

Climate change, central banking and financial supervision: beyond the risk exposure approach

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Abstract: It is now increasingly accepted that central banks and financial supervisors can no longer ignore climate change. However, there is no consensus on how they should address climate issues. On the one hand, there is the view that central banks and financial supervisors should mainly contribute to the assessment of the exposure of the financial system to climate-related financial risks, considering at the same time the possibility of incorporating climate risks into monetary policy and financial supervision and regulation. This approach is currently dominant among central banks in high-income countries. On the other hand, there is the view that central banks and financial supervisors need to take action such that they contribute directly to the decarbonisation of our economies and the prevention of climate systemic risks. In this contribution I analyse the main premises and implications of these two approaches and I explain why a systemic risk approach is more appropriate in the age of climate emergency. I also discuss the challenges involved in a policy agenda aiming at the reduction of climate systemic risks and I outline how these challenges could be tackled.

Key words: climate change, central banking, financial supervision, macroprudential regulation, systemic risk

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1. Introduction

Recent years have seen a growing acceptance of the view that central banks can no longer ignore climate change (e.g. Carney, 2016; Bank of England, 2017; Honohan, 2019; Villeroy de Galhau, 2019; Arndt et al., 2020; Lagarde, 2020). There are two key arguments behind this view. First, climate change poses risks to the financial system (Campiglio et al., 2018; NGFS, 2019). Gradual changes in atmospheric temperature and an increase in the severity and frequency of climate-related events (like hurricanes, wildfires and floods) can affect the ability of households and firms to repay debt, destabilising the banking system. They can also lead to a decline in the prices of bonds and stocks issued by companies that are impacted by these physical changes. On top of it, an abrupt transition to a low-carbon economy due to climate policies, improvements in low-carbon technologies or changes in environmental preferences can affect adversely the financial position of carbon-intensive companies and their lenders. Given that central banks have a responsibility for safeguarding the stability of the financial system, it is now widely accepted that they should analyse these risks and take them explicitly into account in their operations.

Second, it has been argued that climate change can affect the transmission channels of monetary policy and thus the ability of central banks to achieve their inflation targets (e.g. NGFS, 2020a). For instance, physical and transition risks can affect asset prices, exchange rates, expectations and bank lending, which constitute significant channels by which changes in policy rates influence price developments. This makes clear that climate change can undermine the effectiveness of the inflation targeting framework, which is at the core of central banks' operations nowadays.

The establishment of the Network for Greening the Financial System (NGFS), which was launched in December 2017, has played a key role in achieving a consensus in the central bank community about the need for central banks to address climate challenges. The purpose of the NGFS is to enhance the development of environment and climate risk management in the financial sector and to mobilise finance to support the transition to a low-carbon economy. Since its launch, the number of central banks and financial supervisors that have joined the network and support the work of NGFS is constantly increasing. At the same time, a growing number of academic studies and reports have emphasised that there is a need for central banks and financial supervisors to start taking climate change explicitly into account in their decision-making process (e.g. Campiglio et al., 2018; Schoenmaker, 2019; Bolton et al., 2020).

However, the fact that academic and central banking communities broadly agree about the significance of climate change for central banking does not imply that there is a consensus on how central banks and financial supervisors should address climate change issues. The key question is this: should central banks and financial supervisors just focus on the exposure of the financial system to climate risks or should they play a more proactive role by promoting the transition to a low-carbon economy and reduce climate-related systemic risks? The majority of central banks in high-income countries seem to currently support the view that it is not their responsibility to take actions that contribute to the low-carbon transition. The key argument is that the responsibility for such a transition rests with elected governments. Instead, what central banks and financial supervisors need to do, according to this view, is to contribute to the quantification of climate-related risks (which are not currently priced by financial actors) and to take actions that will induce financial institutions and central banks themselves to reduce their exposure to these risks. I call this the ‘risk exposure’ approach.

On the other hand, there is the view that central banks and financial supervisors are not in a position to quantify climate-related risks properly due to the existence of fundamental uncertainty and the complexities linked with system-wide interactions. This view also emphasises that central banks are not neutral in the fight against climate change: their policies shape markets and have an impact on emissions. Hence, their role, it is argued, should not be confined to the passive analysis of climate risks, but it should be expanded to include actions that contribute directly to the transition to a low-carbon economy, in line with the Paris Agreement. This approach recognises that governments need to play the primary role for decarbonisation, but it emphasises, at the same time, the systemic role that central banks play in the modern financial system and their ability to contribute to the acceleration of the low-carbon transition. Since this view analyses the role of central banks from a systems-based perspective and points out the need for the prevention of climate-related systemic risk, I call it the ‘systemic risk’ approach.¹

It is worth emphasising that not all the analyses in the area of central banking, financial supervision and climate change adopt strictly the one or the other approach. For instance, some studies might recognise the system-wide nature of climate risks, but do not necessarily support the idea that central

¹ Chenet et al. (2019) call this view the ‘precautionary approach’, based on the ‘precautionary principle’ which posits that, in the face of uncertainty, preventative policies are necessary to protect the human health and the environment. I use instead the term ‘systemic risk’ (i) to emphasise the different way by which this approach conceptualises risk management compared to the ‘risk exposure’ approach and (ii) to point out the systems-based foundations of this approach, which draw on post-Keynesian and ecological economics.

banks should actively contribute to decarbonisation. Or some analyses might support the policy implications of both approaches. However, the distinction between the two approaches allows us to organise the contemporary debates around central banking and climate change, and illuminate how different theoretical perspectives lead to different policy proposals.

