CENTRAL BANKS AND CLIMATE CHANGE (PART 2). CAN CENTRAL BANKS INTERVENE NOW? AND HOW? ARGUMENTS OF "OPPORTUNITY" AND "SUITABILITY"*

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ABSTRACT

Climate change is humanity's defining challenge for the twenty-first century. Central banks have for a long time been absent from the regulatory picture, but today, this is no longer the case. Having showed in Part 1 that climate change considerations fit within central banks' mandates, this Part 2 now analyzes why central banks can and should act now (opportunity), and then how they should act (suitability). Central banks should act now not only because the cost of waiting is too high, but also because complex models show that climate-related shocks would propagate through a networked financial system, rendering central banks powerless to act. In fact, careful consideration of the argument of opportunity makes it pertinent to ask why central banks did not act earlier. We offer two explanations; one based on the role of uncertainty and ambiguity aversion, and another on the role of slowly changing social norms. Then, we consider how the arguments for and against a proactive approach could play before the courts in the situation where central banks actions are challenged. Then, we show that the current debate on "suitability" is full of misunderstandings. Objections that central banks are "unsuitable" tend to ignore that central banks do not have "one tool", but rather a vast arsenal of tools, and that the risks of endangering "market neutrality" or "independence" should be analyzed in case of both action and inaction. Upon closer consideration, central banks are not asked to exercise new competences or skills, or to upend their mindset, but rather to deploy some of their tools in

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a precise and time-consistent manner. There are obstacles, of course. Central banks are uncomfortable mixing "assertion" and "persuasion"; negative, "brown" approaches may be more effective, but more conflictual. Living with conflict, and trial-and-error may be a given to execute their mandate well in this new setting, but it is a challenge nonetheless.

To overcome it, we need a renewed commitment to central bank independence, but also a gradual change in central bank practices to foster dialogue with democratically elected bodies. This two-pronged approach will place central banks in an adequate role for the twenty-first century, and bolster their legitimacy, and courts should act as gatekeepers.

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INTRODUCTION.

Climate change is humanity's defining challenge for the twenty-first century, and, after a long absence, central banks are beginning to be present in the picture. Part 1 of this article series showed that climate change considerations fit within central banks' mandates.[1] In Part 2 we analyze why central banks can and should act now (i.e., "opportunity"), and how they should act ("suitability").

I. INTERVENING NOW? ARGUMENTS OF "OPPORTUNITY", AND THE TIME HORIZON OF MONETARY POLICY.

The previous Part 1 of this two-part series has shown that the fight against climate change fits within central banks' core mandate of pursuing price stability, and also within their "peripheral" objectives.[2] This justification provides a strong reason to integrate climate change within central banks' policies. However, like St. Augustine's words "God, make me chaste, but not yet,"[3] a second objection could be that central banks may have to integrate climate change in their policies, just *not now* or not until there is more available information. In our view, this reasoning is flawed (*infra* section 3.1.) Furthermore, there is ample legal support for being proactive, even in the face of uncertainty (*infra* section 3.2.)

3.1. Why Now And Not Later? And Why Not Earlier? The Flaws Of "Wait And See."

The argument in favor of "wait and see" is that authorities should not act unless they have more clarity about the consequences of climate change. This is a problem of fundamental uncertainty. However, the challenges of uncertainty are, in our view, outweighed by the catastrophic nature and irreversibility of the harm and the implications of network theory for the propagation of climate shocks through the financial system. All of these suggest a proactive approach (*infra* section 3.1.1.) In light of this problem, the real question is why we have not seen bank action earlier, which may obey less to the nature of central banks' mandates than to the logic of ambiguity/uncertainty aversion (*infra* section 3.1.2.) and to the slow-changing process of social norms (*infra* section 3.1.3.)

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[1] David Ramos, et al., *Climate Change and Central Banks (Part 1). Does Climate Change "Fit" within Central Banks' Mandate?*, 6 BUS. & FIN. L. REV. 213 (2023) [hereinafter, Ramos et al, *Climate Change and Central Banks (Part 1)*].
[2] *Id*.
[3] ST. AUGUSTINE, CONFESSIONS BOOK VIII, CHAPTER VII (Maria Bolding trans., New City Press 1997) (397–400 AD) ("*da mihi castitatiem et continentam, sed noli modo"*).

