

Original Articles

Climate-related financial policy index: A composite index to compare the engagement in green financial policymaking at the global level

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ARTICLE INFO

Keywords:

Climate-related financial policies
Climate risks
Low-carbon transition
Financial stability
Composite index

ABSTRACT

This study presents a composite index for assessing, quantifying, and comparing international engagement based on evidence that countries have been globally committed – to varying degrees – to climate-related financial policymaking in recent decades. The proposed investigation aims to promote awareness about countries' global engagement and identify gaps in climate-related financial policy. Using a standardised metric, researchers and policymakers can use the generated climate-related financial policy index (CRFPI) to compare international commitment to climate-related financial policymaking. Emerging economies are the most engaged in green financial policymaking, although they report the highest within-group variability, indicating no standard or general approach to "greening" the financial system. The index demonstrates a location effect, as most jurisdictions with high CRFPIS are in Asia-Pacific and North Europe. Brazil, China, France, Indonesia, and South Korea had the highest scores among G20 countries. After examining several aggregation approaches, the findings appear to be robust overall.

1. Introduction

Because of the catastrophic effects of environmental degradation from climate change on society and global economic systems, global warming has become one of the most serious and pressing challenges. According to the Intergovernmental Panel on Climate Change (IPCC, 2018), global warming is projected to exceed 1.5 °C between 2030 and 2052, and the most recent report (IPCC, 2021) outlines even more dire future scenarios.

The Paris Agreement in 2015 has laid the foundation for how to address climate change by encouraging the commitment of countries to reduce emissions and thus contributing to mitigation efforts needed to hold the increase in the global average temperature to well below 2°C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5°C. However, the international community is still far from achieving these goals.

The existential threat posed by climate change implies that all policymakers must consider contributing to the fight against global warming. Governments are the primary actors in this endeavor, as the transition toward a low-carbon economy implied by existing international agreements is difficult to achieve by relying on market instruments alone (Stiglitz et al., 2017; Svartzman et al., 2020). Usually,

the focus is on carbon pricing schemes, energy policies, and other fiscal instruments (Long et al., 2016; Kammerer and Namhata, 2018; Skovgaard et al., 2019; Steinebach et al., 2020). However, especially carbon pricing schemes might be difficult to implement (Rosenbloom et al., 2020; Baranzini et al., 2017; Drews and Van den Bergh, 2016).

It is currently widely agreed that central banks cannot stand on the sidelines and should increase their attention to climate change because of the likelihood it will affect their ability to achieve their mandates and the financial sector's stability (Batten et al., 2016; Volz, 2017; D'Orazio and Popayan, 2019; NGFS, 2019; Weidmann, 2020).

Considering the importance of the financial sector in the low-carbon transition and the empirical evidence on the impact of climate-related financial policies on climate change mitigation (D'Orazio and Dirks, 2022), the purpose of this paper is twofold. On the one hand, it intends to provide the most comprehensive and updated information regarding the policies addressing climate risks and scaling up green finance. To this aim, it presents a novel database that covers 74 jurisdictions over the period 2000–2020 and collects the most updated information on the adoption, bindingness, and agents responsible for implementing climate-related financial policies. On the other hand, it aims at providing an objective comparison of the engagement in climate-related financial policymaking at the international level. To this purpose, it

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introduces a methodology to develop a composite index – i.e., the climate-related financial policy (CRFP) index – for assessing, measuring, and comparing international commitment. The proposed index aims to do justice to both the complex multidimensional nature of climate-related financial policymaking and the need of decision-makers and researchers for comprehensive information on this topic.

The remainder of the paper is organized as follows. Section 2 offers a review of the literature and puts the study in context. The methodology and data are presented in Section 3.

Section 4 presents the empirical results and Section 5 offers a discussion of our findings. Finally, Section 6 offers concluding remarks.

2. The financial sector facing climate threats

Although central banks and financial regulators' policies cannot replace climate policy, it is now commonly recognised that they must contribute to scaling up green financing and developing regulations to address climate-related financial risks (Carney, 2015; Campiglio et al., 2018; Carney, 2018; Lane, 2019; NGFS, 2019; Weidmann, 2020). Their action is motivated by the evidence that climate change affects monetary policy and financial regulation (Batten et al., 2016; Campiglio, 2016; Coeuré, 2018; D'Orazio and Popoyan, 2019; Chenet et al., 2021) and financial actors play an essential role in the global economy (Mazzucato and Semeniuk, 2018; Geddes et al., 2018; Krogstrup and Oman, 2019).

Regarding their green finance action, central banks and financial regulators can redirect financial flows towards activities that protect natural capital and positively affect the environment (Galaz et al., 2015). This policy action is also aligned with the Paris Agreement goal (Article 2.1c) of "making finance flows consistent with a pathway towards low greenhouse gas emissions and climate-resilient development" (COP, 2015). This is relevant because, compared with traditional finance, green finance regards environmental protection and the effective use of resources as important criteria for measuring the effectiveness and ultimately realizes sustainable development and promotes economic growth (Donner et al., 2016, may; Steckel et al., 2017; Galaz et al., 2018; Sachs et al., 2019).

Concerning the action taken to tackle climate risks, the efforts of central banks and financial regulators are crucial. Climate change poses threats to the conduct of monetary policy because of its effects on supply price shocks, market volatility, and economic growth, which are related to inflation through credit spreads, saving rates, and real interest rates (Coeuré, 2018; Schnabel, 2020). Additionally, the channels of climate change risk transmission to the financial sector are usually described by referring to physical and transition risks (Carney, 2015; Batten et al., 2016). It is explained that climate change can affect financial stability directly through the impact of more frequent and severe disasters, such as heatwaves, windstorms, floods, or droughts. When physical risks materialize, they can erode the collateral asset values of financial institutions and insurance liabilities. Transition risks can also affect financial markets because of, e.g., unanticipated changes in (climate) policy action, technological progress, or changes in public sentiment (Semeniuk et al., 2021; BCBS, 2021).

As a consequence, climate-related financial risks can cause credit, market, liquidity, and insurance risks (Bolton et al., 2020; BCBS, 2021) because of financial losses, destruction of production capital, the decline in profitability of exposed firms, and stranding of assets related to climate-relevant sectors such as, e.g., fossil fuels and mining (Batten et al., 2016; Elderson, 2018). Central banks and regulators are thus required to assess financial institutions' performance and report how they account for environmental and social issues and provide guidance and requirements regarding how financial institutions impact ecosystems (Scholtens, 2017; HLEG, 2018; ECB, 2020).

2.1. Our contribution to the literature

The international engagement in climate-related financial policymaking has increased in the past decades, although to different extents (Dikau and Ryan-Collins, 2017; D'Orazio and Popoyan, 2019; D'Orazio, 2022). However, it is hard to compare countries' performances globally, considering that different criteria are usually used to assess the "greenness" of a financial system or a central bank and/or financial regulator behavior. A first attempt to provide an index for green financial policymaking is – to the best of our knowledge - presented in D'Orazio and Popoyan (2019). Based on data described in D'Orazio and Popoyan (2019), the Green Prudential Instrument Index (GPII) is developed for 56 countries and conveys qualitative information on the types of green prudential instruments adopted as of December 2018. The GPII comprises eleven categories: Differentiated Reserve Requirements; Lending Limits and Green Financial Principles; Disclosure requirements; Risk assessment; Green Financial Principles; Disclosure requirements and Lending limits and Liquidity instruments; Disclosure requirements and Risk assessment; Disclosure requirements and Lending limits; Disclosure requirements and Stress tests; Lending limits and Stress tests; Green Financial Principles and Stress tests.

More recently, Barnes and Livingstone (2021) released a report where a "scorecard" for G20 central banks and financial supervisors is presented. The system to score and rank G20 countries is based on literature reviews, expert consultation, and bilateral interactions with central bankers and supervisors. The scorecard encompasses four categories; namely, Research and Advocacy, Monetary Policy, Financial Policy, and Leading by Example. The methodology is based on awarding points to policies in each category according to their expected impact. An aggregated score is then assigned to each country based on their monetary and prudential institutions' performance across these categories. Finally, all countries are placed in a final ranking to allow for a comparison.

The contribution of this paper to the existing literature is twofold. First, it provides a novel panel database composed of 74 countries. It collects the most updated information on climate-related financial policies at the international level spanning from 2000 to 2020. Second, it develops a methodology to build a composite index utilizing the data acquired in the database, allowing researchers and policymakers to evaluate global engagement in climate-related financial policies.

The proposed approach differs from existing contributions in several respects. First, it is based on a taxonomy of five climate-related financial policy areas, which represent the basis for an objective and comprehensive evaluation of countries' performances (See Fig. 2). Second, it offers a composite index based on a statistical methodology consisting of the normalization, weighting, and aggregation of five components. In particular, we rely on an objective scoring system of the policies (see Section 3), thus avoiding subjective evaluations of the performance or importance of specific policies. Third, on the one hand, it offers a more comprehensive spectrum of analysis than the existing GPII, as it considers a broader set of financial policies beyond prudential regulations. On the other hand, its scope is narrower than the "green central banking scorecard" in that it does not consider green monetary policy initiatives; rather, it focuses on financial policies exclusively.¹ Fourth, the proposed CRFPI determines to what extent the countries are engaged in climate-related financial policymaking and how they do so. Moreover, it offers a "temporal overview" of climate-related financial policymaking engagement at the international level because it is developed for country data spanning 2000 to 2020. Fifth, the proposed index is developed for a

¹ The rationale for our choice is that the core of policies that have been adopted and considered by central banks and regulators so far are mostly financial. The debate on the "greening" of the monetary policy is instead very recent (see Krogstrup and Oman, 2019; McKibbin et al., 2020; Ostry et al., 2020, among others).

