Seeing climate change like a central banker

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Abstract

A well-established literature in political economy has demonstrated how central banks have been susceptible to new ideas in times of crisis or periods of uncertainty, yet, the type of ideas that this literature has looked at has been economic in nature. It is therefore relevant to look into what happens when central banks are dealing with non-economic issues, in this particular case central banks' recent engagement with climate-related issues. The paper asks how central banks can claim to have institutional expertise in climate change as a field that works from a different scientific standpoint. Building on interviews with central bankers, participant observation at webinars and quantitative content analysis of central bank speeches, this paper argues how central banks, despite lacking climate science expertise, had only limited interactions with climate science and the community of climate scientists, preferring to approach the work with climate-related issues following an economic science ethos with an emphasis on economic training and tools. The paper introduces the concept of epistemic boundaries to explain this relegation of climate-related issues to economically calculable risks stemming from climate change. As such, the argument advances the state of the art by specifying the scope conditions under which central banks are willing to engage with issues that are traditionally subject to the epistemic authority of hard sciences rather than of economics.

Keywords: central banks, climate change, financial governance, economic ideas, epistemic boundaries

Dear reader,

I look forward to present and discuss this paper at EUSA. It is the second paper of my PhD dissertation, but I intend to publish it independently from my dissertation. I would especially appreciate your feedback on whether you think there is coherence between the analytical framework and the analysis. Throughout the process of writing this paper, I knew I had interesting empirics and unique insights from my interviews, but I have found it difficult to find the right analytical frame in order to ensure that my paper speaks to a broader audience within international political economy. I will of course welcome all comments on my paper, but I would especially appreciate feedback on the following questions:

- Is there a clear coherence between the analytical framework and the analysis?
- Does the paper identify a relevant gap in the literature on economic ideas in financial institutions?
- Do you find the contribution to the literature to be convincing and relevant?

1. Introduction

What will happen to the financial system in 2050 in a situation of unmitigated climate change? What would happen when the world face natural catastrophes induced by the climate crisis, and businesses face a rapid transition away from fossil fuels towards greener alternatives? How will climate change shocks transmit to finance and the broader macroeconomy? These are the types of questions that central banks are asking themselves these days. Central bankers now work with different climate scenarios depending on the different types of mitigation, mapping out technology change and transition to a greener economy, and seeking to understand cascade effects and tipping points in climate science to get an idea of the tail risks ahead of us. In other words, central banks are currently seeking to make climate change legible and translating climate science into macroeconomic language and concepts. And they do this largely in isolation from the community of climate scientists and without any prerequisite or prior experience in working with climate science.

We know from the literature that in times of crisis or in periods of uncertainty, central banks have momentarily been susceptible to forms of expertise and ideas from the outside of the traditional realms of central bank expertise: macroeconomic policy, with an emphasis on monetary policy with shadow banking regulation (Ban et al. 2016) and macroprudential regulation as the typical examples (Thiemann et al. 2020, Baker 2013, NPE). Thus, this literature tells us central banks are not as closed as they seem.

Climate change, though building on a logic of modelling and forecasting like economics, is a scientific field that is far from economics, but central banks now acknowledge that it is critical to their mandate. The question then is, what happens in the case where central banks deal with non-economic issues such as climate change, and thereby have neither the training, the credentials nor the credibility to bring judgement? Do central banks open up to the influence from a different scientific discipline, or do they block them and instead impose an economic logic by creating an economic *cognitive infrastructure* (Hirschman and Popp Berman 2014) in the form of new models and measurements?

Given their roles as regulators and supervisors of the financial system, central banks have faced calls for an active and ambitious role in decarbonizing finance with the aim of mitigating climate change. Ranging from calls for a 'green QE' program to 'green haircuts' and a closer coordination between monetary and fiscal policies to support the green transition there have been high hopes for central banks' ability and capacity to address the climate crisis (Campiglio, 2016; Schoenmaker, 2021; Svartzman *et al.*, 2021). The IPE literature would suggest that this is a most-likely case for including *non-economic* scientific expertise such as climate science in central banks because this expertise rests on a different epistemic culture (Knorr Cetina, 1999). However, this paper shows that instead of doing this, the central banks have taken a very narrow focus on their work with climate-related issues, focusing on mapping out the possible transmission channels between climate change, the financial sector and the real economy. Indeed, the approach central banks are taking is not following the calls for urgent action coming from climate scientists (Paterson, 2020) but instead deploys a neoliberal economic logic focusing on financial stability and market-based risk management, both of which operate with more heroic assumptions about the available window for climate action (Langley and Morris 2020) and possibly leading to '*capitalism's creative self-destruction'* (Tarim, 2022, p. 491). In essence, central banks see their main task as one turning climate change into a calculable risk framework through tools of climate stress testing and scenario analysis. This paper seeks to answer how central banks claim to have institutional expertise in climate change being a field that works from an entirely different scientific standpoint, and why central banks have reduced the climate agenda to one that is solely about risks.

