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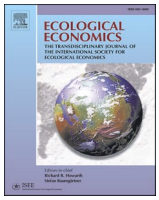

Analysis

Central bank mandates, sustainability objectives and the promotion of green finance

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ABSTRACT

This article examines how addressing climate-related risks and supporting mitigation and adaptation policies fit into central bank mandates. We conduct an analysis of mandates and objectives using the IMF's Central Bank Legislation Database and compare these to sustainability-related policies central banks have adopted in practice. Out of 135 central banks, only 12% have explicit sustainability mandates, while 40% are mandated to support the government's policy priorities, which mostly include sustainability goals. However, given that climate risks can directly affect central banks' traditional core responsibilities, all institutions ought to incorporate climate-related physical and transition risks into their policy frameworks to safeguard macro-financial stability.

1. Introduction

Against the backdrop of increasing public awareness of the risks posed by climate change and the political commitment of the international community to address these challenges as embodied in the Paris Agreement, recent years have seen an intensifying discussion on the role of central banks in addressing risks associated with climate change and in supporting the development of green finance (e.g. Volz et al., 2015; Batten et al., 2016; Volz, 2017; Campiglio et al., 2018; Dikau and Volz, 2019). This has not been a purely theoretical debate. A growing number of central banks have already adopted green finance policies or guidelines, or have started to incorporate climate risk into macro-prudential frameworks (McDaniels and Robins, 2018). This has led to the launch of initiatives such as the Sustainable Banking Network (SBN) and the Central Banks and Supervisors Network for Greening the Financial System (NGFS).

While a general consensus has developed that central banks (and other supervisory bodies) cannot ignore climate change (NGFS, 2018, 2019), there is no agreement on the extent to which climate change (or other environmental risks) should be incorporated into existing operational frameworks or whether central banks should even play a supportive or promotional role in scaling up green finance. This may not be surprising, given the different histories and policy traditions of central banks in different parts of the world and also given the differences in their mandates.

Historically, the role of central banks has evolved considerably, and changes have often occurred in response to crises or perpetual policy problems. For example, the Financial Crisis of 2008/2009 illustrated the implications of the omission of financial stability objectives in most central bank mandates. The crisis triggered a change in the broader environment in which central banks are now operating and thereby also necessitated a further evolution of the role, governance and mandate of these institutions (BIS, 2009). The financial crisis has raised concerns with regard to the role and ability of central banks in preventing and managing financial crises and provoked a discussion of the role of central banks in safeguarding financial stability and, eventually, the recognition of the need to reconsider or adjust the mandates of central banks with regard to financial stability (BIS, 2011).

The impending climate crisis, which will have a potentially disastrous impact on our economies and requires urgent policy action (IPCC, 2018), is once again changing the policy environment in which central banks are operating. Climate change has possibly significant implications not only for the core operations of central banks but also poses the question of their broader role in addressing climate change-related risk and mitigation. How far central banks can go in playing a role as an overall catalyst for mainstreaming green finance on the one hand, and incorporating climate risks in their core policy frameworks on the other hand, depends significantly on their mandates. A close investigation of the legal objectives of central banks is therefore essential in order to substantiate the on-going discussion against the background of the increasingly pressing issue of responding to global warming.

This article seeks to contribute to the broader discussion of the

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implications of climate change for the operations, governance and role of central banks. It is not the aim of this article to set out a one-size-fits-all approach regarding how central banks can become "greener", but rather to contribute to the fundamental understanding of how climate change relates to the operational frameworks of monetary authorities. It is a first attempt at analysing to what extent climate-related risks and mitigation policies fit into the current set of central bank mandates and objectives. To this end, we conduct a detailed analysis of central bank mandates and objectives, using the IMF's Central Bank Legislation Database, and compare these to current arrangements and sustainability responsibilities that central banks have adopted in practice. To scrutinise the alignment of mandates with climate-related policies, we differentiate between the impact of environmental factors on the conventional core objectives of central banking, and a potential promotional role of central banks with regard to green finance and sustainability. Furthermore, we review the potential risks and trade-offs involved when central banks act as catalyst for greening the financial system.

Our analysis of 135 central bank mandates shows that only few central banks – 12% of our sample – operate under a mandate that explicitly includes the promotion of sustainable growth or development as an objective, but another 40% are tasked to support their governments' national policy objectives (often conditioned on not interfering with achieving their primary objective, which usually includes price stability). However, in the ensuing theoretical analysis, we dissect how climate risks may directly impact on traditional core responsibilities of central banks, most notably monetary and financial stability. The implication is that most central banks will have to incorporate climate- and mitigation-risks into their core policy implementation frameworks in order to efficiently and successfully safeguard price and financial stability, even if their mandates make no explicit reference to sustainability. A potential role of central banks in promoting sustainability in the financial system and "greening" the economy is more contentious, not least because of the possibility of distorting effects that direct interventions into the market aimed at "greening" the economy might have, but also due to potential conflicts with the central banks' primary goals. It therefore is essential that a potential supporting role of central banks is covered by their mandates. As mentioned, numerous central banks are already mandated to support national policy objectives. To the extent that the government's policy objectives include climate change mitigation or adaptation, a change of mandate for these central banks to further support the mainstreaming of the financial system would not be required. However, for roughly half of the central banks in our sample, such a promotional role is not covered by their mandate. Whether this should change is ultimately a political decision, which should be made on the basis of a careful assessment of the potential risks involved. However, in a world where the impacts of climate change become ever larger, and climate change calls into question the long-term ability of central banks to maintain financial stability and asset quality if warming goes beyond key thresholds, the cost of not engaging the central bank in the promotion of sustainable finance may become prohibitively high. Indeed, the threats from climate change for macro-financial stability and sovereign risk are in many cases so grave (Volz et al., 2020) that a strong macro-prudential case can be made requiring a proactive role of the central bank in mitigating climate-related risks.

The article is organised as follows. Section 2 empirically investigates the mandates of central banks with regard to general sustainability objectives or objectives securing the central bank's support for national policy priorities. These objectives are compared to the actual "green" activities central banks have started to adopt in practice. Subsequently, Section 3 discusses the extent to which incorporating climate risks and scaling up green finance is covered by central bank mandates. It differentiates between the impact of environmental factors on the conventional core objectives of central banking, and a potential promotional role of central banks with regard to green finance and sustainability. Section 4 reviews the potential risks and trade-offs involved when central banks act as catalyst for greening the financial system. Section 5 summarises and concludes.

2. Central Bank mandates and sustainable central banking in practice

We conduct an empirical examination of current central bank mandates to investigate the extent to which central banks are equipped with objectives that task them to enhance sustainability and mainstream green finance. To this end, we examine the IMF Central Bank Legislation Database (Section 2.02, Objectives of the Central Bank, April 2017 version), which comprises 126 institutions, four of which are the central banks of monetary unions. To this we add nine central banks that are not part of the original database but have adopted green finance policies.[1] The results of our investigation of a total of 135 central bank mandates provide a starting point for the ensuing discussion of whether it is necessary for central banks to further incorporate environmental, social and governance (ESG) criteria into their core activities in Section 3.

Table 1 summarises the results of the investigation of the mandates of 135 central banks with regard to whether they are assigned with objectives that would cover an active promotion or mainstreaming of green finance. The table lists the 70 central banks and monetary unions with a mandate assigning them an objective to either (Bank of England, 2015) enhance, promote or support "sustainability" or "sustainable development/growth", or (Batten et al., 2016) support the government's economic objectives or policy goals. It is important to note that most central bank mandates were written before climate change became a major societal issue, and that references to sustainability or sustainable development/growth, as included in the mandates of many central banks in developing countries, were originally interpreted as mandating a role of the central bank in supporting broader economic development goals and not necessarily a low-carbon transition or other environmental goals. However, going back to the Brundtland report (United Nations, 1987), the concept of sustainable development explicitly comprises environmental sustainability. Moreover, the agreement of the United Nations' Sustainable Development Goals and the Paris Agreement by the international community have placed environmental and climate goals very much at the heart of government policymaking. In the present context, it would be hence problematic for a central bank with an explicit sustainability mandate to ignore climate and other environmental challenges.

Central banks with the objective to support the government's economic objectives or policy goals are included here because these goals may comprise sustainability objectives or climate-neutrality targets. The case of the Bank of England, discussed in more detail below, serves as a good example because its mandate comprises support for the government's economic policy, which includes sustainable growth. Central banks with an objective to promote "sustained" growth or development are not considered to have a sustainability-enhancing mandate and are therefore not included in the table. Table 1 lists the parts of the mandates under which the institutions are assigned the aforementioned objectives and contrast this with the actual "green" activities of central banks to date, as well as with the central banks' choice of monetary policy framework.

An initial result is that out of 135 investigated mandates, 70 central banks and monetary unions are equipped with a mandate to either directly or indirectly, through the government's policy objective, enhance the sustainability of economic growth or sustainability in general (Fig. 1). The mandates of 65 central banks and monetary unions on the other hand, include neither a direct nor indirect sustainability objective.

Of the 70 central banks and monetary unions with a potential

[1] These are the central banks of Singapore, Australia, Bangladesh, India, Lebanon, Mongolia, Nigeria, Pakistan and Samoa.

Table 1
Central banks with explicit or potentially implicit sustainability objectives in their mandate.