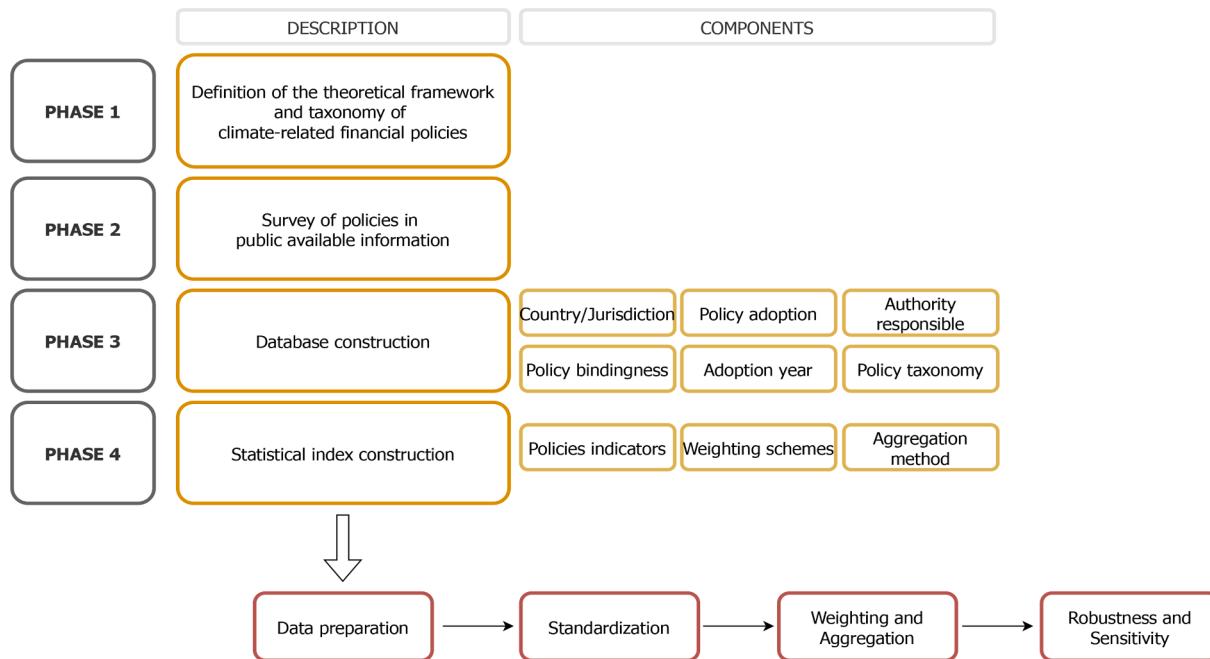


Fig. 1. The conceptual framework for developing the CRFP index. Source: Authors' elaboration.

large sample of 74 countries, thus allowing more comprehensive international comparisons.

3. Conceptual framework and methodology

This section presents the conceptual framework and methodology used to construct the database and the index. The method consists of four phases, as summarized in Fig. 1 and described in the rest of the section.

3.1. Scope and taxonomy of policies

We start our investigation by building on the definition of financial policies as identified by IMF (2000), according to which “[f]inancial policies refers to policies related to the regulation, supervision, and oversight of the financial and payment systems, including markets and

institutions, with the view to promoting financial stability, market efficiency, and client-asset and consumer protection”.

Considering the existing literature Krogstrup and Oman (2019); D'Orazio (2021); D'Orazio (2022) and the debate on the increasing climate risks affecting the financial system as discussed in Section 2, the investigation considers policies addressing the financial sector aimed at

- identifying threats to - and safeguarding - financial stability in the presence of climate-related financial risks; labeled as *green prudential regulations* (GPP).
- promoting green lending and investments through credit allocation and/or lending limits; labeled as *green credit allocation policies* (GCA).
- promoting the creation of green or climate-aligned financial markets; labeled as *green financial principles* (GFG).

Financial Policy Area	Description	Category	Instrument	Objective	Countries that adopted (authority responsible for promotion/implementation)
Policy Area I	Green Prudential Regulations: to promote the development of green macroprudential frameworks	Capital	Quality and level of capital	CAR with GSF/BPF CCyB Sectoral Leverage Ratios Sectoral Capital Requirements Governance and risk management	Mitigate and prevent excessive credit growth and leverage
			Risk management and supervision	Climate-related stress test (macro) Green Asset Ratio	Evaluate effect of economic or financial shocks to the financial system Assess exposure of of banks' portfolios to carbon-intensive assets
			ICAAP	Internal Process of Capital Adequacy Assessment: Include social and environmental risks when assessing their capital needs	Canada (CB), China (PRA), France (PRA), UK (PRA)
			Enhanced risk disclosure and market discipline	Climate-related disclosure requirements	Inform about concentration of carbon-intensive assets in the financial sector
			Liquidity	LCR NSFR	Mitigate and prevent market illiquidity and maturity mismatch
		Large exposures	Lending limits	Large exposures limit	Mitigate systemic risk by limiting the concentration of certain exposures
					All G20 countries except Saudi Arabia
					All G20 countries except Argentina, Mexico, Saudi Arabia, Turkey
					Indonesia (Other)
					Japan (GOVT), South Korea (GOVT)
Policy Area II	Green Financial Principles: to create green financial markets				
Policy Area III	Other disclosure requirements: to promote the public disclosure of climate risks (also for non-financial institutions)				
Policy Area IV	Green bonds issuance: to promote the development of green financial securities				
Policy Area V	Green Credit Allocation Policies: to directly promote green credit measures and investments				

Legend:
 BA BANKING ASSOCIATION
 PRA PRUDENTIAL REGULATORY AUTHORITY
 CB CENTRAL BANK
 GOVT GOVERNMENT
 OTHER INSTITUTION OTHER THAN THE PREVIOUS CATEGORIES

Fig. 2. Overview of the five policy areas used in the creation of the database. Source: authors' elaboration.

- (IV) promoting the public disclosure of climate-related financial risks; labeled as *other disclosure requirements* (ODR), e.g.; climate-related disclosure requirements aimed at non-financial institutions such as insurance companies and pension funds.
- (V) promoting green lending through green bonds; labeled as *green bonds taxonomy and issuing* (GB).

Objectives and instruments characterizing each policy area are summarized in Fig. 2 and described in detail in the following.

Policy Area (I) is characterized by capital regulations, governance and risk management measures, climate-related stress tests (CRSTs), and climate-related risk disclosure aimed at the banking sector.²

Several prudential measures existing under the Basel III framework and can be used to meet the Paris Agreement goals (for a comprehensive review, see D'Orazio and Popoyan, 2019; D'Orazio, 2021). Among capital instruments that could be implemented under Pillar I, existing literature discusses the role of leverage ratios, countercyclical capital buffers, and risk weights applied to banks' assets, such as the Green Supporting Factor (GSF) or the Brown Penalising Factor (BPF).³ However, according to our survey, none has been implemented yet. One reason for this could be that there is still no agreement among supervisors and regulators on whether these measures have the potential to cause market distortions and what risk weights should be applied to different sectors (see BoE-PRA, 2021; Restoy, 2022, for recent debates).

Other measures relate to "Pillar 2 - Risk Management and Supervision" and include, among others, Internal Capital Adequacy Assessment (ICAAP) and climate-related stress tests, which aim at assessing the resilience of the financial system to adverse climate shocks by considering the possible impact of hypothetical climate-related shock scenarios on the stability of individual financial institutions and the financial system in its complexity (NGFS, 2019). They provide useful information to policymakers regarding the financial system exposure to climate-related risks (see, e.g., Vermeulen et al., 2019; Faiella and Lavecchia, 2020) and their results could be used to calibrate and evaluate green macroprudential tools. Other prudential measures, such as disclosure requirements of the physical, liability, and transition risks associated with climate change, are also relevant to developing a credible green financial system and avoiding the so-called "greenwashing" (TCFD, 2018).

Central banks can implement promotional credit measures to encourage green investments directly and are included in the Policy Area (II). Credit allocation instruments are, for example, green lending quotas and concessional loans to priority and environmentally friendly sectors. These instruments are not very common in our sample; however, some interesting cases are offered by Indonesia, South Korea, and Japan.

Policy Area (III) is characterized by policies aimed at "creating green financial markets", such as green finance principles and taxonomies. They are found to be very common, as explained in detail in Section 3.3. Sustainability reporting and compliance practices are increasingly considered complementary to risk management practices in dealing with concerns about the adverse consequences of climate change (Ng,

² The classification used to identify climate-related prudential regulations follows the Basel III classification framework (BCBS, 2011; BCBS, 2017). The Basel III framework was developed by the Basel Committee on Banking Supervision after the Great Financial Crisis and referred to banking regulation agreements related to capital, market, and operational risks. It comprises three pillars, i.e., focus areas: capital regulations, liquidity regulations, risk disclosure, and market discipline.

³ The rationale for implementing prudential measures targeted at financial institutions' capital is that they will help tackle the risks deriving from physical and transition risks (Carney, 2015). At the same time, they could help in scaling up green finance if banks are required to allocate a higher share of capital to loans for green investments.

Table 1
Composition of the sample: frequencies and shares.

Statistic	Frequency	Share
<i>By Authority Responsible/Promoter</i>		
Banking association	7	2.18%
Central Bank	70	21.8%
Government	85	26.5%
Multiple actors	35	10.9%
Others	40	12.5%
Stock exchange/securities exchange/bourse	28	8.75%
Supervisory/Regulatory actor	53	16.56%
<i>By Bindingness</i>		
Mandatory	139	43.4%
Voluntary	44	13.75%
Non-binding/not available	135	42.18%

2018). Thus, policy area (iv) concerns reporting regulations and environmental, social, and governance (ESG) criteria aimed at pension funds, insurance companies, and other non-financial institutions (Della Croce et al., 2011; Boermans and Galema, 2019; Krueger et al., 2020).

Finally, regarding green bonds covered in the Policy Area (V), they are "any type of bond instrument where the proceeds will be exclusively applied to finance or re-finance, in part or in full, new or/and existing eligible green projects" (ICMA, 2018). They have drawn much attention in the past decade, both from academics and policymakers, and they are gaining a key role in funding projects that contribute to environmental sustainability (Ng, 2018; Gianfrate and Peri, 2019; Tolliver et al., 2019; Maltais and Nykvist, 2020).

3.2. Survey of policies and construction of the database

We extensively surveyed official documents by central banks, financial supervisory authorities, governments, and banking associations by relying on the publicly available information from 2000 to 2020. Data is collected for 74 countries (see Appendix A), for which relevant information of the identified five policy areas has been reported and publicly disclosed.

The search terms used are keywords on green finance, the banking industry and financial regulation. These terms include the following: 'finance', 'financing', 'loan', 'credit', 'investment', 'banking', 'bank', 'financial institutions', 'banking sector', 'financial regulation', 'financial policies', 'promotional credit', 'prudential', 'financial principles'. These keywords were combined with adjectives such as 'green', 'sustainable', 'climate-related', 'environmental', 'sustainable' to restrict the search to the policies related to climate risks and low-carbon transition.