Building on interviews with central bankers, participant observation in relevant webinars with central bankers and quantitative content analysis of central bank speeches, I show how there is a hierarchy of sciences within central banks with economics not just being the dominant scientific ethos, but the only scientific ethos within central banks. Instead of taking climate scientists on board in the development of a new framework for climate-related issues, central banks have relied on short-term collaboration at the very outset and readings of the IPCC report as the strategy for 'skilling up' on climate change suggesting hard epistemic boundaries exist within central banks. I therefore make two interconnected claims. First, contributing to the literature on economic expertise, I suggest that within central banks, economics is superior not just to other social sciences (Fourcade et al. 2015), but to natural sciences as well with no exception being made for climate science. Secondly, I add a scope condition to the existing literature on central banks and economic ideas, in the sense that for central banks to be open to external ideas, such ideas must be presented by economists, and represent an economic logic. Thus, where central banks seek to 'scientize' their work (Mudge and Vauchez, 2012; Thiemann, Melches and Ibrocevic, 2020), there appears to be a narrow acceptance of scientific value which is limited to an economic science ethos.

The paper is organized as follows: the subsequent sections offers an overview of the literature and introduces the concept of epistemic boundaries as the analytical framework of the paper. The following section presents the method and the data used in this paper. The fourth section looks into the approach taken by central banks to deal with climate-related issues. The fifth section traces how central banks have approached the work internally in order to ensure the right skills and institutional set up, arguing that there have been a priority of economic skills. Next, I show how central banks have approached the updating of the modelling apparatus. The final section seeks to conclude.

2. Literature review and analytical framework

This paper contributes to an established literature in political economy that explores how ideas travel within central banks (Baker, 2013, 2018; Gabor, 2014; Thiemann, Melches and Ibrocevic, 2020) and international economic institutions more broadly (Helgadóttir, 2016; Clift, 2018; Ban and Patenaude, 2019; Kaya and Reay, 2019). An emerging literature shows that central banks are not as closed as they seem, with the implementation of macroprudential policies post-crisis as the latest example to how, central banks have collaborated with external actors in setting up new measurement systems for systemic risk. Thiemann *et al.* (2020, p. 18) have shown how '*a new post-crisis alliance, whereby certain topics, driven by practical and academic interests generate collaborations between academics and central bankers.*', which they then conclude '*points to an increasing openness of central bankers*' with such a form of collaboration with non-monetary economists was unthinkable prior to the financial crisis. Another example is the debates on shadow banking regulation, which was not just dominated by IO experts from the sphere of central banks (BIS, FSB, IMF), but reinforced their expertise by drawing on research from the Fed and economists at elite US universities, whilst excluding legal scholars and private sector economists (Ban, Seabrooke and Freitas, 2016). This suggests that central banks are open to ideas as long as they come from economists. Indeed, even though the implementation of macroprudential regulation after the financial crisis represented an important ideational shift in terms of how to regulators think of financial regulation (Baker, 2013), it was ultimately an economic idea, though admittedly it was from the outskirts of the field of economics.

The paper furthers this literature by honing in on a new puzzle: how likely are central banks to collaborate with external actors on non-economic issues such as climate change? This matter because the political economy literature on ideas in economic governance tends to consider ideas primarily of economic origin

(Blyth, 2002; Baker, 2013; Helgadóttir, 2016; Clift, 2018). The basic assumption is that it takes an economic idea to spread within economic institutions such as central banks. Again taking the example of the text by Thiemann et al. (2020, p. 3), the outset for their work makes the assumption to look for economists only in asking '*…which group of economists proposed what kind of measurement systemic risk…'*. This is not to say that it would have been relevant to look at non-economists in their particular example, but merely to illustrate that it is an assumption to mainly consider economic ideas presented by economists. Looking at central banks' involvement in climate-related issues and their likelihood of collaborating with climate scientists becomes an important test for whether this assumption in the literature actually holds in all fields of knowledge.

A useful concept to investigate the interaction of different fields of expertise is the concept of epistemic boundaries from the linked ecologies literature introduced by Seabrooke and Tsingou (2016) looking at the interaction of doctors, demographers and economists involved in the work on issues of infertility. They introduce the concept of epistemic boundaries to analyze the interaction amongst professionals coming from different educational backgrounds. Epistemic boundaries arise within a professional ecology *'through common educational training and knowledge practices steeped in a common episteme.'* (Seabrooke and Tsingou, 2016, p. 76). Consequently, it becomes difficult to create ties between different ecologies because professionals have a strong incentive to stay within their epistemic boundary in order to maintain networks and future career prospects, stemming from the rationale that they can risk having their expertise devalued if they go beyond their episteme. However, Seabrooke and Tsingou only explore how interaction occur between professionals *willing* to link. But it remains an open question what happens in situations where epistemic boundaries are hard, in the sense that professionals are not necessarily *willing* to link issues, or only to a certain extent? This paper suggests to take a step back and look at the conditions of which epistemic boundaries occur, which becomes particularly pertinent in this case where central bankers are faced with an idea on non-economic origin.

It is again useful to look to the literature on the implementation of macroprudential regulation after the financial crisis, where policymakers across central banks and supervisory authorities in the face of a new, untested idea (Baker, 2013), had to come up with a new *cognitive infrastructure* that could provide central banks with a measurement framework in order to avoid accountability issues (Goodhart, 2015; Thiemann, Melches and Ibrocevic, 2020). In creating this cognitive infrastructure in constructing measurements for the level of systemic risk at the national as well global level, many of the more ambitious and reformative parts of the macroprudential agenda waned out (Baker, 2018; Kranke and Yarrow, 2019; Thiemann, 2019). Even though macroprudential policies represented an important ideational shift, the implementation has been incremental at best (Baker, 2013; Johnson, Arel-Bundock and Portniaguine, 2019), whilst completely disregarding the social purpose aspect as favored by Minsky (Baker, 2018). Thus, there is a scope condition to be added for epistemic boundaries to be malleable in central banks, and that is that the ideas advocated must be economic in nature.