The aim of this contribution is to compare and contrast these two different views and explain why the systemic risk approach is arguably more appropriate in the era of climate emergency. In Sections 2 and 3, I analyse the theoretical foundations and the policy implications of each of these approaches. In Section 4, I explain the advantages of the systemic risk approach over the risk exposure one. I also discuss the challenges involved in a policy agenda aiming at the reduction of climate systemic risks and I outline how these challenges could be tackled. Section 5 summarises and concludes.

2. The risk exposure approach

The risk exposure approach relies on two key propositions. I explain them in turn.

Proposition 1: Financial markets and central banks have not so far assessed adequately their exposure to climate-related financial risks.

The starting point of the climate exposure approach is the fact that financial markets have only to a very small extent assessed the risks related to climate change (see Carney, 2015; NGFS, 2018; Weidmann, 2019). The result is that the exposure of financial institutions to climate risks is underestimated. This is perceived to be the case primarily due to horizon misalignments and the absence of adequate methodologies and data. Moreover, it is pointed out that central banks, which typically rely on financial markets for the evaluation of risk, have also underestimated the climate risks related with the conduct of monetary policy (see Monnin, 2020). This includes, for example, the climate risk of bonds purchased as part of quantitative easing programs or are included in central bank collateral frameworks.

Proposition 2: Climate risks are exogenous to the actions of central banks and financial supervisors.

In analyses about the exposure of financial markets and central banks to climate risks, it is typically assumed that the physical and transition risks are determined primarily by the actions of governments.

In line with environmental economics, climate change is conceptualised as a ‘market failure’, which is the result of the fact that households and firms do not pay for the damage that they cause when they generate emissions. It is then argued that this issue, which is the source of physical risks, could be simply addressed by imposing a carbon tax (or other forms of carbon pricing), as part of governments’ climate responsibilities (e.g. Olovsson, 2018).²

Although in some cases it is recognised that the lack of carbon pricing is not the sole cause of climate change, it is implicitly argued that the actions of central banks do not have an impact on climate-related financial risks. This is perceived to be so either because the interventions of central banks are (and should be) designed in a way that makes their impact neutral (based on the market neutrality principle) or because their effect on climate risks is negligible. The same is considered to be the case for financial supervisors: their actions are not perceived to have a significant impact on climate risks.

The above two propositions have the following policy implications.

Policy implication 1: Central banks should help private financial institutions to evaluate adequately their exposure to climate-related financial risks.

Given that financial markets have not managed so far to price climate risks, central banks and financial supervisors have a significant role to play in addressing this market failure. They can do so by promoting the development of methodologies that help financial institutions to assess these risks and by encouraging climate-related financial disclosures (see ECB, 2020; NGFS, 2020b). An initiative that has attempted to contribute to this direction is the establishment of the Task Force on Climate-related Financial Disclosures (TCFD) by the Financial Stability Board (FSB). The main aim of TCFD, which was launched in 2015, is to develop climate risk disclosure approaches that will provide information to investors, lenders, insurers and other stakeholders about the climate risks linked with their investments (TCFD, 2019).

An additional significant role that central banks can play in the evaluation of climate risks is to incorporate climate risks into their stress testing exercises. Such preliminary exercises have already been conducted (see, for example, Battiston et al., 2017; 2^o Investing Initiative, 2019; Vermeulen et al., 2019; Allen et al., 2020). The purpose of climate stress tests is to examine the vulnerability of the

² However, an abrupt implementation of a carbon tax policy can cause transition risks; this is taken into account in climate scenarios that have been developed for the finance community (see e.g. Allen et al., 2020; NGFS, 2020b).

financial system to climate-related financial shocks linked with physical or transition risks (see NGFS, 2020b).

Policy implication 2: Climate risks should be reflected in monetary policy operations as well as in financial regulation and supervision.

The risk exposure approach asserts that it is not just the private financial institutions that should incorporate climate risks in their decision-making process. It also asserts that central banks and financial supervisors need to ensure that these risks are reflected in monetary policies and financial supervision and regulation (see, for example, Coeuré, 2018; Villeroy de Galhau, 2019). Table 1 shows some examples of how this could happen in practice.

To begin with, the risk exposure approach suggests that central banks should consider the climate risk profile of different assets when they make decisions about which assets they should purchase under their unconventional monetary policy programmes, or which assets should be included in the list of securities accepted as collateral by central banks when they provide liquidity to commercial banks. Currently, credit quality is one of the criteria used in these decisions. However, the existing credit ratings ignore climate risks. Hence, central banks might currently buy assets with low credit quality from a climate point of view, reinforcing the market failure that the risk exposure approach intends to address. To deal with this, the risk exposure approach suggests that central banks should adjust their risk assessment, for example by excluding from their purchases those assets that exhibit high climate risk or by increasing the haircuts of climate risky assets included in the collateral frameworks.

Table 1: Examples of climate monetary and financial policy tools: risk exposure vs systemic risk approach

	Risk exposure approach	Systemic risk approach
Central bank purchases	Exclusion of assets that exhibit high climate risks	Exclusion of carbon-intensive assets and inclusion of green assets
Collateral framework	Adjustment of haircuts based on climate risks	Adjustment of haircuts and inclusion/exclusion of assets based on greenness/carbon intensity
Capital requirements	Higher capital requirements for assets that exhibit high climate risks	Higher capital requirements for carbon-intensive assets (potentially lower requirements for green assets)

Financial regulation is another example of a policy instrument that can be adjusted according to the risk exposure approach. The rationale is straightforward: higher capital requirements should be imposed on assets that exhibit higher climate risks. This is in line with the traditional micro-prudential approach to regulation that posits that regulatory requirements should reflect the exposure of individual financial institutions to risks.

