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The Green Central Bank Index

Abstract: Climate change is one of the biggest risks to the global financial system and to the economies of perhaps every nation upon this planet. Central banks could play a prominent role in protecting us from this economic upheaval. This paper develops an objective Green Central Bank Index. The index is constructed by identifying nine distinct policy tools which central banks can deploy to further their countries' climate resilience. Central banks can be graded against each of these areas using publicly available information, and the grades combined into an index using appropriate weights. We can therefore measure the intensity with which individual central banks engage with the green agenda and compare to their peers. We apply our Green CB Index to thirteen of the largest and most developed economies in the world. We identify three distinct groups of countries: leaders in climate change who actively use the central banks power and influence to encourage their economies to become sustainable; a second set of countries who either publicly announce their policies to reduce financial risks from climate change but are yet to deploy their full arsenal in support of climate, or the reverse – keeping a low public profile but nonetheless discretely using the position of the central bank to further climate goals; and a final group of countries who are yet to prioritise climate issues. The Index highlights the differing policy challenges facing these three separate central bank groups.

Keywords: central banks, green financial system, low-carbon economy, financial risks from climate change.

JEL Classification: E58, G32, C43.

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1. Introduction

Central banks (CBs) play a prominent role in ensuring financial stability within their countries (Morhachov, Ovcharenko, Ivchenko, Buchniev & Klius, 2020; Zeqiraj, Mrasori, Iskenderoglu & Sohag, 2021). One of the largest risks to the safety and soundness of the financial system, many would argue, is climate change (Backović, Jakšić & Ilić, 2024). The Bank of England (2015, 2017) pointed to two ways in which climate change can have catastrophic financial consequences. First, there are the physical risks of climate-related events such as natural disasters, rising sea levels, droughts, floods, storms, and so on, which may threaten financial stability. Second, as the world economy evolves away from current technologies (e.g. oil) to alternatives (such as renewables), assets may become stranded and face a collapse in their values. This in turn could undermine the financial institutions which have provided the capital for those assets. Both of these risks can be mitigated by timely and steady transition to a low-carbon economy.

CBs have a role to play in the transition to low-carbon economies. CBs have at their disposal immense balance sheets with which they intervene in their domestic economies to maintain price stability. The aggregate size of the CB balance sheets in advanced countries is the equivalent to more than 20% of GDP (BIS, 2011). The balance sheet of the ECB alone at end-2019 was 4.7 trillion euros (ECB, 2020), which is over 40% of the euro area's GDP (IMF, 2020). Not all of this balance sheet takes the form of bonds, but much of it does. For example, the Bank of Japan reports that in September 2020 it held 540 trillion yen (worth 5.1 trillion US dollars) of government and corporate debt (Bank of Japan, 2020). Which assets a central bank deems suitable to buy exerts a huge pressure on the economy.

In a similar manner, the national supervisory authority for financial stability also has a role to play in the transition to a green economy. The conduct of stress tests and the issues focused on in supervisory work create a powerful impetus to behaviour (Martin, 2023). It follows that CBs, including financial supervisory authorities, have the tools to play an important role in managing a safe and purposeful transition to a low-carbon future.

CBs and regulatory authorities are increasingly concerned about the influence of climate change on financial stability of their countries. This is one of the reasons why many of them have joined the Network for Greening the Financial System (NGFS) and begun work streams to identify which climate-related risks can legitimately be tackled within their mandates (BIS, 2020). Interpreting mandates requires discretion and political capital, and as noted above it is widely accepted that climate risk represents a financial risk to market-based economies (Bank of

England, 2017; BIS, 2020a; ESRB, 2016). CBs differ in their willingness to use the tools at their disposal to tackle climate change and adjust financial prudential regulation to facilitate the transition to a low-carbon economy.

Our objective in creating a Green CB Index (GCBI) is to measure the CB differences in the tools they choose to wield, and the commitment they display to protect their economies from climate change. As the index is numerical, CBs can be grouped by score and each group compared to others to identify which CBs are the most active on the climate agenda as compared to their peers. Thus, the GCBI will allow us to identify which policy areas are proving most challenging at different stages of climate engagement. We can therefore use peer comparison to develop targeted policy objectives towards a low-carbon economy for the endogenously identified groups of CBs.

This output of the GCBI is valuable as it rewards those CBs taking steps which benefit us all, and it may strengthen the resolve of these same CB leaders in moving even further and faster in the cause of a safer planet.

The methodology we have developed to construct the Green CB Index is as follows. First, we devised a suite of questions which are designed to address the climate commitment a CB or national financial authority has to three main policy areas: 1) international discussion groups and the CBs' own corporate environmental policies; 2) research and governor public positions; and 3) active use of CB regulatory tools to drive a climate agenda.

These questions are evidenced in a methodical manner and graded consistently as we describe below. The final step is then to apply appropriate weights to all of these grades and aggregate all of these weighted grades into an individual score. As is common in rankings, lower scores will be better, greener in this case. These steps allow us to derive the Index of Green CB behaviour.

The first contribution of this paper is to construct a robust Green CB Index. Another contribution is to demonstrate the GCBI methodology in practice. This will allow us to demonstrate how CBs can be grouped according to their green focus, and how the policy targets for the different groups can be robustly identified.

As a demonstration, therefore, we will apply the GCBI to thirteen prominent CBs, including their national financial stability supervisors, if separate. The considered CBs are given in alphabetical order of commonly used acronym in Table 1. The CB list indicates that we have chosen to apply our GCBI to thirteen CBs from leading economies in the world. The list includes all G7 countries, the ECB as the pre-eminent CB in the euro area,, and the other CBs listed are from the

G20 countries. It follows that the CBs are not representative of the community of nations across the globe; they have been selected because of their prominence and broad international interest.

Table 1: Commonly used abbreviations of the Central Banks

BCB	Central Bank of Brazil
BdF	Banque de France
BoC	Bank of Canada and the Office of the Superintendent of Financial Institutions
BoE	Bank of England
BoI	Bank of Italy
BoJ	Bank of Japan and Financial Services Agency
Bundesbank	Deutsche Bundesbank and Federal Financial Supervisory Authority (BaFin)
CBRF	Central Bank of the Russian Federation (The Bank of Russia)
ECB	European Central Bank and The European Banking Authority
Fed	Federal Reserve System
PBC	People's Bank of China, China Banking and Insurance Regulatory Commission, and the China Banking Regulatory Commission
RBI	Reserve Bank of India
SARB	South African Reserve Bank

We have applied the GCBI to both the central banks and the financial supervisory authorities in countries where this responsibility is separated, as is the case of Canada. We have not applied our methodology to financial conduct regulators as our focus is on reinforcing the economy-wide transition to a low carbon future, rather than preventing the resulting opportunities for mis-selling (e.g. green washing). In the rest of this paper we first develop the questions asked and methodology employed before presenting the ranking amongst the CBs created by the GCBI we develop. First, however, we offer a literature review.