Furthermore, we collected information on (1) the authority in charge of the development or promotion of the policy (we distinguish among central banks, financial supervisors, government or non-governmental actors); (2) the final "beneficiary" of the policy (namely; banks and non-financial institutions).

After collecting the information, it was classified into five categories - as described in Fig. 2 and Section 3.1. We noted which policy has been adopted and the corresponding year for each country, creating a panel database comprising 7770 country-year observations (we consider five policy areas for 74 countries over 21 years). We also collect information on the policy bindingness and assess each policy's strength in the jurisdictions. We code this information as follows: we assign a value of 1 when there is no information on the bindingness, or the policy is not binding; 2 when the policy's adoption is voluntary; and 3 when it is mandatory.⁴

⁴ We note that the codification choice of the bindingness feature along discrete values instead of considering it a binary variable) follows existing literature (see, e.g., Steurer, 2013; Hooghe et al., 2017; Schnabel, 2017; Zurn et al., 2021) and allows us to take into account the richness of information we collected in the review of policies.

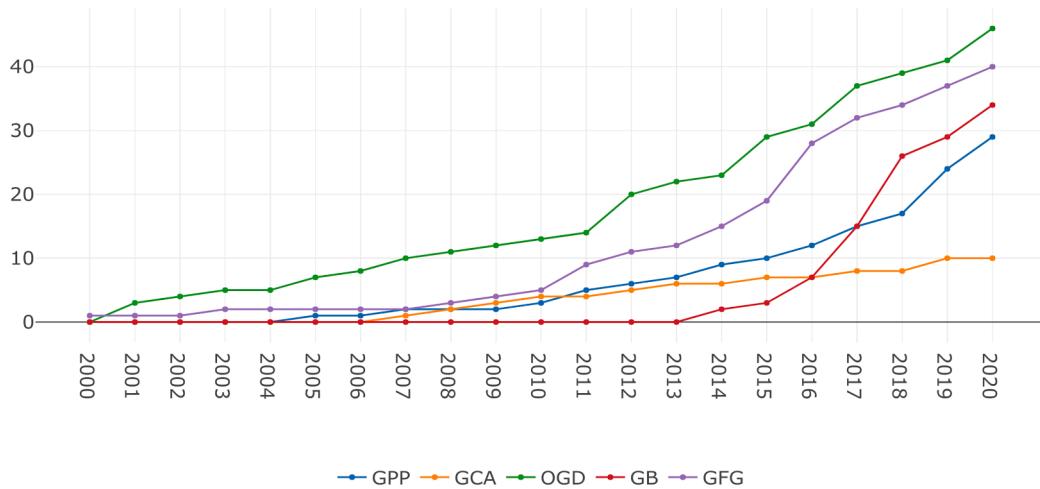


Fig. 3. Total number of policies (by area) adopted yearly at the global level; time span: 2000–2020. Notes. GPP: Green Prudential Policy; OGD: Other Green Disclosure Req.; GFG: Green Financial Guidelines; GB: Green Bonds; GCA: Green Capital Allocation.

3.3. Data description

The database comprises 74 countries, of which 39 are advanced economies, 20 emerging, and 15 developing and covers the period between 2000 and 2020.

Table 1 reports the main features of the novel database used in this paper. Regarding the authorities in charge of the policy's promotion and/or implementation, we find that the highest shares are represented by governments and central banks, followed by financial supervisors and regulators. Regarding the bindingness of policies, 43% of the surveyed measures are mandatory; a similar share (i.e., 42%) is non-binding (or no information was found on the bindingness); the remaining 14% are voluntary measures. Finally, concerning the type of policies implemented each year globally, we report that their adoption has grown steadily over time, reflecting an increased engagement of countries globally, as shown in Fig. 3.

In 2020, which marks the end of our survey, the most common policies recorded were disclosure requirements for non-financial institutions, followed by green finance guidelines, green bonds, prudential policies, and lastly, credit allocation measures, for which we find only ten implemented measures.

Regarding climate-related prudential policies, no measure related to capital requirements, leverage ratios, liquidity regulations or systemically important banks has been detected in the countries surveyed⁵; however, several risk management and supervisory measures have been adopted. Interestingly, we find that the Brazilian supervisory authority has required banks to include social and environmental risks when assessing their capital needs since 2011. Banks are required to demonstrate how they are considering the risk of exposure to socio-environmental damages in their assessment processes and in their

calculation of the capital needed for dealing with risks (i.e., the Internal Capital Adequacy Assessment, ICAAP). Other measures that belong to this policy area are explicitly aimed at governance and risk management. According to our data, Indonesia is the earliest adopter of such measures, as it started to require banks to conduct environmental impact assessments for large or high-risk loans in 1998. Other relevant examples are the Green Credit Policy approved in China in 2007 and the Supervisory Statement issued by the PRA in the UK in 2019 to set expectations for firms regarding their consideration of climate risk across four areas (i.e., governance arrangements, risk management, stress testing, scenario analysis, and disclosure). More recently, central bankers and regulators worldwide have started to consider integrating physical and transition risks in their policymaking through climate-related stress testing. The UK government and regulators, the Central Bank of the Netherlands, and the Banque de France, among others, have lately shown strong leadership in this area (Carney, 2015; DNB, 2017; Batten et al., 2016; BoE, 2019a; BoE, 2019b; BdF, 2020). In Asia, China has exercised strong leadership that encourages environmental stress testing at the portfolio level since 2012 with the Green Credit Guidelines. In North America, the Bank of Canada conducted its first climate-scenario analysis in May 2020. This trend has received a great impulse from the action of the Network for Greening the Financial Sector (NGFS) that has led several of its members to incorporate socially responsible investing in their portfolio management and reviewing their operations (NGFS, 2017; NGFS, 2019). In 2020, the European Central Bank showed a great commitment in this policy area by announcing the goal to make climate change a “mission-critical” priority (FT, 2020) and publishing a report that highlights that banks lag on their climate-related and environmental risk disclosures, despite some improvement since 2019 (ECB, 2020).

Concerning measures in the credit allocation policy area, our survey suggests that they were adopted only by a few economies across all income levels. The leader in this area is Brazil, which has promoted sustainable development since 2008 through lines of credit and programs that foster the population's standards of living and environmental protection (Berchin et al., 2018). Another example is India, which, as a developing economy, adopted a measure in 2015 that requires banks to allocate 40% of their lending to specific sectors such as agriculture. Considering advanced economies, France implemented a credit allocation policy as early as 2007 for a specific type of savings accounts. Banks that offer this type of savings account have to use a percentage of these funds for loans in domestic energy conservation projects; the percentage was increased several times since 2007 and is now as high as 10%.

According to data we collected, some countries, such as UK and

⁵ Capital requirements incorporating climate risk could be an essential tool for jointly addressing climate risks and scaling up green finance. The rationale is that larger risk weights or additional capital buffers for carbon-intensive sectors could limit a bank's exposure to those assets and, depending on the instrument, shift financial flows towards green ones. Climate-related large exposure limits could help contain systemic risks deriving from the materialization of climate risks. Liquidity regulations can be adopted to address serious funding and market liquidity shortages after the materialization of climate-related financial risks. Nevertheless, harmonized taxonomy and enhanced climate-related disclosure requirements are critical for the correct functioning of these climate-related financial instruments. We refer to the detailed discussion on these tools in D'Orazio (2021).

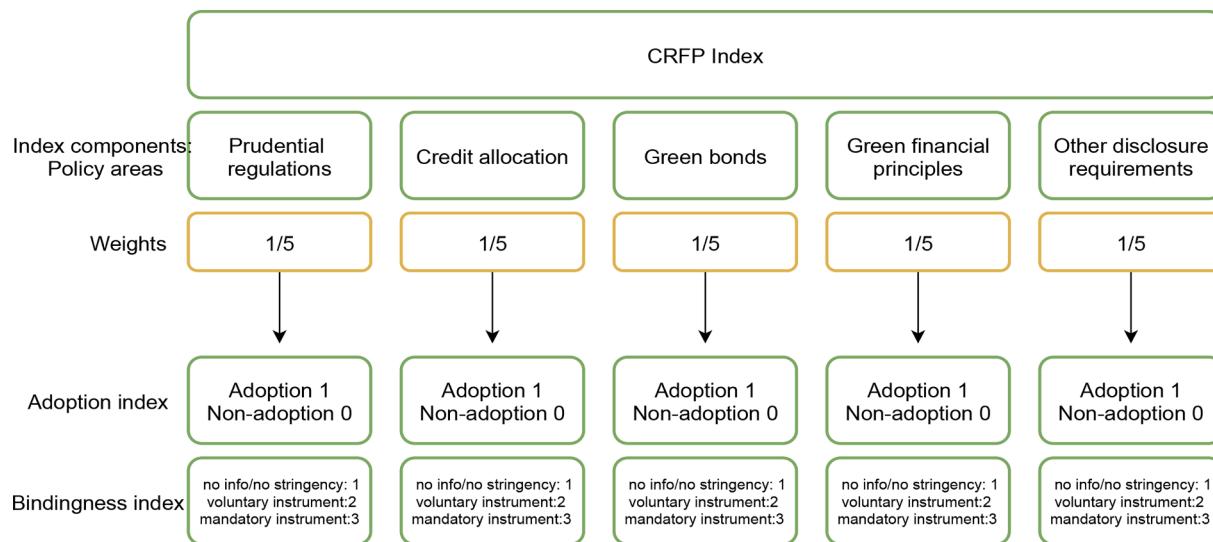


Fig. 4. Design of the climate-related financial policy (CRFP) index.