The risk exposure approach contends that the climate-related actions of central banks and financial supervisors/regulators should not expand beyond the mere reflection of climate risks in their operations and frameworks. The climate problem should be solved almost exclusively by carbon pricing and central banks should not be involved in the decarbonisation process (e.g. Olovsson, 2018). It is argued that the latter should be left to politicians. As Carney (2020, p. 3) puts it ‘...absent explicit direction in its remit, the Bank would not advantage green lending in its risk-based supervision. Its approach would match the inherent riskiness of the assets. To do otherwise would be to mix climate policy with prudential policy.’ Similarly, Weidmann (2019) highlights that ‘...it would be wrong to want to use banking regulations to set climate policy incentives, for example by granting risk weighting “discounts” for “green” assets. Capital requirements should always be geared to risk. Creating incentives to protect the climate, on the other hand, is a matter for politicians.’

Before we proceed to describe the systemic risk approach, it is worth highlighting that the risk exposure approach has so far focused primarily on transition risks.³ Given that the transition risks are to a great extent expected to be higher for carbon-intensive companies, it is often argued that the quantification of climate transition risks and their incorporation into monetary policy and financial regulation can be conducive to high investment in low-carbon technologies (e.g. Monnin, 2018). Although this might be the case, it needs to be highlighted that this is simply a side effect of the risk exposure approach: decarbonisation is not explicitly targeted by this approach (see Weidmann, 2019).

3. The systemic risk approach

The systemic risk approach relies on the following two propositions.

³ One key reason for this is that the physical risks are much more difficult to be conceptualised and quantified compared to the transition ones.

Proposition 1: Climate-related financial risks depend on the complex interactions between the ecosystem, the macroeconomy, the financial system, the society and the political system. Due to fundamental uncertainty, these risks can never be adequately quantified.

The systemic risk approach views climate change as a result of the complex interactions between the ecosystem, the macroeconomy and the financial system, giving at the same time particular attention to the role played by the distribution of power and societal dynamics. This is in line with the tradition of post-Keynesian and ecological economics.⁴ In this context, the continuous rise in greenhouse gas emissions over the last century or so has multiple causes related, for instance, to the lack of adequate environmental regulation, insufficient green public investment, carbon-intensive consumption norms and a powerful financial sector that does not have an interest in divesting from fossil fuels.

According to the systemic risk approach, decarbonisation cannot thus be achieved by relying only on carbon pricing. Instead, the transition to a low-carbon economy requires a combination of fiscal, industrial, financial and regulatory policies. All these policies can affect the path of carbon emissions in the next decades. Physical risks depend to a great extent on how these policies will be materialised. The same holds for the analysis of transition risks which depend on a multidimensional and quickly evolving policy landscape.

At the core of this approach is, therefore, the view that the accurate measurement of climate-related financial risks is an impossible task due to the existence of fundamental uncertainty (see also Chenet et al., 2019). There are two types of fundamental uncertainty: epistemological uncertainty and ontological uncertainty (see Dosi and Egidi, 1991; Davidson, 1996; Lavoie, 2014).

Epistemological uncertainty captures both (i) the uncertainty caused by the lack of all the information that is necessary to measure properly climate effects and (ii) the inability of people to process properly the available information. For instance, we currently have incomplete or no information about the emissions of many companies around the world. This incomplete information prevents an accurate understanding of how different companies might be affected under different climate transition scenarios. But even if such or other types of information were available, we would not still be able to process this information fully, given the limitations of our conceptual frameworks and modelling tools.

⁴ For the links between post-Keynesian and ecological economics, see Kronenberg (2010), Dafermos et al. (2017), Svartzman et al. (2019) and Sawyer (2020).

Ontological uncertainty is associated with the fact the future is transmutable: the decisions taken by individuals and institutions currently about climate change might lead to changes in climate risks that could not be foreseen even by those causing these changes. For example, if some global systemically important banks decide at the same time to stop lending to fossil-fuel companies because of concerns about climate transition risks, the fact that these fossil-fuel companies will lose access to credit from these banks might deteriorate their financial position, exacerbating climate transition risks. Hence, when banks make decisions based on assessments about transition risks, they cannot anticipate how these risk assessments by themselves and other banks will affect the risks that these banks try to quantify.

The existence of fundamental uncertainty does not imply that there should not be attempts to analyse and model climate risks and their implications. But it should be acknowledged that these risks can never be properly quantified and climate scenario exercises should be considered illustrative and explanatory and should not be the sole guide for policy making (see Bolton et al., 2020).

Proposition 2: Climate risks are not exogenous to the actions of central banks and financial supervisors.

From a systemic risk perspective, what central banks and financial supervisors do has implications for climate risks. Although their impact on these risks is less significant compared to government policies, the actions and decisions of central banks have non-neutral climate-related economic effects. For example, when central banks purchase bonds issued by fossil-fuel companies or when they include such bonds in the list of marketable assets that they accept as collateral, they support carbon-intensive production, with adverse effects on physical risks. This is so because, as recent empirical evidence has shown, those bonds that are included in collateral framework and central bank asset purchases exhibit lower yields and the companies that issue these bonds seem to increase bond issuance, employment and investment (e.g. Giambona et al., 2020; Luck and Zimmerman, 2020; Nguyen, 2020; Pelizzon et al., 2020; Todorov, 2020).

