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Finance and climate change: what role for central banks and financial regulators?

Emanuele Campiglio[*], Yannis Dafermos[†], Pierre Monnin[‡], Josh Ryan-Collins[§], Guido Schotten[**], Misa Tanaka[††]

*[**Abstract**]*

Shifting to a low-carbon economy will require a comprehensive set of policies aimed at delivering financial resources to climate-friendly investments, while avoiding destabilising effects on the economic and financial system. Central banks and financial regulators have a role to play in this process. This Perspective discusses both their current and potential interventions in supporting a rapid and orderly low-carbon transition.

*[**Main text**]*

There is by now a widespread consensus that unmitigated climatic change would severely affect global productive assets and lead to large economic losses.[1] Additionally, recent research suggests that climate-related damages could potentially also affect the stability of the financial system.[2–5] The increase in climate-induced *physical risks* (e.g. heat waves, floods and storm surges) could directly affect insurers that cover them. If these risks are uninsured, the losses resulting from weather-related disasters will damage the affected households' and corporates' balance sheets, and the deterioration of their financial position could lead to losses for their lender banks.

To avoid undesirable physical damages and the associated financial instability, a transition to a carbon-free productive system is ultimately necessary. However, the transition itself might increase the risks of economic dislocation and financial losses, and thus could have destabilising effects on the financial system (*transition risks*). Whether driven by (unanticipated) policies, technical development or market preferences, the shift to a new technological paradigm will cause a system-wide societal adjustment, during which certain sectors are likely to lose out. For instance, respecting the 2°C threshold in temperatures will most probably require a large portion of existing reserves of oil, gas and coal to remain in the ground[6,7], and thus be written off from the balance sheets of the companies that own them. Other physical assets that could become stranded include part of the electricity generation capacity stock,

[*] Institute for Ecological Economics, Vienna University of Economics and Business. Emanuele.campiglio@wu.ac.at.
[†] Department of Accounting, Economics and Finance, University of the West of England
[‡] Council on Economic Policies
[§] New Economics Foundation
[**] De Nederlandsche Bank
[††] Bank of England.
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residential housing, real estate, transportation infrastructure and other forms of carbon-intensive industrial technology. Such asset stranding will not only lead to economic losses and unemployment, but will also affect the market valuation of the companies that own these assets, thus negatively impacting their investors, and potentially triggering cascade effects throughout the deeply interconnected financial system.[8]

[TABLE 1 ABOUT HERE]

The objective is to find the narrow and gradually shrinking window of opportunity that would allow societies to achieve a rapid transition to a low-carbon economic system, while avoiding excessive economic losses and financial instability (see Figure 1). Achieving this structural change is likely to require well-targeted policy interventions. First, the absence of a market price for environmental externalities makes the risk-return profile of low-carbon investments unattractive for private investors, relative to high-carbon investments. Additional features of low-carbon investments such as high capital costs, low liquidity on financial markets and the uncertainty regarding technological innovations and the direction of climate policies are preventing financial resources to flow to low-carbon sectors at the required speed and quantity.[9,10] Second, financial markets may not be fully pricing the climate-related risks, due to a combination of imperfect information, behavioural biases and misaligned professional incentives.[11,12] While more empirical research is needed to fully estimate the degree to which climate-related risks are priced in financial assets, several factors indicate that financial actors, despite beginning to develop appropriate methodologies[13], might still lack all the relevant information needed to assess the exposure of their portfolios to climate-related risks. Third, when implemented without the necessary precautions, climate policies can generate substantial transition risks. Thus, policy interventions need to be designed in a way that would allow the corporate sectors (including the carbon-intensive ones) to adjust their business plans and investments smoothly in order to meet the requirements of a low-carbon economy.

The main proposed policy instrument to internalise carbon externalities and spur low-carbon investments has been carbon pricing, which could be implemented either through the introduction of a tax on the carbon content of goods and services, or the creation of a cap-and-trade system of emission allowances[14,15]. Other market-based instruments, such as the introduction of subsidies for clean technologies and a phasing-out of fossil fuel subsidies also follow a similar logic. However, carbon pricing is often perceived as negatively affecting businesses and consumers, thus making it a politically unpalatable choice. More crucially, even when implemented, it might need to be complemented by additional policies that could mobilise the required finance for low-carbon investments.[16,17] This policy *impasse* has led a number of researchers to call for central banks and financial regulators to intervene in support of a rapid and orderly transition.