Tackling these gaps in the literatures on ideas in economic governance and linked ecologies, this paper argues that an important scope condition for ideas to enter central banks and for the epistemic boundaries to be malleable, the idea must be economic in nature (see figure 1). Part of this explanation is found in the particular institutional set up of central banks as independent, technocratic institutions, provided with a mandate restricted to price stability and financial stability (Lombardi and Moschella, 2016; Mabbett and Schelkle, 2019). Central banks have, in their communications at least, adhered to those institutional principles (see for instance survey by Network for Greening the Financial System, 2020). However, the response by central banks to the financial crisis, and again to the outbreak of the Covid-19 pandemic,

suggests that central banks have more leeway in the interpretation of their mandate (Goodhart, 2015; Langley and Morris, 2020; Ban, 2021), implying that this can only be part of an explanation. Adding to this explanation is a strong economic rationale amongst policymakers (Hirschman and Popp Berman, 2014), what Skovgaard (2021) describes as 'economization', a process whereby economic institutions transport climate change into the field of economics to be able to address the issue within their own routines and measures. Furthermore, it is well established in the literature that there is a firm belief in the superiority of economics attributing *'their intellectual standing and autonomy to the reliance on precisely specified and parsimonious models and measures'* (Fourcade, Ollion and Algan, 2015, p. 92). A trend that is even stronger within central banks as technocratic institutions, relying on hierarchical orthodox economic knowledge seeking to steer the economy in an almost *hydraulic* fashion (Braun, 2018) and they would therefore be likely to have this assumption. Therefore the paper hypothesizes that even in a critical case such as that of climate science, where central banks would most likely engage with non-economics expertise, they continue engage in translating that science only through filters of economic expertise familiar to and controlled by central bankers.

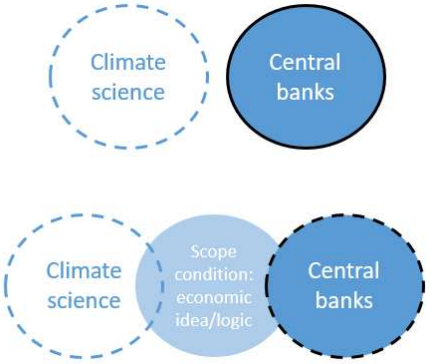

Figure 1: illustration of hard vis-à-vis malleable epistemic boundaries in central banks

3. Methods and data

In order to uncover how central bankers see climate change I draw on transcripts of interviews with central bankers who work with climate-related issues and a sample of 160 speeches retrieved from BIS. The focus of this paper is on so-called Western central banks[1] for the reason that there are widely different approaches once we go beyond this group of central banks, which would add too many variables to the analysis. I have found interviews to be suitable for understanding how central banks think of the work of dealing with climate-related issues as this has allowed me to enter into a conversation with central bankers about how they have addressed the task at hand in dealing with questions related to climate change. A method that have been used for similar purposes in other central bank studies (see for instance Johnson, 2016). I used the semi-structured interview approach in order to set up an overall structure for the interview, whilst allowing for an open and flexible discussion with the interviewee (Kvale and Brinkmann, 2008; Marta, 2021). The speeches have been used a supplement to the interviews, and I include the speeches here to investigate the overall trend in the communication coming from central banks, and not just the ones where interviews were conducted. Speeches are particularly useful to answer the stated research question, as these are occasions for the governor or board members to reflect more broadly on the issue of climate change (Harmon, 2019).

[1] Incl. the Reserve Bank of Australia, the Reserve Bank of New Zealand as well as Bank of Japan.

I have conducted a total number of 18 interviews, primarily with central bankers, but also with external stakeholders such as people working in think tanks and NGOs on this particular agenda. Five of the interviews were conducted with external stakeholders, and these have been explorative interviews, and have been conducted with the purpose of getting a new and different perspective on central banks' work with climate-related issues in preparation for the interviews with central bankers. The interviews with the five externals have not been coded. The remaining 13 interviews have been conducted with central bankers working with climate-related issues. The sampling method have been a combination of strategic sampling and snowball sampling. The interviewees selected on the basis of strategic sampling were selected because from one or more of the following criteria: they figured as contributing author to a report on climate-related issues, they worked as climate coordinator or in the team for climate-related issues, or they held public presentations on climate-related issues. The interviewees were from central banks in Western Europe: Banque de France, ECB, BoE as well as the Danish and Norwegian central banks (see table 1). The interviews were transcribed and then coded into five overall categories following an inductive approach: *economic skills, work with models, mandate, risk, climate science* (see appendix 1 for further details).