2. Literature Review

The premise of this research is that climate change represents a clear and present danger to the financial system. The literature has rapidly formed a consensus around this view. The European Systemic Risk Board (ESRB, 2016) highlights an abrupt forced transition to low-carbon production as a material risk to the financial system. Battiston et al. (2017) concur and argue that the timing of climate mitigation policies is the critical tool necessary to mitigate this risk. The financial sector itself is also vulnerable to severe climate-change induced drops in value

(CISL, 2015). In the event of which the growth rate of the global economy would be permanently reduced (Dietz, Bowen, Dixon & Gradwell, 2016).

Given such predictions, an objective Green Central Bank Index could be very valuable. Creating such an index is the object of this paper. Recently, there has been a heated debate among scholars, policy makers and commentators on the possible tools CBs can, subject to their mandates, use to encourage the shift to low carbon economies. Campiglio et al. (2018) highlight CB's potential to conduct green quantitative easing and discuss how CBs can use financial regulation to reveal information on climate change. The IMF (2019) provides an overview of possible financial policy tools which can be used to encourage the transition to a low-carbon economy, but does not argue in favour of a specific set. D'Orazio and Popoyan (2019b) and Campiglio (2016) argue that CBs should focus on using macroprudential financial regulation to encourage the transition to a low-carbon economy. Dafermos, Nikolaidi & Galanis (2018) and Lamperti, Bosetti, Roven-tini & Tavoni (2019) highlight the role CBs can play in promoting green lending. Policy makers are keen to play their role. In the first comprehensive NGFS report (2019), the CBs acknowledged that climate-related risks are a source of financial risk and in the NGFS guide (2020) the CBs argued that climate-related and environmental risks should be integrated into micro-prudential supervision.

To create a Green Central Bank Index one first has to decide what policy instruments to measure and then to measure them. We take a maximalist approach instead of a narrow one. Hence, the GCBI we develop gives credit, appropriately weighted, to all the tools identified above, instead of privileging a few. Our work, therefore, expands on the existing literature. For example, Dikau and Volz (2020) identify five policy areas through which CBs can pursue a green agenda: green micro-prudential regulation, green macro-prudential regulation, financial market development, credit allocation, and central bank soft power and guidelines. Our work includes all of these. The Climate Bonds Initiative (2019) identifies the following toolkit of CB policies for reducing financial risks from climate change: regulating transparency, financial asset purchase by CBs, financial asset weightings, and credit guidance and incentives. The GCBI we define is sensitive to these observations. Fisher and Alexander (2019) identify three critical areas in which a CB might act in pursuit of green objectives: monetary stability, financial stability, and micro-prudential supervision. Our GCBI covers all of these areas.

We are not the first to seek to measure the performance of CBs across given green policy arenas. We have chosen to rely on openly published information from each CB as such announcements are open to public scrutiny and thus may be more reliable than private assertions. These announcements have been independently ex-

amined by researchers and their contributions to the policy tools identified have been scored. Aggregation of scores across multiple tools allows for any noise to be averaged away yielding objective scores. D’Orazio and Popoyan (2019a) also use publicly available data to construct a dataset on the use of green CB instruments. An alternative approach would be to collect solely numerical data on CB green policies. This would have the benefit of being more objective but has the drawback that only measurable variables can be included. OMFIF (2020) deployed a survey method and asked CBs to comment on their regulatory progress on climate risks. Our approach avoids the risk that CBs might answer in a self-serving way, though we cannot capture actions which a CB has done in secret but does not wish to reveal to the world. A number of studies have used a deep-dive in particular policy areas to explore how CBs are performing (Dikau and Volz, 2019; Dikau and Ryan-Collins, 2017; Oyegunle and Weber, 2015; Volz, 2016, 2018).

3. Materials and Methods

The GCBI we have designed begins with the creation of a suite of questions. How those questions are evidenced, scored, and the scores combined into an index is explained in later sections. First, we describe the questions we have developed as being informative in the construction of the GCBI. Below we present these questions and justify their relevance. The rationale behind the numbering of the questions will become apparent in subsequent sections.

Question 1.1. Is the Central Bank a member of the Network of Central Banks and Supervisors for Greening the Financial System (NGFS)?

The NGFS is a group of CBs and Supervisors willing, on a voluntary basis, to exchange experience and best practice in the development of environmental and climate risk management in the financial sector, and to mobilize mainstream finance in support of the transition to a sustainable green economy. Membership of the NGFS demonstrates a desire to move in the direction of a new climate risk policy framework and to be involved in the latest discussions of climate-related financial risks. At the least, it indicates that the CB appreciates that this is an important image to offer to the world.

Question 1.2. Does the Central Bank have corporate environmental policies and goals for reducing carbon emission?

CBs are observed by market participants and so have an opportunity to model a commitment to protecting the environment and mitigating climate change. This

is a prominent and real demonstration of a CB's contribution to the global fight against climate change.

Question 2.1. Does the Central Bank Governor pay attention to climate-related risk and green finance in his/her speeches?

Investors, banks, and financial institutions pay a great deal of attention to official CB Governor announcements. Official Governor announcements are an indicator for all market participants of current CB policies and their likely evolution. Official discussion by the Governor in support of a move to a low-carbon economy would validate the short-run costs market participants incur in moving to a low-carbon economy.

Question 2.2. Does the Central Bank either (i) assess the impact of climate change on the banking and insurance sectors; or (ii) conduct research in the area of green finance and green bonds?

Officially published CB research regarding the impact of climate change on the banking and insurance sectors reminds investors that financial institutions would suffer significant losses if climate change were to cause a sudden shift in the value of legacy assets. This justifies preventative action by CBs and demonstrates the desire of CBs to know as much as possible about the influence of climate risks on the banking and financial sectors.

Question 3.1. Does the Central Bank have prudential regulation regarding climate-related risks?