Another example is linked with climate stress testing. If at some point central banks decide to conduct climate stress tests to measure how much banks are exposed to climate risks, the process of conducting the stress tests and the announcement of the results of these tests might change the behaviour of financial actors against banks, exposing the latter even more to climate risks. At the same time, in the face of climate stress tests, banks might adjust their lending behaviour. For instance, they

might decide to lend less to companies that are carbon-intensive or their operations are located in climate vulnerable regions. Such a change in lending behaviour could exacerbate climate risks.

The systemic risk approach also emphasises the central role that central banks play in shaping financial markets and providing signals. Take the asset-backed securities (ABSs) market. The fact that the ECB relaxed the collateral eligibility criteria for ABSs in 2008-9 was a significant intervention that put a floor under the price of ABSs. This decision, in conjunction with the introduction of the Asset-Backed Securities Purchase Programme (ABSPP) in 2014 stabilised a market that faced significant pressures after the outbreak of the crisis, giving at the same time a boost to securitisation (see Braun, 2018).

In addition, the way the ECB designed its collateral framework in the 2000s provided significant signals to the private repo markets (Gabor, 2016). Or, when Mario Draghi made his ‘whatever it takes’ speech in 2012, the signal that he gave to the financial markets about the interventions that the ECB was willing to make to ensure the stability in the euro area was sufficient to bring about a sustained reduction in sovereign bond spreads. This implies that the way that central will announce how they will use their tools to address physical and transition risks will by itself have an impact on the expectations of financial players, which will very likely have a non-neutral effect on how these risks will manifest.

Let me now explain which are the key policy implications of these two propositions.

Policy implication 1: Central banks and financial supervisors should take action that is conducive to decarbonisation and the reduction of physical risks.

Given that (i) central banks can affect the financing conditions for green and carbon-intensive activities and shape how financial markets treat such activities, and (ii) physical risks are central for the long-run stability of the financial system, the systemic risk approach advocates that central banks should take action that reduces emissions (see also Chenet et al., 2019). Although their contribution to decarbonisation might be less significant in comparison with government interventions, they have a responsibility to take climate proactive action that is conducive to the long-run stability of the financial system.

Table 1 shows examples of what a proactive approach would mean in practice for monetary policy and financial regulation (see also Campiglio, 2016; Volz, 2017; Monnin, 2018; D’Orazio and Popoyan,

2019; Tooze, 2019; van Lerven et al., 2020). In the case of quantitative easing, central banks could purchase less bonds issued by companies that are carbon-intensive and buy instead more bonds that are issued by companies that are not carbon-intensive or undertake activities that are conducive to decarbonisation. Dafermos et al. (2020a, 2020b) have, for example, shown how the corporate quantitative easing programmes of the Bank of England and the ECB could be modified by excluding carbon-intensive companies and adding bonds linked with a lower climate footprint. In addition, Schoenmaker (2019) has illustrated how central bank asset purchases can be adjusted based on the carbon intensity of bond issuers.

In the case of collateral frameworks, central banks can adjust both the securities that they include in the list of assets that are accepted as collateral for the provision of central bank liquidity and the haircuts of these securities. Haircuts could be adjusted based on the carbon intensity of the issuers of securities (Schoenmaker, 2019); at the same time, securities issued by highly carbon-intensive companies could be excluded from the collateral framework, while securities linked with companies that undertake climate mitigation activities could be included in the list of assets accepted as collateral.

Financial regulation could also become climate-aligned and contribute to decarbonisation. One way for doing so would be through the introduction of a ‘dirty penalising factor’ whereby banks are required to hold higher capital for loans provided to support carbon-intensive companies or activities. Simultaneously, banks could be required to hold less capital against loans provided to green activities (‘green supporting factor’). From the systemic risk perspective, both tools need to be considered since they can contribute to decarbonisation. However, particular attention should be paid to the financial stability implications of the green supporting factor since it can increase the leverage of banks.⁵

At this point it is crucial to pinpoint that this more climate-oriented approach of central banks might look far from the practices currently used by central banks in high-income countries. However, it is less far from tools that central banks in low-income and middle-income countries have already used to promote environmental sustainability. For example, the Bank of Bangladesh requires that financial institutions allocate at least 5% of their total loan portfolio to green sectors; the People’s Bank of China has introduced a facility that provides low-cost liquidity for banks that provide green loans and has

⁵ For a detailed discussion of the features and the potential implications of the green supporting and the dirty penalising factor see D’Orazio and Popoyan (2019), Thomä and Gibhardt (2019), Berenguer et al. (2020), Dafermos and Nikolaidi (2020) and Dunz et al. (2020). See also Finance Watch (2020) for a financial regulation proposal that would make banks’ new fossil fuel exposures entirely equity-funded.

included green performance measurements in the macro prudential assessment of commercial banks; the Reserve Bank of India has included renewable energy companies in its Priority Sector Loans scheme (Dikau and Ryan-Collins, 2017; Volz, 2017; Campiglio et al., 2018; D’Orazio and Popoyan, 2019; Kedward et al., 2020).

According to the systemic risk approach, central banks need also to consider how they can support the financing of climate adaptation activities (like investments in flood protection and agricultural systems), whose role is becoming increasingly important given the current global warming trends. Since climate adaptation can reduce the materialisation of physical risks, the support of adaptation can be conducive to financial stability.

