risks, and (ii) the *environmental footprint* approach, in which haircuts and eligibility are adjusted based on the environmental impacts of financial assets. The two approaches have differing implications and design requirements. We argue that the environmental footprint approach should be at the core of central banks' green transformation of collateral frameworks. This approach contributes directly to the decarbonisation of the financial system, faces fewer practical challenges than the environmental risk exposure approach and does not penalise companies that are exposed to physical risks. It is also conducive to the reduction of systemic physical financial risks.

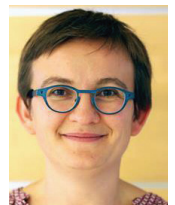
Central banks have a crucial role to play in developing a framework that will accelerate the collection and harmonisation of environmental data associated with financial assets. This will not only help to successfully decarbonise the assets of non-financial corporations included in the collateral framework but will also allow the expansion of greening to other asset classes, such as covered bonds, mortgages, corporate loans and asset-backed securities.

This paper is part of a toolbox designed to support central bankers and financial supervisors in calibrating monetary, prudential and other instruments in accordance with sustainability goals, as they address the ramifications of climate change and other environmental challenges. The papers have been written and peer-reviewed by leading experts from academia, think tanks and central banks and are based on cutting-edge research, drawing from best practice in central banking and supervision.

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1. Introduction

Collateral frameworks are at the core of the liquidity operations of several central banks around the world (BIS, 2013, 2015; Nyborg, 2016; IMF, 2020). The rules governing the eligibility and the terms of use of financial assets as collateral do not only affect the access of commercial banks to liquidity, but also have broader implications for the cost of borrowing and credit practices across the whole financial system (Dafermos et al., 2021b; Vestergaard and Gabor, 2022). Marketable assets that have a favourable treatment in collateral frameworks experience higher demand and, therefore, lower interest rates and higher prices compared with other assets. The decisions of central banks about the collateral rules therefore have non-neutral effects on credit conditions and the real economy.

The existing collateral frameworks suffer from a lack of environmental considerations. This is problematic from a standard risk exposure perspective. As is well-documented, the environmental crisis poses both transition and physical risks to the financial system. These types of risks are ignored in the current credit assessment of the financial assets included in the collateral framework. Accordingly, central banks underestimate the financial risks of assets that are exposed to environmental policies (such as carbon pricing and environmental regulation) and environment-related phenomena (such as floods, hurricanes, sea-level rise and biodiversity loss).

However, the problem with the lack of environmental considerations in collateral frameworks moves far beyond risk exposure: this omission is inconsistent with the environmental crisis that we are facing and the need to do whatever it takes to keep our economies within planetary boundaries. Existing collateral frameworks are not designed to provide incentives for actions that would contribute to the transition to more ecologically sustainable economies. As a result, they tend to favour assets that support polluting activities, many of which are considered to be of high credit quality by the conventional credit assessments that ignore climate risks. Instead of helping to achieve environmental targets, the existing central bank collateral frameworks are, therefore, exacerbating the environmental crisis.

The purpose of this paper is to highlight the need to green the collateral frameworks and to analyse how collateral frameworks can incorporate environmental criteria in practice. We compare and contrast: (i) the environmental risk exposure approach, whereby credit assessments in collateral frameworks are modified to capture the exposure of financial institutions and central banks to environment-related financial risks, and (ii) the environmental footprint approach, in which haircuts and eligibility are adjusted based on the environmental impacts of financial assets.¹ We also outline methodological and data challenges involved in the process of greening collateral frameworks, explain the role of central bank mandates and discuss how the greening of collateral frameworks can move beyond the securities issued by non-financial corporations.

We proceed as follows. Section 2 explains why the current design of collateral frameworks is problematic from an environmental perspective. Section 3 analyses the environmental footprint approach and the risk exposure approach to the greening of collateral frameworks. Section 4 outlines methodological and data challenges in the design of environment-aligned collateral frameworks. Section 5 compares the two approaches, explains why the environmental footprint approach should be at the core of greening collateral frameworks and describes the role of central bank mandates. Section 6 discusses challenges before setting out a way to move beyond non-financial corporate securities. Section 7 concludes.

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¹We use the term ‘environmental footprint’ in a dynamic way to capture past, current and future environmental impacts of assets.