Central bank of	Primary objective	Monetary policy framework	Sustainability objective	"Green" central banking activities
Austria (ESCB)	Price stability	Other (EMU)	"Without prejudice to the objective of price stability, the ESCB shall **support the general economic policies in the** Union with a view to contributing to the achievement of the objectives of the Union as laid down in Article 3 of the Treaty on European Union"	2018: Oesterreichische Nationalbank becomes a NGFS member
Belgium (ESCB)	Price stability	Other (EMU)	"Without prejudice to the objective of price stability, the ESCB shall **support the general economic policies in the** Union with a view to contributing to the achievement of the objectives of the Union as laid down in Article 3 of the Treaty on European Union"	2018: Nationale Bank van België (NBB) becomes a NGFS member and TCFD supporter
Botswana	Monetary stability	Exchange rate anchor (composite)	"(c) thirdly, to assist insofar as it is not inconsistent with the objectives as set out in paragraphs (a) and (b), in the attainment of **national economic development goals**."	
Brazil	Needs of the economy, development	Inflation targeting framework	"I. adapt the money supply to the real **needs of the national economy** and its **development process**;"	2011: Banco Central do Brasil (BCB) Resolution 3,988 incorporates risk of exposure to environmental damages into "Internal Process of Capital Adequacy Assessment" (ICAAP) requirements 2012: BCB becomes a SBN member 2014: BCB issues Guidelines on "Social and Environmental Responsibility for Financial Institutions" and discusses and defines E&S risk exposure; Brazilian Monetary Council (CMN) issues resolution on Financial Institution's Socio-Environmental Responsibility 2018: CMN requires asset managers to consider (ESG) Risks 2019: CMN requires Pension Funds to state whether they consider E&S issues in investment decisions 2020: BCB becomes a NGFS member; launches sustainability agenda, embedding sustainability into currency reserves management, bank stress tests and lending criteria
Bulgaria (ESCB)	Price stability	Exchange rate anchor (Euro)	"Without prejudice to the objective of price stability, it shall support the general economic policies in the Union with a view to contributing to the achievement of the objectives of the Union as laid down in Article 3 of the Treaty on European Union."	
Cambodia	Price stability	Exchange rate anchor (US dollar)	"The principle mission of the Central Bank is to determine and direct the monetary policy aimed at maintaining price stability in order to facilitate economic development **within the framework of the Kingdom's economic and financial policy**."	2016: National Bank of Cambodia, the Association of Banks in Cambodia (ABC) and the Ministry of Environment launch the Cambodian Sustainable Finance Initiative 2019: National Bank of Cambodia endorses Sustainable Finance Principles, which are adopted by Cambodian Banks 2020: National Bank of Cambodia becomes a NGFS member
Congo, Democratic Republic of	Price stability	Monetary aggregate target	"Without detriment to the principal objective of general price stability, the Bank shall support the **government's general economic policy**."	
Croatia (ESCB)	Price stability	Exchange rate anchor (Euro)	"Without prejudice to the objective of price stability, it shall support the general economic policies in the Union with a view to contributing to the achievement of the objectives of the Union as laid down in Article 3 of the Treaty on European Union."	
Cyprus (ESCB)	Price stability	Other (EMU)	"(2) Without prejudice to this primary objective and subject to the fulfilment of its obligations under Article 105 paragraph (1) of the Treaty, the Bank shall **support the general economic policy of the State**."	2020: Central Bank of Cyprus becomes a NGFS member
Czech Republic (ESCB)	Price stability	Inflation targeting framework	"Without prejudice to its primary objective, the Czech National Bank shall support the general economic policies of the Government leading to **sustainable economic growth** and the general economic policies in the European Union with a view to contributing to the achievement of the objectives of the European Union"	
Denmark (ESCB)	Price stability	Exchange rate anchor (Euro)	"Without prejudice to the objective of price stability, it shall support the general economic policies in the Union with a view to **contributing to the**	2019: Danmarks Nationalbank becomes a NGFS member

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Table 1 (*continued*)

Central bank of	Primary objective	Monetary policy framework	Sustainability objective	"Green" central banking activities
			achievement of the objectives of the Union as laid down in Article 3 of the Treaty on European Union."	
Egypt	Price stability	Other	"The Central Bank shall work on realizing price stability and banking system soundness, within the context of the **general economic policy of the State**."	2019: Central Bank of Egypt becomes a SBN member
Estonia (ESCB)	Price stability	Other (EMU)	"(1) The primary aim of the Bank of Estonia is to maintain price stability. The Bank of Estonia also supports the achievement **of other economic policy objectives** in accordance with the Treaty on the Functioning of the European Union."	2020: Eesti Pank becomes a NGFS member; launches report that outlines the long-term impact of climate change on the Estonian economy
Eurozone (ESCB)	Price stability	Other (EMU)	"Without prejudice to the objective of price stability, the ESCB shall **support the general economic policies** in the Union with a view to contributing to the achievement of the objectives of the Union as laid down in Article 3 of the Treaty on European Union."	2018: ECB becomes a NGFS member 2020: Launches public consultation on its guide on climate-related and environmental risks, announces that bonds with coupon structures linked to certain sustainability performance targets will become eligible as collateral for Eurosystem credit operations and also for Eurosystem outright purchases for monetary policy purposes 2021: ECB sets up climate change centre
Fiji	Price stability	Exchange rate anchor (composite)	"(a) to protect the value of the currency in the interest of balanced and **sustainable economic growth**;"	2012: Reserve Bank of Fiji establishes Agriculture and Renewable Energy Loans Ratio, requiring banks to allocate 2 percent of deposits to the renewable energy sector 2017: Reserve Bank of Fiji becomes a SBN member
Finland (ESCB)	Price stability	Other (EMU)	"Without prejudice to the objective laid down in paragraph 1, the Bank of Finland shall also support the achievement of other **economic policy objectives** in accordance with the Treaty."	2018: Bank of Finland introduces responsible investment standards to the management of its investment portfolio, becomes NGFS member
France (ESCB)	Price stability	Other (EMU)	"Within this framework, and without prejudice to the primary objective of price stability, the Banque de France shall contribute to the **government's general economic policy**."	2017: Banque de France launches NGFS 2018: BdF investigates the extra-financial performance of its portfolios and applies Responsible Investment Charter to the management of its assets 2019: BdF publishes Financial Stability Review on the subject of Greening the Financial System 2020: BdF launches responsible investment strategy
Gambia, the	Price stability	Monetary aggregate target	"(d) encourage and promote **sustainable economic development** and the efficient utilisation of the resources of The Gambia through the effective and efficient operation of a financial system."	
Georgia	Price stability	Inflation targeting framework	"2. The National Bank shall ensure stability and transparency of the financial system and facilitate **sustainable economic growth** in the country, if this is possible without posing a threat to attaining its main objective."	2017: National Bank of Georgia (NBG) becomes SBN member 2020: NBG becomes a NGFS member and publishes ESG reporting and disclosure principles
Germany (ESCB)	Price stability	Other (EMU)	"Without prejudice to the objective of price stability, the ESCB shall **support the general economic policies in the Union** with a view to contributing to the achievement of the objectives of the Union as laid down in Article 3 of the Treaty on European Union"	2017: Deutsche Bundesbank becomes a founding member of NGFS
Ghana	Price stability	Inflation targeting framework	"(2) Without prejudice to subsection (1) the Bank shall **support the general economic policy of the Government** and promote economic growth and effective and efficient operation of banking and credit systems in the country, independent of instructions from the Government or any other authority."	2016: Bank of Ghana becomes SBN member 2019: Bank of Ghana launches the Ghana Sustainable Banking Principles
Greece (ESCB)	Price stability	Other (EMU)	"Without prejudice to this primary objective, the Bank shall **support the general economic policy of the government**."	2019: Bank of Greece becomes a NGFS member
Hungary (ESCB)	Price stability	Inflation targeting framework	"(2) Without prejudice to its primary objective, the MNB shall **support** the maintenance of the stability of the financial intermediary system, the enhancement of its resilience, its **sustainable contribution to economic growth**; furthermore, the MNB shall support the **economic policy of the government** using the instruments at its disposal."	2019: Magyar Nemzeti Bank (MNB) becomes a NGFS member, launches green preferential capital requirement programme and recommends requiring all credit institutions to have an environmental risk management system 2020: Central Bank of Hungary endorses the UN's Principles for Responsible Investment
Iceland	Price stability	Inflation targeting framework	"The Central Bank shall **promote the implementation of the Government's economic policy** as long as it does not consider this inconsistent with its main objective as described in Paragraph 1 above."	
Indonesia	Price stability			

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Table 1 (*continued*)

Central bank of	Primary objective	Monetary policy framework	Sustainability objective	"Green" central banking activities
		Inflation targeting framework	"(2) To achieve the goal referred to in paragraph (1), Bank Indonesia shall conduct monetary policy on a sustained, consistent, and transparent basis, **taking into account the general economic policies of the government**."	1998: Bank Indonesia introduces regulation to require banks to conduct environmental impact assessments for large or high risks loans 2005: Bank Indonesia issues regulation requiring commercial banks to include environmental measures in assessments of business prospects 2012: Bank Indonesia issues Green Lending Model Guidelines for Mini Hydro Power Plant Projects 2014: Bank Indonesia develops voluntary Green Lending Model Guidelines for Mini Hydro Power Plant Projects for banks 2019: Bank Indonesia becomes a NGFS member
Iraq	Price stability, maintaining competitive market-based financial system	Exchange rate anchor (US dollar)	"The primary objectives of the CBI shall be to achieve and maintain domestic price stability and to foster and maintain a stable and competitive market-based financial system. Subject to these objectives, the CBI shall also promote **sustainable growth**, employment, and prosperity in Iraq."	2019: Central Bank of Iraq becomes a SBN member
Ireland (ESCB)	Price stability	Other (EMU)	"Without prejudice to the objective of price stability, the ESCB shall **support the general economic policies in the Union with a view to contributing to the achievement of the objectives of the Union** as laid down in Article 3 of the Treaty on European Union"	2019: Central Bank of Ireland becomes a NGFS member 2020: Annual report announces the establishment of a Climate Change Team
Israel	Price stability	Inflation targeting framework	"(2) to **support other objectives of the Government's economic policy**, especially growth, employment and reducing social gaps, provided that, in the Committee's opinion, this support shall not prejudice the attainment of Price Stability over the Course of Time"	2020: Bank of Israel becomes a NGFS member
Italy (ESCB)	Price stability	Other (EMU)	"the ESCB shall **support the general economic policies in the Union** with a view to contributing to the achievement of the objectives of the Union as laid down in Article 3 of the Treaty on European Union"	2019: Banca d'Italia becomes a NGFS member
Kenya	Price stability	Other	"(3) Subject to subsections (1) and (2), the Bank shall **support the economic policy of the Government**, including its objectives for growth and employment. No. 9 of 2007"	2015: Central Bank of Kenya and Kenyan Banking Association adopt Sustainable Finance Guiding Principles 2017: Central Bank of Kenya (with Kenya Bankers Association, Capital Markets Authority and the National Treasury) issues Green Bond Programme
Kosovo	Financial system stability, efficient payment system	Exchange rate anchor (Euro)	"3. Without prejudice to attainment of these two objectives, the Central Bank shall **support the general economic policies of the Government**."	
Latvia (ESCB)	Price stability	Other (EMU)	"Without prejudice to the objective of price stability, it shall support the general economic policies in the Union with a view to contributing to the achievement of the objectives of the Union as laid down in Article 3 of the Treaty on European Union." "Without prejudice to the primary objective, the Bank of Latvia shall support the general economic policies in the European Union in accordance with Article 127(1) of the Treaty"	2020: Latvijas Banka becomes a NGFS member
Liberia	Price stability	Exchange rate anchor (US dollar)	"c. encourage and mobilization of domestic and foreign savings and their **efficient allocation for productive economic activities**; […] e. foster monetary, credit and financial conditions conducive to **orderly, balanced and sustained economic growth and development**."	
Lithuania (ESCB)	Price stability	Other (EMU)	"**support the economic policy carried out by the Government** of the Republic of Lithuania, without prejudice to the primary objective of the Bank of Lithuania and to the extent this meets the objectives of the European Central Bank and of the European System of Central Banks."	2017: Bank of Lithuania initiates amendments to Law on Companies, triggering the countries' first private green bond issuance 2020: Lietuvos Bankas becomes a NGFS member; Financial Stability Report 2020 addresses climate change challenges to financial stability
Luxembourg (ESCB)	Price stability	Other (EMU)	"Without prejudice to the objective of price stability, the ESCB shall **support the general economic policies in the Union** with a view to contributing to the achievement of the objectives of the Union as laid down in Article 3 of the Treaty on European Union"	2018: Banque Centrale du Luxembourg becomes a NGFS member
Macedonia, Former Yugoslav Republic of	Price stability	Exchange rate anchor (Euro)	"(3) The National Bank shall **support the general economic policies** without endangering the achievement of the objective set forth in paragraph (1) of this Article and in conformity with the	