There are several ways in which central banks and financial regulators can engage with climate change and the low-carbon transition. First, they can favour the assessment of climate-related risks, both for single institutions and at the systemic level. This is the strategy currently implemented by some central banks in high-income countries. Second, they can employ the policy tools at their disposal to mitigate climate-related risks and support the development of low-carbon activities. While several examples of

proactive behaviour by central banks are available in emerging economies, to date this approach has not been implemented systematically.

[TABLE 2 ABOUT HERE]

Risk disclosure and climate stress testing

The potential mis-pricing of climate-related risks and its impact on financial stability have attracted increasing attention of central banks, financial regulators and other institutions responsible for financial stability.[3,18–24] The main event initiating this trend has been the 2015 speech by Mark Carney, Governor of the Bank of England and Chairman of the Financial Stability Board[18]. Carney discussed the 'tragedy of the horizon' embedded in the different time spans that characterise monetary and financial stability policies (2-5 years) and the much longer-term perspective required to deal with climate change (10 to 50 years and beyond). Carney also formally introduced the idea that physical and transition risks could potentially present risks to financial stability, and thus are relevant to financial regulators.

Since then, several central banks have also started assessing the exposure of their domestic financial system to climate-related risks. For instance, De Nederlandsche Bank (DNB) has conducted a study of the Dutch financial system to find that, while the exposure to fossil fuel producers is probably too small to represent a systemic threat, the broader exposure of the financial sector to carbon-intensive sectors is large enough to pose potential systemic risks.[25] Other central banks have expressed interest in developing similar methods; the Bank of England reviewed the exposures of the UK insurance sector to climate-related financial risks in 2015, and is conducting a similar review of the banking sector.[26] The European Systemic Risk Board has also considered the potential impact of the transition to a low-carbon economy on financial stability,[23] while Sweden's Finansinspektionen has commissioned a report to examine the effects of climate change on financial stability.[24]

In addition to quantitatively assessing the relevance of climate-related risks for financial stability, central banks and financial regulators have also been seeking to enhance the resilience of the financial system to climate change by supporting measures to facilitate an orderly market transition to a lower-carbon economy. For example, the Financial Stability Board established a Task Force for Climate-related Financial Disclosures in 2015, to develop voluntary climate-related disclosures that could promote more informed investment, credit and insurance underwriting decisions. Its final report, published in June 2017, makes sector-specific recommendations on how companies with public debt or equity could voluntarily disclose climate-related financial risks, in order to better inform their investors, lenders and insurance underwriters.[27] The support for the development of voluntary disclosure standards is in line with the wider strategy of encouraging the financial industry to appropriately price climate-related risks, while respecting the freedom of enterprise and market dynamics. Other measures include nurturing the expanding market of 'green bonds'[28] and supporting the international effort on the topic.[26] The Bank of England and People's Bank of China, for instance, are leading the Green Finance Study Group of the G20.[29]

Climate-aligned financial regulation

A more proactive option is to adapt prudential financial regulations to take into account climate-related financial risks. Macro- and micro-prudential regulations encompass a range of regulatory instruments aimed at limiting systemic financial risk, or specific financial risks at specific financial institutions, including reserve and capital requirements, caps on the loan-to-value, ceiling on credit growth, and others.[30,31] These criteria might be recalibrated to include climate considerations and provide financial institutions with incentives to expand the amount of lending flowing to low-carbon activities.[32,33]

Some emerging market central banks have used their powers over prudential policies in order to encourage lending to low-carbon activities[34]. For example, Banque Du Liban differentiates reserve requirement ratios - i.e. the required ratio of central bank reserves held by private banks to their stock of deposits – according to the amount of bank lending flowing to renewable energy and energy efficiency projects.[35] Banco Central do Brasil requires commercial banks to incorporate environmental and social risk factors in to their governance framework and demonstrate how these risks are evaluated when calculating their capital needs.[36]