Green prudential regulations from the CB or financial stability regulator provide guidance and pressure to the financial sector to ensure climate risks are embedded in a sound risk management framework. Furthermore, prudential regulation can play a role in encouraging climate risk management to become a mainstream practice by using financial institutions to pressure the non-financial institutions they do business with to manage their climate related risks (Lamperti et al., 2019). This question privileges regulation over supervisory guidance, even though a well-meaning regulator can use supervision to achieve very substantial behavioural change (Fisher and Alexander (2019). However, explicit regulation has the force of law and requires CB political capital to set, while supervisory expectations can be more permissive and adaptable to the supervisor-bank relationship; this flexibility is one of their policy advantages, while for the purposes of a Green CB Index, it is one of their weaknesses. Some CBs have argued that it is unclear if mandates permit the use of prudential regulation. However, other CBs have already acted to interpret their mandate permissively (Campiglio et al., 2018).

Question 3.2. Does the Central Bank provide the financial and banking sector with a definition of green and brown assets or green and brown taxonomies?

Without a clear definition of green and brown assets or green and brown taxonomies, financial institutions and companies define “green” assets in their own terms. Competing interpretations of green securities handicap the development of a deep and liquid green securities market by sowing confusion amongst investors and generators of green debt. A CB endorsed green definition would facilitate market development and would encourage the collection of information on green assets in a consistent manner, lowering asymmetric information impediments to green market formation.

Question 3.3. Does the Central Bank include climate risk in stress-testing?

Climate-related risks may materialise over decades, but CB actions today will affect the extent to which Financial Institutions begin to prepare for those risks. CB climate stress-tests are a natural way of ensuring the improvement and management of climate risks by banks and financial institutions. Climate stress-tests demonstrate the resilience of the financial market to physical and transition risks associated with different possible climate scenarios. They therefore encourage investors to focus also on these risks and so to improve the monitoring of green actions of Financial Institutions and also non-Financial Institutions invest in.

Question 3.4. Does the Central Bank establish mandatory requirements on climate-related financial risk disclosure?

Accurate and timely disclosure of current and past operating and financial results is fundamental to efficient capital-allocation decisions. Mandatory requirements on climate-related financial risk disclosure helps companies better demonstrate responsibility and foresight in their consideration of climate issues. This will lead to a smarter and more efficient allocation of capital, and help smooth the transition to a more sustainable low-carbon economy. Such requirements would likely increase the quality of investor monitoring of green conduct.

Question 3.5. Does the Central Bank either (i) buy green bonds for its asset repurchase program, QE programmes, reserve management policy, staff pension funds, investments; or (ii) use explicit sustainability or green indices to determine a proportion of the securities bought?

There is some debate amongst CBs as to whether a CB can, within its mandate, buy green assets which are, at least at present, less liquid than government debt (Campiglio et al., 2018). However, current uncertainty as to the future demand

for green assets is likely to be damaging the incentives to create green assets. A CB commitment to buying green assets would underpin demand and so encourage greater green bond issuance, thus encouraging the deepening of green securities markets. Once again, though, some CBs have interpreted their mandate permissively, an outcome which is easier if the green bonds are bought independently of quantitative easing for other reserve management purposes (Campiglio et al., 2018). The certainty of a CB being present in the future as a buyer and seller of green assets would lower the risks that market-makers might perceive of being stranded in the future with green assets. CB presence in green securities markets would signal acceptance of green securities as a key asset class for the long term, and CB purchases would act as a certificate of green authenticity. Including this question ensures a CB Governor prepared to use the CB balance sheet to foster the transition to a low-carbon economy is recognised.

In our view, these questions capture the key features we identified above: active engagement by CBs in international discussion groups and research; green CB leadership in the management of their own institution; and active use of CB regulatory tools, including the balance sheet, to drive a climate agenda. We now turn to the question of evidencing each CB's performance against the above questions, using this evidence to assign a score to each CB, and so ultimately allow the creation of an index.

The source of information for answers to the GCBI questions is the data posted on official websites of central banks and authorities responsible for supervision and regulation of financial institutions. This data includes CB annual reports, press releases, reviews, speeches, research papers, and articles. We have also used the reports and publications of the World Bank, the Bank for International Settlements, the Climate Bonds Initiative, and the Central Banks and the Supervisors Network for Greening the Financial System. Only public (official) information has been used for CB assessments.

Using the evidential sources above, we grade each CB in the study against each of the GCBI questions using a 4-point scoring scale. A CB amasses 1 point for a given question if the answer to the question can be classed as “yes”, that is the stated characteristic in the question is permanently, always, or across-the-board, true. A score of 2 points is earned if the answer is “mostly”, that is the characteristic is almost permanently, almost always, or almost fully, true. It is immediate that low points are better, and indeed the GCBI will, as is common in rankings, ultimately award the lowest numerical value to the greenest CB.

A score of 3 points is earned for a GCBI question if the answer to the question posed is “partially”, that is, the characteristic is partly, not always, but in some cases, true. While the least green score of 4 points is awarded if the answer to the question posed is “no”, that is the characteristic is never, or in no case, true. In Table 2 we outline in more detail the data sources used for each question posed.

Table 2: Evidential Sources for GCBI Questions

	Question	Data sources
1.1	Is the Central Bank a member of the Network of Central Banks and Supervisors for Greening the Financial System (NGFS)?	Supervisors Network for Greening the Financial System (NGFS) website, https://www.ngfs.net/en/about-us/membership
1.2	Does the Central Bank have corporate environmental policies and goals for reducing carbon emissions?	CB annual report with attention to whether: the report carries information on the risks caused by climate change; whether the CB sets a target for its own carbon emissions.
2.1	Does the Central Bank Governor pay attention to climate-related risks and green finance in his/her speeches?	Examination of official speeches of the CB Governor at conferences, official meetings, and interviews given to mass media.
2.2	Does the Central Bank either (i) assess the impact of climate change on the banking and insurance sector; or (ii) conduct research in the area of green finance and green bonds?	Use of the CB website to determine if the CB reports identify any work on climate change prevention, green finance, or climate-related risks.
3.1	Does the Central Bank have prudential regulation regarding climate-related risks?	Using the CB website and that of the authority responsible for the supervision and regulation of financial institutions we explore: Does the CB require financial institutions to decrease the volume of loans provided to major polluting companies and increase the volume of loans provided to environmentally friendly companies? Does the CB stimulates green finance and green bonds issuance? Does the CB guide the financial institutions to invest in green assets? Does the CB issue any requirements, guidance, quotas or recommendations as to how to manage, assess and monitor climate-related risks or conduct stress tests of climate risks? Does the CB require the disclosure of climate information in its reporting forms?
3.2	Does the Central Bank provide financial and banking sector with a definition of green and brown assets or green and brown taxonomies?	Answered with reference to the official CB website and that of international organizations.
3.3	Does the Central Bank include climate risk in stress-testing?	Sources used as in question 3.1.
3.4	Does the Central Bank establish mandatory requirements on climate-related financial risk disclosure?	Sources used as in question 3.1.
3.5	Does the Central Bank either (i) buy green bonds for its asset repurchase program, QE programs, reserve management policy, staff pension funds, investments; or (ii) use explicit sustainability or green indices to determine some of the securities it buys?	Assessed with reference to the official CB website including (i) any officially announced purchases of green bonds for any CB asset repurchase program, for any QE program, for CB reserve management or for staff pension funds or (ii) assessment as to whether the CB uses explicit sustainability or green indices to determine some of the securities it purchases.