3.1.1. Why Now And Not Later? The Case For Proactivity: Irreversibility, Connectivity And Network Externalities.

Arguments of opportunity are shaped by several challenges. First, climate change's causes are cumulative, and its consequences long-term. This is a problem since human beings are "present biased"[4] or "hyperbolic discounters",[5] including over climate change policy.[6] Second, there are large uncertainties on climate change's effects, and humans' ability to mitigate them.[7] Thus, the case for proactivity must be justified.

The first, obvious reason for a proactive approach is that the cost of waiting or delaying action is extremely high, as overwhelmingly as shown by scientific evidence.[8] As authorities decide whether and when to act, greenhouse gases (hereinafter "GHGs") accumulate and create irreversible effects,[9] making risks asymmetric and strengthening the case for a proactive approach. A recent study makes this quantitatively very clear: a policy (e.g., a carbon tax) that turns out to be overly pessimistic is much less costly than an overly optimistic one.[10] The key is not on the policy but on a decision based on costs and benefits. If climate change affects central bank objectives,[11] the decision of when to act should be influenced by weighing the costs and risks of intervening against the costs and risks of not doing so. Even if we later consider possible constraints, the prima facie case against waiting is overwhelming.

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[4] Ted O'Donoghue & Matthew Rabin, *Present Bias: Lessons Learned and to be Learned*, 105 AM. ECON. REV. 273, 273 (2015).

[5] Jess Benhabib, et al., *Present-Bias, Quasi-Hyperbolic Discounting, and Fixed Costs*, 69 GAMES & ECON. BEHAV. 205, 205 (2009); this has implications for all sorts of problems, such as a tendency to under save for retirement. See, e.g., Diamond, Peter & Botond Köszegi. *Quasi-Hyperbolic Discounting and Retirement*, 87 J. PUB. ECON. 1839, 1840 (2003).

[6] Partha Dasgupta, *Discounting Climate Change*, 37 J. RISK & UNCERTAINTY 141, 161 n.32 (2008).

[7] John Reilly, et al., *Uncertainty and Climate Change Assessments*, 293 SCI. 430 (2001); Geoffrey Heal & Bengt Kriström, *Uncertainty and Climate Change*, 22 ENV'T & RES. ECON. 3, 3 (2002).

[8] Michael Jakob, et al., *Time to Act Now? Assessing the Costs of Delaying Climate Measures and Benefits of Early Action*, 114 CLIMATIC CHANGE 79, 79 (2012); Julien Beccherle & Jean Tirole, *Regional Initiatives and the Cost of Delaying Binding Climate Change Agreements*, 95 J. PUB. ECON. 1339, 1339 (2011); Joeri Rogelj, et al., *Probabilistic Cost Estimates for Climate Change Mitigation*, 493 NATURE 79, 79 (2013).

[9] Cass R. Sunstein, *Irreparability as Irreversibility*, 2017 SUP. CT. REV. 93 (2018) [hereinafter: Sunstein, *Irreparability as Irreversibility*]; Cass R. Sunstein, *On Irreversible Harm (with Special Reference to Climate Change), in* RATIONALITY, DEMOCRACY, AND JUSTICE: THE LEGACY OF JON ELSTER 59 (Claudio Lopez-Guerra & Julia Maskivker eds., 2015).

[10] John Hassler, et al., *On the Effectiveness of Climate Policies* 1 (IIES Working Paper, 2020) (available at https://www.bde.es/f/webpi/SES/seminars/2020/Fich/sie20200226.pdf) ("We first compare policies that have the right design–global carbon taxes–but the wrong magnitude: a tax that is set based on worries about climate change that ex post turn out to be overly pessimistic and a tax based on the reverse mistake (an optimistic view that turns out to vastly understate the climate challenge ex post). We find a sharp asymmetry: the former is not very costly at all to human welfare whereas the latter is very costly.").

[11] *See generally* David Ramos et al. *Climate Change and Central Banks (Part 1)*, *supra* note 1.