However, several factors contribute to explaining the reluctance of regulators in high-income economies to use prudential regulations as a tool to support the low-carbon transition. First, despite explicitly recognizing the relevance of climate-related financial risks, most central banks and financial regulators do not consider their mandate to justify the adjustment of prudential policies for the purpose of directing finance towards low-carbon activities, unless they can establish that these risks are material, and are systematically higher for high-carbon activities. For example, if there is sufficient evidence that mortgage loans for energy efficient homes are less risky than mortgage loans for energy inefficient homes, then it could be justifiable to differentiate capital requirements on these loans on prudential grounds. Otherwise, reducing risk weights on bank loans to low-carbon investments could jeopardise short-term prudential policy objectives. Second, climate-aligned prudential policy could be too blunt a tool if applied to entire productive sectors or companies, as it would not support those traditionally high-carbon companies - e.g. utilities - investing in low-carbon technologies. Finally, high-carbon companies could bypass the tightening of prudential policy by raising funds on the international financial markets, unless complementary policies targeting alternative financing sources are also implemented. Nevertheless, central banks and financial regulators can still encourage regulated firms to take into account climate-related risks through their supervisory process, e.g. by scrutinising their risk models to examine whether climate-related risks are being taken into account, without necessarily taking regulatory actions.

Climate change and monetary policy

In addition to financial regulation, central banks can consider aligning their monetary policy tools to environmental sustainability goals. Monetary policy refers to the range of instruments central banks have at their disposal to manage the amount of liquidity available to commercial banks, as well as its price. 'Conventional' monetary policy before the 2007 financial crisis mainly consisted in setting the interest rate at which banks could borrow from the central bank, against a collateral. In the aftermath of the financial crisis, several central banks have initiated 'unconventional' Quantitative Easing (QE) programmes, consisting of large-scale purchases of financial assets of different types (sovereign and

corporate bonds, among others) in order to meet their inflation targets and to boost private sector spending.

While usually meant to be market-neutral, some central banks have reframed their monetary policies, mostly of the 'conventional' type, to support low-carbon activities[34]. Bangladesh Bank, for instance, offers refinancing lines to commercial banks at preferential terms for their green loans.[37] The Bank of Japan's Loan Support Program offers subsidised loans to financial institutions supporting several 'lending priority sectors', including 'environment and energy businesses'.[38]

Additional policies can be considered. For instance, central banks' collateral frameworks could be adapted to reflect climate change considerations. The collateral framework defines assets that banks can pledge to get liquidity from the central bank, as well as the relative amount that they can borrow against those assets. The criteria used by central banks to establish the eligibility of an asset as collateral and the 'haircut' imposed have deep impact on the desirability - and thus price - of the asset.[39] Being included in the collateral framework can induce an "overproduction" of these assets by financial institutions, which is not without consequences for the real economy.[40] Including climate-related considerations in collateral framework criteria would make low-carbon financial assets relatively more attractive to banks and thus improve funding conditions for the transition. A case for taking into account climate-related risks in determining the collateral eligibility and haircut could be made if these are not adequately reflected in credit ratings.

Perhaps more importantly, central banks could calibrate their QE programmes to include climate considerations. Until now, their asset purchase strategies have been driven by the desire to avoid 'distorting' the market, while at the same time ensuring that assets being purchased meet high credit standards. The European Central Bank (ECB), for instance, buys sovereign bonds respecting the current maturity distribution, and allocates purchases of corporate bonds across sectors according to the current bond market sectoral weights.[41,42] However, recent research has suggested that the 'neutral' stance adopted by central banks has inadvertently led their purchases of corporate bonds to be skewed in favour of large carbon-intensive companies, reflecting their relatively strong credit ratings.[43] This bias is inevitable given that many green sector firms are too small to issue corporate bonds and are dependent on bank financing. This raises a concern that central banks' asset purchase could have an unintended consequence of undermining their own effort of encouraging financial markets and institutions to better account for climate-related financial risks.

A first way to reduce the distortion in central banks' current asset purchase programmes is to incorporate climate-related criteria or, more in general, environmental, social and governance (ESG) criteria in assessing whether an asset is eligible for purchase. If credit ratings provided by rating agencies are considered not to adequately reflect climate-related financial risks, central banks could consider developing in-house methodologies to do so. Such a policy would be in line with their existing policy to appropriately assess financial risks associated with asset purchase, and could lead central banks to exclude certain set of assets. While no central bank has set ESG criteria for asset purchases under their QE programmes, the Swiss National Bank does have its own ethical and corporate governance criteria to exclude certain set of companies from its foreign equity purchase.[44] The DNB also has ESG criteria and purchases green bonds for own-account investments.[45] The Norges Bank has ESG criteria for the

government's pension fund that it manages, and explicitly excludes companies involved in coal-based energy production or responsible for severe environmental damage.[46] The objective is not to support financing of low-carbon sectors, but to prevent their cyclical interventions from inadvertently financing firms which do not meet a set of non-financial ESG criteria, including societal climate goals.