2. Why are current approaches to collateral frameworks problematic from an environmental perspective?

While monetary policy is typically associated with setting an overnight interest rate or undertaking large-scale asset purchases, scant academic and public attention is devoted to the role of collateral frameworks. Core to central bank liquidity operations, collateral frameworks play a key role in the implementation of monetary policy, stabilising financial markets and helping to shield central banks from potential balance sheet losses when extending credit to the banking sector (Bindseil et al., 2017). Many central banks use collateral frameworks to identify the types of assets that banks can use to get access to central bank liquidity.² This includes both short-term and longer-term liquidity. Indeed, in many central banks – such as the People’s Bank of China (PBoC), Bank of Japan (BoJ), Bank of Korea (BoK), Bank of England (BoE) and the European Central Bank (ECB) – collateral frameworks now underpin longer-term targeted refinancing operations (see Colesanti Senni and Monnin, 2021 for an in-depth study of various countries’ targeted refinancing operations).

Central banks demand collateral from the commercial banking sector in exchange for providing banks with central bank reserves, which are used to settle payments. The collateral thus acts as a form of guarantee against the credit that central banks provide to banks that are short of central bank money. The collateral is intended to protect central banks from potential financial losses in the event that banks are not able to meet their loan obligations. Importantly, central banks do not simply accept any type of asset as collateral for their lending: the role of the collateral framework is to define a list of low-risk assets based on specific eligibility criteria.

In this respect, the central bank collateral framework and the eligibility criteria set can be extremely powerful and reverberate throughout the rest of the financial sector – affecting financial market prices and the allocation of capital more widely (see, for example, Nyborg, 2016; Nguyen, 2020; Pelizzon et al., 2020 and Mésonnier et al., 2022). Assets deemed eligible by the central bank as collateral automatically become more valuable to the banking sector (and the financial sector more widely), which increases the demand for them. The eligible assets also appear as safe assets to investors and creditors, who may also be more willing to finance eligible companies at lower interest rates. The eligibility criteria are mainly related to (i) the credit risks of assets, and (ii) other factors beyond credit quality, such as the place of issuance and the currency in which assets are denominated.

The collateral frameworks include several asset classes. These can be marketable assets (such as government bonds, corporate bonds and asset-backed securities) and non-marketable assets (such as credit claims). Typically, government bonds have the highest representation in the pool of eligible assets. For example, in the Eurosystem collateral framework, central government securities make up about 50% of the eligible assets (Dafermos et al., 2021b). However, the use of the assets issued by the private sector is on the rise – see for example the changes to the collateral frameworks that were made after the COVID-19 outbreak (summarised in Dikau et al., 2020).

Importantly, within their collateral framework central banks also set a particular ‘haircut’ to every eligible asset. Given financial markets are subject to significant volatility, when selling the collateral to recuperate the credit extended should the debtor default, the selling price of the asset may have fallen from when it was originally offered as collateral. To shield themselves from such price reductions, haircut regimes are designed to reflect the possible volatility of the collateral deemed to be eligible. Accordingly, the haircut level is contingent on a number of variables, mainly consisting of the credit quality (i.e. credit rating), the maturity, and the coupon type (in the case of bonds).

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²The Banco de México, Bank of Canada, Bank of England, Bank of Japan, Central Bank of Chile, Central Bank of West African States, European Central Bank, Magyar Nemzeti Bank and Reserve Bank of Australia are some examples of central banks that use collateral frameworks (see BIS, 2013; Dikau et al., 2020).

The haircut thus plays a crucial role since it establishes the amount of central bank money that banks obtain in exchange for the collateral put up – the greater the haircut, the less the funding obtained (Dafermos et al., 2021b). Accordingly, alongside interest rates, haircuts can have considerable influence over a bank's underlying cost of funding. Moreover, the eligibility criteria and haircut standards of central banks have a significant influence over the credit operations of private financial institutions, including shadow banks,³ that lend against collateral and implement their own haircuts (see Bindseil et al., 2017). In this respect, collateral frameworks and haircuts have wider implications for the functioning of the financial system. Indeed, central banks' haircuts determined by credit risk can amplify fluctuations in the financial cycle (e.g. by reinforcing liquidity spirals), considerably affecting financial price dynamics and the distribution of financial resources more broadly (e.g. Gabor and Ban, 2016; Barthélemy et al., 2018).

Problematically, however, climate risk assessments are not considered when eligibility and haircuts are determined (Monnin, 2018). The credit risk measures used by the Bank of England and the ECB, for example, rely on the assessment of credit rating agencies. As has been recently pointed out by the Network for Greening the Financial System (NGFS), although credit rating agencies have started to incorporate environmental factors into their assessments, they are still very far from properly accounting for environmental risks (NGFS, 2022).

Accordingly, many central banks contain a variety of securities issued by fossil fuel and other carbon-intensive companies in their collateral frameworks. By virtue of being deemed eligible in the collateral framework of the central banks, a reasonable implication is that these 'dirty' corporates receive more credit and benefit from cheaper borrowing. Similarly, the climate risk and climate footprint of eligible securities are not considered when applying and determining haircuts. These low haircuts effectively signal to financial markets that these 'dirty' assets carry very low risk, lowering the borrowing cost for them (Dafermos et al., 2021b).