France, have been engaged in green finance policymaking since the early 2000s, with the adoption of climate-related disclosure requirements (mainly for non-financial institutions, pension funds, and insurance companies) and the so-called “green” finance principles and guidelines aimed at creating a financial market aligned with climate change concerns. Other countries, such as the German financial regulatory agency (BaFin) and the Banco Central do Brazil, are considering sustainability risk management and ESG disclosures. In some cases, we also note that the attention to climate risks led to the adoption or consideration of quantitative exercises to assess the financial system's resilience to climate exposures. Relevant examples in this respect are France and The Netherlands. Concerning green financial principles, we find several recent examples in developing green taxonomies at the global level (see [OECD, 2020a](#), for a review). Regulatory authorities in emerging economies have been active in this respect, starting from 2015. Among others, the Green Finance Committee of the China Society for Finance and Banking, a subsidiary of the People's Bank of China, issued a Green Bond Endorsed Project Catalogue in 2015 ([GFC, 2015](#)). After that, different institutions such as ministries, commissions, and regional authorities have published additional green standards and classification methods. Other relevant cases in Asia are provided by Bangladesh and Mongolia, which adopted green banking guidelines in 2017 and 2019, respectively ([BB, 2020](#); [FSCM, 2019](#)). In the EU, the green taxonomy debate started in 2018, with the first proposal by the European Commission ([EC, 2018](#)), followed by establishing a Technical Expert Group (TEG) on sustainable finance in July 2018. The TEG published its final report in March 2020, providing recommendations on the design and guidance on how companies and financial institutions can use and disclose against the taxonomy ([TEG, 2020](#)). Because of political negotiations, the regulation entered into force only in July 2020. France was the first country to issue a sovereign green bond in 2017; nevertheless, it does not have a sustainable finance taxonomy *per se* ([OECD, 2020b](#)).

Policies promoting green bonds are more recent compared with other policy areas. Early adopters are the United States and South Africa, making first steps in this direction in 2014. In the United States, California issued a 300 million USD green bond directly, while in South Africa, the stock exchange in Johannesburg offered a framework to issue green bonds. A prominent example for developing economies is Nigeria, which first provided green bond guidelines in 2016, created a mandatory framework in 2017, and released its 29.7 million USD green bonds. In 2020, 34 out of the 74 countries in our sample already implemented a policy aimed at green bonds.

3.4. The climate-related financial policy index: methodological description

Following a standard statistical-methodological approach for constructing composite indices (see, e.g., [OECD, 2008](#); [Dobbie and Dail, 2013](#); [Greco et al., 2019](#)), our proposed CRFP index is built by relying on four main steps involving (i) definition of the individual indicators, (ii) normalization, (iii) weighting, and (iv) aggregation of the five components. The design of the index is illustrated in Fig. 4.

3.4.1. Policies indicator and their bindingness

Using the data collected as described in Section 3.1, for each country i and each policy area j , we define a policy indicator I_{ijt} , as shown in Eq. 1. It is composed of P_{ijt} which defines the policy P at time t for country i . It is then multiplied with the bindingness indicator B_{ijt} observed for each policy for country i at time t . This step is crucial, and it is performed to control for possible differences in the relevance of the bindingness of the policy.

$$I_{ijt} = P_{ijt} \times B_{ijt} \quad (1)$$

3.4.2. Normalization

After defining the phenomenon we want to study and describing the individual indicators, we proceed with the implementation of the statistical analysis by following existing literature (see [OECD, 2008](#); [Dobbie and Dail, 2013](#); [Usobiaga-Liano and Elkins, 2021](#), among others).

Several normalization procedures exist in the literature, such as the Z-score or Gaussian normalization, min–max normalization, and distance to reference normalization. In our approach, the policy indicator is rescaled by using the min–max method, which allows us to rescale our data into different intervals based on the minimum and maximum values, so that indicators have an identical range.⁶ The normalized scores are calculated as follows:

$$SC_t = \frac{I_t - I_{min,t}}{I_{max,t} - I_{min,t}} \times 100 \quad (2)$$

We are interested in a panel analysis of the index performance;

⁶ This step aims to make the indicators comparable after multiplying the policy index with the bindingness index. Usually, normalization is required before any data aggregation as the indicators in a data set often have different measurement units. To ease notation, we remove the subscripts j indicating the individual policy areas and i indicating the country.

Table 2
Overview of settings and aggregation and weighting methods.

Setting	Index Label	Method	Weighting scheme	Description
1	CRFPI1	Additive model	Equal weights	Weighted sum of policies <i>with</i> bindingness
(benchmark)			$\omega = 0.2$	
2	CRFPI2	Additive model	Different weights	Weighted sum of policies <i>with</i> bindingness
			$\omega_{OGD,GB,GFG} = 0.111$	& differentiated weights for the prudential (GPP) and credit allocation (GCA) policy areas
			$\omega_{GPP,GCA} = 0.333$	
3	CRFPI3	Additive model	Equal weights	Weighted sum of policies <i>without</i> bindingness
4	CRFPI4	Additive model	$\omega = 0.2$	Weighted sum of policies <i>with</i> bindingness
			$\omega = 0.2$	& detailed policy indicator for the prudential policy area

which the weights are fixed and exogenously set.⁷

3.4.4. Uncertainty analysis: considering alternative settings

In the benchmark setting, we consider an equal weighting scheme so that ω takes the value of 1/5 for all the five policy indicators described above. Other aggregation methods and weighting schemes could be conceived. Three additional settings are designed to experiment with alternative weighting assumptions and illustrate how sensitive the proposed index is to changes in the steps followed to construct it. An overview is offered in Table 2 and results are presented in Section 4.2.

Setting 2 considers the same additive model as the benchmark-setting but assigns higher weights to prudential and credit allocation policy areas and lower weights to the other three areas. The rationale is to consider the core set of climate-related financial policies, as described in D'Orazio and Popayan (2019).

In Setting 3, the index is computed by relying on an aggregation method that applies the same weights to the components as the benchmark but does not consider policy bindingness.

Finally, in Setting 4, we apply the same additive model as in the benchmark, but propose an alternative way of computing the policy indicator for the prudential policy area, as shown in Eq. 4. We consider the five different policy instruments that characterize the prudential policy area (namely, credit risk management, climate-related stress

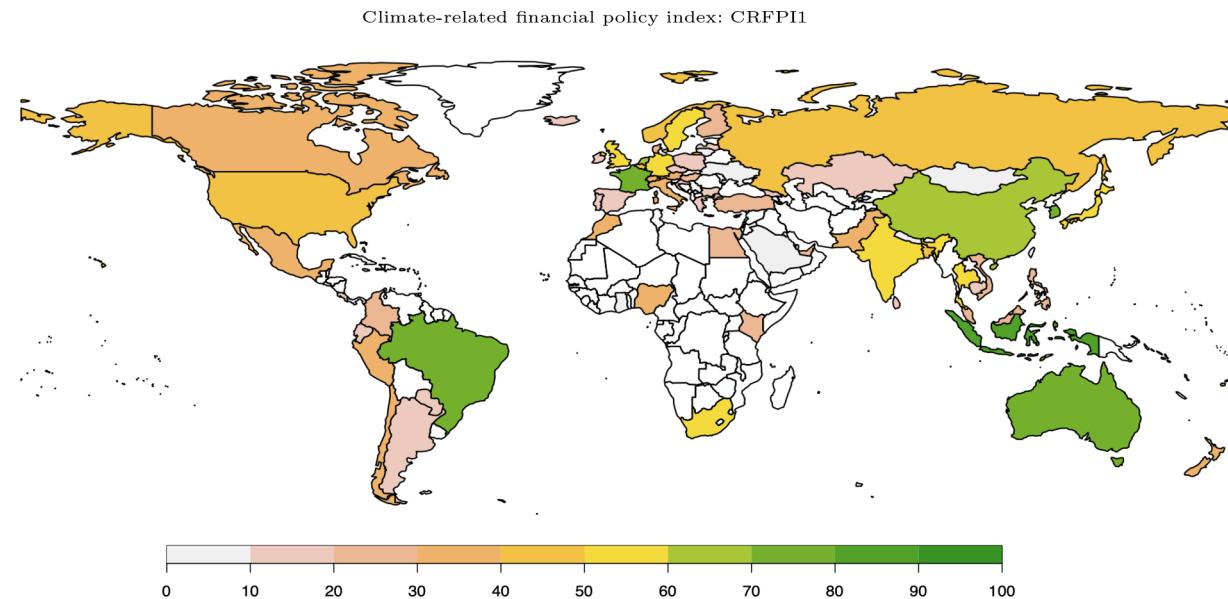


Fig. 5. Benchmark setting: the distribution of the CRFP index.

therefore, the re-scaling considers the upper and lower boundaries within the same period.

3.4.3. Aggregation and weighting

For each country in each period, we then aggregate the individual re-scaled indicators in a single index; namely, the $CRFPI_t$, as follows:

$$CRFPI_t = \sum_{j=0}^P \omega SC_{j,t} \quad (3)$$

where ω represent the weight applied to each re-scaled policy indicator.

Following the existing literature, the weight assigned to an indicator (e.g., the policy area in our case) reflects its relative importance or contribution to the index (see, e.g., OECD, 2008), although, as noted by Becker et al. (2017), it does not necessarily represent how much they impact the final index score. In our analysis, we decided to opt for a simple additive weighting aggregation (SAW) method, according to

tests, disclosure requirements for banks, ICAAP, and differentiated reserve requirements) and use them to construct a detailed sub-index for prudential policy, i.e., $I_{i,t}^{PP}$ shown in Eq. 4.

⁷ Several weighting techniques can lead to different results (Böhringer and Jochum, 2007; Greco et al., 2019; Dobbie and Dail, 2013). The most common technique is the non-parametric Data Envelopment Analysis (DEA) approach in that it allows each evaluated country to look for optimal weights that maximize the composite indicator relative to the other countries. However, the flexibility of the approach dismisses the neutrality requirement of Arrow's theorem, according to which "all alternatives (e.g., countries) must be treated equally" (see the discussion in Greco et al., 2019). Because of these methodological issues and considering the nature of our indicator, we preferred to adopt a simpler weighting technique, allowing us to avoid making too strong assumptions about the values of the weights. A similar argument has been discussed in the methodological approach developed in Usabiaga-Liano and Elkins (2021).