Policy implication 2: Climate-aligned monetary and financial policies should be coordinated with other climate policies such that their contribution to climate risk is maximised. Coordination is also required among central banks.

From a system-wide perspective, the isolated implementation of climate-aligned central bank tools will be far from being enough to safeguard financial stability in the long run. Fiscal, industrial and environmental regulation policies have an important role to play and policy coordination is necessary. This coordination is essential not only because it can lead to more substantial reductions in emissions, but also because it can minimise some transition effects that climate-aligned regulation and central banking tools might have.

For example, Dafermos and Nikolaidi (2020) have shown that the introduction of a dirty penalising factor can lead to an increase in default rates since a significant part of the firm sector is carbon-intensive and can experience a decline in credit availability and, hence, a deterioration in its liquidity position. However, this increase can be lower if the dirty penalising factor is accompanied by a carbon tax and a green subsidy policy mix. This is so since green fiscal policy can increase green investment and reduce thereby the amount of loans that are subject to higher capital requirements.

Moreover, given that physical climate-related risks depend on global emissions, isolated country-specific central bank and financial supervision interventions are unlikely to have an important effect on physical risks. For instance, even if some central banks try to reduce emissions in their countries, the impact on physical risks would be small without coordinated measures at the global level. Central bank coordination is thus essential from a systems perspective.

4. Why we need a systemic risk approach

There are at least three reasons why the systemic risk approach is preferable to the risk exposure one. First, the risk exposure approach over-simplifies the processes that determine climate-related financial risks. According to this approach, the fact that financial institutions have not incorporated climate risks into their operations is considered to be primarily the result of the lack of transparency and the lack of information. It is implicitly assumed that once this is addressed, climate risks will be accurately captured. It is not thereby recognised that in a world of fundamental uncertainty the transition and physical risks rely on system-wide implications and are not independent of how private financial institutions and central banks behave. In that sense, the risk exposure approach repeats the mistakes that financial regulators made in the period prior to the global financial crisis. One such mistake was that the Basel II micro-oriented prudential measures incentivised banks to take more risks during periods of high perceived stability, leading ultimately to higher systemic risk.

Post-crisis, Basel III introduced measures that try to address this problem. One such measure is the counter-cyclical capital buffer: under Basel III, banks might face higher capital requirements during periods of excess aggregate credit growth and lower capital requirements during periods of low credit growth (BIS, 2010). By recognising the impact that capital requirements can have on the lending behaviour on banks, one of the aims of the countercyclical capital buffer is to reduce system-wide risk by contributing to the reduction of credit availability during upturns and increase credit availability during downturns.

Therefore, what Basel III does through the countercyclical capital buffer is that it identifies a source of systemic risk (the source of risk is the excess credit expansion in the upturn and the weak credit expansion in the downturn) and adjusts capital requirements such that this risk is reduced. In similar lines, the systemic risk approach identifies greenhouse gas emissions as a source of systemic risk and suggests that monetary and financial policies can be used to reduce these emissions. On the contrary, the risk exposure approach does not target explicitly this source of systemic risk. Its main aim is to protect individual institutions from climate risks and improve the micro-based credit standards of central banks; it does not intend to change financial behaviour such that the systemic risk is reduced.

Second, the risk exposure approach is likely to act as a barrier to decarbonisation. Central banks seem currently willing to incorporate climate risks into their tools under the condition that these risks will

be properly measured. Although there has recently been a lot of progress on this, we are still far from the development and application of widely accepted methodologies for the measurements of these risks. This means that the development of climate-aligned tools might delay significantly if most central banks continue relying on the risk exposure approach. Moreover, it is not clear if the application of such methodologies will ultimately be beneficial for the promotion of low-carbon activities. For instance, it is not clear that dirty assets are riskier than green assets: the evidence is still inconclusive on this issue (see e.g. NGFS, 2020c). Therefore, even if central banks and financial supervisors decide to incorporate climate risks into their policies and frameworks, it might still be the case that the financing of low-carbon investment will not be enhanced.

Third, the risk exposure approach can undermine climate adaptation. While the incorporation of transition risks into central banking tools, financial regulation and disclosures has the potential to have favourable effects on the decarbonisation process, the side effects of the incorporation of physical risks can be adverse. Consider, for example, a company that is located in a country or region that is particularly vulnerable to climate change and is therefore exposed to climate risks. This company needs to spend a potentially significant amount of money to undertake investment in climate adaptation. Therefore, it is crucial for it to have access to financial markets and bank loans at a low cost. If the bonds, stocks and loans of this company are penalised by central banks, financial regulators and private financial institutions, the attempts of this company to adapt to climate change will be undermined and its financial position is very likely to become worse. Actually, there is already evidence according to which the cost of debt is higher in climate vulnerable countries (see Kling et al. 2018, 2021.). The tendency of the financial system to penalise such countries, that are in high need of climate adaptation investment, can be exacerbated if financial institutions and central banks start to more actively manage their exposure to physical risks.

Although I view the systemic risk approach as superior to the risk exposure one, there is a series of issues that would arise in the case that central banks decide to implement such an approach. A first issue is whether such an approach is in line with the mandates of central banks and the market neutrality approach that many of them adopt. As far as the mandate is concerned, from a systems-based perspective, any contribution that central banks make to the reduction of emissions is conducive to the reduction of physical risks and is, thus, in line with their financial stability mandate, especially if this mandate is interpreted over a long-run horizon. Hence, although the incorporation of environmental sustainability into the mandate of central banks might facilitate the implementation of

the systemic risk approach, this is not strictly necessary. A re-interpretation of the financial stability mandate might suffice.