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Table 1 (*continued*)

Central bank of	Primary objective	Monetary policy framework	Sustainability objective	"Green" central banking activities
			principle of open market economy and free competition."	
Madagascar	Price stability	Monetary aggregate target	"To that end, the central bank shall be fully independent to develop and implement monetary policy. It shall carry out its mission in respect of credit **policy within the framework of the government's general economic policy**."	
Malawi	Issue legal tender (external price stability 3rd, national price stability 4th)	Monetary aggregate target	"(2) In pursuing, or in performing any functions in the pursuit of, its principal objectives, the Bank shall act with due regard to the interest of the national economy and to the **economic policies of the Government**."	
Malaysia	Monetary stability, financial stability	Other	"(1) The principal objects of the Bank shall be to promote monetary stability and financial stability conducive to **the sustainable growth of the Malaysian economy**."	2010: Bank Negara Malaysia (BNM) develops a Green Technology Financing Scheme to promote investment in the green technology industry in cooperation with the Ministry of Finance, the Credit Guarantee Corporation and the Ministry of Energy, Green Technology and Water. 2012: BNM hosts a Green Technology Financing Conference 2017: BNM creates a Technical Working Group on Green Finance, leading to issuance of first green Islamic bond 2018: BNM becomes a NGFS member and launches Value-Based Intermediation (VBI) Financing and Investment Impact Assessment Framework 2020: BNM issues VBIAF Sectoral Guides on Palm Oil, Renewable Energy and Energy Efficiency, starts pilot implementation of the Climate Change and Principles-Based Taxonomy
Malta (ESCB)	Price stability	Other (EMU)	"Without prejudice to the objective of price stability, the **ESCB shall support the general economic policies in the Union** with a view to contributing to the achievement of the objectives of the Union as laid down in Article 3 of the Treaty on European Union"	2019: Central Bank of Malta becomes a NGFS member
Mauritania	Price stability	Other	"In addition, and without prejudice to the objective of price stability, the Bank shall strive to ensure the stability of the financial system and shall **contribute to the implementation of the general economic policies defined by the government**."	
Moldova	Price stability	Inflation targeting framework	"(2) Without prejudice to the primary objective, the National Bank shall foster and maintain a stable market-based financial system and **support the general economic policy of the State**."	
Montenegro	Financial system stability, price stability	Exchange rate anchor (Euro)	"The Central Bank shall, without prejudice to pursuing its objectives, **support the pursuing of economic policy of the Government of Montenegro** (hereinafter: the Government), acting thereby in accordance with the principles of free and open market and freedom of entrepreneurship and competition."	
Morocco	Price stability	Exchange rate anchor (composite)	"Without prejudice to the price stability objective established in coordination with the Minister of Finance, the Bank performs its functions in the **framework of the government's economic and financial policy**."	2014: Bank Al-Maghrib becomes a SBN member 2018: Bank Al-Maghrib becomes a NGFS member 2019: Bank Al-Maghrib becomes a TCFD supporter and publishes 'Roadmap for Aligning the Moroccan Financial Sector with Sustainable Development'
Myanmar	Price stability	Monetary aggregate target	"The Central Bank shall, in accordance with its aim, also endeavor to attain the following objectives: […] (d) to **support the general economic policy of the Government** conducive to the sustained economic development."	
Namibia	Monetary stability, credit and financial system stability	Exchange rate anchor (other)	"(e) to assist in the attainment of national economic goals."	
Nepal	Price stability,	Exchange rate anchor (other)	"(1) The objectives of the Bank shall be as follows: (a) To formulate necessary monetary and foreign exchange policies in order to maintain the stability of price and balance of payment **for sustainable development** of economy, and manage it; […] (2) The Bank shall, without any prejudice to the objectives referred to in subsection (1), extend co-operation in the **implementation of the economic policies of Government** of Nepal."	2014: Nepal Rastra Bank becomes a SBN member 2018: Nepal Rastra Bank issues 'Guideline of E&S Risk Management for Banks and Financial Institutions'
	Price stability	Other (EMU)		

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Table 1 (*continued*)

Central bank of	Primary objective	Monetary policy framework	Sustainability objective	"Green" central banking activities
Netherlands (ESCB)			"Without prejudice to the objective of price stability, the ESCB shall **support the general economic policies in the Union** with a view to contributing to the achievement of the objectives of the Union as laid down in Article 3 of the Treaty on European Union."	2014: De Nederlandsche Bank's (DNB) mandate is updated to include "sustainable prosperity" and "financial stability," as well as equipping the DNB with new macro-prudential instruments and tools to fulfil the task, and publishes a Corporate Social Responsibility (CSR) Strategy for 2019-2025 2016: DNB publishes an exploratory study on the transition to a carbon-neutral economy and establishes the Sustainable Finance Platform 2017: DNB becomes a TCFD supporter, founding member of the NGFS and publishes an Assessment of Climate-Related Risks for the Dutch Financial Sector 2018: DNB organises International Climate Risk Conference for Supervisors and becomes first central bank to sign up to the UN's Principles for Responsible Investment 2020: DNB publishes report on biodiversity loss and associated risks, publishes report on good practices to manage climate risks
Paraguay	Price stability, stability of financial system	Inflation targeting framework	"A State Central Bank, which will be a technical organization, is hereby established. It will be exclusively charged with issuing currency and**, in accordance with the objectives of the national governmen**t' economic policy, will participate with other State technical organizations in formulating monetary, credit, and foreign currency exchange policies"	2016: Banco Central del Paraguay becomes a SBN member 2020: Banco Central del Paraguay becomes a NGFS member
Philippines	Price stability	Inflation targeting framework	"The primary objective of the Bangko Sentral is to maintain price stability conducive to a balanced and **sustainable growth of the economy**. It shall also promote and maintain monetary stability and the convertibility of the peso."	2013: Bangko Sentral ng Pilipinas (BSP) becomes a SNB member 2020: BSP becomes a NGFS member; approves a Sustainable Finance Framework
Poland (ESCB)	Price stability	Inflation targeting framework	"1. The basic objective of the activity of the NBP shall be to maintain price stability, while **supporting the economic policy of the Government**, insofar as this does not constrain the pursuit of the basic objective of the NBP."	
Portugal (ESCB)	Price stability	Other (EMU)	"Without prejudice to the objective of price stability, the ESCB shall support the general economic policies in the Union with a view to contributing to the achievement of the objectives of the Union as laid down in Article 3 of the Treaty on European Union"	2018: Banco de Portugal (BdP) becomes a NGFS member 2020: BdP publishes commitment to sustainability and sustainable finance
Qatar	State policy, Exchange rate stability	Exchange rate anchor (US dollar)	"The Bank shall act to **implement the general economic and developmental policy of the State** in a way which does not contradict the following objectives: […]"	2018: Qatar Central Bank cooperates with Qatar Development Bank to promote sustainable investment
Romania (ESCB)	Price stability	Inflation targeting framework	"Without prejudice to the objective of price stability, it shall support the general economic policies in the Union with a view to contributing to the achievement of the objectives of the Union as laid down in Article 3 of the Treaty on European Union."	2020: National Bank of Romania becomes a NGFS member
Russian Federation	Price stability	Inflation targeting framework	"The principal objective of the Bank of Russia's monetary policy shall be to protect and ensure stability of the rouble by way of maintaining price stability, including for the creation of conditions for **balanced and sustainable economic development**."	2011: Bank of Russia (BoR) issues Regulation on Information Disclosure, including use of energy resources, risk factors, corporate governance and remuneration, and compliance with the Russian Code of Corporate Governance 2014: BoR issues Code of Corporate Governance that requires assessment of ESG risk 2016: BoR reviews financial market regulation, including provisions on green bonds 2019: BoR becomes a NGFS member 2020: BoR begins consultation on the prospects for estimating and monitoring of climate risks
San Marino	Financial system stability, protection of savings	Exchange rate anchor (Euro)	"c. providing adequate support to the financial system of the Republic, to include **performing the functions of incentive and guidance**;"	
Serbia, Republic of	Price stability	Inflation targeting framework	"Without prejudice to its objectives referred to in paragraphs 1 and 2 of this Article, the National Bank of Serbia shall **support the pursuance of economic policy of the Government** of the Republic of Serbia (hereinafter: the Government), operating in accordance with the principles of a market economy."	
	Price stability			2012: Monetary Authority of Singapore (MAS) issues Code of Corporate Governance including

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Table 1 (*continued*)

Central bank of	Primary objective	Monetary policy framework	Sustainability objective	"Green" central banking activities
Singapore (monetary authority)		Exchange rate anchor (composite)	"The principal objects of the Authority shall be — (a) to maintain price stability conducive to **sustainable** growth of the economy"	Sustainability Issues 2015: MAS supports Singapore Stewardship Principles for Responsible Investors 2016: MAS becomes founding member of the Sustainable Insurance Forum 2017: MAS launches Green Bond Grant Scheme, becomes founding member of the NGFS and a TCFD supporter 2019: MAS launches Singapore's Green Finance Action Plan, becomes founding member of Asia Sustainable Finance Initiative 2020: MAS publishes three consultation papers on Proposed Guidelines on Environmental Risk Management for banks, asset managers and insurers; launches the MAS Global FinTech Innovation Challenge
Slovak Republic (ESCB)	Price stability	Other (EMU)	"Without prejudice to the objective of price stability, the ESCB shall **support the general economic policies in the Union** with a view to contributing to the achievement of the objectives of the Union as laid down in Article 3 of the Treaty on European Union."	2019: Národná banka Slovenska becomes a NGFS member
Slovenia (ESCB)	Price stability	Other (EMU)	"Without prejudice to the objective of price stability, it shall support the general economic policies in the Union with a view to contributing to the achievement of the objectives of the Union as laid down in Article 3 of the Treaty on European Union."	2020: Banka Slovenije becomes a NGFS member
South Africa	Price stability	Inflation targeting framework	"The primary objective of the Bank shall be to protect the value of the currency of the Republic in the interest of **balanced and sustainable economic growth in the Republic**"	2019: The South African Reserve Bank (SARB) becomes a NGFS member 2020: SARB publishes working paper on 'Climate change and its implications for central banks in emerging and developing economies'
Spain (ESCB)	Price stability	Other (EMU)	"Without prejudice to the objective of price stability, the ESCB shall **support the general economic policies in the Union** with a view to contributing to the achievement of the objectives of the Union as laid down in Article 3 of the Treaty on European Union."	2018: Banco de España becomes a NGFS member
Sweden (ESCB)		Inflation targeting framework	"Without prejudice to the objective of price stability, it shall **support the general economic policies in the Union** with a view to contributing to the achievement of the objectives of the Union as laid down in Article 3 of the Treaty on European Union.", "The objective of the Riksbank's activities shall be to maintain price stability. The Riksbank shall also promote a safe and efficient payments system."	2018: Sveriges Riksbank becomes a NGFS member 2020: Launches consultation on the sustainable finance strategy for improved and uniform disclosure of climate-related risks
Switzerland	Interest of the country, price stability	Other	"1. The National Bank shall pursue a monetary policy **serving the interests of the country as a whole**. It shall ensure price stability. In so doing, it shall take due account of the development of the economy."	2016: Swiss National Bank issues Annual Environmental Report, explaining its strategy in connection with climate change 2019: Swiss National Bank becomes a NGFS member
Tanzania	Price stability	Monetary aggregate target	"(1) The primary objective of the Bank shall be to formulate, define and implement monetary policy directed to the economic objective of maintaining domestic price stability conducive to a **balanced and sustainable growth of the national economy**. (2) Without prejudice to subsection (1), the Bank shall ensure the integrity of the financial system and **support the general economic policy of the Government** and promote sound monetary, credit and banking conditions conducive to the development of the national economy."	
Turkey	Price stability	Inflation targeting framework	"The Bank shall, provided that it shall not conflict with the objective of maintaining price stability, **support the growth and employment policies of the Government**."	
Ukraine	Monetary stability	Inflation targeting framework	"The National Bank shall also promote **sustainability of the economic growth** and second the **economic policy of the Cabinet of Ministers of Ukraine** provided that it does not prevent the NBU from attainment of the objectives determined in the second and third parts of this article."	2020: National Bank of Ukraine becomes a SBN member
United Kingdom (ESCB)	Price stability, financial stability	Inflation targeting framework	"(a) to maintain price stability, and (b) subject to that**, to support the economic policy of Her**	2015: Bank of England (BoE) Governor Mark Carney highlights the Bank's view on climate change 2016: BoE publishes research on climate change and