The final step is then to combine the points awarded for each of the questions asked into an overall score. We have determined nine questions, each of which addresses a different aspect of possible green CB behaviour. However, in our view not all the questions should carry equal weight in the final determination. Where a CB is undertaking an action which requires clear policy commitment, then this should be acknowledged as being more challenging than another action which allows the signalling of green intentions at little cost. Our weighting of the questions posed is captured by the numbering system we have used.

Questions 1.1 and 1.2 are given the lowest weight amongst the questions posed. To satisfy these questions positively does not require a challenging policy commitment to new behaviour. Rather low cost, arguably cosmetic, actions are all that is required. We stress that this does not mean that CBs who, for example, are members of the NGFS do so for purely PR reasons. Rather, if a CB felt under pressure to be green, joining the NGFS would allow the CB to say it was taking a green action with limited alteration to business as usual. Questions numbered with the pre-fix number one enter into the GCBI with no further alteration.

Questions 2.1 and 2.2 carry more weight. The scores for these questions are multiplied by two before being added into the GCBI Index. These two questions address whether the CB Governor publicly commits to a green agenda, or commits real resources in the form of research and advocacy budgets to supporting a transition to a green economy. The resources, compared to the balance sheet of a CB are modest, but are real nonetheless. Thus these questions carry the middle weight in our analysis.

Questions with the pre-fix 3. Questions from 3.1 through 3.5 carry the most weight. The scores earned by a CB for each of these questions are multiplied by three before being added to the GCBI Index. These questions assess whether the CB commits material resources to the cause of transitioning to a Green Economy, and/or whether the CB makes clear policy choices that are backed by actions and resources, to move their national economy to a green footing. We can make such an example. A commitment to use climate metrics in stress testing (question 3.3) commits the CB's reputation to climate issues and exposes the regulated entities to material costs. Insisting that this must be done requires CB's political will.

The Green Central Bank Index is therefore calculated as (Figure 1):

Figure 1: The Green Central Bank Index

$$\begin{aligned}
 GCBI = & [\text{Sum of points scored from questions 1.1 and 1.2}] \\
 & + 2 \times \left[\begin{array}{c} \text{Sum of points scored from} \\ \text{questions 2.1 and 2.2} \end{array} \right] \\
 & + 3 \times \left[\begin{array}{c} \text{Sum of points scored from} \\ \text{questions 3.1 through 3.5 inclusive} \end{array} \right]
 \end{aligned}$$

It is apparent, as noted above, that the greener the CB, the lower the value of the GCBI attained. This is a standard feature of rankings. The best value of the GCBI achievable is therefore 21, achieved by scoring one point for each of the nine questions, and then aggregating up as in the formula. The worst value of the GCBI achievable is 84, achieved by scoring four points for each of the questions and then aggregating up as in the formula.

The Green CB Index is constructed by human assessment of the evidence against all nine questions. As noted above, this approach has the benefit over using statistical data that a complete analysis can be undertaken of all policy areas, and not one focused only on those for which numerical data are available. The disadvantage of our approach is that even though researchers have tried to assess the written evidence objectively, being human it is possible for some inconsistency in individual questions to creep in. The Green CB Index is robust to this in two ways. Firstly, there are not one or two but nine questions to assess and the independent scores across these questions are aggregated. Any small random errors in one question will be matched by similar errors in the opposite direction for other questions. Thus overall the index remains robust. Secondly, we will be careful in classifying the CBs into groups with similar scoring. This is sufficient to identify valuable policy conclusions and avoids any claims of spurious accuracy. As a result, the robustness of the process can be assured.

This, therefore, completes the first contribution of this paper. We have developed the Green Central Bank Index. We now move on to the second contribution to demonstrate how it can be implemented and the results interpreted.

4. Results

In this section we illustrate how our GCBI can be applied. We demonstrate this below for the countries listed in the Introduction using data which was current through 2020. The results of the GCBI reflect the status of the CBs up to that time. In this section, we give a brief overview of this work, presenting the CBs in alphabetical order of their acronym. The question-by-question scores achieved by

each CB are given in Table. A reader who wishes to jump to the ranking results will find these in the next section, specifically in Table 4. A detailed analysis underpinning the analysis presented below is contained in the Online Supplementary Materials.

Table 3: Answers to the GCBI Questions By CB; analysis of data valid until summer 2020¹

Questions	PBC	BdF	ECB	BCB	BoE	BoI	Bundesbank	BoC	BoJ	RBI	SARB	CBRF	Fed
Group 1													
1.1 Is the Central Bank a member of the Network of Central Banks and Supervisors for Greening the Financial System (NGFS)?	1	1	1	1	1	1	1	1	1	4	1	1	4
1.2 Does the Central Bank have corporate environmental policies and goals for reducing carbon emissions?	4	1	1	2	1	1	1	1	4	2	4	4	3
Group 2													
2.1 Does the Central Bank Governor pay attention to climate-related risk and green finance in his/her speeches?	1	1	1	4	1	3	4	3	1	4	3	4	4
2.2 Does the Central Bank either (i) assess the impact of climate change on the banking and insurance sectors; or (ii) conduct research in the area of green finance and green bonds?	1	1	1	3	1	2	1	1	3	3	3	3	3
Group 3													
3.1 Does the Central Bank have prudential regulation regarding climate-related risks?	1	2	3	1	3	4	3	4	4	3	4	4	4
3.2 Does the Central Bank provide the financial and banking sector with a definition of green and brown assets or green and brown taxonomies?	1	3	3	1	4	4	3	4	4	4	4	4	4
3.3 Does the Central Bank include climate risk in stress-testing?	3	3	3	4	2	4	4	3	4	4	4	4	4
3.4 Does the Central Bank establish mandatory requirements for climate-related financial risk disclosure?	1	1	2	1	3	4	4	4	4	4	4	4	4
3.5 Does the Central Bank either (i) buy green bonds for its asset repurchase programme, QE programmes, reserve management policy, staff pension funds, investments; or (ii) use explicit sustainability or green indices to determine some of the securities it buys?	1	1	2	4	4	1	3	3	4	4	4	4	4

¹ Full analysis is available in the Online Appendix: <https://docs.google.com/spreadsheets/d/1HwVpC4i-8CKUk14clexQGY9qOCeCDTTBniYlOqNcs-0/edit?usp=sharing>

4.1. BCB - Central Bank of Brazil

Score: 50

The BCB is the only CB which secured yes answers to many of the group 3 questions, while simultaneously scoring poorly on the group 2 questions. The absence of prominent official announcements by the BCB Governor regarding climate-related risks does not prevent it from adjusting its prudential regulation to climate-related risks. According to the World Bank Report, Brazil has been a pioneer in its policy efforts to protect the environment and manage climate-related risks (World Bank Group, 2018).