In this respect, both the eligibility criteria and haircuts within central bank collateral frameworks create favourable financing conditions – an implicit subsidy – for corporates that engage in the most carbon-intensive activities. Without apt consideration of environmental risks and environmental footprint assessments, collateral frameworks are laced with a carbon bias, structurally biasing market prices and the allocation of capital towards carbon-intensive activities. Consequently, in their current form, collateral frameworks are at odds with the Paris Agreement on climate change, while also reinforcing various financial market failures and the wider carbon lock-in. They are also inconsistent with a variety of central banks' own principles for maintaining the credit risk standards needed for the sound implementation of monetary policy (Monnin, 2018), and contradict the prudential standards by which central banks are meant to hold private financial institutions to account (see Gabor et al., 2018).

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3. Incorporating environmental considerations into collateral frameworks

We analyse two approaches for the incorporation of environmental considerations into collateral frameworks: the *environmental risk exposure* approach and the *environmental footprint* approach. The conceptual foundations of these approaches are described in detail in Dafermos (2021).

3.1. Environmental risk exposure approach

In the environmental risk exposure approach, environment-related financial risks are seen as new types of financial risk that need to be addressed by central banks. Environment-related financial risks include climate risks but also risks beyond climate

³By 'shadow banks' we mean financial institutions that fall outside the realm of traditional regulated banking and engage in collateral-based activities.

change, such as the financial effects of water scarcity and biodiversity loss (see e.g. NGFS, 2021b; Kedward et al., 2020).

In the context of collateral frameworks, the environmental risk exposure approach suggests that haircuts and eligibility need to be recalibrated such that they reflect these risks. For example, assets that are characterised by higher transition and physical risks need to see an increase in their haircuts or they might need to be excluded from collateral frameworks. This approach argues that, without such a recalibration, financial institutions and central banks are exposed to higher financial risks. This is not acceptable from the standard risk management perspective used in collateral frameworks.

The environmental risk exposure approach is based on a micro perspective: it assumes that central banks cannot affect environmental risks, but they have a responsibility to protect their balance sheets and the private financial system from exogenously determined environmental risks. Therefore, this approach ignores the impact that collateral frameworks have on the financing of activities with different environmental footprints and the implications of this financing for the environmental risks themselves. In other words, the environmental risk exposure approach ignores double materiality – the fact that the financial system is not only affected by the environment, but that the environment is also affected by the financial system (for details on the concept of double materiality, see Oman and Svartzman, 2021; Täger, 2021).

Crucially, the environmental risk exposure approach does not aim to improve the credit conditions for financial instruments linked to green activities or to reduce carbon credit. This might be a positive environmental side effect of the application of this approach if credit assessments suggest that carbon-intensive financial assets are associated with higher transition risks.⁴ The main purpose of the environmental risk exposure approach is, instead, to correct the pricing of environmental risks in the financial markets. This correction might have negative side effects as well. For example, companies that are more exposed to floods, wildfires or biodiversity loss (i.e. to physical risks) might see an increase in the haircuts of their bonds if the environmental risk exposure approach is applied. This could hinder the financing of adaptation investment that is necessary to reduce the exposure of these companies to environment-related phenomena.

The ECB recently announced that it will use the environmental risk approach for greening the Eurosystem collateral framework. In particular, it intends to adjust the haircuts that are applied to the corporate bonds based on their climate risks (see ECB, 2022).

3.2. Environmental footprint approach

The environmental footprint approach is based on the idea that collateral frameworks need to contribute directly to the decarbonisation of financial markets and help to address the environmental crisis. This approach, therefore, suggests that the environmental footprint of assets should be one of the criteria that central banks use when they decide about the level of haircuts and the eligibility of assets. The environmental footprint of assets includes not only the impact on climate change, but also the impact on other aspects of the environmental crisis, such as water scarcity, deforestation, the degradation of oceans and biodiversity loss. However, based on the current data availability, it is much easier to capture the climate footprint than the broader environmental footprint.

Although the environmental footprint approach departs from the conventional way of thinking about collateral frameworks, it is consistent with central bank mandates that include the support of sustainable development/growth or the safeguarding

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⁴This might also have negative financial side effects since companies with carbon-intensive assets might experience an increase in their cost of borrowing, which could hinder their transition efforts.

of financial stability (we explain this in more detail in Section 5.2). Moreover, the adjustment to the collateral rules that this approach requires is relatively straightforward once suitable environmental indicators have been developed (see Section 4.2).⁵

The environmental footprint approach highlights that the degradation of ecosystems and the depletion of natural resources is the result of complex interactions between social, financial, macroeconomic, ecological and political systems. Accordingly, due to the powerful position that central banks have in the global financial system, they have a non-neutral effect on the environmental crisis. An implication of this is that central banks' decisions about the collateral frameworks can affect environmental outcomes and therefore environment-related financial risks. The latter should not be viewed as being exogenous to what central banks do, even if, compared with governments, central banks have a lower impact on environmental outcomes.