An alternative, more proactive approach would be to privilege the purchase of financial assets issued by specific entities, in order to improve the financing conditions for low-carbon sectors. More specifically, a 'green QE' strategy would steer the purchase strategy away from securities issued by carbon-intensive companies, privileging securities issued by low-carbon entities, such as 'green bonds'.[47] Thus far, no central banks, including those in emerging market economies, have used their asset purchases to specifically target green sectors, and several central bankers have explicitly ruled out the option as out of their mandate.[48] Central banks also view QE to be a temporary monetary policy tool, deployed due to the current ineffectiveness of conventional monetary policy, but that will ultimately be unwound. For these reasons, using them to provide long-term financing to specific sectors would overburden central banks with responsibilities outside their mandate and potentially compromise their effectiveness. Moreover, low-carbon assets usually do not meet the existing financial risk standards to be included into the list of eligible assets for central bank purchase, which mainly consist of investment grade bonds – i.e. bonds with low default risk. Purchasing them could raise concerns regarding the quality of central banks' portfolio. Finally, limiting the assets eligible for purchase could potentially undermine the effectiveness of monetary policy to achieve its main objectives.

At the same time, central bank purchase of low-carbon assets that are guaranteed by a government or issued by public sector entities has not been controversial. For example, the ECB allocates around 10% of its Public Sector Purchase Programme to bonds issued by international organisations and multilateral development banks located in the euro area. Several development banks have been at the forefront of low-carbon financing. The European Investment Bank (EIB), for instance, dedicates a minimum of 25% of its lending to climate action projects.[49] Thus, the ECB might already be indirectly supporting low-carbon investments through the inclusion of EIB assets in its QE programme.

It´s a matter of mandate

Ultimately, what central banks and financial regulators will do to support a smooth transition to a low-carbon economy will depend on what their mandate allows, how this is interpreted, and their willingness to act.

Central banks are public institutions with specific objectives that are usually determined by national governments. Alongside their mandate to operate monetary policy to maintain price stability, most major central banks have some mandate to maintain the stability of the financial system. Some central banks, especially those in emerging economies, have a larger spectrum of goals that may include direct supervision and regulation of financial institutions, exchange rate stability, employment creation and economic growth.[50,51] Mandates have also dramatically changed throughout the history of central banking.[52]

Among these objectives, climate change and the low-carbon transition are predominantly relevant for the achievement of financial stability objectives. This has been recognised by most central banks, although, as discussed above, the policies put in place to address climate-related financial risks vary depending on what central banks deem admissible and appropriate. Central banks in high-income countries have preferred to adopt a market-neutral approach, supporting the process of recognition and assessment of climate-related risks by private financial institutions. This suggests that, contrary to real estate sectors in the aftermath of the 2007 financial crisis, carbon-intensive sectors are not currently considered a sufficiently urgent threat to financial stability to justify an interventionist stance, and central banks prefer to leave to governments the responsibility to implement climate-aligned policy or, possibly, modify their mandate. In many emerging economies, where central banks' mandates are broader and their connection with the government stronger, the variety of tools to address climate-related financial risks has been wider.

More in general, the wider is the range of its objectives, the easier it is for a central bank or a financial regulator to justify actions to address climate-related risks, or indeed explicitly encourage more financing towards low-carbon sectors. Additionally, the more diversified is the set of policy tools at its disposal, the more targeted can be its interventions to mitigate climate-related risks. Finally, the longer is the time horizon considered by the central bank when formulating its strategies, the more relevant will be climate-related risks in the assessment, and the more justified will be the measures implemented to address them.