Interviewee	Organization	Time frame	No. of interviews
Junior central banker	BdF	2022	1
Principal Adviser	ECB	2021	1
Senior central banker	BdF	2021	2
Senior central banker	BdF	2021	1
Senior central banker	Nationalbanken	2020-2021	2
Former senior central banker	BoE	2021	1
Senior central banker	ECB	2021	1
Senior central banker	ECB	2022	1
Junior central banker	BdF	2021	1
Senior central banker	Norges Bank	2021	1
Senior central banker	BoE	2022	1

Table 1: overview of interviewees

The speeches used in the paper are drawn from the database of speeches from BIS, also known as the central bank of central banks (Seabrooke, 2006). Speeches are increasingly used in research on central banks and have been used for both qualitative and quantitative purposes (Bholat *et al.*, 2015; Harmon, 2019; Johnson, Arel-Bundock and Portniaguine, 2019). I have searched the BIS database for speeches on climate change in the period starting 29 September 2015, the day Mark Carney gave his speech "Breaking the Tragedy of the Horizon" that is widely considered as the first time a high-ranking central bank member publicly discussed climate-related issues, up until 31 December 2021. 5,960 speeches were given by central bank governors and board members in this period. In order to ensure coherence in the analysis of the speeches, the main topic of the speech had to be around climate change. Thus, only speeches where climate-related words[2] appeared in the title or the first paragraph are included in the sample. This totaled to 216 speeches from central bank governors and board members globally. However, given that this paper focuses on Western central banks, the sample was narrowed further down to 160 speeches. The speeches were then analyzed using a quantitative content analysis, based on a simple word frequency count in Nvivo to identify the words that occurred the most often. Based on the word count, the speeches

[2] Examples of such words are climate (change), sustainability, green, Paris Agreement, Net Zero, carbon neutrality, etc.

were coded using Nvivo's automatic coding function, after which I ran a 'matrix coding query' to see the words that occurred most often in relation to the word 'climate'. Such a quantitative content analysis have many pitfalls (see for instance Bholat *et al.*, 2015), and one has to be careful in drawing too many conclusions. However, it has been included in this paper as a robustness check of the findings from my interviews, to see if I could identify the overall patterns from in the interviews in the public communication from central banks as well. I will discuss the results of the content analysis in the next section.

4. Greening finance or financing green?

Many were surprised when Mark Carney in 2015 made the case that climate change falls under the remit of central banks. It was unexpected that such words should come from the governor of one of the world's largest central banks. Not at least because recognizing that climate change could pose a risk to the financial system represented a break with neoclassical economic thinking, which up until that point had refuted the urgency of climate change with arguments that climate change would only happen far into the future, and it would mostly affect less developed countries. With such an ideational break, and with the use of unconventional monetary policies after the outbreak of the financial crisis, the debate around the role of central banks in addressing the climate crisis only heightened (Langley and Morris, 2020). Thus at the very outset, it was far from settled whether central banks' engagement should be one of 'financing green' or 'greening finance'.

There are many avenues for central banks in turning towards 'financing green'. Svartzman et al. (2020) argue that since risks stemming from climate change is largely unhedgeable, central banks must become involved in policy coordination as a way to ensure structural change in mitigating climate change in order to fulfil their mandate of financial stability. Chenet et al. 2021 calls for forward-looking policies favoring '*precautionary but active policies that avoid large losses across scenarios regardless of the likelihood of any given scenario'* legitimizing ambitious policy interventions to protect human health and the environment (Chenet, Ryan-Collins and van Lerven, 2021, p. 7). If policymakers were to follow such a precautionary approach, the authors suggest to integrate climate risks into capital requirements, align climate risks with credit controls and credit guidance, and to integrate climate-related risks into monetary policy operations. Another tool is to make use of a 'tilting' approach for the asset purchase programs, whereby central banks can tilt their collateral frameworks and asset purchases towards low carbon assets. If the ECB followed a so-called 'medium tilt', it would have the potential to reduce carbon emissions by 55% in its portfolio without an impact of the transmission mechanism of monetary policy (Schoenmaker, 2021). In either case, it is argued that all these approaches fall within the mandate of central banks, and the mandate should therefore, in theory, not be an excuse for pursuing a strategy of financing green.

However, if we look at what central banks have actually been doing they have turned to market-correcting tools such as climate stress testing and adopting frameworks that ought to improve the disclosure of climate-related risks (Vermeulen *et al.*, 2018; Alogoskoufis *et al.*, 2021; Bank of England, 2021). Through the NGFS central banks have set out to map how climate-related risks could impact financial stability, where the NGFS have ventured on '*the process of designing a climate regulatory regime that seeks to apply the (shades of) green/dirty to the entire universe of assets… to reorient credit from dirty to green activities'* (Gabor, 2021, p. 444). These are policy tools which at best guide the markets towards green investments at a pace that is too slow in the midst of a climate crisis, and at worst induce regulated banks and insurance companies to use shadow banking as a 'spatial fix' for climate risks (Langley and Morris, 2020). One important exception is Schnabel's push for the argument that the principle of market neutrality reproduces market failures

such as climate change, and that ECB therefore needs to move away from this principle in their pursuance of their asset purchase programs (Schnabel, 2020), which have so far yielded little concrete results. In other words, central banks have come to see their main task as one turning climate change into a calculable risk framework through tools of climate stress testing and scenario analysis and thereby a focus on 'greening finance'.

This focus on 'greening finance' becomes evident with a look at central bankers speeches on green finance. The quantitative content analysis conducted for the sample of speeches confirms that when it comes to climate-related issues, the focus is largely on how to address so-called climate-related risks (see table 2). The word that is most often put in relation with 'climate' is 'risk' with the word 'financial' entering the second place. In comparison 'risk' is mentioned more than three times as often as 'green' or 'sustainability'. Since the word 'policies' figure on this list as well, it is worthwhile to look into more specifically what types of policies central banks discuss in their speeches. Climate policy is mentioned 110 times in 20 different speeches. Monetary policy, on the other hand, is mentioned 498 times across 80 different speeches, whilst financial stability is mentioned 470 times in 114 speeches.[3] Finally, fiscal policy, which were to play a role if the aim was to 'finance green', is mentioned only 22 times in eight speeches.