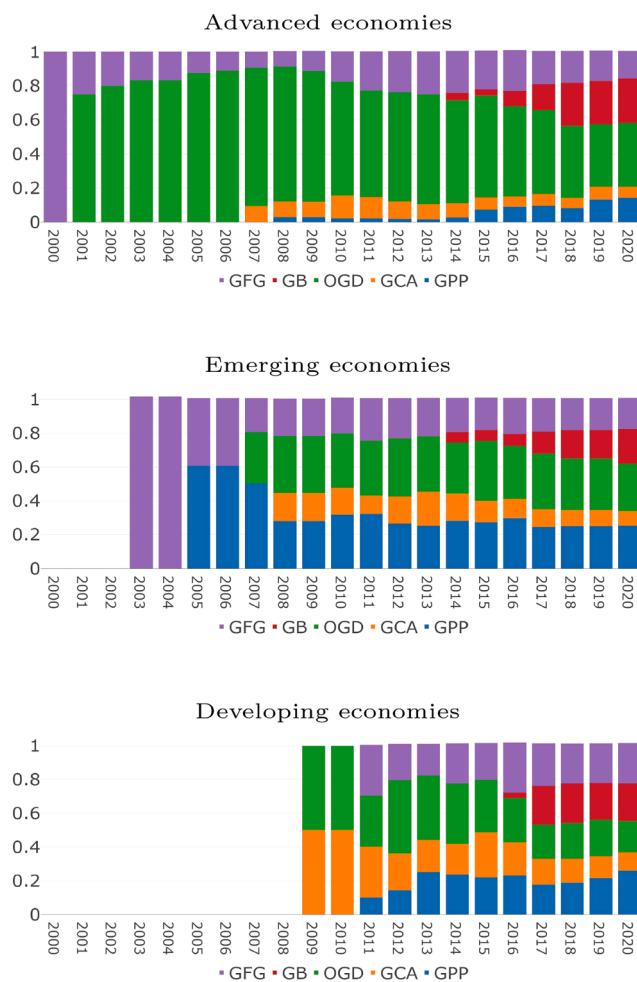


Fig. 6. Benchmark setting: the relative use of policies over time by income group. Notes. GPP: Green Prudential Policy; OGD: Other Green Disclosure Req.; GFG: Green Financial Guidelines; GB: Green Bonds; GCA: Green Capital Allocation.

$$I_{i,t}^{pp} = \rho(I_{i,t}^\alpha + I_{i,t}^\beta + I_{i,t}^\gamma + I_{i,t}^\delta + I_{i,t}^\eta) \quad (4)$$

where

- $I_{i,t}$ stands for the instrument for country i at time t
- the greek letters used as exponents are the labels of the types of policies and are defined as follows:
 - α denotes credit risk management
 - β denotes climate-related stress tests
 - γ denotes disclosure requirements for banks
 - δ denotes ICAAP
 - η denotes differentiated reserve requirements
- ρ is the weighting parameter for the instruments that belong to the prudential policy area and takes the value of 1/5.

The normalized prudential policy area indicator is then included in the computation of the CRFPI as explained in Section 3.4; i.e., by relying on an additive model with equal weights. Studying this additional setting will allow us to consider the multidimensionality of the prudential policy area, characterized by five different policy instruments. Additionally, it will show the implications of constructing a more complex index version by relying on a more accurate indicator of prudential policies.

4. Results

4.1. Countries' performance under the CRFPI

Figs. 5 and 6 report the results by using the benchmark method and by considering the distribution of the index for 2020 and the distribution of the sub-indices (i.e., the indicators of the different policy areas) over the period 2000–2020, respectively.

First, we note that a high CRFPI characterizes very few countries; they are Australia, Brazil, China, France, Indonesia, the Netherlands, and South Korea, as highlighted in green in Fig. 5. The index allows us to identify the country with the lowest CRFPI, i.e., Saudi Arabia (highlighted in grey), followed by several countries with low performances, such as Argentina, Ecuador, Spain, Portugal, and Iran, highlighted in pink.

Second, we observe a “location” or bandwagon effect that characterizes South and East Asia and the Pacific countries. A similar effect is observed in Europe, where the leading actors are France and the Netherlands, followed by Germany, the UK, and Sweden (highlighted in yellow). Instead, in Latin America, there is only one leading country, i.e., Brazil, while other countries perform quite poorly, with below-average index values. In North America, the highest index is observed for the USA, but its green financial policymaking is not prominent compared to other global examples. Only a few cases are observed in the African continent, and among them, the highest CRFPI is recorded in South Africa.

We note that the results observed for Australia, China, and Brazil, among others, are particularly interesting and show the potential of the proposed index. For these countries, the CRFP index highlights a high commitment to financial policymaking; it is, however, not aligned with the achievement of climate objectives at the national level. In particular, the scores reported for these countries seem to be at odds with the Australian economic and energy policy (consider, e.g., that it is the world's biggest exporter of coal) (Crowley, 2021; Hudson, 2019; Edwards, 2019), the current debate on the high pollution levels reported in China (Shao et al., 2006; Wong, 2013; Guan et al., 2014) and the approach of Bolsonaro's government against environmental and sustainability goals in the past years (Araújo, 2020; Pereira and Viola, 2019; Brito et al., 2019). The rationale for this observed “inconsistency” can be twofold. On the one hand, when central banks and financial supervisors promote the policies, the independence of monetary policy and financial authorities from political power might allow them to pursue climate-related objectives irrespective of the national (i.e., government) engagement in climate policy. On the other hand, it could be interpreted as a misalignment or lack of coordination among policy actors, thus calling for closer cooperation to achieve important sustainability and climate mitigation objectives. The index thus proves useful to point out that an extraordinary engagement in climate-related financial policymaking does not always translate into environmentally or sustainable virtuous policy outputs.⁸

By dividing the sample into three income groups according to the World Bank classification, we can distinguish the differences across time for the different policy indicators. As shown in Fig. 6, advanced countries have been the most active across the whole policy spectrum since the early 2000s. The highest share over the 21 years covered in our analysis is allocated to other green disclosure requirements (green area in the graphs), followed by green financial principles. More recently, green bonds have started to gain importance because of investors' increased attention to environmental investments. Similarly, green prudential regulations are becoming widespread, mostly because of the

⁸ Because of lack of data, the index does not allow to test the effectiveness of climate-related financial policies in scaling up green finance or addressing climate risks. Considering the importance of this aspect, this is left for future research.

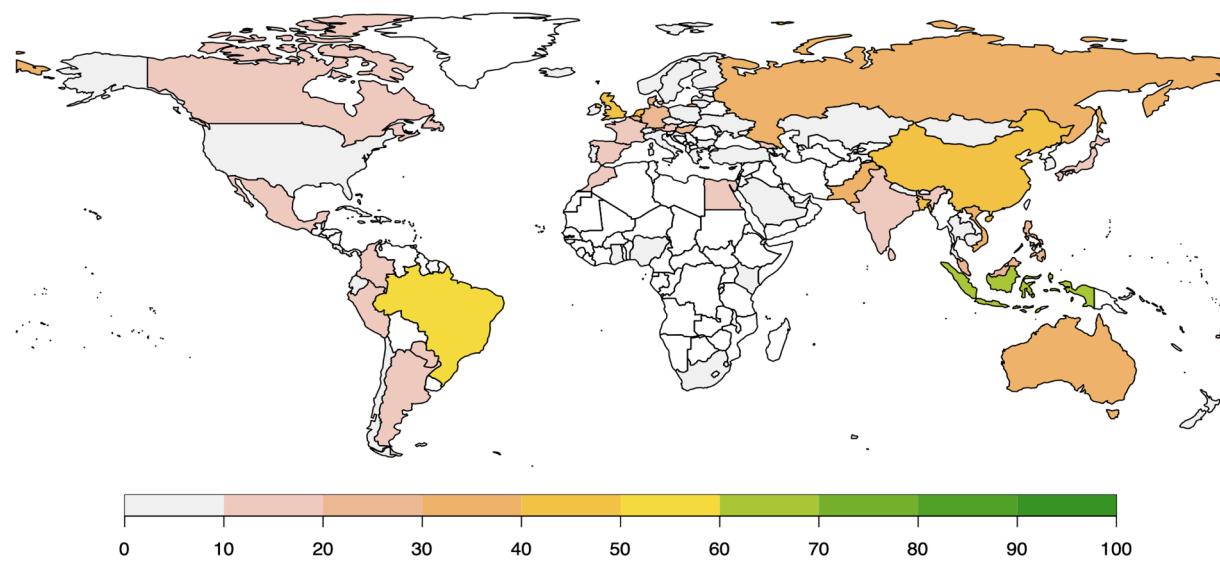


Fig. 7. The distribution of the CRFP index by considering policies promoted and implemented by central banks and financial regulators.

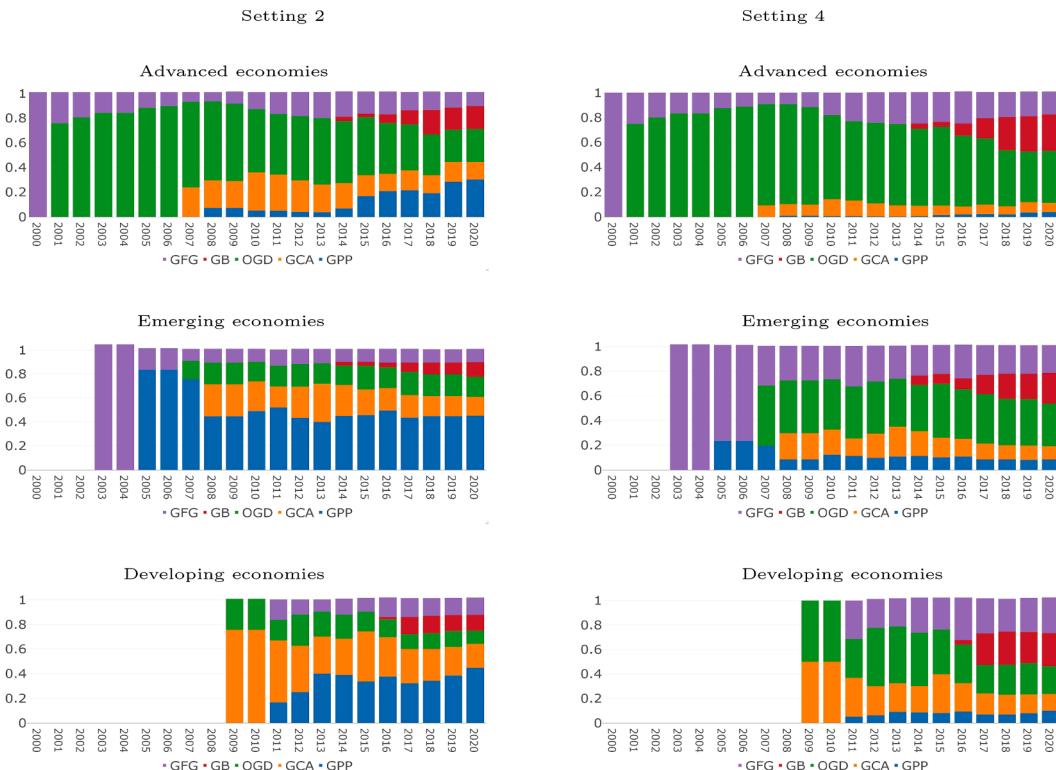


Fig. 8. The relative use of policies over time by income group in the two settings. The graphs on the left refer to Setting 2; the graphs on the right refer to Setting 4.
Notes. GPP: Green Prudential Policy; OGD: Other Green Disclosure Req.; GFG: Green Financial Guidelines; GB: Green Bonds; GCA: Green Capital Allocation.

implementation of climate-related stress tests in several jurisdictions such as the UK, France, and the Netherlands. Concerning emerging economies, no policies were found until 2003. Overall, the shares of policies are different from advanced economies because a bigger role is played by green prudential policies (blue area in the graphs), followed by credit allocation measures (orange area). Regarding developing economies, we observe that climate-related financial policies have started to be adopted later compared to countries belonging to the other two income groups. The share of the different policy areas is similar to those observed in emerging economies in the past years. However, a slightly higher share is reported for the green prudential and credit

allocation policies starting from 2015.