As far as the market neutrality issue is concerned, the systemic risk approach is clear on this. It contends that many central bank interventions are not actually market-neutral: as the second proposition of this approach suggests, central banks have in many cases in the past shaped financial markets. Additionally, the pursuit of market neutrality is not desirable, especially in the context of climate change. This is so because the support of the existing carbon-intensive market structure is conducive to higher physical risks and undermines system-wide stability.⁶

A second issue is how the climate footprint of companies that issue bonds and take out loans can be defined such that monetary policy and financial regulation be adjusted accordingly. There are many challenges in defining greenness and dirtiness. However, some progress has recently been made in this issue. For example, despite its limitations (see Gabor et al., 2019), the EU Taxonomy (see EU Technical Expert Group on Sustainable Finance, 2020) can be a starting point for defining greenness. Dirty companies have in some studies been identified based on the NACE 4-digit sectors that they belong to (e.g. Battiston et al., 2017; Battiston and Monasterolo, 2019; Dafermos et al., 2020a, 2020b) as well as based on their emission intensity (e.g. Schoenmaker, 2019). The expectation is that the coming years will see an improvement in the availability of data related to greenness and dirtiness, as well as in the methodologies that identify the climate footprint of activities and companies. Importantly, the more quickly central banks and financial supervisors incorporate climate issues into their operations and decisions, the higher is expected to be the pace of the progress on this issue.

A third issue is how central banks can coordinate in practice in order to support simultaneously decarbonisation. This sounds like a very challenging task given that it has not actually happened again in the past. However, NGFS has already created a platform that has the potential to be used for the promotion of such a coordination. If NGFS supports explicitly the systemic risk approach, it can become the key network for sharing good practices and providing guidelines on how central banks and financial supervisors can implement effectively climate-aligned financial and monetary policies.

At the same time, it is important that such a coordination takes into account climate justice issues and the different responsibilities of the Global South and the Global North with regard to climate change.

⁶ For a critique to the money neutrality principle, see also van't Klooster and Fontan (2020) and Cahet-Fourrot (2020).

Given that the Global North carries the main responsibility for the cumulative greenhouse gas emissions that have caused global warming (Botzen et al., 2008; Hickel, 2020), it is crucial to recognise that the central banks in the Global North need to take more drastic action in the climate adjustment of their tools. It is also significant to consider that the Global South is generally much more vulnerable to climate change (Edmonds et al., 2020; Perry, 2020). The central banks in the Global South should therefore make more efforts to support the financing of climate adaptation investment.

5. Conclusion

Despite the recent consensus that central banks should consider climate change in their monetary analyses and decision-making, no consensus exists on how this should be done in practice and what the theoretical underpinnings of central bank interventions should be. Currently, most central banks in high-income countries seem to be in favour of the risk exposure approach. This approach emphasises the need to assess and quantify the exposure of the financial system to climate risks and reflect these risks in central bank and financial supervision/regulation tools.

On the contrary, the systemic risk approach emphasises that, due to the existence of fundamental uncertainty, it is impossible to measure climate risks accurately. Drawing on post-Keynesian and ecological economics, this approach views climate change from a system-wide perspective, emphasising the complex interactions between the macroeconomy, the financial system, the ecosystem, the political system and the society. It also highlights that central bank interventions and financial regulations affect the way that climate risks materialise. Hence, the adoption of the systemic risk approach would make central banks more active actors, since it would suggest that central banks need to intervene as soon as possible to help reduce climate-related instability. This approach also opens up the possibility for a policy coordination in the fight against climate change, both at the national and the global level.

I have argued that in the era of climate emergency, central banks need to adopt as soon as possible the systemic risk approach, drawing on practices that have already been implemented by some central banks in low-income and middle-income countries. This would involve significant challenges, such as the need for an accurate definition of degrees of greenness and dirtiness. But the more central banks delay to become more pro-active in the area of the climate crisis, the more they lose the opportunity to contribute to the fight against climate change and the more they share the responsibility for the implications of climate inaction. Central bank intervention will not in any case be sufficient to address

the climate problem: other policies and deeper structural social changes are necessary to take place at the same time (see Svartzman, 2020). However, a change in the direction of the most powerful institutions in finance-dominated capitalism would definitely be an important step in decarbonising our economies and safeguarding the resilience of the financial system.