In July 2011, the BCB issued the circular 3547 establishing procedures for commercial banks' Internal Capital Adequacy Assessment Process (ICAAP) and requiring that banks take into account the risk of exposure to environmental damage. Through stress tests banks have to evaluate the sufficiency of their capital to cover a variety of risks, including those arising from exposure to social and environmental damage. Banks that are subject to ICAAP regulation are also required to submit an annual report to the BCB outlining how they assess and calculate risks, explore implications for capital adequacy, and consider their exposure to social and environmental damages. This Circular also requires banks to publicly disclose their environmental and social risks as part of the market discipline disclosure rules of Pillar 3 in Basel III (International Finance Corporation World Bank Group, 2019).

In 2015, the BCB issued Resolution 4427 which determines the rules of credit monitoring and risk management. This resolution requires banks to inform the BCB of the exact coordinates of all rural financed projects, including crop financing, formation or recovery of pasture, and investment in crops and forests (International Finance Corporation World Bank Group, 2019). Further in 2017, the BCB issued Circular 3846 on the ICAAP which requires mandatory disclosure of any kind of exposure to social-environmental risks in the financial institutions' risk assessment process and in the calculation of capital adequacy (BCB, 2020).²

² In addition, the BCB is responsible for socio-environmental development and has implemented its Policy for Socio-Environmental Responsibility (PRSA), which requires the CB to take into consideration the environmental impact of its working processes and operating conditions.

4.2. BdF - Banque de France

Score: 36

Banque de France (BdF) is the first of the euro area CBs we cover and so at this point a note is in order as to how these banks fit within the Eurosystem and relate to the ECB, which we also cover below. Euro area central banks are part of the European System of Central Banks (the ESCB). These banks no longer have individual responsibility for European monetary policy; they have collective responsibility through their voice on the ECB. Euro area CBs do, however, contribute to European policy and exercise important CB and often regulatory activities within their home countries. These include the exercise of monetary policy decisions within their own jurisdictions, the use of their balance sheet within parameters which are consistent with overall ECB policy, and often financial stability.

The BdF avoided fully negative responses to any of the questions in the GCBI. The BdF was among the NGFS founding members, and since the NGFSs foundation, the BdF has been its Secretariat. The BdF Governor, François Villeroy de Galhau, is on record repeatedly discussing climate-related risks and green finance. The BdF conducts its own research on assessing climate-related risks in the banking and insurance sectors and is active in developing a European taxonomy of sustainable economic activities. Furthermore, according to the BdF Annual Report 2018, the BdF has set as its strategic objective a 9% reduction in emissions between 2014 and 2020 (Banque de France, 2019).

According to article 173 of the French Energy Transition Law, BdF has been required to set disclosure requirements for banks and listed companies regarding climate-related risks (UNEP FI, 2019). In 2020, BdF has announced that it will publish the results of climate stress tests for French banks and insurance companies (Reuters, 2019a).

4.3. BoC - Bank of Canada and Office of the Superintendent of Financial Institutions

Score: 64

The BoC has mostly “yes” answers to the group 1 and 2 questions, but scores poorly on the weight 3 questions. The BoC is an NGFS member and has a strategy of greening the CB itself through cutting waste and managing its carbon

footprint. The BoC has identified a goal to green the BoC pension fund, but has not enacted clear rules as yet. The BoC regularly publishes the results of climate change research conducted on its website.

There is, however, no special prudential regulation regarding climate risks. The BoC is reported by the press as being in the process of developing climate stress-testing frameworks to assess the resilience of the Canadian financial system to hypothetically extreme but plausible scenarios (Canada's National Observer, 2019). So the BoC avoids the least green score on the weight 3 questions in relation to stress testing.

4.4. BoE - Bank of England

Score: 54

The BoE picks up top marks on weight 1 and weight 2 questions. The BoE was one of the first to become a founding NGFS member. The former BoE Governor, Mark Carney, was perhaps the first CB governor to highlight the problem of climate change and financial stability in his speech in 2015 (Bank of England, 2015). Throughout his leadership of the BoE, he regularly emphasized the problem of climate change and climate-related risks. In December 2019, the United Nations Secretary-General appointed Mark Carney as the UN Special Envoy for Climate Action and Finance, a move seen as a response to the former Governor Carney's work in encouraging the leaders in business and finance to change their approach to climate change. The BoE is pursuing the goal of offering international leadership in understanding climate change risks and green finance (Bank of England, 2019a). To reach this goal, the BoE has actively conducted numerous research projects in the area of climate change and posted them on the special website page devoted to Climate Change.

The BoE is committed to reducing the environmental impact of its operations. The BoE's 'Greener Bank' programme is focused on reducing its carbon emissions, improving its energy efficiency, cutting its consumption of natural resources, and managing waste production and disposal. The BoE has made a full climate-related financial disclosure with respect to its own operations (BoE, 2020).

Most of the answers to GCBI questions from group 3 get "partially", "mostly" or "not" responses. There is not currently special prudential regulation regarding climate risks in the BoE regulation. Thus no specific action on the part of regulated firms is required. However, in April 2019, the BoE and PRA published

supervisory statement SS3/19, which asks regulated firms to reflect on their approaches to managing the financial risks of climate change and to develop their own disclosure policy on financial risks from climate change (Bank of England, 2019b). Furthermore, the BoE is reported as having the intention to publish the results of climate stress tests in 2021. These stress tests would include a "catastrophic business-as-usual scenario", as well as a scenario that mimics the transition to net-zero by 2050 (Central Banking, 2019).

The position of the BoE regarding the purchasing of green bonds was announced by Mark Carney in 2019. It was to seek government approval for such purchases. This has not been forthcoming as yet.