	A : Climate
1 : Economy	393
2 : Financial	918
3 : Green	321
4 : Market	298
5 : Need	418
6 : Policy	492
7 : Risk	1046
8 : Sector	369
9 : Sustainability	267
10 : Transition	405

Table 2: overview of words used most often in relation to 'climate'

Thus, it is clear that even though central banks would have different ways of addressing climate-related issues that could more effectively address the structural changes required, central banks have taken the strategy of greening finance through market-correcting tools. However, such a risk-based approach has severe potential pitfalls, in the sense that it is difficult to account for tail-risks (Lockwood, 2015). It can also make risks seem governable, but at the same time making them more elusive as it shifts the focus away from the relevant entity (in this case climate change) to the management of future uncertainties (Kranke and Yarrow, 2019; Scheper and Gördemann, 2022). Such issues are not entirely irrelevant given the fact that with climate change we look into a future marked by great uncertainty in the form of complex chain reactions and cascade effects (Bolton *et al.*, 2020). The next section will go on to explore how this risk-based attitude have impacted the way central banks have sought to acquire skills and knowledge on climate-related issues.

[3] Financial stability is included here as a proxy for financial sector policies that does not fall under monetary policy.

5. Skilling up on climate change

With central banks having reduced the work with climate-related issues to one of 'greening finance' through adequate risk measures, they also put climate change on par with other types of risks. As one interviewee explained, climate change was ultimately about tail risk stemming from an uncertainty in terms of policy and technological developments, and it was all a matter of how to account for this uncertainty, which is what economists usually do.[4] The task they as central bankers were faced with was to understand the economic and financial ramifications '*which is not completely unrelated to what we normally do.*'.[5] Another interviewee elaborated how it was a question of looking at factors such as taxation, public investment and capital accumulation, which '*is quite the standard*'.[6] The 'society' of the institutions weighted heavily: some interviewees described that they wanted to do more ambitious work, but were either censored by the senior management, or exercised self-censorship in order to maintain credibility inside the institution.[7] Thus, central bankers turned climate-related issues into a standard economic question that related to risk, tax as well as monetary and financial stability.

Since central bankers considered these 'traditional' topics as the main issues related to climate, they also found the most suitable way, institutionally speaking, of starting this work was to have economists to work on the issue instead of climate scientists. Since it was a matter of modelling risks, they perceived it as easier for an economist to 'skill up in climate' compared to engaging systematically with climate scientists 'skilling up' in macroeconomics and financial stability.[8] When the work with climate-related issues was reduced to a matter of risk and the impact on the macro economy, economists were also the ones who were most capable of working with the issue. As one interviewee pointed out '*eventually the depth of what you need to master is greater on the macro and financial side* [vis-à-vis climate, red.]'.[9] In fact, rather than hiring new perspectives from the outside, the main approach in central banks was to ask people who already worked within the organization to take up the work in this agenda. This had the obvious advantage that they knew the institution, the particularities of central banks and how to navigate the stakeholders, which was perceived as just as important as getting actual analytical work done.[10]

In line with this thinking, in-house expertise on the finance-climate nexus was swiftly institutionalized in internal silos. Indeed, the main approach that has been taken by the central banks is to have one person or a small group of people responsible for coordinating the work on climate within the central banks. At the BoE they set up a Climate Hub tasked coordinate the climate work within the BoE with the other units. The ECB has taken a similar approach with the establishment of the Climate Change Centre that was established with a coordinating role vis-à-vis the rest of the organization. In smaller central banks such as the Danish and Norwegian central banks one person has been assigned the coordinating effort.

In common though is that the person-in-charge in the organizations I interviewed is an insider, primarily with a background in economics, but also in law. One was asked to take up the coordinating role when returning to the central bank after two years at the IMF. While seconded, he had worked with climate change as one issue amongst others, but he did still not feel he had any particular prerequisites for taking

[4] Interview 5
[5] Interview 7
[6] Interview 2
[7] Interview 8 and 9
[8] This concept of 'skilling up' appeared during one of my interviews, and I have found it to be an illustrative metaphor for the process that has been happening in the central banks.
[9] Interview 3
[10] Interview 11

up this position. Another was hired for the role as climate coordinator coming from another central bank. With a PhD in economics, he had no prior experience working with climate. As part of the hiring process the central bank looked for climate scientists or economists with expertise in natural resources or agriculture, but it was eventually concluded that they did not have a sufficient understanding of macroeconomic issues and financial stability.[11] The head at the ECB Climate Change Centre, Irene Heemskerk, is not an economist, but has a jurist. However, she came to the ECB as a former advisor to Frank Elderson, then chair of the NGFS and now Executive Board Member at the ECB, and therefore counts as an insider as well. Making climate 'mainstream' internally in the organization was a particularly difficult and at times toxic topic, and thus the idea was to have people who were used to the jargon and the way of working in central banks. Especially when presenting these issues to senior management.[12]

Starting to work with climate-related issues as central bank insiders there was a recognition they did not have the expertise nor the capacity to deal with this issue. At the outset, they followed a two-pronged strategy. First, acquainting themselves with the literature they all found the best and most obvious place to start was the IPCC reports, which they thought of as well-established and trust worthy expert knowledge. Other sources included reports from IEA and sources such as the well-established journal *Nature*. Acknowledging they had lacked the same kind expertise in climate science like they enjoyed in economics to deem what was 'good science', they started with the IPCC reports. This stemmed from the rationale that it consisted of a broad range of well-established scholars, who would not be part of the IPCC if they did not have a good reputation. Given that IPCC scientists are considered as well-established they are also seen as the *'least controversial'* experts,[13] and thereby a safe choice for the prudent central banks.