However, there is a second, less obvious reason for swift action on climate-related exposures. If we go back to the debates on central banks and asset bubbles,[12] former advocates of a reactive ("clean" v. "lean") approach who later changed their views, like economist Frederic S. Mishkin, still argued that the key was less in asset bubbles than in leverage. Leverage was what created financial frictions and amplified shocks, which messed with the transmission mechanism and made monetary policy hard to implement.[13]

In our view, the best candidate to be the "new leverage" is network connectivity. Put another way, the financial system's complex network structure may compound climate-related shocks, making them less predictable and manageable.[14] As acknowledged by the Network for Greening the Financial System ("NGFS"), there are two possible scenarios relevant to a climate-risk assessment of portfolios: an *orderly* transition, with early introduction of climate policies leading to predictability of risks and their proper pricing by financial markets, and a *disorderly* one, in which climate impacts are not anticipated by investors.[15] In the orderly transition, firms and investors have time to adapt. In the disorderly one, shocks can lead to market and societal instabilities due to the deeply interconnected structure of the financial system.[16] Indeed, financial institutions have created a web of interactions whose size and topology are of such complexity that quantitative methods, chiefly those from physics,[17] are needed to study it.

The complex structure of the financial system is associated with highly complex dynamics as well. In the last decade, it has become increasingly clear that the consequences of such dynamics are very

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[12] *Id.* at 225.
[13] Frederic S. Mishkin, *How Should Central Banks Respond to Asset-Price Bubbles? The 'Lean' Versus 'Clean' Debate After the GFC*, RSRV. BANK OF AUSTL. BULL. 59 (2011); *see also* Frederic S. Miskin, *Monetary Policy Strategy: Lessons From the Crisis* 1 (Nat'l Bureau of Econ. Rsch., Working Paper No. 16755, 2011).
[14] The literature on networks and financial contagion is vast. *See* Franklin Allen & Douglas Gale, *Financial Contagion*, 108 J. POL. ECON. 1 (2000); Xavier Freixas, Bruno M. Parigi & Jean-Charles Rochet, *Systemic Risk, Interbank Relations, and Liquidity Provision by the Central Bank*, 32 J. MONEY, CREDIT & BANKING 611, 611–12 (2000); Franklin Allen & Ana Babus, *Networks in Finance*, *in* THE NETWORK CHALLENGE: STRATEGY, PROFIT, AND RISK IN AN INTERLINKED WORLD 367, 370 (Paul R. Kleindorfer & Yoram Wind eds., 2009); Franklin Allen et al., *Financial Connections and Systemic Risk* (Nat'l Bureau of Econ. Rsch., Working Paper No. 16177, 2011). For approaches that have common aspects with ours, see Daron Acemoglu, Asuman Ozdaglar & Alireza Tahbaz-Salehi, *Systemic Risk and Stability in Financial Networks*, 105 AM. ECON. REV. 564 (2015); Matthew Elliott, Benjamin Golub & Matthew O. Jackson, *Financial Networks and Contagion*, 104 AM. ECON. REV. 3115 (2014).
[15] *Guide for Supervisors Integrating Climate-Related* and *Environmental Risks Into Prudential Supervision*, NETWORK FOR GREENING THE FIN. SYS. (May 27, 2020), https://www.ngfs.net/en/guide-supervisors-integrating-climate-related-and-environmental-risks-prudential-supervision; see *also* Stefano Battiston, et al., *Accounting for Finance is Key for Climate Mitigation Pathways*, 372 SCI. MAG. 918 (2021).
[16] NETWORK FOR GREENING THE FIN. SYS., *supra* note 14.
[17] Marco Bardoscia et al., *The Physics of Financial Networks*, 3 NAT. REV. PHYS. 490, 490 (2021).

important. As shocks hit the system, current financial links between firms and/or investors might break while at the same time new ones arise. This, in turn, changes the way the shocks propagate on the network. Only a proper understanding of the feedback loop between network topology and the stability of the financial system will allow a proper assessment of risks.[18]

Crucially, these feedback loops mean that the system may seem in "equilibrium" while being on the verge of collapse. For example, Squartini, et al. studied quarterly interbank exposures among Dutch banks over the period 1998–2008. Their work showed that the topology of the network suffers major structural changes at the onset of a crisis, but also that there are "precursors" of structural change or early-warning signals of an impending crisis.[19] Yet, those signals may be undetectable from reconstructions of the networks based on partial bank-specific data, as is generally done. Therefore, we could be on the verge of a serious shock arising from network reconfigurations driven by investors taking positions to face climate change risks and be completely unaware of it. The following reinforces the case for action:

> To better understand this issue, we rely on a model to study the contract externalities that may warrant an intervention that impacts the shape of financial networks. Specifically, we consider a financial network with borrowers and investors. The borrowers need the support of an investor to take to fruition a risky opportunity. The investors provide the capital to the borrowers, as well as insurance and hedging opportunities to one another. As a result, investors enjoy direct and indirect benefits from linking with one another. Borrowers, on the other hand, benefit from having a connection with an investor, which provides them with the opportunity to realize gains. However, there is a cost to both direct and indirect connections, as they can create a chain of financial shocks and defaults if their investment fails to deliver. The key assumption we will make is that contracting is bilateral, so that a borrower can compensate her investor for the possible direct harm inflicted, but indirect connections do not get a compensation.[20]

[18] Co-Pierre Georg, *The Effect of the Interbank Network Structure on Contagion and Common Shocks*, 37 J. BANKING & FIN. 2216, 2217, 2228 (2013).
[19] Tiziano Squartini, et al., *Early-Warning Signals of Topological Collapse in Interbank Networks*, 3 SCI. REPS. 1, 1–4 (2013).
[20] Antonio Cabrales et al., *Network Formation and Heterogeneous Risks* 2 (Eur. Comm'n, Working Paper No. 891124, 2022).

Furthermore, a key aspect is that networks in equilibrium may not be efficient, or socially optimal.[21] Both equilibrium and efficient networks have a core-periphery structure, with a group of centrally located institutions completely interconnected between themselves ("investors") and a group of (typically smaller) banks ("borrowers") that connect to only one (or few) of the core banks.[22] This is typical of real-life interbank markets,[23] which also exhibit certain banks' systematic behavior as consistent borrowers or lenders (investors),[24] with investors also having links between themselves.[25]

In our model, efficient networks form minimally connected components that are symmetric (i.e., all having the same size), with borrowers attached to a single investor and each investor having few (or no) borrowers attached.[26] *Equilibrium* networks, on the other hand, are different, with all investors having the same number of borrowers connected to them and all components are minimally connected trees.[27] In addition, all components, except at most one, have the same number of investors.[28] The implications for the relationship between efficiency and equilibrium is that there is a non-internalized negative contracting externality. Investors contract with too many borrowers because they do not take into account the effects on other investors and borrowers in the component.[29] Thus, joining a component is less profitable for an investor, the components' size is smaller than optimal, and the number of borrowers per investor in equilibrium is also larger than the social optimum.

If connectivity in equilibrium is not optimal because each investor downplays the effects of shocks in borrowers, large (e.g., climate-related) shocks may result in widespread contagion in a way that would hinder central banks' ability to stabilize the situation, such as by affecting the transmission mechanism.[30] This provides a strong rationale for proactive action that avoids large climate-related shocks in the first place.

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[21] Our insights result from the model developed by one of the authors of this paper, with several other co-authors. See Antonio Cabrales, Piero Gottardi & Fernando Vega-Redondo, *Risk-Sharing and Contagion in Networks*, 30 REV. FIN. STUDIES 3086, 3086, 3089 (2017) [hereinafter: Cabrales et al., *Risk-Sharing & Contagion in Networks*]. We refer to this as "our model."

[22] *Id.* at 3115.

[23] For the Netherlands, see Daan't Veld & Iman van Lelyveld, *Finding the Core: Network Structure in Interbank Markets*, 49 J. BANKING & FIN. 27, 36 (2014). For Germany, see Ben Craig & Goetz von Peter, *Interbank Tiering and Money Center Banks*, 23 J. FIN. INTERMEDIATION 322, 323 (2014).

[24] Ben Craig & Yiming Ma, *Intermediation in the Interbank Lending Market* 8 (Fed. Rsrv. Bank of Cleveland, Working Paper No. 20-09, 2020).

[25] *Id.* at Figure 1.

[26] This is because the costs are borne by all the investors of the component, and it is efficient to limit the number of investors in a component to avoid those costs. *See* Cabrales et al., *Risk Sharing and Contagion in Networks*, *supra* note 21, at 3107.