4.5. BoI - Bank of Italy

Score: 63

The BoI has only "yes" answers to GCBI group 1 questions, which shows that the BoI is ready to discuss climate-related risks as a member of the NGFS. Additionally, starting in 2010, the BoI annually updates its Environment Report (Bank of Italy, 2020). According to this Report for 2018, the BoI has the following environmental objectives: the rational use of energy resources, optimal waste management, sustainable mobility, green procurement, and the promotion of an environmentally friendly culture (Bank of Italy, 2019).

The BoI does have one "yes" answer to the group 3 questions achieved with respect to the BoI's management policy of its financial investments. In BoI investment choices, priority will be given to companies that adopt green environmental, social, and governance (ESG) practices. The financial investments of the BoI's own funds amount to around €8 billion. The BoI's press release also stated: "Overall, as a result of the new criteria, there will be an improvement in the environmental footprint of the Bank's equity portfolios in terms of total greenhouse gas emissions (about -23 per cent, equal to -0.75 million tons), energy consumption (about -30 per cent, equivalent to 7.67 million gigajoules) and water consumption (about -17 per cent, equal to 6.95 million cubic meters)" (Bank of Italy, 2019).

4.6. BoJ - Bank of Japan and Financial Services Agency

Score: 73

The BoJ joined the NGFS as a member in November 2019, and the BoJ Governor, Kuroda Haruhiko, pays significant attention to climate-related risks in his official announcements. Further, the Financial Services Agency (FSA) signed an agreement with a London-based sustainability think tank to assess the impact of climate risk on Japan's financial stability (OMFIF 2020). However, the BoJ scores poorly on all of the weight 3 questions.

4.7. Deutsche Bundesbank and Federal Financial Supervisory Authority

Score: 63

The Bundesbank is a founding NGFS member and has its own corporate goals for reducing carbon emissions (Bundesbank, 2015). Bundesbank analyses the impact of climate change and climate policy on the financial sector and, together with the Federal Financial Supervisory Authority (BaFin), have organized sustainable finance conferences.

Nonetheless, the Bundesbank President, Dr. Jens Weidmann, was less open, in comparison with his peers, to climate-related risk and green finance in his official speeches. He held the view that fighting climate change is the government's responsibility, not the CB's. As a result, there are not any "yes" answers to the weight 3 questions. However, some answers get "mostly" or "partially" responses. In January 2020, the BaFin published its Guidance Notice on Dealing with Sustainability Risks. In addition, BaFin welcomes initiatives on the development of a generally accepted sustainability taxonomy at the European level. The BaFin President, Felix Hufeld, said that as soon as high-quality ESG data become available to all, then we can look forward to their inclusion in financial market decisions (BaFin, 2019).

As a fiscal agent, Bundesbank has been managing several large-scale public pension fund portfolios for 16 German Federal states as well as for the central government. Four out of sixteen portfolios have already invested using an ESG approach, or invest in Green Bonds. In total, these portfolios have a volume in the range of substantial single-digit billions of euros. Bundesbank is also considering investments in sustainable assets in its own funds and how it might take sustainable investment criteria into account (Bundesbank, 2019).

4.8. CBRF - Central Bank of the Russian Federation (The Bank of Russia)

Score: 79

The CBRF became a member of the NGFS in December 2019. In the Bank of Russia Financial Stability Review Q2 – Q3 2019, the CBRF reports that “in Russia approaches to assessment of climate-related risks are at an early stage of development” (Bank of Russia, 2019a). In the same Financial Stability Review, the CBRF recognized the necessity of: developing climate risk assessment practices in Russia; implementing stress tests for extreme weather conditions risks for insurance companies; strengthening requirements on climate-related disclosures; the development of supervisory reporting of climate risks, and aggregated database on disasters (Bank of Russia 2019a,b). However, these policies are yet to be adopted and so the CBRF secured ‘no’ answers to all the weight 3 questions.

4.9. European Central Bank and European Banking Authority (EBA)

Score: 45

Since December 2019, when Christine Laggard took over as the ECB president, the ECB’s position as a global driver towards environmental issues has strengthened. The ECB is a member of the NGFS and regularly posts various ECB research on climate-related risks. According to the Risk Assessment of the European Banking System dated November 2019 as part of the EBA Action Plan on sustainable finance, the EBA is developing climate-change stress tests. Further, the EBA is in the process of implementing technical standards for applying all the disclosure requirements in Titles II and III of Part 8 of the amended rules of capital and liquidity CRR2, including the environmental, social, and governance-related disclosure requirements (EBA, 2019).

The ECB is a member of the Technical Expert Group on Sustainable Finance (TEG) in the European Commission which is responsible for the development of a taxonomy that defines which activities are viewed either as environmentally sustainable (green) or as harmful (brown). Currently, the ECB report on the Eurosystem’s asset purchase programme contains the following statement: “Despite the absence of an explicit environmental target in the asset purchase programme, the ECB has purchased green bonds under both the corporate sector purchase programme and the public sector purchase programme. These purchases have contributed to the establishment of a well-diversified portfolio” (ECB, 2018; emphasis added). Thus the ECB acknowledges the value of targeting green assets

and allows itself to buy them; however, some allowance is made in the GCBI scoring to acknowledge that these purchases occurred in the absence of an overarching green asset purchase goal.

4.10. Fed - Federal Reserve System

Score: 81

The Fed has only two “partial” answers to group 1 and 2 questions. The Fed is not a member of the NGFS. However, the Fed Chair, Jerome Powell, in January 2020, during a monetary policy decision press conference, announced that the Fed has discussed the possibility of joining the NGFS (Central Banking, 2020). The Governor Powell does not pay significant attention to climate-related risk and green finance in his personal addresses, and rather has opined on a lack of relevance of the climate change problem with respect to the Fed, asserting that climate-related risks do not fit squarely within the CB’s existing framework for assessing financial stability and that the Fed’s mandate does not include reducing CO2 emissions (The Wall Street Journal, 2019). However, a Vice Chair Lael Brainard in her speech announced “To fulfil our core responsibilities, it will be important for the Federal Reserve to study the implications of climate change for the economy and the financial system and to adapt our work accordingly” (Reuters, 2019b; Fed, 2019a).

In November 2019, the Federal Reserve Bank of San Francisco organized the first “Economics of Climate Change” conference (FRBSF, 2019). In addition, there are relevant research papers on the Fed website regarding Climate Change and the Federal Reserve.

There is no available information as to the Fed’s corporate environmental policies and goals for reducing carbon emissions. However, the Fed has undertaken an objective of considering its environmental impact and sustainability (Fed, 2019b).