Finally, we can analyze and compare countries' engagement using our proposed methodology by focusing on the agent responsible for or promoting the policy. Taking advantage of the features of our database, we select the sub-sample of policies promoted and implemented exclusively by central banks and financial regulators. This investigation is particularly interesting considering the debate on green central banking, as discussed in Section 2, and that they have been promoting 38% of the climate-related financial policies, as shown in Table 1. The distribution of the index shown in Fig. 7 highlights that in this case, the most committed country to green financial policymaking is Indonesia,

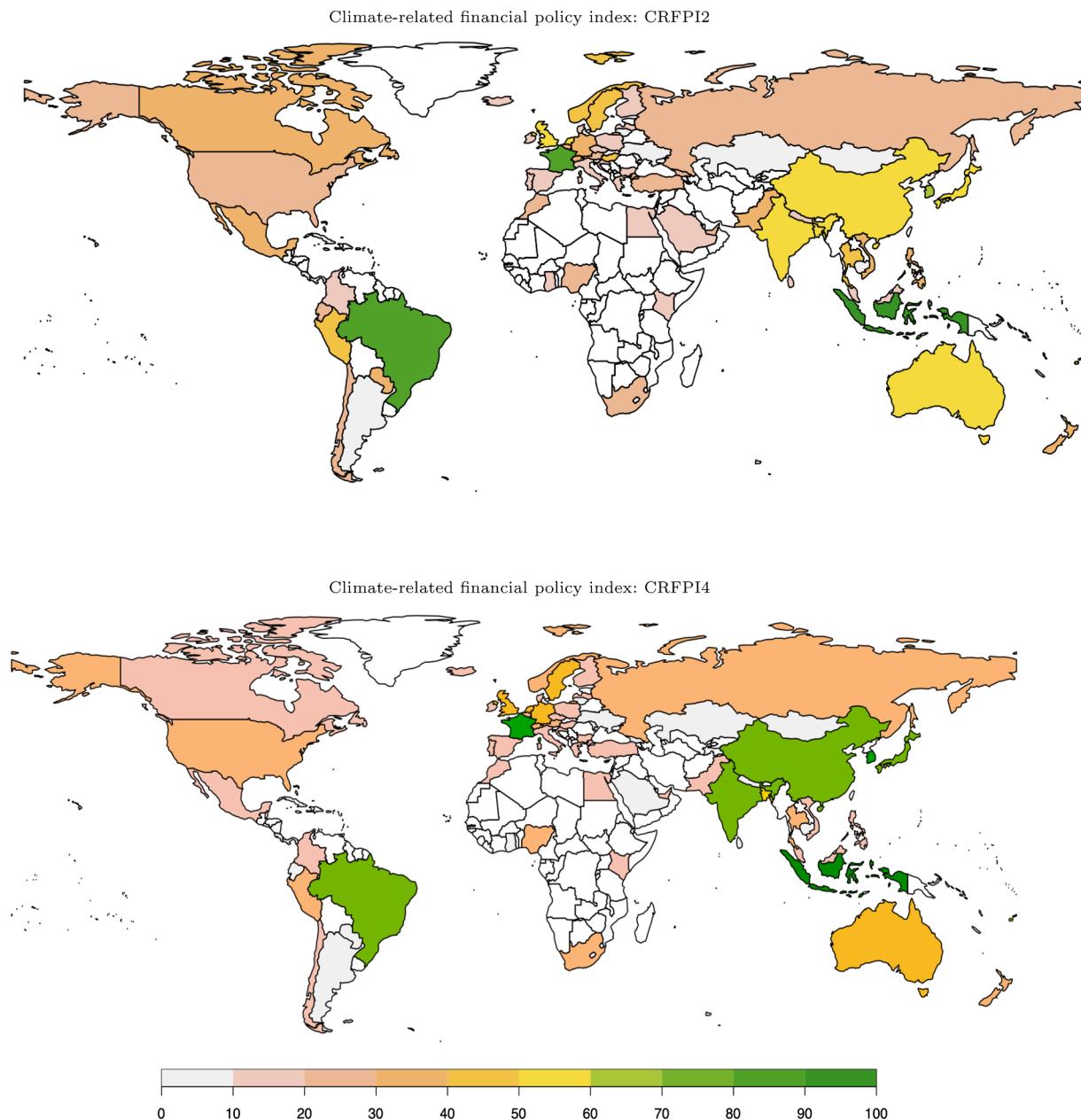


Fig. 9. A comparison of the distribution of CRFPI2 and CRFPI4 in 2020.

followed by Brazil and then China and the UK. Thanks to this approach, it is possible to visualize that overall, the majority of the countries - and in this specific case, central banks and financial supervisors - have a policy performance that is below the average (<50).

4.2. Robustness and sensitivity analysis

We now focus on the index obtained by considering alternative settings as explained in Section 3.4.4. In particular, we compare the index's performance when assigning higher weights to prudential and credit allocation policies (Setting 2) and by considering a more detailed construction for the prudential policies indicator (Setting 4). These analyses allow us to emphasize that the proposed index contributes to the literature on standard macroprudential policies (see Fendoğlu, 2017; Cerutti et al., 2017; Jiménez et al., 2017; Akinci and Olmstead-Rumsey, 2018, among others), and by shedding light on the adoption of climate-related financial policies, it could be used as a complement to the macro-prudential index developed by Cerutti et al. (2016).

4.2.1. A comparison of CRFPI2 and CRFPI4

We start with analyzing the shares of the policies over time as shown in Fig. 8.

In Setting 2, we observe a "size" effect (for all income categories) on the percentage of prudential and credit allocation policies caused by larger weights ascribed to them compared to the benchmark.

In Setting 4, prudential policies (see the blue area of the graphs) account for a lower share of overall policies for all income groups, even though this more complex setting benefits individual countries if they implement several prudential policy measures at the same time. This result is observed because of the small number of countries implementing a wider variety of prudential policies.

We then focus on the performances of individual countries in 2020 by comparing the results obtained by applying the two methods, as shown in the maps reported in Fig. 9. The general results of our benchmark-setting seem to be confirmed with a concentration of countries with a high index in South-East Asia and the Pacific, followed by some EU countries and Brazil in South America. However, it is also

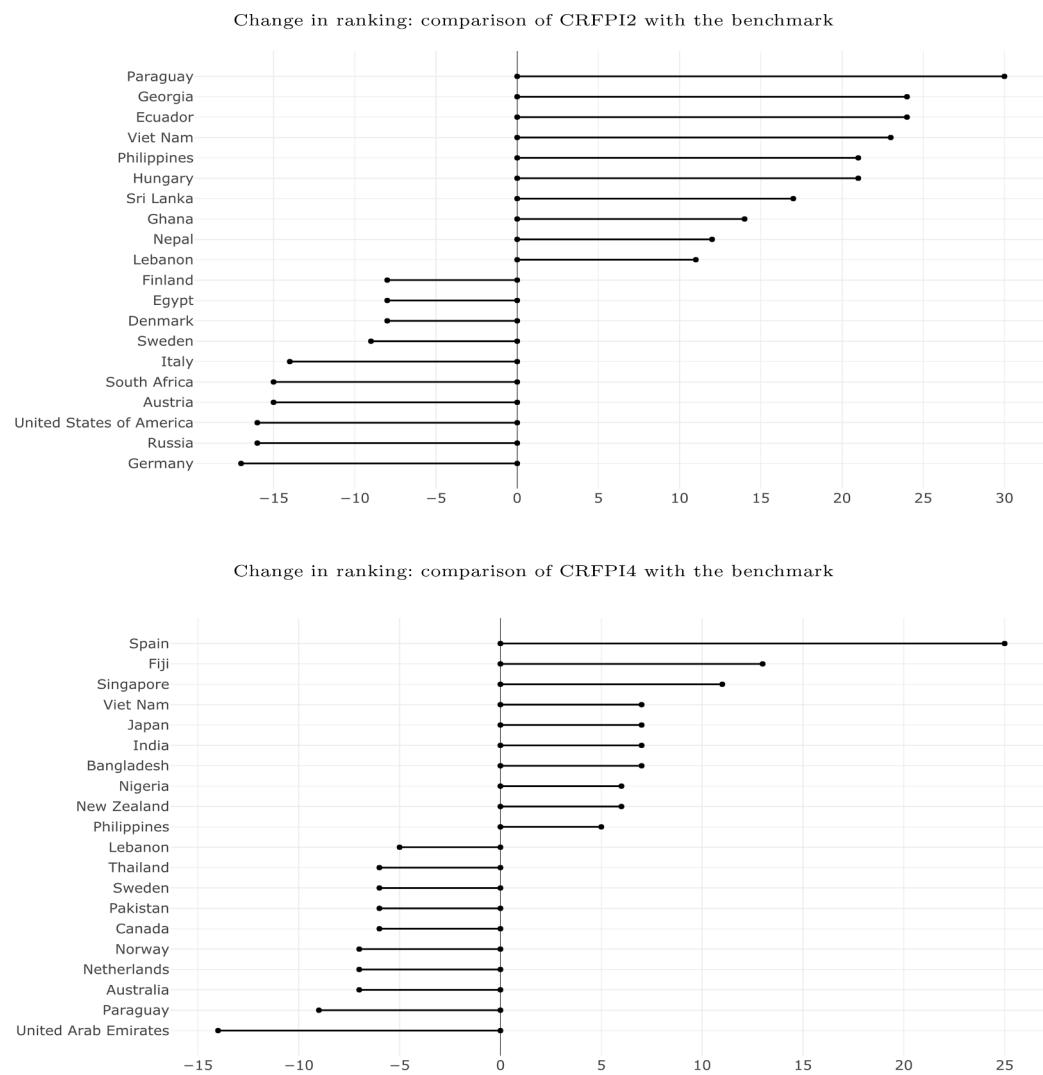


Fig. 10. Change in rankings in 2020: comparison of different settings.

clearly visible that the overall global performance is weaker than the benchmark results. When considering CRFPI2, we note that some of the countries leading in the benchmark setting (e.g., China and Australia) are not labeled in green anymore, implying that their performance has been penalized by introducing the higher weights for the prudential and credit allocation policies. High index scores still characterize Brazil, France, South Korea, and Indonesia. When considering CRFPI4, we note that Brazil, France, and Indonesia are not affected by the aggregation method; they score quite well in all index dimensions, including the specific prudential policies. Australia is penalized compared to other settings, pointing to a lower country's engagement in the prudential policy dimension. Overall, the method implied by the CRFPI4 leads to a lower score unless countries implement a wider variety of prudential policy measures. This evidence could set the right incentives for policymakers and make focusing on a single measure less beneficial.