According to the environmental footprint approach, collateral frameworks can affect environmental outcomes via two channels (see also Dafermos et al., 2022). The first is the demand channel: by penalising polluting assets and supporting environmentally-friendly assets, central banks can affect the demand for these bonds and hence their yields in a way that is more conducive to environmentally-friendly investment. Empirical evidence has shown that eligibility and haircuts affect the cost of borrowing and bond issuance (see Nguyen, 2020; Pelizzon et al., 2020). The second is the environmental signalling channel: by identifying which companies perform better or worse from an environmental perspective (using Paris-aligned scenarios as reference for evaluating progress), central banks can provide strong signals to the financial markets that can induce firms to adopt more environmentally-friendly business models.⁶

Aspects of the environmental footprint approach have recently been introduced into some central banks' collateral frameworks. In 2018, the People's Bank of China decided to include green bonds in the pool of eligible assets that banks can use as collateral for borrowing through the central bank's medium-term lending facility. The PBoC also gave a 'first-among-equals' status to green bonds (see PBoC, 2018; Dikau and Volz, 2021; Macaire and Naef, 2022).⁷ In 2020, the ECB included sustainability-linked bonds into the list of eligible assets of the Eurosystem collateral framework (see ECB, 2020). In both cases, no risk considerations were involved in these decisions. However, more recently, the ECB has announced that it will restrict the share of assets with a high carbon footprint that can be pledged as collateral, with the aim of reducing the risks in the Eurosystem credit operations (see ECB, 2022). Although this decision has an environmental footprint flavour, it is justified with reference to the risk exposure approach.

4. Methodological and data issues

In this section, we outline the key methodological and data issues related to the implementation of the environmental footprint and environmental risk exposure approaches. We focus on the case of the assets of the non-financial corporate sector, where the implementation of these approaches is more straightforward. The application of the two approaches to other assets (e.g. covered bonds, mortgages, corporate loans, asset-backed securities) is discussed in Section 6.

An important general issue for the assessment of non-financial corporate assets is whether this assessment should be done at the level of an asset, company or activity. An asset-based assessment can capture the fact that companies issue bonds that are meant to fund specific environmentally-friendly activities (like green

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⁵Crucially, this approach is consistent with a precautionary approach to monetary and financial policy that emphasises that central banks need to take preventive action against the environmental breakdown (Chenet et al., 2021, 2022).

⁶Note that, through these two channels, the price of environmentally-friendly assets might be inflated. This is desirable from an environmental physical risk perspective, but it might make specific green firms more reliant on debt in the short run – and, thus, more financially fragile. This is not a problem, however, since it can be captured by the standard credit assessments used in collateral frameworks.

⁷Macaire and Naef (2022) show that this decision reduced the yield of green bonds compared with the yield of non-green bonds.

bonds or sustainability-linked bonds). However, (i) in many cases such bonds have been issued by companies that have a high carbon intensity, which implies that some greenwashing issues might arise (see Ehlers et al., 2020), and (ii) from a risk perspective the probability of defaulting on these bonds is not independent of the other operations of companies.

Conducting an evaluation at the company level avoids these limitations. This evaluation can rely both on the activities in which the companies engage (if they are carbon-intensive or green) and indicators about the progress that companies have made – or intend to make – to reduce their negative environmental impact (their absolute emissions reduction rate, their plans for decarbonising their operations, and so on). However, relying only on the company-level information might ignore specific asset-related efforts that some companies are currently making to reduce their environmental impact. Therefore, using a combination of asset-level and company-level information (if data availability permits that) provides a more integrated understanding of the environmental profile and environmental risks of the assets included in collateral frameworks.

4.1. Applying the environmental risk exposure approach

The purpose of the environmental risk exposure approach is to quantify the effects of transition risks and physical risks on the credit evaluation of bonds issued by non-financial corporations. This requires three steps. First, it is essential to identify scenarios that illustrate how these risks might materialise in the future. Second, these risks need to be translated into specific probabilities of default. Third, the climate risk-adjusted probabilities of default should be incorporated into the haircuts and the eligibility of assets.