References

- Allen, T., Dees, S., Chouard, V., Clerc, L., de Gaye, A., Devulder, A., Diot, S., Lisack, N., Pegoraro, F., Rabate, M. and Svartzman, R. (2020). Climate-related scenarios for financial stability assessment: An Application to France, Banque de France Working Paper 774, July.
- Arndt, C., Loewald, C. and Makrelov, K. (2020). Climate change and its implications for central banks in emerging and developing economies, South African Reserve Bank Working Paper 20/04.
- Bank of England (2017). The Bank of England's response to climate change, Quarterly Bulletin 2017 Q2.
- Battiston, S. and Monasterolo, I. (2019). How could the ECB's monetary policy support the sustainable finance transition?, mimeo, University of Zurich.
- Battiston, S., Mandel, A., Monasterolo, I., Schütze, F. and Visentin, G. (2017). A climate stress-test of the financial system, *Nature Climate Change*, 7 (4), 283-290.
- Berenguer, M., Cardona, M. and Evain, J. (2020). Integrating climate-related risks into banks' capital requirements, I4CE Institute for Climate Economics.
- Bolton, P., Despres, M., da Silva, L.A.P., Svartzman, R. and Samama, F. (2020). The green swan: Central banking and financial stability in the age of climate change, Bank for International Settlements, January.
- Botzen, W. J., Gowdy, J. M. and van den Bergh, J. C. (2008). Cumulative CO2 emissions: shifting international responsibilities for climate debt, *Climate Policy*, 8 (6), 569-576.
- Braun, B. (2018). Central banking and the infrastructural power of finance: the case of ECB support for repo and securitization markets, *Socio-Economic Review*, 18 (2), 395-418.
- Cahet-Fourot, L. (2020). The future of central banking – Central banking for a social-ecological transformation, this volume.
- Campiglio, E. (2016). Beyond carbon pricing: The role of banking and monetary policy in financing the transition to a low-carbon economy, *Ecological Economics*, 121, 220-230.
- Campiglio, E., Dafermos, Y., Monnin, P., Ryan-Collins, J., Schotten, G. and Tanaka, M. (2018). Climate change challenges for central banks and financial regulators, *Nature Climate Change*, 8 (6), 462-468.
- Carney, M. (2015). Breaking the tragedy of the horizon-climate change and financial stability, Speech given at Lloyd's of London, 29, 220-230.
- Carney, M. (2016). Resolving the climate paradox, Speech Arthur Burns Memorial Lecture, Berlin 22 September.

- Carney, M. (2020). Letter to the Chair Elect of the Treasury Select Committee, available at: <https://publications.parliament.uk/pa/cm5801/cmselect/cmtreasy/correspondence/Mark-Carney-BoE-to-Chair-270220.pdf>
- Chenet, H., Ryan-Collins, J. and van Lerven, F. (2019). Climate-related financial policy in a world of radical uncertainty: Towards a precautionary approach, UCL Institute for Innovation and Public Purpose Working Paper 2019-13.
- Cœuré, B. (2018). Monetary policy and climate change, speech at a conference ‘Scaling up Green Finance: The Role of Central Banks’ organised by the NGFS, the Deutsche Bundesbank and the Council on Economic Policies, November.
- BIS (2010). Guidance for national authorities operating the countercyclical capital buffer, Basel Committee on Banking Supervision, December.
- Dafermos, Y and Nikolaidi, M. (2020). How can green differentiated capital requirements affect climate risks? A dynamic macrofinancial analysis, available at SSRN: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3658088.
- Dafermos, Y., Nikolaidi, M. and Galanis, G. (2017). A stock-flow-fund ecological macroeconomic model, *Ecological Economics*, 131, 191-207.
- Dafermos, Y., Gabor, D., Nikolaidi, M. and van Lerven, F. (2020a). Decarbonising the Bank of England’s Pandemic QE: ‘Perfectly Sensible’, New Economics Foundation, August.
- Dafermos, Y., Gabor, D., Nikolaidi, M., Pawloff A. and van Lerven, F. (2020b). ‘Decarbonising is easy: Beyond market neutrality in the ECB’s QE’, New Economics Foundation, October.
- Davidson, P. (1996). Reality and economic theory, *Journal of Post Keynesian Economics*, 18 (4), 479-508.
- Dikau, S. and Ryan-Collins, J. (2017). Green central banking in emerging market and developing country economies, New Economics Foundation.
- D’Orazio, P. and Popoyan, L. (2019). Fostering green investments and tackling climate-related financial risks: Which role for macroprudential policies?, *Ecological Economics*, 160, 25-37.
- Dosi, G. and Egidi, M. (1991). Substantive and procedural uncertainty, *Journal of Evolutionary Economics*, 1 (2), 145-168.
- Dunz, N., Naqvi, A. and Monasterolo, I. (2020). Climate transition risk, climate sentiments, and financial stability in a stock-flow consistent approach, *Journal of Financial Stability*, Forthcoming.
- ECB (2020). Guide on climate-related and environmental risks: Supervisory expectations relating to risk management and disclosure, May.
- EU Technical Expert Group on Sustainable Finance (2020). Taxonomy: Final report of the Technical Expert Group on Sustainable Finance, Brussels, March.

- Edmonds, H.K., Lovell, J.E. and Lovell, C.A.K. (2020). A new composite climate change vulnerability index, *Ecological Indicators*, 117, 1-8.
- Finance Watch (2020). Breaking the climate-finance doom loop: How banking prudential regulation can tackle the link, June.
- Gabor, D. (2016). The (impossible) repo trinity: the political economy of repo markets, *Review of International Political Economy*, 23 (6), 967-1000.
- Gabor, D., Dafermos, Y., Nikolaidi, M., Rice, P., van Lerven, F., Kerlake, R., Pettifor A., and Jacobs, M. (2019). 'Finance and climate change: a progressive green finance strategy for the UK', Report of the independent panel commissioned by Shadow Chancellor of the Exchequer John McDonnell MP
- Giambona, E., Matta, R., Peydró, J.L. and Wang, Y. (2020). Quantitative easing, investment, and safe assets: the corporate-bond lending channel. Investment, and safe assets: The corporate-bond lending channel, *Barcelona Graduate School of Economics Working Papers* 1179.
- Hickel, J. (2020). Quantifying national responsibility for climate breakdown: an equality-based attribution approach for carbon dioxide emissions in excess of the planetary boundary, *The Lancet Planetary Health*, 4 (9), e399-e404.
- Honohan, P. (2019). Should monetary policy take inequality and climate change into account?, *Peterson Institute for International Economics Working Paper* 19-18.
- Kedward, K., Ryan-Collins, J. and Chenet, H. (2020). Managing nature-related financial risks: a precautionary policy approach for central banks and financial supervisors, *UCL Institute for Innovation and Public Purpose Working Paper* 2020-09.
- Kling, G., Lo, Y., Murinde, V., and Volz, U. 2018. Climate vulnerability and the cost of debt. SSRN paper, available at: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3198093
- Kling, G., Volz, U., Murinde, V. and Ayas, S., 2021. "The impact of climate vulnerability on firms' cost of capital and access to finance." *World Development*, 137.
- Kronenberg, T. (2010). Finding common ground between ecological economics and post-Keynesian economics, *Ecological Economics*, 69 (7), 1488-1494.
- Lagarde, C. (2020). Climate change and the financial sector, Speech at the launch of the COP 26 Private Finance Agenda, February, available at: https://www.ecb.europa.eu/press/key/date/2020/html/ecb.sp200227_1~5eac0ce39a.en.html.
- Monnin, P. (2018). Central banks and the transition to a low-carbon economy, *Council on Economic Policies*, Discussion Note 2018/01.
- Monnin, P. (2020). Shifting gears: integrating climate risks in monetary policy operations, *Policy Brief* 2020/1.