The second strategy was to have direct, yet unsystematic, interactions with climate scientists. This was a way for them to internalize external expertise and familiarize themselves with the topic. However, not knowing what makes 'good climate science', the first relevant question to ask here, is how central bankers decided who to collaborate with? Again, the IPCC plays a key role. In the answer to who to collaborate with, central bankers followed the same logic. Lacking the expertise within the organization, they went for the trusted and established expert knowledge and reached out to climate scientists who had worked on the IPCC reports, which freed them from the dilemma of evaluating what makes a good climate scientist. The 'renowned' and 'famous' IPCC scholars became the starting point for the collaboration stemming from the rationale that *'if everyone thought they were fundamentally wrong in what they were doing, they would not have that reputation.'*.[14] They then expanded their network from there, again to make sure that they got skilled up through external collaboration.

The central banks had different strategies for the external collaboration with climate scientists. Some climate scientists were invited for a single meeting or to give a single presentation to inform on a very specific phenomenon or question in terms of what kind of things they needed to think about or account for in their work, or to get access to a specific kind of data. One explained that as they ventured into the work with climate-related issues they held one meeting at a time with different climate scientists to be able to understand how climate change unfolds on the short term. They found that in order to be able to assess how climate-related risks unfold they needed to understand not just what the world would look like in 2050 or 2100, but what would happen on the way there. And so, the approach was to go from one

[11] To preserve the anonymity of the interviewees I have made no reference to the interviewees here.
[12] Interview 3 and 11. See also Ban, Freitas and Seabrooke (2016) for the role of jurists in financial regulation post-crisis.
[13] Interview 1
[14] Interview 11

connection to the other '*until the marginal cost of one meeting was greater than the marginal benefit*'.[15] Another explained how it was useful to have climate scientists to come in and give a presentation on a very specific phenomenon such as particular physical risks and outlining trigger points. The aim with such presentations was to talk senior people through the key issues on climate change, but they could not venture into longer-term collaborations as they were not able to quantify how it would affect the economy.[16]

The other approach was to try to establish more long-term relationships with climate scientists. This was also an active strategy at the outset. But the central bankers found it was hard with the long-term relationships, because the climate scientists found it difficult to understand the work they were doing. The feeling was that climate scientists were focusing on the bleak long-term picture to prompt action by governments, whereas the central banks needed knowledge on the 'short-term', i.e. 10 to 30 years.[17] The long-term collaborations that central banks deemed most valuable were with people who had a background in climate and finance:

> *If you take a pure climate scientists, they don't understand central banking. They don't understand economics, so it's actually quite hard to get them to tell us exactly the right things. So you sort of have to get the people who work at the cross roads of the knowledge we need, who can tap into the economics and finance side but still have the climate background.*[18]

Thus, there was a feeling that climate scientists did not understand economics and the particularities of central banking and it was therefore difficult to establish a longer-term relationship with climate scientists.[19]

Hence, there appears to be a firm belief in the economic logic of reasoning, suggesting a hierarchy of sciences within central banks where economics stands other types of sciences, even in cases where they are dealing with issues that are not purely economic. The emphasis on economic 'skills' over climate science 'skills' as well as the limited inclusion of climate scientists which only happened at the outset, suggests hard epistemic boundaries within central banks and which only becomes malleable to the extent that the issue can be dealt with through an economic logic of reasoning. This is even more evident when we look at how central bankers have approached the work of adapting the modeling framework.

6. New uncertainties, new modeling approaches?

As part of adopting the work in central banks to climate-related issues, a large part of the resources invested in the work have gone into the development of models that can tell about the impact of physical and transition risk on the macro economy and financial stability. In order to better account for climate-related risks these had to be reflected *'in the central bank workhorse models to account for their interactions with other, more standard risks within the usual monetary policy horizon'* (Drudi *et al.*, 2021, p. 67). In other words,

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[15] Interview 3
[16] Interview 11
[17] This might be short term for a climate scientist, but what is interesting here is that 10 to 30 years is actually way beyond the time horizon for traditional macroeconomic forecasting, which typically looks at 2 years, at the outermost 5-10 years.
[18] Interview 11
[19] The exception here is the latest developments at the ECB who put up a job posting for a new position as climate scientist at the Climate Change Centre, with the explicit requirement to have a background in natural sciences (https://talent.ecb.europa.eu/careers/JobDetail/Climate-Scientist-Climate-Change-Centre/4589, accessed 10/3/22) to get science in house and to have the network to bring in relevant competencies from the outside (Interview IH). The climate scientist had not been hired as I conducted my interviews, and at the time of writing it is too soon to tell what impact this will have.

central banks have set themselves on the task of setting up a *cognitive infrastructure* to be able to work with climate-related issues. The problem, however, was that there was no preexisting model that could account for both. Similar to the work on macroprudential regulation a lot of time and energy have been devoted in the central banks to update and accommodate the modelling framework (Kranke and Yarrow, 2019; Thiemann, Melches and Ibrocevic, 2020). First, they are seeking to adopt their traditional macroeconomic models that deal with inflation, growth, technological developments and so on so forth to include climate-related issues. Second, work is undergoing in terms of developing scenarios used to predict future mitigation and adaptation pathways, stemming from the realization that backward looking data cannot be used when it comes to climate-related issues (Bolton *et al.*, 2020).