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Table 1 (*continued*)

Central bank of	Primary objective	Monetary policy framework	Sustainability objective	"Green" central banking activities
			Majesty's Government, including its objectives for growth and employment."	central banks and organises workshops and conferences on the subject on climate risks and financial stability; co-chairs the G20 Green Finance Study Group (renamed in G20 Sustainable Finance Study Group in 2018) 2017: BoE becomes founding member of the NGFS 2018: BoE reviews impact of climate change on the UK banking sector 2019: Bank of England Prudential Regulation Authority (BoE PRA) conducts General Insurance Stress Tests (GIST) to assess the impact of climate change, publishes Framework for Assessing Financial Impacts of Physical Climate Change and issues Supervisory Statement (SS3/19) on Enhancing Banks' and Insurers' Approaches to Managing the Financial Risks from Climate Change 2020: BoE will disclose how financial risks from climate change are managed across its operations
West African Monetary Union (WAMU)	Price stability	Exchange rate anchor (Euro)	"Without prejudice to this objective, the Central Bank shall lend its support to the economic policies of the West African Economic and Monetary Union (WAEMU), with a view to **achieving sound and sustainable growth**."	2020: Central Bank of West African States becomes a NGFS member
Zimbabwe	"Regulate the monetary system"	Exchange rate anchor (US dollar)	"(b) To protect the currency of Zimbabwe in the interest of **balanced and sustainable economic growth**"	

Source: Compiled with data from the IMF Central Bank Legislation Database, IMF (2018), Volz (2019), Dikau and Volz (2019) and central bank reports and websites.

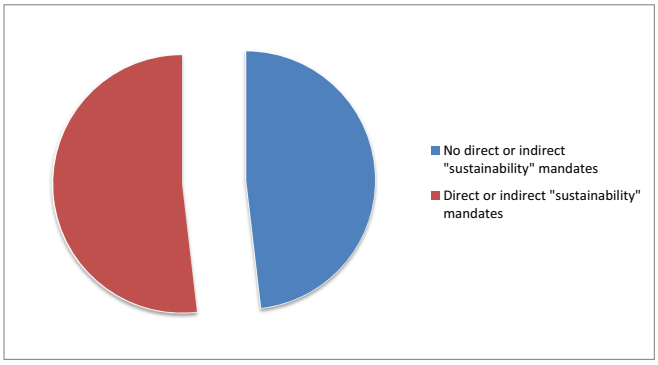

Fig. 1. Central Banks with and without "Sustainability" Mandates.
Note: Out of a total of 135 investigated central banks.
Source: Compiled by authors.

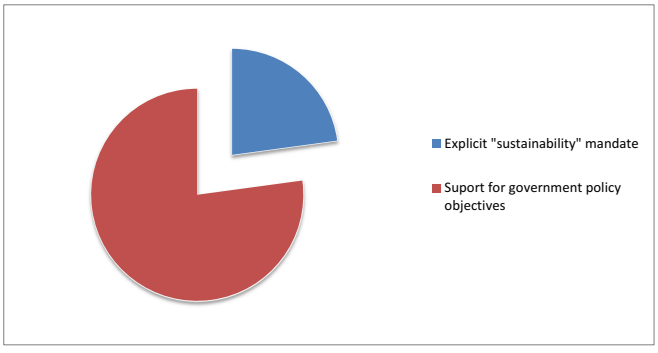

Fig. 2. Explicit and Potential Sustainability Objectives.
Note: Out of the 70 central banks with a 'direct' or 'indirect' sustainability mandate.
Source: Compiled by authors.

sustainability objective, the central banks of 15 countries (Czech Republic, Fiji, Gambia, Georgia, Hungary, Iraq, Malaysia, Nepal, Philippines, Russian Federation, Singapore, South Africa, Tanzania, Ukraine and Zimbabwe), as well as one monetary union (West African Monetary Union, WAMU) are charged with mandates that include an explicit objective for the promotion or support of "sustainable" economic growth or development (Fig. 2). In almost all cases, the pursuit of this promotional sustainability objective is subject to achieving the core objective of price stability. The other 54 central banks are mandated with the objective of supporting the government's policy priorities. This objective is in almost all cases subject to not impeding the central bank's ability to pursue its primary objective, which usually is price stability. The analysis also shows that a large proportion of central banks with direct or indirect sustainability mandates are in emerging market and developing country economies, where mandates have traditionally not only been broader, but in part also included explicit "promotional" objectives (Dafe and Volz, 2015). With regard to monetary policy frameworks, Table 1 shows that there is no strong correlation between the inclusion of a direct or indirect sustainability mandate in a central bank's mandate and its choice of policy framework. Of the 70 central banks of our sample with a direct or potentially implicit sustainability mandate, 20 are operating under an inflation targeting framework, 19 rely on an exchange rate anchor, six target monetary aggregates, and the frameworks of 25 are classified by the IMF (2018) as "other", including the national central banks of all 19 member countries of the Eurozone as well as the European Central Bank (ECB).

While just 12% of the investigated central banks have explicit sustainability mandates and 54 (or 40%) are mandated to support the government's policy priorities and hence potentially sustainability, 48% of those investigated have no direct or indirect mandate demanding the central bank's engagement with climate change-related topics. However, there are numerous central banks – 33 according to our current count – whose mandates do not mention sustainability or support of government policy (which are therefore not listed in Table 1) that nevertheless have begun to address climate change-related risks and sustainability challenges. These are listed in Table 2, which first presents the green activities of the respective central bank, followed by their mandated core objectives and monetary policy framework.

Most of the "green" central banking activities listed in Tables 1 and 2

Table 2
Central Banks engaged in "green" activities and their core objectives and monetary policy framework.

Central bank of	Monetary policy framework	"Green" central banking activities	Mandated objectives
Armenia	Inflation targeting framework	2020: Central Bank of Armenia becomes a NGFS member	"The primary objective of the Central Bank shall be to ensure stability of prices in the Republic of Armenia."
Australia	Inflation targeting framework	2018: Reserve Bank of Australia becomes a NGFS member 2019: Reserve Bank of Australia discusses incorporating climate models in economic modelling 2020: Financial Stability Review identifies climate change financial risk vulnerability assessment as a key focus for 2021	"a) the stability of the currency of Australia; b) the maintenance of full employment in Australia; c) and the economic prosperity and welfare of the people of Australia."
Bangladesh	Monetary aggregate target	2009: Bangladesh Bank (BB) introduces green refinancing lines 2011: BB issues Policy Guidelines on Green Banking 2012: BB becomes a SNB member 2016: BB launches its Green Transformation Fund and issues green portfolio ceilings at 5% and Integrated Risk Management Guidelines for Financial Institutions and Banks 2017: BB issues Guidelines on Environmental & Social Risk Management for Banks and Financial Institutions 2019: BB expands Green Transformation Fund (GTF) from just three sectors to include all manufacturing and export-oriented entities	Price stability, "towards fostering growth and development of country's productive resources in the best national interest"
Canada	Inflation targeting framework	2019: Bank of Canada becomes NGFS member, hosts climate change and central banking workshop and launches research initiative on climate-related risks 2020: Bank of Canada and Office of the Superintendent of Financial Institutions launches pilot project on climate change scenarios	"to promote the economic and financial welfare of Canada" (Bank of Canada Act, 2019)
China, People's Republic of	Monetary aggregate target	2007: People's Bank of China (PBOC), China Banking Regulatory Commission (CBRC) and Ministry of Environmental Protection (MEP) launch Green Credit Policy ("Opinions on Enforcing Policies and Regulations on Environmental Protection to Prevent Credit Risk") 2015: PBOC publishes notice on Green Financial Bonds in China's Inter-Bank Bond Market and together with the China Securities Regulatory Commission (CSRC) issues guidelines defining criteria and category for green bond projects 2016: PBOC issues Guidelines for Establishing the Green Financial System and co-chairs the G20 Green Finance Study Group (renamed in G20 Sustainable Finance Study Group in 2018) 2017: PBOC becomes a founding member of NGFS, incorporates green finance into the macro-prudential assessment system, including through positive incentives for commercial banks to increase their stock of green credit and boost green deposits to supplement green credit and PBOC and other ministries and commissions jointly issue a Financial Industry Standardization System Construction Development Plan (2016–2020), including "green financial standardization" with a focus on product standards, information disclosure standards and green credit rating standards for financial institutions 2018: PBOC accepts green loans with AA rating as collateral in the medium-term loan facility, issues a trial Green credit performance evaluation plan for banking deposit financial institutions,	Price stability "and thereby promote economic growth."