- Lavoie, M. (2014). *Post-Keynesian Economics: New Foundations*, Edward Elgar, Cheltenham and Northampton, MA.
- Luck, S. and Zimmermann, T. (2020). Employment effects of unconventional monetary policy: Evidence from QE, *Journal of Financial Economics*, 135 (3), 678-703.
- NGFS (2018). NGFS first progress report, Network for Greening the Financial System, October.
- NGFS (2019). Network for greening the financial system: first comprehensive report: a call for action, climate change as a source of financial risk, Network for Greening the Financial System, April.
- NGFS (2020a). Climate change and monetary policy: initial takeaways, Network for Greening the Financial System, May.
- NGFS (2020b). Guide for supervisors: integrating climate-related and environmental risks into prudential supervision, Network for Greening the Financial System, May.
- NGFS (2020c). A status report on financial institutions' experiences from working with green, non green and brown financial assets and a potential risk differential, Network for Greening the Financial System, June.
- Nguyen, M. (2020). Collateral haircuts and bond yields in the European government bond markets, *International Review of Financial Analysis*, 69, 1-10.
- Olovsson, C. (2018). Is climate change relevant for central banks?, *Sveriges Riksbank Economic Commentaries*, 13.
- Pelizzon, L., Riedel, M., Simon, Z. and Subrahmanyam, M.G. (2020). Collateral eligibility of corporate debt in the Eurosystem, *SAFE Working Paper 275*.
- Perry, K. (2020). Realising climate reparations: towards a global climate stabilization fund and resilience fund programme for loss and damage in marginalised and former colonised societies, *SSRN paper*.
- Sawyer, M. (2020). The past, present and future of evolutionary macroeconomics, *Review of Evolutionary Political Economy*, 1, 37-54.
- Schoenmaker, D. (2019). Greening monetary policy, *Working Paper 2*, Bruegel.
- Svartzman, R. (2020). Monetary and financial policies for an ecological transition – An overview of central banks' actions and some reflections on post-Keynesian insights, this volume.
- Svartzman, R., Dron, D., and Espagne, E. (2019). From ecological macroeconomics to a theory of endogenous money for a finite planet, *Ecological economics*, 162, 108-120.
- TCFD (2019). Task force on Climate-related Financial Disclosures status report: 2019 status report, June 2019.

- Thomä, J. and Gibhardt, K. (2019). Quantifying the potential impact of a green supporting factor or brown penalty on European banks and lending. *Journal of Financial Regulation and Compliance*, 27 (3), 380-394.
- Todorov, K. (2020). Quantify the quantitative easing: Impact on bonds and corporate debt issuance, *Journal of Financial Economics*, 135 (2), 340-358.
- Tooze, A. (2019). Why central banks need to step up on global warming, *Foreign Policy*, July, available at: <https://foreignpolicy.com/2019/07/20/why-central-banks-need-to-step-up-on-global-warming/>
- van Lerven, F., Jourdan, S. and Bryer, N. (2020). The European Central Bank and climate change: Five steps towards a sustainable recovery. NEF, Positive Money Europe, and 350.org, available at: <https://neweconomics.org/uploads/files/ecb-climate-change1a.pdf>
- van't Klooster, J. and Fontan, C. (2020). The myth of market neutrality: A comparative study of the European Central Bank's and the Swiss National Bank's corporate security purchases, *New Political Economy*, 25 (6), 865-879.
- Vermeulen, R., Schets, E., Lohuis, M., Kölbl, B., Jansen, D.J. and Heeringa, W. (2019). The Heat is on: A framework for measuring financial stress under disruptive energy transition scenarios, DNB Working Paper 625.
- Villeroy de Galhau, F. (2019). Climate change: central banks are taking action, *Banque de France Financial Stability Review* 23, June 2019.
- Volz, U. (2017). On the role of central banks in enhancing green financing, *UN Environment Inquiry Working Paper* 17/01, Geneva.
- Weidmann, J. (2019). Climate change and central banks, welcome address at the Deutsche Bundesbank's second Financial Markets Conference, October, available at: <https://www.bundesbank.de/en/press/speeches/climate-change-and-central-banks-812618>.
- 2° Investing Initiative (2019). Storm ahead: A proposal for a climate stress-test scenario, *Discussion Paper* April 2019.