The work on adapting the existing macroeconomic modelling framework aimed at combining existing macroeconomic models with climate models. This is work-in-progress within the central banks, where the method is to look through the existing modelling framework and thereby *'rebuild new models that are fit for macroeconomics at the time of climate change'*.[20] This however, proves to be quite challenging, since there is a 'disconnect' between climate models and macroeconomic models (Drudi *et al.*, 2021), patching together *'two things that are not meant to be patched together'*.[21] A first issue pertains to the time horizon, where the traditional horizon for central bank forecasting is 2-5 years. When it comes to climate change modelers in the central banks are now forced into experimenting with how to incorporate much longer time horizons and look into decades and not years. This poses a challenge not just to the modelling exercise, but also because the long time perspective opens up to other types of discussions which can be hard to justify in terms of the remits of central banks:

> *I think this is a difficulty and something we have been grappling with internally which is once you bring into the prudential toolkit a 10 year horizon, why only climate? Why don't we talk about other things such as pandemics, wars, digitalization, or demographic change?* [22]

A second issue relates to the level of complexity. Knowing that not one model can include all factors and variables, it is unclear how best to approach this. Central bankers run experiments with different existing models such as DSGE models that is traditionally used in central banks (see Helgadóttir, 2021 for further explanation) but is weak on the climate components. An alternative model is the newer G-Cube model which is more rich on the climate-economy-finance nexus, but which in turn is too broad brushed: *as you know, any model has to be a simplification of a complex reality, otherwise you're asking, like in the 1970s, for these massive models that are meant to explain everything, but they are subject to the Lucas critique*.[23] Thus, economists within the central banks work within the epistemic boundaries, as the modelling need to follow that of economic reasoning, while being careful in not opening up for other avenues for discussion, knowing that they are trying to 'patch together' different modeling approaches. Henceforth, there is not and acceptance of the fact that working with climate-related issues might require a more multifaceted modelling framework as it seeks to depict a complex reality.

At the NGFS the focus has been to develop so-called scenario analysis. Scenario analysis is a way to explore the financial impact of different possible outcomes for climate change and climate policies under different timeframes (Network for Greening the Financial System, 2019, p. 21) allowing to account for the *multiplicity of climate change outcomes* in a given realization of the future (Chenet, Ryan-Collins and van

[20] Interview 3
[21] Interview 3
[22] Interview 7 and 1
[23] Interview 7

Lerven, 2021). The turn to scenario analysis represents an important break with the reliance on historical, backward looking data stemming from the realization of *'the uncertain and forward-looking nature of climate-related risks'* (Bolton *et al.*, 2020, p. 21). The development of scenario analysis is interesting because this is where the work with climate-related issues is most pertinent. The design of the scenario analysis implies that central banks through the work of the NGFS have developed an analytical framework that account for possible climate futures taking into consideration possible transition pathways, climate policies as well as changes in climate, weather conditions and natural catastrophes.

In designing these scenarios it was quickly agreed within the NGFS to come up with a common framework that could be used by all members. Within NGFS it was decided that the task needed to be outsourced to external organizations, and NGFS received a grant from Bloomberg Philanthropies and ClimateWorks Foundation to develop this work. Following the same approach as that of 'skilling up' they again looked to the IPCC and chose to work with a specific group of modelers known for their work on Integrated Assessment Models (IAMs). NGFS chose this group of modelers because they were most widely used by the IPCC and therefore considered as the 'least controversial' group of scientists and type of model.[24] However, this type of models also have a tendency to rule out radical uncertainty in terms physical and transition risks (Svartzman *et al.*, 2021). NGFS thereby outsourced the work on designing scenarios to three external organizations: PIK, IIASA and GCAM[25] with the goal of developing *'a more detailed data-driven narrative and quantitative parameters as a foundation to these scenarios.'* (Network for Greening the Financial System, 2019, p. 21). What is interesting to note here is the emphasis on data-driven and quantitative parameters, which is often used to legitimize and justify interventions (Thiemann, Melches and Ibrocevic, 2020).

The process however, saw little direct involvement from the central banks. The central bankers in the NGFS secretariat acknowledged they did not have a sufficient level of knowledge in terms of engaging in detailed discussions on climate. As a result, discussions were kept at a more general level, for instance in terms of the extent to which the IAMs relied on carbon capture technology.[26] The discussions of the scenarios within the central banking community have also been limited to one of ensuring an ever higher level of granularity in terms of sectors and geographical distribution (Alogoskoufis *et al.*, 2021).[27] The current focus of the NGFS consortium is to refine the scenarios by *'adding further sectoral granularity'* (Network for Greening the Financial System, 2021, p. 45). Indeed the aim is to have granular data that can show how the risks unfold geographically, at different times and under different climate change scenarios.[28] The logic is that granularity is key in order to be able to assess how the green transition affects the different parts of the economy as well as the different regions of an economy, ultimately down to the individual firm to be able to identify the financial exposures.[29] Thus, the discussion around scenario analysis has been reduced to one of access to data, which frees the involved economists for discussions around climate-related issues to which they are alien.