Central banks' operations generally aim to avoid 'distortions' in the functioning of private markets. Awarding preferential treatment to low-carbon sectors would qualify as such a distortion. However, there are plenty of current and historical examples in which central banks have implemented sector-specific policies.[47,53,54] The US Federal Reserve has explicitly targeted the housing market in the aftermath of the financial crisis. The Funding for Lending Scheme of the Bank of England aims at incentivising lending to small and medium enterprises.[55] The Reserve Bank of India imposes to commercial banks to allocate a certain proportion of lending to a list of 'priority sectors', which now include renewable energy.[56] Similarly, Bangladesh Bank has introduced a minimum credit quota that financial institutions have to allocate to green sectors, currently set at 5%.[37]

Addressing the climate crisis

To conclude, policymakers now face the challenging task of ensuring a structural shift to a low-carbon society while concurrently safeguarding economic prosperity and the stability of the financial system. Achieving this goal will require financial markets and institutions to start considering climate-related risks in their financing decisions. Central banks and financial regulators can contribute to this process in several ways. First, they can support measures to improve financial markets' ability to take into account climate-related risks, e.g. better disclosure of such risks. Second, central banks and financial regulators should further deepen their activities in assessing climate-related financial risk exposures of their regulated firms, including what data and methods they are using in assessing these risks, and take appropriate actions if prudential risks are found to be material. Finally, central banks might wish to consider whether they should account for climate-related factors in determining eligibility of assets for its asset purchase programmes or as collateral in their market operations. A necessary precondition for the successful implementation of any type of climate finance policy is to develop a comprehensive and standardised

categorisation of 'low-carbon' or 'green' assets. While some progress has been made[57,58], much work on this remains to be done.

The role of central banks and financial regulators in using their policy tools to re-direct finance towards low-carbon investments, e.g. via bank lending, has been the most controversial. Their monetary and macroprudential policy tools could prove effective in managing a potential 'carbon bubble' before it creates systemic effects. However, these institutions could be willing to do more to encourage lending towards low-carbon investments only if they perceive their mandate to allow them to do so. Whether such a mandate is appropriate requires further examination. First, there is a risk of overburdening central banks and financial regulators with an excessively wide range of responsibilities, which could take up management capacity at the detriment of their primary objectives of maintaining monetary and financial stability. Second, as unelected institutions, it may be undesirable to confer them too much power without the proper democratic checks and balances, especially as this would leave these institutions vulnerable to lobbying by special interests.

Ultimately, the intervention of central banks and financial regulators will depend on how urgent and systemic society perceives the climate issue to be. Elected governments, as principal responsible for strategic planning, should start implementing climate-friendly policies as soon as possible. However, if it is true that climate change is indeed 'the greatest and widest-ranging market failure ever seen'[59], the effort for a smooth low-carbon transition will have to involve the entire societal body, including the financial sector, and require the implementation of a comprehensive set of policies, some of which might require the collaboration of central banks and financial regulators. If this is considered to be desirable in the future, they should find themselves ready to take up the challenge.

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Table 1 The low-carbon transition trade-off

	No transition	'Rapid and orderly' transition	Abrupt transition
Short term	No stranded assets	Minimal stranding of assets	Stranded physical assets (e.g. fossil fuel reserves and carbon-intensive capital stocks)[6,7] Stranded financial assets (e.g. loss in market valuation and cascade effects)[8]
Long term	Climate-induced damages to productive assets[1] Climate-related financial losses[4]	Minimal climate-induced damages to physical and financial assets	No significant climate-induced damages to physical and financial assets

Table 2 Climate-friendly interventions by central banks and financial regulators

	Concept	Current applications
Assessment of climate-related risks	Develop and apply methodologies to identify and measure climate-related risks	De Nederlandsche Bank[3] Bank of England[4]
Disclosure of climate-related risks	Develop standardised methods of climate-related risk reporting	Task Force on Climate-related Financial Disclosures[5] French Energy Transition Law[6]
Climate-aligned prudential regulation policy	Use prudential regulation tools (e.g. reserve and capital requirements) to incentivise lending to low-carbon activities	Banque du Liban[7] Banco Central do Brasil[8]
Green central bank financing	Provide additional/subsidised liquidity to banks lending to low-carbon activities	Bangladesh Bank[9] Bank of Japan[10]
Lending quotas	Impose a minimum proportion of bank lending to flow to low-carbon sectors	Reserve Bank of India[11] Bangladesh Bank[9]
Inclusion of ESG criteria in monetary policy	Include ESG criteria in the evaluation of the overall risk of an asset purchased or accepted as collateral	Only for own purchase (DNB, Norges Bank)[12,13]
Green Quantitative Easing	Purchase 'green' assets as part of Quantitative Easing programmes	Only indirectly through development banks' assets (e.g. European Investment Bank bonds)