4.11. PBC - People's Bank of China, China Banking and Insurance Regulatory Commission, and China Banking Regulatory Commission

Score: 30

The PBC’s approach to the regulation of climate-related risks spans the set of questions which comprise the GCBI. There is only one “no” answer, which is

to the question regarding corporate environmental policies for reducing carbon emissions. The information on the existence of such policies is absent from the PBC website. Most of the answers to almost all questions from all the three groups are either “yes” or “mostly”.

The PBC is one of the 8 CBs that were the first to become NGFS members in 2017 and establish task forces - groups for climate risk assessment and green finance standards development. The PBC governor, Yi Gang, repeatedly underlines in his speeches China’s strong commitment to green and sustainable development. This PBC commitment is manifested in its financial market prudential regulation. The PBC issued a number of notices and guidelines for banks to change their lending policies and disburse loans to environmentally friendly companies. To reach this goal, the PBC has provided the financial and banking sector with taxonomies for green products and required that banking institutions report green credit statistics and include environmental risks in stress tests. Furthermore, according to the PBC Guidelines for Establishing the Green Financial System, the PBC promotes international cooperation in green finance under the framework of the G20 and stimulates institutional investors to invest in green assets (PBC, 2016).

The PBC GCBI score is the greenest among the 13 assessed CBs, a finding which appears to contradict the fact that China ranks first among the world’s top 15 CO₂ emission-generating countries (World Economic Forum 2019). We emphasize that the authors are not conflicted and have no link to China; this entire analysis is conducted objectively. However, it is possible for China to be both a large polluter and have a Green CB. China is the most populated country in the world, China is a major exporting power, and China leads the world in terms of manufacturing output (World Economic Forum 2020). The colossal volume of goods being produced can (and does) lead to huge absolute levels of pollution. Nonetheless the evidence we have analysed shows that the Chinese CB is actively green. China has succeeded in lowering some pollutants, e.g. Sulfur Dioxide³, but though annual Carbon Dioxide emissions appear to have peaked since 2014 in some sectors (energy and cement⁴) the cumulative CO₂ emissions are still rising though at a less rapid rate.⁵

³ <https://earthobservatory.nasa.gov/images/91270/sulfur-dioxide-emissions-fall-in-china-rise-in-india>

⁴ <https://ourworldindata.org/co2/country/china?country=~CHN>

⁵ Idem.

4.12. RBI - Reserve Bank of India

Score: 77

The RBI has three “partially” answers to group 2 and 3 questions and one “most-ly” answer to the group 1 questions, otherwise the answers are all in the negative. The RBI does not have official corporate environmental policies and goals for reducing carbon emissions⁶. The RBI did not publish freestanding research regarding climate-related risks, however, the RBI mentioned climate change and climate-related risks in some of its publications in 2019 such as the Financial Stability Report and Annual Report. In the RBI Global Banking Development report, the RBI highlighted the FSB recommendations on the Task Force for Climate-related Financial Disclosures and concluded that policy action is needed to promote green finance in India.

It is noteworthy that the RBI issued climate-related credit policies and lending requirements for banks. According to these requirements, the RBI has included lending to small renewable energy projects within the targets of its Priority Sector Lending requirements (PSL) (Climate Transparency, 2017). The 4% balance of the PSL quota must be spent on renewable energy products, housing and social infrastructure lending, and similar (Climate Bonds Initiative, 2019).

In 2015, the RBI allowed Indian banks to support corporate bonds issued for infrastructure projects through a form of credit enhancement. This intervention has the effect of benefitting green bonds (The Energy and Resources Institute, 2018).

4.13. SARB - South African Reserve Bank

Score: 77

The SARB has “partially” answers to group 2 questions and one “yes” to the questions in group 1. The SARB is a member of the NGFS. SARB Governor, E L Kganyago, has occasionally mentioned climate-related risk in his official announcements. He underlined the necessity of dealing with climate change in his Communiqué of the Fortieth Meeting of the IMFC (IMF 2019) and he takes the view

⁶ However, according to the RBI Annual Report 2018-19, the RBI received the “Green Champion Award” under the category of “Government Organization Leading the Green Building Movement in India” (RBI, 2019).

that the financial sector must be prepared for climate change related problems (Eyewitness News, 2020). The issues of climate change and climate risks are discussed in sections of SARB Financial Stability Review 2019, Prudential Authority Annual Report 2018/19 and South African Reserve Bank Annual report 2018/19 (SARB 2019a; 2019b; 2019c).

4.14. Green Central Bank Index Results

We first identify the three groupings of CBs. We then use our peer analysis to identify the differing bespoke policy goals which are suitable for the three groupings we identify.

4.15. Green Central Bank Ranking

We begin this section by presenting the rank order results of the Green Central Banking Index in Table 4. As noted above, the data we have used is current through to Summer 2020:

Table 4: Green Central Bank Index (as of Summer 2020)

Group Rank	CB name & acronym	GCBI score
1	People's Bank of China (PBC), China Banking and Insurance Regulatory Commission (CBIRC), and China Banking Regulatory Commission (CBRC)	30
1	Banque de France (BdF)	36
2	European Central Bank (ECB) and The European Banking Authority (EBA)	45
2	Central Bank of Brazil (BCB)	50
2	Bank of England (BoE)	54
2	Bank of Italy (BoI)	63
2	Deutsche Bundesbank (Bundesbank) and Federal Financial Supervisory Authority (BaFin)	63
2	Bank of Canada (BoC) and the Office of the Superintendent of Financial Institutions	64
3	Bank of Japan and Financial Services Agency (FSA)	73
3	Reserve Bank of India (RBI)	77
3	South African Reserve Bank (SARB)	77
3	Bank of Russia (CBRF)	79
3	Federal Reserve System – Fed	81

Source: Created by authors

The results of the GCBI reveal that there are perhaps three clear clusters of CB activity as regards climate change. During the period studied, it seem to us that climate change leaders are the highest two ranked CBs: People's Bank of China, and Banque de France. Thus we identify group 1, the greenest CBs as the cluster with GCBI scores below 40. These CBs secure positive responses to almost all questions of the GCBI. These CBs may not have been the first pioneers of climate issues, but their current actions suggest that they recognize the risks of climate change to the financial system and are world leaders in using the tools at their disposal to steer their economies to a sustainable footing.

The next cluster of CBs, which we have labelled a group 2 had GCBI scores between 45 and 65. These CBs are: Central Bank of Brazil, Central Bank of Canada, and the remaining European CBs considered: those pertaining to the UK, Italy, Germany, and the ECB. With the exception of Brazil, these are CBs which typically score excellently on the low point questions, but less well on the weightier questions which require material resources to be expended on green issues. Brazil inverts this, portraying a less green image whilst implementing green policies at a CB level.