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Table 2 (*continued*)

Central bank of	Monetary policy framework	"Green" central banking activities	Mandated objectives
		further refining the evaluation criteria for the green credit performance of banking financial institutions, starts accepting green loans with AA rating as collateral in the medium-term loan facility and together with the CSRC jointly issues China's Green Bond Verification Guidelines 2020: PBC releases Green Bond Endorsed Project Catalogue; publishes public consultation draft of its 'Notification on Evaluation of Green Finance Performance of Deposit-Type Financial Institutions in the Banking Industry'	
Colombia	Inflation targeting framework	2019: Banco de la República (BANREP) becomes a NGFS member 2020: BANREP is granted the ISO 14001 Certification for its commitment to environmental protection, appropriate management of environmental risks and impacts, and sustainable use of resources; publishes working paper on 'Climate Change: Policies to Manage its Macroeconomic and Financial Effects'	Price stability (El Congreso de Colombia, 1993)
Costa Rica	Inflation targeting framework	2011: Banco Central de Costa Rica (BCCR) begins compiling Costa Rican Environmental Accounts for Water, Forest and Energy 2019: BCCR becomes a NGFS member 2020: BCCR launches Strategic Plan 2020–2023 that includes analytical activities on climate change	Price stability, promote orderly developments (Ley Orgánica del Banco Central de Costa Rica, 1995)
Ecuador	Exchange rate anchor (US Dollar)	2020: Central Bank of Ecuador launches and leads Sustainable Finance Initiative.	"1. To provide the necessary means of payment for the economic system to operate efficiently.2. To establish overall cash flow levels mat guarantee adequate financial security margins."
Hong Kong (SAR)		2019: Hong Kong Monetary Authority (HKMA) becomes a NGFS member, TCFD supporter and establishes the Centre for Green Finance (GCF) under its Infrastructure Financing Facilitation Office, announces Green Finance Development measures and supports green bond issuance 2020: HKMA establishes the Green and Sustainable Finance Cross-Agency Steering Group, issues the Common Assessment Framework on Green and Sustainable Banking	Price stability (website)
Iceland	Inflation targeting framework	2020: Sedlabanki Islands becomes a NGFS member	"The principal objective of the Central Bank of Iceland is to promote price stability. […] The Central Bank shall promote the implementation of the Government's economic policy as long as it does not consider this inconsistent with its main objective as described in Paragraph 1 above."
India	Inflation targeting framework	2015: Reserve Bank of India introduces sustainability considerations to its Priority Sector Lending – Targets and Classification 2019: RBI revises guidelines for its Priority Sectors Lending programme, includes Renewable Energy 2020: RBI issues bulletin 'Climate Change: Macroeconomic Impact and Policy Options for Mitigating Risks'	"maintain price stability while keeping in mind the objective of growth"
Japan	Inflation targeting framework	2019: Bank of Japan becomes a NGFS member	"achieving price stability, thereby contributing to the sound development of the national economy."
Jordan	Exchange rate anchor (US dollar)	2016: Central Bank of Jordan becomes a SBN member	"The objectives of the Central Bank shall be to maintain monetary stability in the Kingdom and to ensure the convertibility of the Jordan Dinar, and to promote the sustained

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Table 2 (*continued*)

Central bank of	Monetary policy framework	"Green" central banking activities	Mandated objectives
			economic growth in the Kingdom in accordance with the general economic policy of the Government."
Korea, Republic of	Inflation targeting framework	2019: Bank of Korea becomes a NGFS member	"(1) The monetary and credit policies of the Bank of Korea shall be carried out **in harmony with the economic policy of the Government** insofar as this does not impeding the price stabilization."
Lao P.D.R.	Other	2012: Bank of Lao becomes a SBN member	"maintaining stability of the value of Kip and contributing to the growth and efficiency of the socio-economic development of the Lao PDR."
Lebanon	Exchange rate anchor (US dollar)	2001: Banque du Liban (BDL) publishes Circular No 81, introducing differentiated reserve requirements, favouring loans tied to energy saving plans 2010: BDL issues circular to promote Financing for Green Sectors 2013: BDL issues Circular 313 to incentivise eco-friendly investment 2014: BDL establishes Subsidized Loan Scheme to Green Sectors 2017: BDL issues Circular to decrease the total liabilities subjected legal to reserve requirements from foreign currency loans balance to finance investments incentivise eco-friendly investment	"safeguarding the national currency in order to ensure the basis for sustained social and economic growth. This mission consists of: •Safeguard of monetary and economic stability •Safeguard of the soundness of the banking sector •Development of money and financial markets"
Maldives	Exchange rate anchor (US dollar)	2021: Maldives Monetary Authority becomes a SBN member	"(a) to issue currency and regulate the availability, and international value of the Maldivian Rufiyaa; (b) to provide advisory services to the Government on banking and monetary matters; (c) to supervise and regulate banking so as to promote a sound financial structure; and (d) to promote in the country and outside the country the stability of Maldivian currency and foster financial conditions conducive to the orderly and balanced economic development of Maldives"
Mauritius	Other	2020: Bank of Mauritius becomes a NGFS member	"The primary object of the Bank shall be to maintain price stability and to promote orderly and balanced economic development."
Mexico	Inflation targeting framework	2017: Banco de México (Banxico) becomes founding member of the NGFS 2020: Banxico publishes report on 'Climate and Environmental risks and opportunities in Mexico's financial system from diagnosis from action'; creates a Sustainable Finance Committee together with the Ministry of Finance	Price stability, "thereby strengthening the State's guidance of national development"
Mongolia	Other	2012: Bank of Mongolia (BoM) becomes a SBN member 2014: Bank of Mongolia issues Mongolia Sustainable Finance Principles and Sector Guidelines (with Mongolia Banking Association) 2019: BoM and other members of the Financial Stability Council approve the Mongolian Green Taxonomy 2020: Launches its Green Loan Statistics based on the Mongolian Green Taxonomy (2019) to calculate the amount and ratio of green loans in portfolios	Price stability, "maintain[ing] the stability of financial market and banking system to support balanced development of national economy"
New Zealand	Inflation targeting framework	2018: Reserve Bank of New Zealand becomes a NGFS member 2019: Reserve Bank of New Zealand reviews Reserve Bank Act to consider how climate risks could affect financial stability 2020: Reserve Bank of New Zealand supports the New Zealand Government approval to introduce mandatory climate-related financial disclosures	"(a) formulating and implementing monetary policy designed to promote stability in the general level of prices, while recognising the Crown's right to determine economic policy; and (b) promoting the maintenance of a sound and efficient financial system"
Nigeria	Monetary aggregate target	2012: Central Bank of Nigeria becomes a SBN member and together with the Nigerian Banking Association	"Monetary and price stability", financial stability, economic and financial advice to government

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Table 2 (*continued*)

Central bank of	Monetary policy framework	"Green" central banking activities	Mandated objectives
		adopts Sustainable Banking Principles	
Norway	Inflation targeting framework	2018: Norges Bank becomes a NGFS member 2019: Norges Bank submits consultation response to the Climate Risk Commission's report 'Climate risk and the Norwegian economy' describing the relevance of climate risk for the analyses and operations in the functions within Norges Bank's mandate.	"The Bank shall be an executive and advisory body for monetary, credit and foreign exchange policy. It shall issue banknotes and coin, promote an efficient payment system domestically as well as vis-à-vis other countries and monitor developments in the money, credit and foreign exchange markets."
New Zealand	Inflation targeting framework	2018: Reserve Bank of New Zealand becomes a NGFS member 2019: Reserve Bank of New Zealand reviews Reserve Bank Act to consider how climate risks could affect financial stability	"formulating and implementing monetary policy designed to promote stability in the general level of prices, while recognising the Crown's right to determine economic policy"
Pakistan	Other	2015: State Bank of Pakistan becomes a SBN member 2017: State Bank of Pakistan issues the Green Banking Guidelines, outlining Environmental Risk Management Guidelines	"regulate the monetary and credit system of Pakistan and to foster its growth in the best national interest with a view to securing monetary stability and fuller utilisation of the country's productive resources"
Samoa	Other	2019: Central Bank of Samoa becomes a SBN member	"[…] promoting internal and external monetary stability; promoting a sound financial structure; promote credit and exchange conditions conducive to the orderly and balanced economic development of Samoa; […]" (website, Central Bank of Samoa Act 1984)
Seychelles	Monetary aggregate target	2020: Central Bank of Seychelles becomes a NGFS member	"(1) The primary objective of the Bank is to promote domestic price stability; (2) The other objectives of the Bank are […] (b) to promote a sound financial system"
Sri Lanka	Other	2016: Central Bank of Sri Lanka becomes a SBN member 2019: Central Bank of Sri Lanka launches a Roadmap for Sustainable Finance in Sri Lanka	"(a) economic and price stability; and (b) financial system stability, with a view to encouraging and promoting the development of the productive resources of Sri Lanka."
Thailand	Inflation targeting framework	2019: Bank of Thailand (BoT) becomes a NGFS member and launches	"(The BOT's objectives are to carry on such tasks as

Table 2 (*continued*)

Central bank of	Monetary policy framework	"Green" central banking activities	Mandated objectives
		Guidelines for Responsible Lending Institutions 2020: BOT co-authors report on 'The Roles of ASEAN Central Banks in Managing Climate and Environment-related Risks'; announces sustainability as an integral part of all operations and as a strategic Challenge of the Bank's Strategic Plan 2020–2022; signs MoU with UK government, including on consideration for the environment and risks from climate change.	pertain to central banking in order to maintain monetary stability, financial institution system stability and payment systems stability", "To undertake the tasks in paragraph one, the implementation of economic policy of the government shall be taken into consideration."
Tunisia	Other	2019: Banque Centrale de Tunisie becomes a NGFS and a SBN member	"The general mission of the Central Bank is safeguard price stability. In this regard, it is responsible for: - monitoring monetary policy; – controlling currency in circulation and ensuring the proper functioning of payment systems; – supervising lending establishments; and - preserving the stability and security of the financial system."
United States of America	Other	2020: US Federal Reserve becomes a NGFS member	"[The Fed] shall maintain long run growth of the monetary and credit aggregates commensurate with the economy's long run potential to increase production, so as to promote effectively the goals of maximum employment, stable prices, and moderate long-term interest rates."
Uruguay	Inflation targeting framework	2020: Banco Central del Uruguay becomes a NGFS member	"A) price stability that furthers the objectives of growth and employment. B) regulation of the operations and supervision of the payment and financial systems so as to promote soundness, solvency, efficiency, and development."
Vietnam	Exchange rate anchor (composite)	2012: State Bank of Vietnam (SBV) becomes a SBN member 2015: SBV issues directive on Promoting	"3. The State Bank performs the state management of monetary, banking and foreign exchange (below referred to as

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Table 2 (*continued*)

Central bank of	Monetary policy framework	"Green" central banking activities	Mandated objectives
		Green Credit Growth and Managing Environmental and Social Risks in Credit Extension SBV: Action Plan of Banking Sector to Implement the National Green Growth Strategy until 2020 2016: SBV issues circular on ESG factors, requiring lending to take environmental protection into account 2017: SBV renews commitment to implementing the Green Growth Program and the Program of Preventing Climate Change 2018: SBV approves a Scheme on Green Bank Development in Vietnam	monetary and banking) operations and performs the function of a central bank in issuing money, a bank of credit institutions and a provider of monetary services for the Government."

Source: Compiled by authors, drawing on Volz (2019), Dikau and Volz (2019), IMF (2018), central bank websites and central bank acts (directly referenced).

appear to be aimed at incorporating climate change-related risks into the financial system, as well as mainstreaming and pricing-in more general ESG risks into the activities of financial institutions by providing them with tools, knowledge and adequate green guidelines. Furthermore, most of these policies aim at enhancing the efficiency of central banks' core objective (mostly price or financial stability) policy implementation frameworks by allowing central banks to operate in financial systems that increasingly incorporate climate risks and price-in ESG criteria. Fig. 3 provides an overview of the adoption of different types of "green" activities by central banks over time.