Fig. 10 provides a more detailed inspection of the ten highest gains and losses in the ranking of the countries compared to our baseline setting.

From the top panel, we observe that when working with the aggregation method of Setting 2, which assigns higher weights to prudential and credit allocation policies, some countries witness very large changes. For example, South Africa and Austria lost 15 positions; USA and Russia lost 16 positions, and Germany dropped by 17 positions, suggesting that these countries did not involve themselves in those

policy areas. According to our data, Germany did not implement any prudential or credit allocation policy and is heavily penalized in this setting. Other countries, such as Paraguay, Georgia, Ecuador, and Viet Nam, improve their overall rank by rising by more than 20 positions; this reflects the efforts of these countries regarding prudential and credit allocation policies. Interestingly, we note that all countries that move up in the rank are emerging and developing economies, while those downgraded are mostly all advanced economies.

When describing the performance according to the CRFPI4 compared to the benchmark, as displayed in the bottom panel, we observe different changes in the countries' ranks. First, Spain in Europe, New Zealand, Nigeria and Fiji, Singapore, Viet Nam, Japan, India, and Bangladesh in Asia improved their ranks. Other countries, such as Paraguay, Australia, the Netherlands, and Norway, lost several positions. The United Arab Emirates is the country that is the most penalized by this aggregation method, as it loses more than 20 positions.

Additionally, as shown in Table 3, compared to the index computed in the benchmark setting, both the CRFPI2 and CRFPI4 lower the average scores in all groups of countries. Emerging economies emerge as the most engaged in climate-related financial policymaking according to the CRFPI1 and CRFPI2 and exhibit a strong heterogeneity within the group. When considering CRFPI4, the performance of advanced and emerging economies does not diverge much on average. On average, developing countries are the least engaged and present the lowest

Table 3

Summary statistics by income group of the CRFP index in 2020; comparison of indices performance considering alternative aggregation methods.

Index	Country group	Mean	St. Dev.	Min	Median	Max
CRFPI1						
	Advanced	33.385	20.731	6.000	26.000	80.000
	Emerging	34.250	22.969	6.000	26.000	86.000
	Developing	23.933	15.346	6.000	26.000	53.000
CRFPI2						
	Advanced	26.103	20.268	3.000	18.000	81.000
	Emerging	31.800	24.447	7.000	27.000	92.000
	Developing	22.933	16.884	3.000	14.000	55.000
CRFPI3						
	Advanced	44.615	26.142	20.000	40.000	100.000
	Emerging	48.000	23.753	20.000	40.000	100.000
	Developing	40.000	16.903	20.000	40.000	60.000
CRFPI4						
	Advanced	20.462	15.627	3.000	17.000	66.000
	Emerging	21.950	19.909	2.000	14.000	73.000
	Developing	16.200	15.082	2.000	14.000	51.000

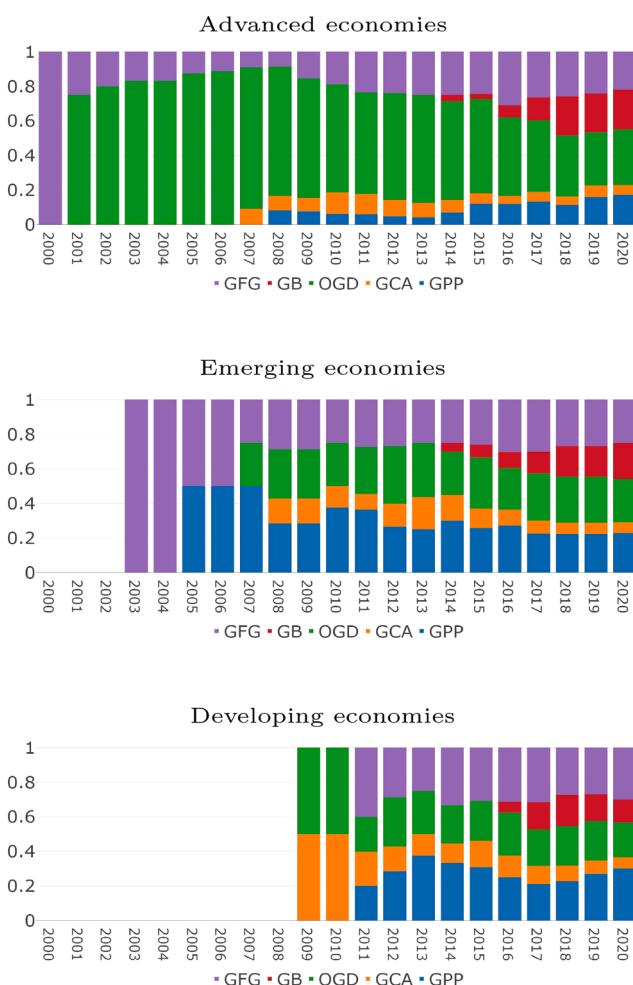


Fig. 11. Setting 3: the relative use of policies over time by income group. Notes. GPP: Green Prudential Policy; OGD: Other Green Disclosure Req.; GFG: Green Financial Guidelines; GB: Green Bonds; GCA: Green Capital Allocation.

within-group heterogeneity.

4.2.2. Countries' performance under the CRFPI3 setting

Setting 3 considers the index without the bindingness of policies. Fig. 11 shows that the highest share of the index for advanced economies is represented by the other green disclosure requirements, followed by green financial principles. Green bonds were introduced in 2014, and the highest shares are observed in advanced and emerging economies; they are more recent in developing countries. Compared to the benchmark-setting, we note that the shares of green principles and prudential policies in developing countries are the most affected by this different aggregation method, as they get higher shares when the bindingness of the policy is not taken into account. Similarly, but with an opposite effect, when looking at emerging economies, we note that credit allocation policies get a lower share (over time) than the benchmark. This suggests that including the bindingness in the index computation delivers more robust results.

Further comparisons with other methods are possible by considering the index in 2020. We note that the mean, minimum and maximum values of CRFPI3 reported in Table 3 are the highest compared to the indices computed with other aggregation methods. This is expected, as the index does not consider the policy's bindingness. Emerging economies score the highest CRFPI3, followed by advanced economies. Regarding the inter-group variation as expressed by the standard deviation, we note that in this case, advanced economies report the highest values compared to other income groups.

4.3. A focus on G20 countries

Before concluding our methodological proposal for the CRFP index, we present an application to G20 countries. As they represent the leading global economies and are the most significant contributors to global carbon emissions, we deem it relevant to discuss the role of climate-related financial policies from the G20 perspective. We report the rank of G20 countries in Fig. 12 by considering three alternative versions of our index. Some interesting results emerge from our analysis. First, by looking at the top of the rank in the three panels, we record that Brazil, China, France, Indonesia, and South Korea are always among those located in the highest positions, irrespective of the chosen aggregation method. This highlights the strong commitment of these countries to climate-related financial policymaking. Differences in the score values depend on the weighting schemes and computation methods following the discussion in previous sections. Second, we note some persistence when considering the countries at the bottom of the rank. For example, Argentina, Saudi Arabia, Turkey, and Italy are characterized by very low index values, indicating a weak overall engagement regardless of the aggregation method.

This analysis shows that the method developed in the paper is robust (Tate, 2012) as the rank of the countries is confirmed by varying the aggregation method. Some variations reflect the importance of some policy areas in the jurisdictions; thus, alternative aggregation methods can be used to perform different assessments, depending on the focus on a specific policy area. Additionally, it highlights that some jurisdictions located at the bottom of the rank and/or those that score below average values (<50) require a stronger engagement in climate-related financial policymaking to be aligned with the goals of the Paris Agreement.

4.4. CRFPI1 with non-binary policy indicators

Finally, we provide the results of our index calculated using a different approach for the data input (i.e., the first step of the index construction phase, as shown in Fig. 1). Our methodological approach