As far as the first step is concerned, the climate finance community is increasingly using the NGFS scenarios for quantifying climate risks. NGFS identifies three sets of scenarios: orderly, disorderly and hot house world scenarios (NGFS, 2021a). In the orderly and disorderly scenarios, carbon prices are assumed to increase sufficiently such that global warming does not exceed 1.5°C or 2°C above pre-industrial levels. In the orderly scenarios, there is an early and smooth increase in carbon prices, while in the disorderly scenarios the NGFS assumes an abrupt increase in carbon prices after 2030. Under the hot house world scenarios, the increase in carbon prices is very small and, as a result, transition risks are low. However, physical risks are high in the long run.

Although the NGFS scenarios can easily be used for the analysis of climate-related financial risks, it is worth noting that they suffer from two limitations. First, they do not incorporate macrofinancial feedback loops (see Gourdel et al., 2022). Some effects of climate change on the financial system are taken into account, but the feedback effects of the financial system on the real economy are ignored.⁸ Thus, double materiality is not considered. Second, the only climate policy that the NGFS scenarios explicitly consider is carbon pricing. Other climate policies, such as green public investment and environmental regulation, that can play an important role in the climate transition and affect risks, are not introduced in the scenarios.

The second step is to translate the scenarios about climate risks into probabilities of default using granular company-level data. The simplest way to do this is to specify the channels through which the climate transition and physical events might affect the inflows/outflows and the leverage of firms at the micro level.⁹ Examples of these channels include the following: a higher carbon tax could increase the expenses of firms; the transition to a low-carbon economy could lead firms to increase their debt-financed green capital spending; carbon-intensive energy firms might lose market shares and see a decline in their revenues; an increase in green public investment

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⁸For the importance of these feedback loops, see Battiston et al. (2021) and Dafermos and Nikolaidi (2021).

⁹The translation of macro effects into micro ones has limitations: it ignores feedback and network effects.

could increase the revenues of firms that produce green goods; and floods and wildfires could destroy the physical capital of firms. Through these channels, firms' ability to repay debt could be affected.

As long as appropriate data is available, the translation into probabilities of default can be done through econometric approaches (Alogoskoufis et al., 2021) or by using standard financial risk models such as the Merton model (Belloni et al., 2022). In econometric approaches, the impact of profitability, leverage and other financial variables on the probability of default observed in past data can be used as a guide for estimating how future changes in firms' financial position can affect their default under different scenarios. In financial risk models, the pathway of the leverage of firms can directly translate into probabilities of default once the past asset volatility and the time to repayment have been considered.

Once climate-risk-adjusted probabilities of default have been specified, the third step is to modify haircuts and eligibility.¹⁰ This could happen, for example, by adjusting the credit ratings of assets based on the climate risks to which they are exposed – these ratings directly affect the haircuts in the existing collateral frameworks. A significant challenge for central banking authorities is, however, that they need to specify the scenario that they will use as a reference for adjusting haircuts and eligibility. Due to the uncertainty about the implementation of climate policies, it is very difficult to identify an objective way of selecting a scenario. For instance, if central banks believe that governments will adopt ambitious policies very soon, they might use orderly scenarios as the key reference for adjusting their collateral frameworks. If, on the other hand, they think that the transition will never happen properly, they could use hot house world scenarios as the main reference point (such as the NGFS Nationally Determined Contributions [NDCs] scenario; see NGFS, 2021a). In any case, subjective views are inevitable. An alternative option would be for central banks to select an average probability of default for each company among different scenarios. However, this might be misleading since it would be very difficult to assign meaningful probabilities to the different scenarios.

Another significant limitation of the risk exposure approach is that the probabilities of default are not exogenous to the environmental adjustment of collateral frameworks. A risk adjustment of haircuts and eligibility can affect the financial position of companies, which in turn can change their rate of default. For example, if central banks increase the haircuts for carbon-intensive companies, these companies might experience an increase in their cost of borrowing, making it more difficult for them to get access to finance and repay their accumulated debt.

4.2. Applying the environmental footprint approach

The environmental footprint approach does not require the quantification of risks. Instead, it emphasises the evaluation of the firms' environmental performance. The environmental footprint approach can be applied in two steps. First, the environmental footprint of assets and their issuers should be identified. Second, haircuts and eligibility should change, based on the environmental footprint.

This environmental performance is best captured both by the types of activities that companies engage in, and through micro indicators that capture progress with respect to environmental targets. As far as activities are concerned, the taxonomies of green and carbon-intensive activities can be a useful starting point. For example, the EU Taxonomy provides a classification of green activities (European Commission, 2020), which are defined as those activities that substantially contribute to climate mitigation without harming other environmental objectives.¹¹ Similar green taxonomies have been recently developed in several countries (such as China,

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¹⁰For a risk-based proposal that focuses on the assets that are pledged as collateral instead of those that central banks specify as eligible, see Oustry et al. (2020).