Importantly, Table 2 shows that 33 central banks address climate change-related and other ESG risks even in the absence of explicit sustainability mandates. For instance, not all central banks that have joined the NGFS have an explicit or potentially implicit sustainability objective in their mandate. However, all central banks that are members of the NGFS have explicitly accepted climate change as a source of financial risk and have hence concluded that ensuring the financial system's resilience towards these risks lies within the mandates of central banks and financial supervisors (NGFS, 2018, 2019). This highlights an important point – central banking activities depend in practice not only on the formal mandate but also its interpretation, which can be ambiguous. In the following, we illustrate the interpretation of mandates relating to climate risk and sustainability for three cases, namely the European System of Central Banks (ESCB), the Bank of England, and the Dutch central bank.

In the case of the Eurozone, Article 127 (Bank of England, 2015) of the Treaty on the Functioning of the European Union clearly defines price stability as the primary objective of the ESCB. However, it also states that "[w]ithout prejudice to the objective of price stability, the ESCB shall support the general economic policies in the Union with a view to contributing to the achievement of the objectives of the Union as laid down in Article 3 of the Treaty on European Union." Article 3 (Battiston et al., 2017) of the Treaty on European Union in turn includes the objective of "sustainable development of Europe based on balanced economic growth and price stability, a highly competitive social market economy, aiming at full employment and social progress, and a high level of protection and *improvement of the quality of the environment*" (emphasis added). This means that the ESCB's mandate does indeed include, inter alia and without prejudice to the objective of price stability, supporting the European Union's environmental objectives (Volz,

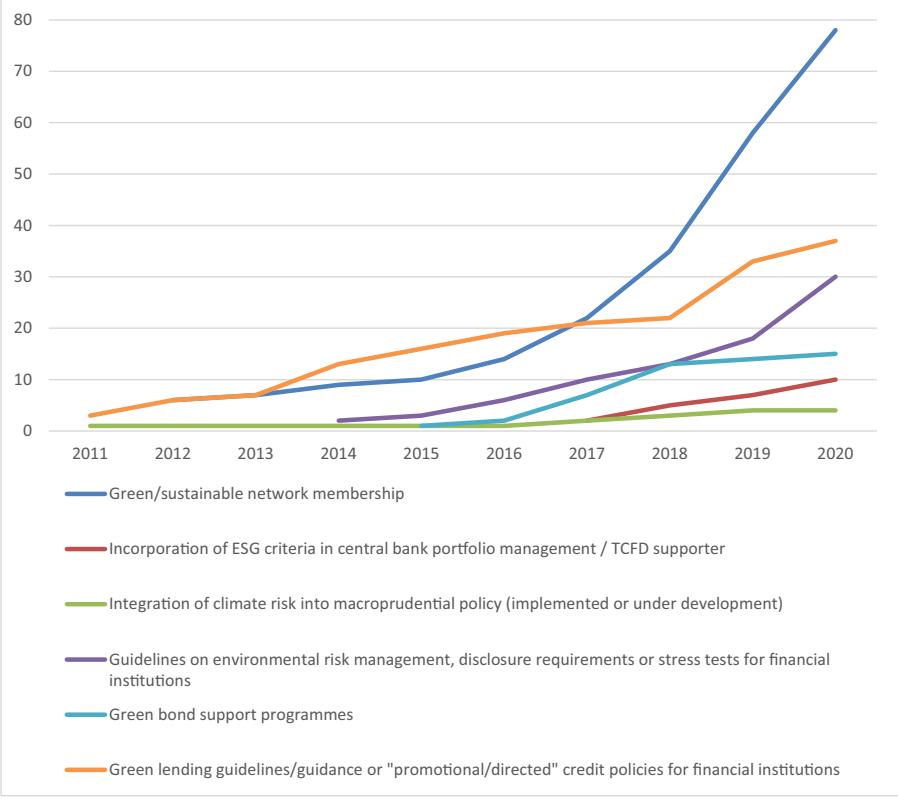

Fig. 3. Number of Central Banks that Have Adopted "Green" Activities (by Type). (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)
Note: All data included in Tables 1 and 2.
Source: Compiled by authors.

2017). This gives rise to the question of the extent to which the political authorities and the public at large want the ESCB to play an active role in supporting environmental objectives. As the current discussions in the Eurozone show, it is not solely up to the central bank to interpret its mandate – ultimately, central bank policies need to be based on public and political support.

Recent research has begun to explore the Eurozone's ability to promote environmental protection in more detail (Solana, 2019) and, in particular, the policy space created by the ECB's mandate for green monetary policy (Fischer, 2018). With regard to the threat of material climate-related risks, the ECB states that while it does not see that these risks pose a threat for financial stability in the euro area in the short-term, banks may be indirectly but substantially affected by "more frequent and severe extreme weather events or by the ongoing transition to a low-carbon economy" (ECB, 2018: 5). Benoît Cœuré, at the time a Member of the Executive Board of the ECB, also addressed the underlying question of whether environmental issues are part of the ECB's mandate, arguing that while the Treaty mandates the protection and improvement of the quality of the environment, it also opens up the question of "why the ECB should not promote industries that promise the strongest employment growth, irrespective of their ecological footprint" (Cœuré, 2018), thereby pointing to potentially conflicting objectives outside of the ECB's core functions. On the issue of how climate change affects the conduct of monetary policy, Cœuré (2018) reasons that it may "complicate the correct identification of shocks relevant for the medium-term inflation outlook, […] increase the likelihood of extreme events and hence erode central banks' conventional policy space more often, and […] raise the number of occasions on which central banks face a trade-off forcing them to prioritise stable prices over output" (Cœuré, 2018).[2] However, Cœuré argues that generally, "there is scope for central banks themselves to play a supporting role in mitigating the risks associated with climate change while staying within [their] mandate" (ibid.).

Frank Elderson, a Member of the Executive Board of the ECB, emphasises that the provisions in the ECB mandate "although not conferring a specific mandate for ECB climate change action, do require us to take into account the EU's environmental objectives and policies when pursuing both our primary and secondary objectives" (Elderson, 2021). He also asserts that "the ECB must respond to risks related to climate change that may have an impact on its balance sheet" (ibid.). Overall, he stresses that the "underlying rules determine general – but clear – obligations and limits on how the ECB must contribute to society's urgent need to tackle climate change" and that "[t]hey provide substantial scope for necessary action across our various functions" (ibid.).

The Bank of England is an example of a central bank whose mandate has no explicit references to sustainability and has been accused of overstepping its mandate by addressing challenges posed by climate change. The Bank of England's pro-active stance towards addressing climate-risks has been condemned by some as being part of the Bank's "mission creep" of offering warnings on topics some consider too political for the institution (Binham and Crow, 2018; Crow and Binham, 2018). However, the Bank's mandate obliges it to support the government's economic policy and objectives for growth, which are set out in HM Treasury's Annual Remit for the Monetary Policy Committee. For instance, HM Treasury (2018) explicitly and repeatedly sets out "sustainable and balanced growth" as the government's economic policy objective. It could therefore be argued that the Bank is thereby also furnished with a(n) (indirect) sustainability objective through supporting the government's sustainable economic growth policy. Then Bank of England Governor Carney strongly maintained that the Bank considers it a central part of its responsibility to identify, warn against and mitigate any kind of threat to financial stability, including those from climate change-related risks; Carney "bristled at suggestions he was overstepping the mark by asking banks to do more to model climate risks, from the impact of floods on their mortgage books to whether new green policies could hurt the creditworthiness of their corporate clients" (Crow and Binham, 2018). With regard to the Bank's approach to mitigating climate risks or greening the financial system, Carney voiced his distaste for a "surreptitious" approach or implicit guidance through central bank soft power and "against lowering capital requirements for a bank if they invest in a green project per se" (ibid.). Instead, Carney expressed support for explicit climate change-related regulation or carbon pricing.[3] Regarding a "promotional" role in enhancing green climate policy, Carney points to the limits of the mandated role of central banks, which, he maintains, cannot "substitute for governments in climate policy" (Crow and Binham, 2018), a view that he shares with virtually all central bankers.

The case of the De Nederlandsche Bank's (DNB) mandate and objectives offers further insights into the complexity of assessing a central bank's "green" role based on its legal objectives. As part of the ESCB, the DNB's objectives and tasks are determined by the same provisions of the Treaty that determine the mandates of all national EU central banks, namely, price stability, support for the general economic policies in the EU and to act in accordance with open market principles (DNB Bank Act, 1998, section 2). Despite the absence of "sustainability" from its statutory act, today the DNB is widely credited for having formally integrated sustainability into its operational framework. This was due to the deliberate decision in 2011 by the then newly-appointed board of the DNB to update the central bank's mission statement (Knot, 2018). Against the background of the Financial Crisis of 2008, financial stability was considered by the DNB's board to be a necessary central pillar of its mission statement in order to differentiate the new approach from the pre-Crisis one, the latter of which had proved to create "prosperity [that] had turned out not to be sustainable" (ibid.). Hence, since 2011, the DNB's mission statement, both as a central bank and financial supervisor, requires the DNB "to safeguard financial stability and thus contribute to sustainable prosperity in the Netherlands" (ibid.). However, at the time, the term "sustainability" did not necessarily have the same connotation that it has today with regard to climate change and greening of financial systems (ibid.). Nonetheless, this has led the DNB to incorporate sustainability considerations into most of its core operations, including in economic research (ibid.). Furthermore, the DNB recognises the necessity to contribute to sustainable development (Knot, 2015). While the DNB is careful to emphasise that "as a central bank and supervisor, we must not overstretch our mandate", it does consider ways to "impact investment decisions and credit allocation" and help "transform the financial infrastructure" to take into account the transition to a low carbon economy to fall under its mission of "safeguarding sustainable prosperity" (Elderson, 2018).

3. Central banking and climate change – theoretical considerations[4]

The analysis above has not only shown significant differences in central banks' mandates, it has also revealed large differences in practice in how central banks have started to address climate change-related

[2] Similarly, Bundesbank President Jens Weidmann (2019) has acknowledged that "[t]he importance of climate change and climate policy for central banks is not confined to our role as financial supervisors and guardians of financial stability, though. There can be all manner of monetary policy implications, too. Both climate change and climate policy can have a bearing on macroeconomic indicators such as output and inflation."

[3] Governor Mark Carney compared the Bank of England's plan to stress test the balance sheets of the largest UK banks against potential threats from climate change in order to assess the adequacy of capital to hold off a shock with "the traditional "eyebrow raise" governors would use to signal their displeasure at certain banking activity in the past" (Binham and Crow, 2018).

[4] This section builds on Dikau and Volz (2019).

concerns. Against this background, this section first considers how climate risks and their mitigation relate to central bank mandates and how these new challenges and potential responsibilities fit into conventional policy frameworks and affect the traditional core responsibilities of central banks, i.e. monetary and financial stability. It subsequently discusses the second, more contentious dimension of green central banking – i.e. an active contribution to a greening of the financial system and the economy as a whole by central banks. The distinction between core and promotional objectives in central bank mandates also relates to a recognition of the different time horizon of objectives, as well as to the broad differences between advanced, and developing and emerging economies. In the latter, central bank mandates have more commonly tended to include promotional objectives.