The final cluster we label group 3. These CBs have GCBI scores above 70. These CBs are those of the US, the Russian Federation, Japan, India, and South Africa. These CBs do not score well on almost any of the questions suggesting that environmental issues are not, as yet, as significant a policy focus as they are for their peers.

These trends are particularly visible when the results are broken down by questions. This is done in Table 3.

The three groupings appear endogenously from the spread of the GCBI scores. We have also conducted a sensitivity analysis to ensure that our GCBI results are robust to changes in weightings which reduce the prominence of the CB regulatory tools questions with weights 2 and 3. To achieve this we recalculated the GCBI score with the weights of 2 and 3 questions being reduced by 10%. The comparison of the results is presented in Table 5. The 10% change in weighting reinforces the three groupings of CBs which we identify.

Table 5. Results of the Green Central Bank Index Sensitivity Analysis

Rank in sample	CB name & acronym	GCBI score	Results of sensitivity analysis /GCBI score
1	People's Bank of China (PBC), China Banking and Insurance Regulatory Commission (CBIRC), and China Banking Regulatory Commission (CBRC)	30	27.5
2	Banque de France (BdF)	36	32.6
3	European Central Bank (ECB) and The European Banking Authority (EBA)	45	40.7
4	Central Bank of Brazil (BCB)	50	45.3
5	Bank of England (BoE)	54	48.8
6	Bank of Italy (BoI)	63	56.9
6	Deutsche Bundesbank (Bundesbank) and Federal Financial Supervisory Authority (BaFin)	63	56.9
8	Bank of Canada (BoC) and the Office of the Superintendent of Financial Institutions	64	57.8
9	Bank of Japan and Financial Services Agency (FSA)	73	66.2
10	Reserve Bank of India (RBI)	77	69.9
10	South African Reserve Bank (SARB)	77	69.9
12	Bank of Russia (CBRF)	79	71.6
13	Federal Reserve System – Fed	81	73.6

Source: Created by authors

5. Discussion

The calculations underlying the Green CB Index we have demonstrated allow us to determine which policy tools are proving most difficult for Central Banks at these differing stages to wield to combat climate change. Using these detailed results (see Table 4) we derive the key policy implications for each of the three groups of countries we have identified.

The leaders from the Green CB Index are the group 1 CBs; as of 2020, these were the CBs of China and France. These CBs score highly on many of the criteria which form the Green CB Index, but not on all. The policy areas in which even these CBs score poorly form the policy targets we would point to. We identify two:

Assess climate-risk in regulatory stress-testing. Doing so would force all regulated financial institutions to assess climate risk to all businesses they lend to – that is almost all of the economy. Banks would then adjust their lending towards businesses which are sustainable. This is perhaps the critical step in the transition to

a low-carbon economy. It is a step a number of CBs have discussed, but none has been successfully implemented so far.

Define green assets. China does this, as does Brazil (which is in the second group), but France does not as yet. A clear definition of green assets is essential to underpin the market in green assets and give all firms in the economy a motivation to implement and fund green production.

The group 2 countries comprise the remaining European CBs considered (that of the UK, Italy, Germany, and the ECB), and Canada and Brazil. These countries score well on the Green CB Index, though lagging behind the scores of the leading countries. To formulate policy targets for these countries we do not point to areas which have eluded even the leaders thus far, though these would be valuable goals. We instead point to policies the leaders have shown can be tackled. We point to three targets:

Mandate climate-related financial disclosure. Such rules force financial institutions to recognize the climate problem formally. The French and the Chinese do this through formal laws and regulations, as do the Brazilians in this group. The Bank of England is on the way to achieving this through a process of consultation and supervisory expectations.

Include Climate Risk in Prudential Regulation. Once the problem is recognized, forcing financial institutions to be robust to the dangers of climate change is the next target. Prudential Regulations have legal force, show transparently what the CB requires and, once established, it can be strengthened to manage the required journey towards a low-carbon economy.

Buy green assets. The CB is perhaps the most prominent actor in any economy. When it buys green to accomplish its monetary policy objectives then it can underpin the green economy.

Brazil is unusual here, it has progressed on many of these ‘hard’ targets, whilst avoiding the ‘easier’ targets of taking a public stand. One can only speculate why a CB would be willing to act green but not say so publicly.

The final group of countries, those in group 3 have yet to fully embrace their potential role in steering their economies to avoid disasters climate change could unleash. (These are the CBs of the US, the Russian Federation, Japan, India and South Africa). The policy targets for this group depend upon whether they wish their development in the green agenda to be public or to be green whilst avoiding public pronouncements.

If the path to sustainability is to be transparent then the European countries show the way. The easiest target in this case is to score highly on the level 1 questions and then aim for the level 2 ones. The first step is therefore to introduce goals for the CB itself to reduce its carbon emissions. The level 2 questions require the Governors of these CBs to more publicly commit themselves to the necessities caused by climate change, and to expand the public research and advocacy around climate issues.

If however, a CB feels public statements are not advisable in their political context, then Brazil offers a model. In this case, the target is to jump directly to the first two policy targets for the middle group of countries: mandating climate-related financial disclosure, and including climate risk in prudential regulation. These interventions can be achieved without high-profile public pronouncements, and yet have the effect of steering the economy to a low-carbon future.

6. Conclusions

The results of the GCBI calculation have revealed that there is wide variation in the focus on the green agenda across CBs, and further this variation exists between CBs of both advanced and emerging economies. We have found three broad clusters of CBs when ranked according to their focus on green issues. The top ranked CBs are those of China and France. For the period studied they have committed significant effort and resources to tackling climate change. They use their balance sheets in green investments, assess green issues in stress testing, and seek to provide taxonomies for green assets to encourage the green focus of the financial systems in their jurisdiction.

The lowest ranking cluster is comprised of the CBs of Japan, India, South Africa, the Russian Federation, and the United States. These CBs, during the period under consideration, were only prepared to discuss the financial risks from climate change, and are not ready to commit material resources to this cause, nor to use prudential regulation to drive the pace of domestic change. The middle group, comprising the remaining European CBs considered (that of the UK, Italy, Germany, and the ECB), and Canada and Brazil take an in-between position. Apart from Brazil, there is a clear policy focus on the environment and use of stress testing tools, but a reluctance to deploy the CB balance sheet or to define and mandate specific climate-related risk measures on regulated institutions.

In addition, calculations underlying the Index allowed us to determine which policy tools have proved the most difficult for the central banks at these differ-

ing stages to wield to combat climate change. Using detailed results of the GCBI calculation, we derived the key policy implications for each of the three groups of countries we have identified.

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