¹¹The EU Taxonomy, however, has limitations (see Dafermos et al., 2021a), so adjustments might be necessary before applying it to collateral frameworks.

Singapore and Colombia), while in other countries (such as the UK, Brazil and South Africa) the development of green taxonomies is still in progress (see Climate Bonds Initiative, 2022). Regarding carbon-intensive activities, Battiston et al. (2017) provide a classification that can be used as a basis for specifying such types of activities, while Urgewald (2021) and Rainforest Action Network et al. (2022) provide guidelines about specifying companies that engage significantly in fossil-fuel activities.

Turning to micro-based indicators, both backward-looking and forward-looking aspects should be considered for the decarbonisation of the collateral framework (see Dafermos et al., 2021b for the case of the ECB). Backward-looking indicators refer to the current and past climate performance of companies. The current carbon intensity of companies (given by emissions over revenues) compared with the carbon intensity of their peers is an example of a backward-looking indicator. Another is the emissions reduction rate that companies have achieved over the last few years, which can be compared with the emissions reduction rate that is consistent with 1.5 °C transition pathways (see UNEP, 2019, 2020). Forward-looking indicators can be developed based on decarbonisation targets of firms for the coming years.

Backward-looking and forward-looking metrics about the climate footprint of companies have both strengths and weaknesses (see TCFD, 2021; Bank of England, 2021; Dafermos et al., 2022). The main strength of backward-looking metrics is that they capture the actual environmental performance of economic units and can be easily understood. However, they do not consider the plans that economic units might have for the reduction of their environmental footprint in the coming years. Forward-looking metrics do consider the environmental plans of economic units, but they do not necessarily take into account that these plans might not be credible.

Crucially, backward- and forward-looking indicators should not rely only on emissions. These indicators could also consider environmental expenditures or the planned fossil-related investment of firms. The 'green' label of bonds should also be considered, but attention needs to be paid to greenwashing issues.

A significant challenge with the use of micro-based indicators is that suitable data is not always available. For example, many companies do not report targets for the reduction of emissions or do not report their emissions data for a large number of previous years. An additional challenge is the lack of data for Scope 3 emissions, which are very large in specific sectors.¹²

Once environmental footprint indicators have been identified, the second step is to use these indicators to change haircuts and eligibility. One approach would be for companies to be classified into different environmental 'buckets' based on their overall environmental performance (see Dafermos et al., 2022 for how this could be done). Then haircuts can be adjusted depending on the environmental bucket that each firm belongs to. There are various ways through which this adjustment could take place (see Dafermos et al., 2021b; McConnell et al., 2022; Schoenmaker, 2021). For example, the securities of companies that engage in carbon-intensive activities can be assigned a higher haircut, but this haircut can be reduced if companies have a relatively low climate footprint, as this is reflected in the climate bucket. The bonds of companies that engage in green activities could experience a lower haircut but this could increase if their climate footprint is relatively high based on their climate bucket. In addition, companies that engage in highly carbon-intensive activities and whose performance is not aligned with the Paris Agreement targets can be excluded from the collateral framework. These bonds can be replaced with other, more environmentally-friendly bonds.

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¹²Note that the incorporation of Scope 3 emissions into the measurement of emissions might give rise to double-counting issues, which need to be treated carefully (see Shrimali, 2021).

5. Why should central banks use the environmental footprint approach?

We recommend that central banks design the greening of their collateral frameworks on the basis of the environmental footprint approach, focusing at the same time on the analysis of system-level financial risks. In this section we explain why this should be the case. We also discuss the role of central bank mandates.

5.1. Advantages of the environmental footprint over the environmental risk exposure approach

The preceding discussion suggests that the environmental footprint approach has the following key advantages over the environmental risk exposure approach.

First, it allows central banks to play a more active role in the fight against the environmental crisis. For instance, polluting assets are directly penalised in a green collateral framework that has been designed based on the environmental footprint approach. On the contrary, such assets can experience an increase in haircuts or exclusion only under certain conditions and scenarios – and only as a side effect – in the environmental risk exposure approach.

Second, although the environmental risk exposure approach requires an improvement in data availability about the environmental performance of companies, it does not require the quantification of financial risks that is necessary for the environmental risk exposure approach. There are significant challenges in quantifying financial risks, such as the need to select arbitrarily from a large set of scenarios. Crucially, such a quantification will always be imperfect in a world of fundamental uncertainty (see also Chenet et al., 2021). It is not by chance that the progress that has been made in identifying and assessing these risks is still at a preliminary level (see NGFS, 2022). The risk exposure approach also suffers from the fact that risks are not exogenous to central bank actions: once a central bank decides to increase the haircut of a bond based on climate criteria, the company that issues this bond will not be in the same financial position as before. Thus, using the risk exposure approach as a basis for greening collateral frameworks poses many practical problems. On top of that, it can delay central banking action: central banks might decide to not adjust collateral frameworks until climate risk methodologies and data have sufficiently improved. Delaying action is at odds with the urgency of the environmental crisis.