Taken together, the work with adapting the existing modelling framework and the development of new forward-looking scenarios demonstrate how the work with climate-related issues became subject to an

[24] Interview 1
[25] The interviewee explained that the GCAM goes under the name of the model (GCAM) and not the institutional affiliation (like PIK and IIASA). GCAM is developed by the Pacific Northwest National Laboratory based at the University of Maryland.
[26] Interview 1
[27] Interview 1 and 10
[28] Interview 5
[29] Participant observation at Green Finance Research Advances in Paris, December 2021.

economic logic of reasoning with an emphasis on quantification and data access, previously shown in the literature to legitimize intervention (Thiemann, Melches and Ibrocevic, 2020; Skovgaard, 2021). It ensured that central banks could address climate-related issues with the tools already part of their existing toolbox such as stress testing, while at the same time avoiding to decide on *'the right policy mix',*[30] and dealing with the '*important trade-off between climate action and inequality*'.[31] Scenario analysis come in particularly handy here, as it is a way for the central banks to show what *can* happen and demonstrate the worst case scenarios without having to argue which way is the better way to deal with such circumstances.[32]

Even though the design of the scenarios has involved external climate expertise, it ultimately represents an economic idea of stress testing that has been widely used since the financial crisis. The work was commissioned by central banks stemming from the reasoning that revealing the risk level will incentivize the financial system to accommodate accordingly, when the urgency of climate change calls for much more drastic measures (Christophers, 2017; Chenet, Ryan-Collins and van Lerven, 2021). In short, the perfect tool for depoliticizing the discussion around climate-related issues (Stahl, 2021). Instead of acknowledging the fact that the economy is embedded in the environment which calls for an entirely new approach to modelling, which embraces complexity and the use of non-equilibrium models (Svartzman *et al.*, 2021), the work with models and scenario analysis has become subject to a simplification of reality, because this is the reasoning behind economists' way of modeling.

7. Conclusion

This paper presents a case of how central banks deal with non-economic issues such as climate change, and how they deal with such an issue with no previous experience or prerequisites. I find that central banks claim institutional expertise on such a matter by making climate change subject to an economics logic, more particularly one about risk, which means that they can deal with these issues using the skills and tools they traditionally make use of. At the same time, central bankers have outsourced the parts of the work that required core climate science competencies to external actors (the development of scenario analysis), choosing the 'least controversial' type of model, acknowledging that they had little expertise to call judgement in this matter. Thus, central banks have outsourced all the climate aspects of climate-related issues, to make sure that they only have to deal with the risk aspects which fall under their competencies. However, this is not without consequences. These so-called IAMs are ill fit for capturing tail risks (Svartzman *et al.*, 2021), which is quite a paradox as this is exactly the purpose of stress tests. In fact, it is openly spoken of that some of these models are too optimistic, but modelers use it anyhow because this is the one used by NGFS.[33]

These findings suggests that there are hard epistemic boundaries within central banks, where central banks are only susceptible to new ideas when they are presented as being economic in nature. This is evident in the predominance of the idea of climate-related *risks*, the insistence that it requires economic training to deal with such issues, as well as the way central bankers seek to adapt their existing modelling framework to address this particular new type of risk. I thereby show how there is a strong hierarchy of sciences within central banks, with an economic science ethos being at the very top, dominating to such an extent that it is considered second to none even in the case where central banks are dealing with an issue of non-economic character. Thus, I have argued in this paper how central banks are only open to

[30] Interview 11
[31] Interview 7. This is also important since it is a bit of a paradox since research have shown that QE increases inequality (references).
[32] Interview 1
[33] Participant observation at Green Finance Research Advances seminar in Paris, December 2021.

external ideas to the extent that ideas are presented by economists, and represent an economic logic, adding this as a scope condition to the existing literature for ideas to travel within central banks.

It is beyond the scope of this paper to determine what led to this focus on climate as a risk issue in the first place. I have only argued here that there is a predominant economic science ethos, which leads to a very particular way of dealing with non-economic issues in central banks. It is left for future research to discuss whether the risk framing occurred as a result of central banks' mandate or simply because this is what they can do within central banks in terms of skills. Such research would resemble a discussion of the chicken or the egg, but it would nevertheless be important for further advancements in the literature around central banks. I have also disregarded the emerging, nevertheless important, emerging discussion on issues related to biodiversity in central banks. I leave it to future research to explore whether the emphasis on economic reasoning that is outlined in this paper would also hold in the case of biodiversity. A final important limitation of this paper is that it only focuses on so-called Western central banks, pointing to the ironic observation that the title of this paper is somewhat overstated, as it only seeks to uncover how Western central banks see climate change. Research conducted on Peoples Bank of China suggests PBoC has taken a different approach with a focus on green bonds and credit guidance (Dikau and Volz, 2021), and thus there is more potential to discover this 'seeing like' approach in full. What this paper has done is to show that for an idea to enter a Western central bank it most take the form of an economic idea, and whether the same holds for central banks in other parts of the world remains to be explored.

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Appendix 1

Overview of coding scheme

Code	Subcode
Work with models	Scenario analysis
	IAMs
Risk	Physical risks
	Transition risks
Prefers economic skills	
Climate skills	
Mandate	Climate is for democratically elected governments
	Financial stability
	Price stability