3.1. Central Banks' core objectives and climate change

A first question concerns the mandated objectives and governance arrangements required for the effective conduct of core monetary policy functions given the risks and policy challenges posed by climate change. The core responsibility of most central banks – often specified in the mandate as the singular or primary objective of monetary policy – is safeguarding low and stable inflation. Sometimes embedded in an inflation-targeting framework, this primary focus of central banks on price stability is based on the strong empirical evidence that in the short-run, high inflation (and high volatility) distort the decision-making process with regard to savings, investment and production and hence slows economic growth (Fischer, 1993). Low and stable inflation is therefore understood to be a necessary precondition for growth or development to take place. Apart from maintaining low and stable inflation, safeguarding financial stability has traditionally been the other important concern for central banks, which have historically acted as lender of last resort. Although there was a trend since the 1990s to assign responsibility for financial stability to dedicated financial supervisory authorities, it has received renewed attention as a crucial central banking objective against the background of the Global Financial Crisis. As discussed, a further (often secondary) goal of central banking is supporting wider economic policy objectives such as sustainable growth or, in some cases, maximum employment. A strong argument for central banks to take environmental factors into account in the conduct of monetary policy in the pursuit of their core objectives can be derived from how these central goals are affected by climate change and other environmental risks.

Prices and price variability, which are at the centre of attention of most central banks, could be affected through various channels by anthropogenic climate change and an associated increase in the frequency and severity of extreme weather events. To start with, climate change may have a significant impact on agricultural production, both domestic and abroad, and hence on food prices, which are an important component of consumer price inflation. For instance, climate change-related droughts and floods may have a significant impact on agricultural output and cause supply shocks and hence rising prices and cost-push inflation. For economies in which agricultural production is a central pillar of the economy – which is often the case in developing economies – climate change effects on the agricultural sector may also have a broader impact on aggregate income and employment. More broadly, climate change can lead to supply-side shocks that may cause a trade-off for central banks between stabilising inflation and stabilising output fluctuations (Cœuré, 2018). For instance, natural hazards may destroy production capacity, while extreme temperatures may lead to productivity shocks. These can cause pressure on both input and output prices.

While a first concern is how climate change-related hazards may directly affect prices, a second issue of concern is the potential impact of climate change mitigation policy on inflation. An important issue in this context is the potential impact that climate change mitigation policies may have on energy production and prices (Volz, 2017). McKibbin et al. (2017) discuss how different climate change policy regimes – carbon policies such as a carbon tax, a permit trading system, and other regulatory measures – could theoretically affect different monetary policy regimes. In a scenario where the introduction of a carbon tax causes aggregate output to decline and inflation to spike, no response by the central bank would yield a permanently lower output level and no change in the long-term growth rate. In the case of a strict inflation-targeting regime, the central bank would respond to the spike in inflation by raising interest rates, thereby further slowing the economy, but also causing exchange rate appreciation. While both would have a depreciating effect on inflation, the overall decline in output would be worse than in the case without central bank intervention. McKibbin et al. also discuss implications for other monetary policy regimes, including flexible-inflation targeting and price-level targeting, and come to the overall conclusion that solely responding to the inflationary component, without taking rising prices and decreasing output resulting from climate policy into account, may lead to unnecessarily large output losses. Monetary policy therefore has to consider climate-related effects on food or energy prices, as well as the impact of climate change mitigation policies because of potentially important implications for core inflation.

While most central banks now recognise that climate change can influence key macroeconomic variables, including output, consumption, investment, productivity, employment, wages, international trade, exchange rates, inflation and inflation expectations (NGFS, 2020), and a consensus has emerged that central banks ought to identify the transmission channels and risks for macroeconomic stability and take them into account in their policy decisions, the degree to which they have a role in pre-emptively addressing the very cause of these risks through active policy is subject to on-going debate.

Apart from the implications for price stability, the impacts of climate change on financial stability provide a strong rationale for central banks to take environmental risks into account and, where appropriate, directly address sustainability challenges. Given that climate-related risks are non-linear, tipping points could exacerbate the climate crisis and lead to a drastic reassessment of risk, leading to a "climate Minsky moment" (Carney, 2016) that could wreak havoc in financial markets. To the extent that environmental damages and climate-related risks affect the stability of banks, insurance firms and other financial actors, they need to be of concern for central banking. Thus far, only a few central banks and financial supervisors have been concerned with environmental risk, and even fewer have considered it as part of their systemic risk framework, even though risks arising from climate change can constitute a significant systemic risk for the financial sector and economies at large (Volz, 2017). However, a broad consensus is emerging that climate change and related mitigation policies will have substantial repercussions on the functioning of economies and hence, financial systems (Bank of England, 2015; Carney, 2015; Monnin, 2018; NGFS, 2019).

Three different types of risk through which climate change may affect financial systems have been identified: transitional risk, physical risk, and liability risk (Carney, 2015). Transitional risk describes the uncertainty associated with policy, price, and valuation changes that may occur in the process of mitigating climate change and reducing carbon emissions. The transition to a low-carbon economy will entail a large-scale structural change (Semieniuk et al., 2021). International goals, such as limiting global warming to two degrees, will require powerful policy initiatives, such as the introduction of carbon taxes or extensive environmental regulation, which will affect the valuation of carbon-intensive businesses and may render assets of coal, gas, and oil companies less valuable with potential systemic repercussions in case these policy changes have not been priced-in. Volz (2017) also discusses the development of new technologies in the process of climate change mitigation that may render existing technologies redundant, and the associated revaluation of assets, as a potential source of financial instability, which, if they do not occur in a gradual manner, may have

systemic implications.

Physical risk describes the risk of natural hazards, such as floods and storms, which may cause direct damages to an economy, as well as indirectly through the disruption of international production and supply chains. Climate-related damages and risks are understood to be potentially significant and to not only cause disruptions for individual firms or sectors, but also have systemic repercussions for the economy and therefore, financial stability. Increasing levels of physical risk can be expected to have particularly large repercussions for the insurance sector. As recognised by the Bank of England (2015), climate change-induced and other vital environmental changes therefore have clear implications for central banks because they may negatively affect the stability of financial institutions and systems. Climate vulnerability may also have significant impact on the fiscal position and debt sustainability (Kling et al., 2018; Volz et al., 2020). Pricing-in physical risks is an essential step in avoiding these negative repercussions for the economy and seems especially crucial for the valuation of long-term investments.

Thirdly, liability risk describes climate or environmental risks that occur due to uncertainty surrounding potential financial losses and compensation claims stemming from damages caused by climate change-related natural hazards (Bank of England, 2015; Carney, 2015). For instance, agents may seek compensation for financial damages from carbon extractors or emitters and environmental polluters, creating repercussions for the insurance sector that provides third-party liability insurance, which in turn has implications for financial regulators, such as central banks (Bank of England, 2015).

Thus, there is a strong rationale for central banks to address sustainability-related financial risks. However, it is important to consider the different roles that central banks play in financial supervision. Whereas some central banks have a responsibility for financial supervision, others are responsible only for monetary policy. For the former, sustainability risks will undoubtedly have to be integrated in their micro-prudential supervisory frameworks and policies, given the materiality of climate-related financial risks. However, even for central banks without mandate for micro-prudential supervision, consensus is emerging that they need to address climate and other sustainability risks in their macro-prudential frameworks and policies. Due to the potentially systemic nature of climate change and the risk of 'green swan' events (Bolton et al., 2020), there is a particularly strong case for central banks to respond to climate change risks as part of core macro-financial stability mandates. An important starting point for the calibration of macro-prudential policies is the identification of these risks and the modelling of the exposure of financial institutions and the system as a whole. For instance, De Nederlandsche Bank has implemented a macro-prudential climate stress test, focusing on the energy transition and identifying mining, petrochemical and utilities industries as the most vulnerable sectors that would could cause sizable losses for the financial system (Vermeulen et al., 2018). The responsibility of central banks to safeguard overall macro-financial stability therefore provides a strong rationale for not only the identification of risks, but potentially for assuming a pre-emptive role in accelerating the transition towards a carbon-neutral economy (Schnabel, 2020).

An important aspect of the role of central banks in addressing climate risks relates to the time inconsistency problem. Due to an often high degree of independence, differing objective functions, and inflation aversion, central banks tend to be better positioned than the government to address the time inconsistency problem (Berger et al., 2001). The commitment to medium term policy goals, traditionally low and stable inflation, that would allow for a maximum of sustainable growth is also relevant when it comes to addressing climate-related issues, albeit these still tend to be outside of the time horizon customarily considered by central banks (Carney, 2015). Given the nature of climate change, the sustainability agenda is extending time horizons for economic policies, which essentially implies that policy makers ought to maximise the sustainable growth rate not just over a business or credit cycle, but over (at least) a generation (Fisher and Alexander, 2018). Arguably, central banks are better placed to address the time inconsistency problem than other agents. Of course, it will be crucial not to lose focus on monetary and financial stability – which are indeed necessary pre-requisites for long-term sustainability policies.

Overall, a consensus has been emerging in the central banking community that both physical and transition risk can impact on macroeconomic stability and create and intensify risks to the stability of individual financial institutions and the financial system at large, and that potential disruptions from climate change ought to be analysed and different climate scenarios need to be considered by central banks (Bank of England, 2015; Carney, 2015; NGFS, 2018).

3.2. *"Promotional" objectives*

The second dimension of green central banking – an active contribution to a greening of the financial system and the economy as a whole – has been more contentious. Promotional objectives generally address long-term targets for central banks, such as economic development or growth, the promotion of sustainability and, theoretically, also the greening of the economy or climate change mitigation. First coined by Keynes (1913) in the context of central banking in a developing country context, promotional objectives have historically usually only explicitly been stated in the statutes of central banks in developing and emerging economies, while remaining absent from those of advanced economies' central banks, where, at most, promotional objectives were informally and implicitly conveyed.

Theoretically, central banks have numerous powerful tools at their disposal to affect credit allocation and the investment behaviour of financial firms.[5] Whether and to what extent a central bank should use its powers and actively engage in "greening" the financial system and the economy depends on two factors: its legal mandate, and the extent to which it is best placed to correct certain types of market failures, considering the ability and suitability of other policy institutions to steer the green transformation (Volz, 2017).

For central banks to assume an active "greening" role, an explicit legal mandate is required to pursue environmental and sustainability objectives, given the potentially distributive consequences. As discussed in Section 2, central banks in most of today's advanced economies have a relatively narrow mandate with the primary objective of pursuing price stability and, in some cases, financial stability. As discussed, such narrow mandates arguably require central banks to explore climate and environmental risks with regard to these core goals, but they do not mandate them to go further and to actively promote sustainability and green finance. In developing and emerging economies, central bank mandates are often more comprehensive and include social and economic objectives (and sometimes sustainability). This is reflected by the fact that central banks in many developing and emerging economies have been comparatively more active in promoting green finance and sustainable development, as discussed above. In specific circumstances, there may indeed be good reasons for why central banks should be mandated to play a promotional role with regard to green finance and sustainability (if they aren't already). We will discuss these reasons in the following section, before turning to potential risks and trade-offs in Section 4.