Third, the environmental footprint approach does not have direct adverse effects on those companies that suffer from an exposure to physical risks and have to invest more in adaptation because of that. Such adverse effects might, however, materialise in the case of the risk exposure approach. As highlighted before, firms that are exposed to physical risks might face worse credit conditions if the risk exposure approach is implemented: their exposure to physical risks might cause their credit ratings to deteriorate and lead central banks to increase the haircuts of their assets or exclude them from the pool of eligible assets. If this happens, they will be less capable of financing climate adaptation, which might increase physical risks at the system level.¹³

5.2. Consistency with central bank mandates

A key question for the use of the environmental footprint approach in the greening of collateral frameworks is whether this approach is consistent with the mandates of central banks.¹⁴ We can distinguish between three cases.

First, if the support of sustainable economic growth and development is part of the mandate of a central bank, the answer is straightforward: the central bank needs to consider the use of the environmental footprint approach in the design of its collateral framework, if such a framework is currently used or will be used in the

“The environmental footprint approach has several key advantages over the environmental risk exposure approach.”

¹³The environmental footprint approach can also have some adverse effects on the financing of adaptation in the case that carbon-intensive companies (that can experience an increase in their costs of borrowing if the environmental footprint approach is applied) are exposed to physical risks. However, in contrast to the risk exposure approach, companies are not directly penalised for being exposed to physical risks. Also, the environmental footprint approach provides the flexibility to central banks to adjust haircuts and eligibility to support the financing of climate adaptation, if they decide that this is important from a systemic risk perspective. In contrast, it would be inconsistent for the risk exposure approach to ignore physical risks.

¹⁴The environmental risk approach is in any case consistent with the financial stability objectives of central banks and the prudential rationale of collateral frameworks.

future. This is the case in several countries, such as Czech Republic, Singapore, South Africa and Zimbabwe, as well as in the West African Monetary Union (see Dikau and Volz, 2021).

Second, if the support of government policies is included in the mandate of central banks, and governments have explicit environmental commitments (as is, for example, currently the case for the ECB and the Bank of England), then the environmental footprint approach should be applied under the condition that it will not undermine the primary mandate of the central banks. In practice, this means that the overall haircut-adjusted value of the financial assets that can be posted as collateral should remain almost unchanged after the environmental adjustments of eligibility and haircuts. Otherwise, there is a danger that banks might face liquidity problems that can have unintended consequences for financial stability and credit availability. This can be achieved through a careful recalibration of haircuts and eligibility.¹⁵

Third, where environmental considerations are (directly or indirectly) absent in the mandate of a central bank, the environmental footprint approach can still be relevant for central banks with financial stability mandates since (i) it can contribute to the reduction of physical risks for the financial system and (ii) it can protect the financial system from transition shocks. The contribution to the reduction of physical risks is important from a macroprudential and double materiality perspective (see Dafermos, 2021). This reduction will be greater in the case of large jurisdictions (like the jurisdiction of the Eurosystem) and if central banks coordinate in greening their collateral frameworks. The protection from transition shocks will be more significant if the decarbonisation of the financial system takes place as soon as possible. Note that this can be particularly important for low- and middle-income countries whose financial systems might face transition shocks due to climate policies implemented in high-income countries (an example of such a policy is the carbon border adjustment mechanism promoted in the context of the European Green Deal; see Vickers et al., 2021).

The implementation of the environmental footprint approach does not preclude the incorporation of environmental risk exposure indicators into the credit risk analysis of collateral. For example, in the process of greening their collateral frameworks central banks might adjust the haircuts of assets twice to simultaneously capture (i) exposure to climate risks (which should be reflected in credit ratings) and (ii) their greenness/dirtiness. This would mean that a specific carbon-intensive asset that is both harmful to the environment and is exposed to transition risks would experience an increase in its haircut via two routes. Central banks therefore need to continue their attempts to identify and assess environment-related financial risks. However, they should not use risk exposure as the sole criterion for greening collateral frameworks.

6. Addressing data challenges and moving beyond non-financial corporate securities

Progress is needed to improve data availability and to expand greening to other asset classes included in the collateral framework.