[27] *Id.* at 3088–89.

[28] The remaining component being strictly smaller. *See id.* at 3088–89.

[29] *Id.*

[30] *Id.* at 3086.

The model's extensions reinforce this view. First, if we account for *heterogenous* borrowers (e.g., "brown" and "green" firms), "brown" firms with higher social costs have far more links in equilibrium than is socially optimal.[31] Heterogeneity thus increases equilibrium inefficiency.[32] Second, if we account for investors' differences in private "linkage costs" when the information about investor types is public, there is assortative matching among investors. These include high-cost types forming "closed components," consisting only of low-types, so as to avoid suffering the costs of "excessively" connected high-types.[33] However, if the information about investor types is private (investors do not know the type of other investors with whom they match and thus expect the population average), the low-cost investors desire even more connections with other investors than they would with public information. This is because they know that they may get connected to some high-cost investors who have few connections and thus carry lower externalities. The opposite happens with the high-cost types. Nevertheless, the effect of incomplete information is to reduce total connectivity, as the low-types reduce their connection by more than the high-types increase. In this case we find less connectivity as a result of asymmetric information (à la Akerlof's model), but now the reason is not the inefficient agents' lower trade, but rather the ones creating more externalities.[34] This result is very important in our context because we currently suffer from opacity (asymmetric information) about the riskiness of the different firms because of their exposure to climate induced energy transition.

This result resonates with the emphasis of Acemoglu et al. on the anticipation of shocks as a way to generate market freezes.[35] However, unlike in their case, in our model it arises because of heterogeneities in the propensity of different actors to be stricken by shocks. Our view is consistent with the evidence that market freezes in the Eurosystem where considerably heterogeneous and did not affect all institutions equally.[36]

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[31] In an extension for heterogeneous borrowers, a type of borrower (type 1) has lower direct cost and a bigger cost on the indirect connections than the other (type 2), and type 1 borrower has a higher private benefit to its directly linked investor and a higher social cost for everyone else than type 2. Think of type 1 firms as "brown" firms that are heavier emitters of greenhouse gases, and type 2 as "green" firms that significantly lower emissions. We show that in equilibrium each investor has more type 1 than type 2 connections. The efficient solution has the exact opposite, every investor should have more type 2 than type 1 connections. *See generally* Cabrales et al., *Risk Sharing and Contagion in Networks*, *supra* note 21, at 3086.

[32] Thus, the rationale for addressing the risks of "brown" firms is much more serious than in a standard context. *See id.* at 3088–89.

[33] The low-cost types prefer to have more borrowers attached to them, and the high-cost types prefer less borrowers. *See id.* at 3113–14.

[34] *See* George A. Akerlof, *The Market for "Lemons": Quality Uncertainty and the Market Mechanism*, 84 Q. J. ECON. 488, 490–91 (1970).

[35] Daron Acemoglu et al., *Systemic Credit Freezes in Financial Lending Networks*, 15 MATHEMATICS & FIN. ECON. 185, 187 (2021).

[36] Silvia Gabriell & Co-Pierre Georg, *A Network View on Interbank Market Freezes* 18 (Deutsche Bundesbank Working Paper No. 44, 2014).

The conclusions are relevant and nuanced. Central banks and financial regulators could try to tinker with the network structure to minimize the impact of climate-related shocks. However, all studies suggest (i) that networks are inevitable, (ii) that connectivity is something that public authorities can control only to a certain extent, (iii) that a better understanding of network dynamics would be needed to do so, and (iv) that even with better understanding, networks are a complex science phenomenon subject to non-linearities and feedback loops. Thus, even if networks share with "leverage" their susceptibility to amplify shocks, that does not mean that the optimal response should be the same. Rather, it seems that, notwithstanding their attempts to understand network dynamics better, central banks and financial authorities should react to complexity by trying to avoid the shock from happening in the first place. This, in turn, is linked to attitudes to uncertainty or ambiguity.