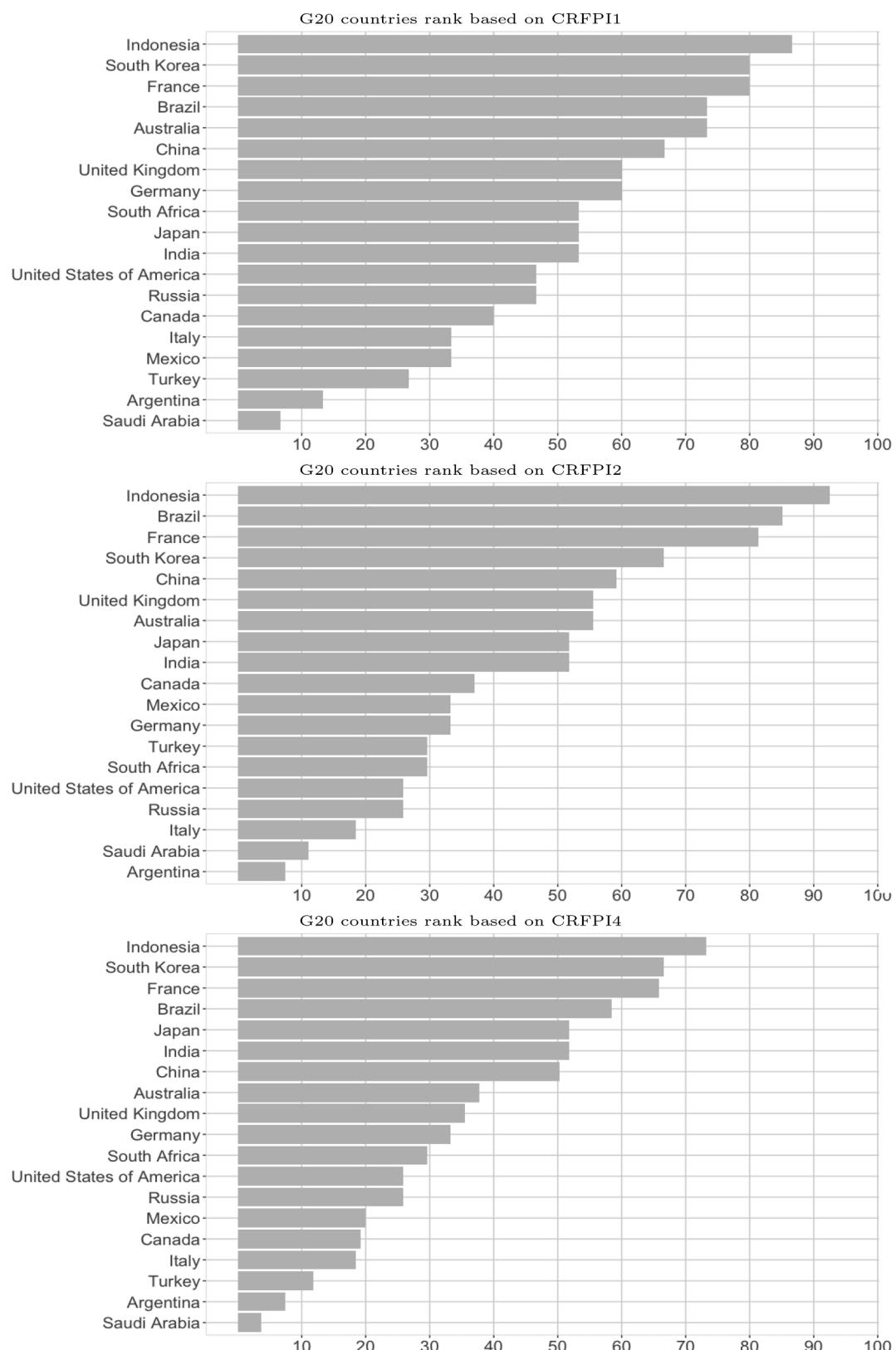


Fig. 12. Comparison of the performance of G20 countries in 2020 based on alternative aggregation methods.

Table 4

Comparison of country ranks for CRFPI1 in 2020 by using alternative approaches for data input.

Country	Standard “binary” approach (1) Rank	Alternative “granular” approach (2) Rank
Indonesia	1	7
France	2	2
South Korea	3	10
Australia	4	4
Brazil	5	3
China	6	1
United Kingdom	7	5
Lebanon	68	73
Lithuania	69	65
Mongolia	70	56
Nepal	71	74
Panama	72	66
Saudi Arabia	73	67
Ukraine	74	68

allows us to distinguish between a so-called “standard binary approach” which is the standard approach used in the previous sections and an “alternative granular approach”.

In this section, rather than utilizing a *binary variable* to represent policy adoption for each country in each year for each policy area indicator, we report the results of an exercise that considers the *number of policies* adopted by each country in each year for each policy area indicator, demonstrating the versatility of our index and the value of the dataset created for this study.

We believe that the proposed standard “binary” approach (i.e., one that employs a dichotomous policy adoption variable as data input) captures worldwide policy engagement differences while remaining appropriate in an environment where general adoption is still limited, such as the one described in our survey (especially until 2015). As more data becomes available due to (perhaps) stronger policy adoption to respond to increased climate risks in the coming years, the alternative “granular” method will provide a more nuanced picture of global engagement.

To provide an example of the functioning of the alternative approach, we report in Table 4 the rank of countries according to the CRFPI1 in 2020, focusing on the first and the latest seven positions, computed by using the two methods. In particular, we show in column (1) the country's rank when the index is computed with the standard approach and then compare it with the score obtained with the alternative approach in column (2).

This experiment demonstrates some changes in ranking, both at the top and the bottom; nevertheless, in most cases, the improvement or worsening of rankings is relatively small. China, in particular, benefits the most from the alternative approach because it has implemented the largest number of policies in all policy areas, and the bulk of them are also mandatory in terms of bindingness. France and Australia do not experience any changes in their rank. South Korea, instead, is the most affected by the “granular” computation method as it has so far implemented only very few policies.

5. Discussion

Climate change is a historical challenge for sustainable development, which requires a global response, including adequate financial resources, as reflected in Article 2 of the Paris Agreement. Climate change also poses a threat to financial stability and monetary policy conduct, necessitating greater participation from all policymakers, central banks, and financial regulators in tackling physical and transition risks.

Against this backdrop, we can derive some interesting implications from calculating the index proposed in our study.

First, emerging economies report the highest average CRFPI (in most aggregation settings); they thus emerge as the most engaged in climate-related financial policymaking according to all aggregation methods. However, they are characterized by the highest within-group variability, indicating no standard or general approach to greening the financial system.

Second, advanced economies also report an overall high average index value, with a slightly lower standard deviation than emerging economies. They also record the earliest engagement by adopting green disclosure requirements for non-financial institutions (NFI) since the early 2000s.

Third, when considering the more complex index version, i.e., the CRFPI4, emerging economies appear as the most engaged on average, reporting a higher standard deviation than other income level subsamples. Developing countries are the least engaged on average; they started later than other income groups to adopt these policies and present the lowest within-group heterogeneity compared to the other income groups.

Fourth, when comparing the alternative settings for computing the CRFPI, we observe a sort of location, or bandwagon, effect⁹ and find that in the benchmark and Setting 4, most countries with a higher CRFPI are located in the Asian-Pacific region. France and the Netherlands are the most active countries in Europe, followed by the United Kingdom.

Fifth, the results obtained by focusing on the G20 economies show that the method developed in the paper is robust. The countries' rank (at the top and the bottom of the distribution) is largely confirmed by varying the aggregation method. The ranks' variations observed in comparing the alternative indices reflect the importance of some policy areas in the jurisdictions. We note that this feature can be exploited to perform different assessments, depending on the interest in a specific policy area.

The index might be used to investigate whether there is an empirical relationship between climate-related financial policies and climate mitigation. The first contribution in this direction is provided by D'Orazio and Dirks (2022), which studied whether the implementation of climate-related financial policies resulted in CO2 emissions reductions in G20 countries. The study uses panel quantile regression to show that the stock of policies adopted before 2015 has a larger impact on emissions in high emission countries, i.e. those at the top of the CO2 emissions distribution. In countries with lower CO2 emissions quantiles, recent policy actions have influenced CO2 emission reduction. As a result, climate-related financial policies could play a role in mitigation efforts.

The index, however, does not allow for testing the effectiveness of climate-related financial policies in scaling up green financing or addressing climate risks due to a lack of data. Indeed, more data and information would be required, particularly for some countries, to perform a more thorough analysis of the financial resources mobilized (i.e., created) by the policies included in the index. Given the relevance of this topic, it will be studied further in the future.

6. Conclusions

This research intended to collect the most comprehensive data on the adoption of climate-related financial policies, including information on the date of adoption, the authority accountable for it, and the bindingness, while taking into account differences in financial policymaking at the international level. It also aimed to design a statistical measure, the climate-related financial policy index, based on the unique data obtained to assess international engagement at the global level.

Overall, the analysis suggests that the proposed approach and

⁹ The results reported in D'Orazio (2022), which uses cluster analysis to investigate the determinants that lead to the emergence and diffusion of climate-related financial policies, confirm this effect.

resultant index could be used to shed light on countries' engagement in climate-related financial planning and to highlight policy gaps in relevant policy sectors.

The index enables us to highlight that some jurisdictions at the bottom of the ranking, such as Saudi Arabia, Argentina, Turkey, Italy, Canada, Russia, and the United States, clearly require a stronger engagement in climate-related financial policymaking to be aligned with the Paris Agreement's goals, as their scores are below average. We believe this is especially important because these policies can make it easier for governments to implement long-term climate policies that will improve our societies' sustainability by contributing to stable economies and financial markets and providing additional resources for the low-carbon transition.

When additional data become available due to the growing adoption of climate-related financial policies, the index proposed in this study could be used in two directions. First, it will enable a more nuanced study and comparison among nations, highlighting engagement in specific policy areas or the entire spectrum of climate-related finance policy. Second, it might be used to investigate the relationship between policy adoption and credit market changes and assess their effectiveness in managing credit and financial cycles in the face of climate risks.

Data availability statement

The datasets generated during and/or analysed during the current study are available from the corresponding author on reasonable request.

Ethics statement

Not applicable.

CRediT authorship contribution statement

Paola D'Orazio: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Software, Visualization, Writing - original draft, Writing - review & editing. **Steffen Thole:** Data curation, Formal analysis, Writing - original draft, Software, Visualization.

Declaration of Competing Interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: Paola D'Orazio reports financial support was provided by Ruhr University Bochum – Research Department Closed Carbon Cycle Economics.

Acknowledgements

We acknowledge support by the Open Access Publication Funds of the Ruhr-Universität Bochum.

Appendix A. List of countries included in the analysis

See [Table A1](#).

Table A1
Countries classification by income group – World Bank classification.

High income Advanced economies	Upper-middle income Emerging economies	Lower-middle income Developing economies
Australia	Argentina	Bangladesh
Austria	Brazil	Cambodia
Bahrain	Bulgaria	Egypt
Belgium	China	Ghana
Canada	Colombia	India
Chile	Costa Rica	Kenya
Croatia	Ecuador	Mongolia
Cyprus	Fiji	Morocco
Czech Republic	Georgia	Nepal
Denmark	Indonesia	Nigeria
Finland	Kazakhstan	Pakistan
France	Lebanon	Philippines
Germany	Malaysia	Sri Lanka
Greece	Mexico	Ukraine
Hungary	Paraguay	Viet Nam
Iceland	Peru	
Ireland	Russia	
Israel	South Africa	
Italy	Thailand	
Japan	Turkey	
Latvia		
Lithuania		
Luxembourg		
Netherlands		
New Zealand		
Norway		
Panama		
Poland		
Portugal		
Saudi Arabia		
Seychelles		
Singapore		
South Korea		
Spain		
Sweden		
Switzerland		
United Arab Emirates		
United Kingdom		
United States of America		

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