The limited availability of environmental data is a barrier to the proper implementation of the environmental footprint approach and the incorporation of environmental risks into the collateral framework. Over the last few years, the availability of emissions data has improved, especially for large companies. However, significant progress should be made in the reporting of Scope 3 emissions, the credibility of emission reduction targets and the reporting of environmental effects beyond the generation of emissions (green capital spending, investment in recycling

“The implementation of the environmental footprint approach does not preclude the incorporation of environmental risk exposure indicators into the credit risk analysis of collateral.”

¹⁵For an example of how this can be done in the case of asset purchases, see Dafermos et al. (2022).

and material efficiency, generation of hazardous waste and so on). Central banks can set specific data disclosure requirements for companies that wish to be included in the list of eligible assets. This would significantly help to achieve progress in this area.

Another important challenge for the greening of collateral frameworks is that more work needs to be done to capture the environmental impact of, or risks to, assets associated with financial institutions, such as covered bonds, mortgages, corporate loans and asset-backed securities. For example, assessing the environmental impact of covered bonds and asset-backed securities is less straightforward than assessing the environmental impact of securities issued by non-financial corporations. Quantifying this impact requires two steps: first, it is necessary to identify the environmental impact of all the assets that are included in the pool of assets that back up the covered bonds and asset-backed securities; second, the relative importance of each of these assets in the pool should be calculated. Although relevant metrics have been developed for the second step,¹⁶ an important challenge is that granular data for these pools of assets is not always available. The same is the case for data associated with mortgages and corporate loans.¹⁷

As highlighted above, government bonds constitute a significant part of the assets that can be used as collateral. However, the incorporation of environmental criteria into the eligibility and the haircuts of these bonds should be treated with caution and needs to rely on principles other than those used for private assets. First, countries have differentiated responsibilities in reducing emissions, in the context of global climate justice. Second, the way that emissions are measured can lead to different outcomes: production-based emissions are not the same as consumption-based emissions. Third, penalising countries for the environmental policies of their governments might create unfair results. Given all these issues, a possible best way forward – at least as a first step – would be for green sovereign bonds (which are bonds that governments issue to finance specific green public activities) to receive preferential treatment in collateral frameworks, such that the yield of these bonds declines.¹⁸

From a risk exposure perspective, the impact of climate pathways on the probability of default of private assets and government assets should be treated differently. Although physical and transition risks can affect the revenues and expenditures of governments (as is the case in the private sector), the defaults on government debt depend to a great extent on political and institutional factors – such as the position of a country and its currency in the global financial architecture – which cannot be captured by standard quantitative analyses.

7. Conclusion

Collateral frameworks are at the core of central bank operations around the world and are increasingly powerful in the era of market-based finance. The rules governing collateral frameworks have significant implications not only for the access of commercial banks to central bank liquidity, but also for financial transactions and credit conditions in the broader financial system. Making collateral practices greener is, therefore, highly important for transforming finance in the age of environmental collapse.

We have explained why the approach that the central banks might use to incorporate environmental criteria into collateral frameworks matters. The adoption of an environmental footprint approach – in which eligibility and haircuts are adjusted on the basis of the greenness and dirtiness of assets – can directly contribute to the achievement of environmental targets and to the reduction of the physical risks that finance faces at the system level. In contrast, relying solely on an environmental risk exposure approach for greening collateral frameworks could

“From a risk exposure perspective, the impact of climate pathways on the probability of default of private assets and government assets should be treated differently.”

¹⁶An example is the Weighted Average Carbon Intensity (WACI); see e.g. TCFD (2021).

¹⁷For the analysis of the climate footprint of bank loans, see Faiella and Lavecchia (2020), Ehlers et al. (2022) and Mésonnier et al. (2022).

¹⁸For the recent issuance of green sovereign bonds, see Climate Bonds Initiative (2021).

delay action and have adverse effects on the fight against the environmental crisis. It could also be at odds with macroprudential approaches to financial stability that require more proactive actions.

The environmental footprint approach can be used directly by central banks that have a primary mandate to support sustainable growth/development or have a secondary mandate to support government environmental policies. But it can also be used by central banks that have a financial stability mandate since this approach can contribute to the reduction of systemic environmental risks. Therefore, several central banks around the globe would be able to apply this approach to their collateral frameworks without necessarily seeing a change in their mandates. In addition, central banks can recalibrate collateral frameworks using the environmental footprint approach, continuing at the same time their attempts to identify and assess environment-related financial risks with the purpose of incorporating them into collateral frameworks. It is also highly important for central banks to develop a framework that will accelerate the collection and harmonisation of environmental data that is necessary for the greening of the financial system. This will permit the green recalibration of collateral rules to be expanded to several asset classes, beyond the securities of non-financial corporations.

“Making collateral practices greener is highly important for transforming finance in the age of environmental collapse.”

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