Achieving the global climate targets will not only require the financial sector to play a central role in financing sustainable and green investment, but also to curb funding away from environmentally harmful activities. In the absence of public intervention, banks and other financial institutions may allocate their resources to environmentally and socially undesirable activities, such as carbon-intensive or polluting ventures in order to maximise their private returns. This discrepancy between environmental and social returns, and private returns

[5] For an overview, see Volz (2017), Dikau and Volz (2019), and Dikau et al. (2020).

represents a market failure or imperfection that may call for efficiency-enhancing government intervention. That free markets do not necessarily yield Pareto-efficient allocations has been investigated by Greenwald and Stiglitz (1986), based on the understanding that if information is incomplete or asymmetric, or when markets are incomplete, outcomes may not be efficient and can be improved through government intervention. With regard to the allocation of credit, Stiglitz (1994) discusses an efficiency-enhancing role of credit policies based on the assumption that the private returns of commercial bank lending are not necessarily congruent with social returns. Stiglitz argues that in order to overcome these discrepancies between private and social return, directed credit, restricted lending to some activities, and promoting investment in others may be justified. With regard to sustainable growth and green finance, externalities that cause an environmentally suboptimal allocation of credit by commercial banks and other market participants may call for a more active, market-correcting role of central banks. However, the argument outlined by Stiglitz (1994) is based on the presumption that governments have the necessary information to intervene in face of market failure and correct these. A counter-argument would be that of potential government failure, where public intervention creates new distortions (Wolf, 1979; Krueger, 1990). Nonetheless, the analytical findings on pervasive market failures do not disappear in face of evidence that government intervention has often failed in the past (Datta-Chaudhuri, 1990).

Still, intervention by the central bank conceptually constitutes a second-best solution to the problem of market imperfection. The preferable first-best solution would be the removal of the market failure. For instance, a carbon-pricing mechanism that internalises the social costs of carbon emissions would constitute a preferred, first-best, market failure-correcting policy that may prevent or dis-incentivise environmentally undesirable investment; the problem, however, is that such first-best policies may not always be politically feasible or may take a long time to establish (Volz, 2017). In the case where the optimality conditions of fixing market failure cannot be satisfied, the intervention of the central bank through environmental financial regulation or the interference into the allocation of resources can be interpreted as a second-best solution based on the theory of the second-best by Lipsey and Lancaster (1956) (Volz, 2017). In practice, second-best policies could be implemented by mandating central banks to address such externalities by affecting the creation and allocation of credit.

Central banks and other financial regulatory authorities can influence investment decisions and the allocation of resources and credit through a number of different policy implementation instruments. Their regulatory oversight over money, credit, and the financial system puts central banks in a uniquely powerful position that enables them to incentivise or direct resources away from carbon-intensive sectors and towards green investment. Especially in developing countries, central banks typically have a strong institutional standing that enables them to shape policy outcomes in ways that other public institutions, such as environmental ministries, are unlikely to achieve. However, given their enormous powers, it is crucial to consider the limits to central banks' mandates and honour the need for accountability to the public. The accountability of central banks with respect to functions and objectives is a complex issue (BIS, 2009). The more political the work of central banks becomes, the more their independence will be questioned, suggesting a need for more and better communication, especially over controversial areas (Blinder et al., 2017). While most would agree that central banks can and must increase their accountability by increasing transparency (e.g. Buiter, 2014), it is important to recognise that transparency is a necessary but not a sufficient condition for accountability. Nevertheless, it will be crucial for central banks to explain clearly and transparently to the public what actions they take to enhance sustainability outcomes, and how they expect the adopted measures to work.

Historically, credit allocation policies and various other instruments of "financial repression" were widely used, and in many cases, led to substantial distortions of financial systems with often unwanted repercussions for savings and prices; in these cases, the consequence often was the underdevelopment of financial markets. While the historic success or failure of credit allocation and financial repression policies is subject to on-going debate, such instruments stand in strong contrast to the widely accepted notion of the neutrality of monetary policy and central banks in general towards different investment classes, sectors, or types of firms. Allocating financial resources towards or away from certain sectors and companies implies favouring certain segments of the economy over others and appears to be incompatible with the modern understanding of independent central banks. Nonetheless, many central banks in emerging and developing economies have resorted to these policies as viable, second-best solutions to promote sustainable development and green investment. The notion of the market-neutrality of monetary policy has come under intense scrutiny more recently. A controversial discussion has emerged on the distributional consequences of the negative interest and quantitative easing policies adopted by major central banks (e.g. Gornemann et al., 2016, Coibion et al., 2017, Colciago et al., 2019). Regarding environmental impacts of central bank policies, a number of studies have shown that the corporate asset purchase programmes of several major central banks display a strong carbon-bias (Matikainen et al., 2017; Dafermos et al., 2020a; Dafermos et al., 2020b), which means that central banks are effectively perpetuating an existing market failure and undermining the declared climate goals of their governments.

Another kind of market failure involves missing or incomplete financial markets that impede the trading of different forms of credit, assets, or risks (Volz, 2017). While central banks most certainly have a role to play in financial market development and in establishing primary and secondary markets for securities, as well as money and exchange markets where none exist (Gray and Talbot, 2007), they may also be in a position to aid the development of new green market segments. For example, central banks can contribute to creating a regulatory environment that promotes green bonds issuances and trading in secondary markets. In this context, Dikau et al. (2021) emphasise that the actions, as well as inactions, of central banks have an impact on expectations and behaviour in financial markets and can indeed shape markets and thereby affect capital formation and, thus, the carbon trajectory of an economy.

4. Risks and trade-offs

While the article has thus far argued that there may be a case for a pro-active, "sustainable development role" of central banks, one needs to be clear about the risks of overstretching central banks' mandates. In this context, it is important to discuss how overburdening central banks with more responsibilities could backfire on them, as well as the implications for their independence in tasking them with more political work. Two risks are particularly important.

First, on a functional level, central banks will encounter problems if they are supposed to achieve too many objectives and have too few tools – this is the so-called Tinbergen rule (Volz, 2017). In principle, if central banks were tasked with environmental goals, they would need to be equipped with effective instruments in order to achieve these goals without compromising other goals. It should be noted though that the financial and macroeconomic risk challenges stemming from climate change discussed above are issues central banks have to deal with in any case. That is, as far as the traditional core responsibilities of central banks – safeguarding macroeconomic and financial stability – are affected, there is no need to add environmental goals to central banks' mandates, as these are implicitly already part of their mandate. Yet, it will be critical to analyse in detail how environmental and climate change risks can be adequately incorporated into existing frameworks. Recent years have seen considerable efforts by central banks and academics to develop macro-prudential frameworks and instruments (e.g. Mendoza, 2016; Battiston et al., 2017). The understanding of how to

best incorporate climate risk into macro-prudential analysis is still at an early stage, but a consensus is clearly emerging that climate and environmental risks need to be addressed in both micro- and macro-prudential supervision. At the same time, the extent to which central banks should use tools at their disposal to play a pro-active sustainable development role to promote green investment and dis-incentivise dirty investments is still heavily disputed, and there are indeed concerns that promoting specific sectors such as the green economy may cause conflict with other central bank goals, including financial stability.

Second, there is a danger that too much power may be extended to institutions with limited accountability to the public. Since the 1980s, a relatively broad consensus has developed that central banks should be granted institutional independence, i.e. the conduct of monetary policy in pursuit of goals set by the government should be free from political influence. As central bank policies have adopted unconventional monetary policies in the post 2008-crisis era, they have faced increased criticism for taking policy decisions that critics say go beyond their mandate (e.g. Tucker, 2018). For example, a quasi-fiscal role of central banks is widely considered problematic as central banks have no political legitimacy for taking decisions about the allocation of public spending. Still, it is important to recognise that monetary policy has always had distributional consequences and that central banking cannot be reduced to a purely technical exercise. As discussed before, more and better communication and enhanced transparency will be necessary to strengthen accountability.

Central banks need to create the legitimacy of their actions through clearly communicating their assessment of the risks and the rationale for their policy actions. Otherwise, they may be at risk of losing their independence (Eichengreen et al., 2011). As highlighted by Groepe (2016: 1), "the biggest risk to central bank independence is the possible backlash from being unable to deliver on unreasonable expectations. Central bank mandates have expanded – perhaps appropriately so – but there are limits to what monetary policy was designed to achieve. Central banks cannot be, and should not be regarded as, 'the only game in town'." Indeed, there is a danger that "governments, parliaments, public authorities, and the private sector assume central bank policies can substitute for the structural and other policies they should take themselves" (G30, 2015: xii).

5. Conclusions

Our empirical investigation has shown how central bank mandates relate to green activities of supporting sustainable growth, mainstreaming green finance or incorporating climate-related risks into core policy implementation frameworks. We show that, on the one hand, 52% of the 135 investigated central banks and monetary unions are already mandated to either explicitly contribute to the sustainability of growth and development or to support the government's economic policies, which would usually include sustainability objectives. ESG criteria would not have to be added to the mandates of these institutions. On the other hand, 48% of central banks have no explicit or implicit sustainability objectives. However, many of them have nonetheless begun to engage in various green activities. Most of these activities aim at incorporating environmental and climate-related risks into the core policy implementation frameworks under the objectives of price and financial stability. As we show, climate risks can very directly impact on traditional core responsibilities of central banks, most notably monetary and financial stability. As a consequence, an integration of ESG factors into central banks' core policy implementation frameworks may not only be necessary to efficiently and successfully safeguard price and financial stability, it would be also covered by mandates that make no explicit or implicit reference to sustainability. A potential role of central banks in promoting sustainability in the financial system and "greening" the economy, however, is more contentious because of the possible distorting effects of such policies. It therefore is crucial that such a potential promotional role of the central bank is covered by the mandate.

While central banks have a potentially large number of instruments to affect the allocation of capital towards green investment, this does not imply that they should necessarily be tasked to do everything they possibly could. Starting with existing central bank mandates – which differ across countries/monetary areas – and also taking into consideration different central banking traditions, a discussion is needed about the extent to which and the way how central banks should support their respective government's sustainability policies. The outcomes of such deliberations will inevitably differ across countries and will also be contingent on institutional legacies (Johnson, 2001; North, 1990). The path-dependent nature of institutional change, which also is affected by established cultural patterns, requires that institutional traditions are considered so that resistance to change does not undermine attempts at institutional redesign.

The ways in which central banks will address the climate emergency will inevitably differ. The extent to which a central bank adopts a more activist approach to support a government's sustainability objectives is ultimately a political decision. Nevertheless, it should be clear that climate change and mitigation policies will have very profound impacts on economies, with potentially significant implications for macroeconomic and financial stability. These need to be tackled by central banks as part of their core responsibilities. A central bank that does not address climate risks is failing to do its job.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this article.

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