3.1.2. Why Now And Not Earlier? (Alternative Explanations For Passivity) (I): The Role Of Ambiguity Aversion.

There is no doubt that the world will warm considerably in the next century, with or without abatement efforts, but the warming will be far larger without abatement. However, there is very large uncertainty on the precise magnitudes and process[37] and decision-makers do not know or cannot agree on: (i) the system models, (ii) the prior probability distributions for inputs to the system model(s) and their interdependencies, and/or (iii) the value system(s) used to rank alternatives.[38] On top of that, as previously shown, the financial sector and its links is a clear example of a complex system where large shocks can be easily amplified by the pattern of connections. But, this pattern also adds uncertainty about the final outcome.

In light of all this, we could look at central banks' "wait and see" strategy on climate change as "ambiguity aversion."[39] Far from a mere theoretical possibility, studies in the specific field of climate change have suggested that policymakers indeed are ambiguity averse.[40] Even if we do not extrapolate the conclusions on policymakers in general to central bankers,[41] bankers have to deal with ambiguity-averse policymakers and general population in their strategies for action and communication. Thus, understanding the implications of ambiguity aversion is key to

[37] *See, e.g.*, Clara Deser et al., *Uncertainty in Climate Change Projections: The Role of Internal Variability*, 38 CLIMATE DYNAMICS 527, 527 (2012).
[38] Robert Lempert et al., *Characterizing Climate-Change Uncertainties for Decision-Maker*, 65 CLIMATIC CHANGE 1, 2 (2004).
[39] Daniel Ellsberg, *Risk, Ambiguity, and the Savage Axioms*, 75 Q.J. ECON., 643, 656, 663–64 (1961).
[40] Löıc Berger & Valentina Bosetti, *Are Policymakers Ambiguity Averse?*, 130 ECON. J. BEHAV. & ORG. 621, 624, 649 (2020). These authors studied a sample of participants and negotiators at the Paris UN Climate Conference (COP21).
[41] *Id.* at 648–49. The authors point out that factors such as whether the policymakers were negotiators or participants, whether they came from OECD or non-OECD countries, and their degree of quantitative sophistication influenced their degree of ambiguity aversion (although they all tended to be ambiguity averse). These and other factors could influence the attitudes towards ambiguity in a subset of policymakers such as central bankers.

design an adequate response.

When it comes to problems that humanity has never confronted before, like man-induced climate change, authors suggest that it may be unwise to use standard theoretical tools to make decisions, like expected utility theory.[42] Some alternatives may be more desirable, like a "precautionary principle." Under this principle, if reverting a shock is harder than preventing it, the burden of proof must be reversed and favor those proposing preventive action (mitigation, in case of climate change).[43] Others deal with this under option theory.[44] Yet, authors also suggest that policy discussion is not properly informed by the theory of choice under uncertainty, making it confusing and unscientific.[45] Thus, whereas there is no consensus on whether ambiguity aversion is a rational or irrational response in itself,[46] adopting an asymmetric attitude to climate change that chooses inaction by default is not rational.[47]

To make the response more rigorous, it is important to rely on existing models, and evidence. First, for modelling purposes, the departing assumption is that individual decision-makers often cannot agree the prior probability distributions for this problem. One way to deal with this is to dispense with the assumption that agents have a single probability distribution to make decisions and instead consider multiple priors.[48] Then, the different actions are ordered by focusing for each one on the distribution that gives it the worst expected utility, and then choosing the one given the maximum utility. This procedure is called

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[42] *See* Howard Kunreuther et al., *Risk Management and Climate Change*, 5 NATURE CLIMATE CHANGE 1, 2 (2012); *see also* Kenneth Arrow & Leonid Hurwicz, *An Optimality Criterion for Decision Making Under Uncertainty*, *in* UNCERTAINTY AND EXPECTATION IN ECONOMICS 1, 3 (C.F. Carter; J.L. Ford, eds., 1972).

[43] John Quiggin, *The* Precautionary Principle *in Environmental Policy and the Theory of Choice Under Uncertainty* 3, 5 (Murray Darling Program, Working Paper No. M05#3, 2004); Loïc Berger et al., *Managing Catastrophic Climate Risks Under Model Uncertainty Aversion*, 63 MANAGEMENT SCIENCE 1, 14 (2016).

[44] *See generally* Kenneth Arrow & Anthony C. Fisher, *Environmental Preservation, Uncertainty, and Irreversibility*, 88 Q.J. ECON. 312, 313–15 (1974).

[45] Quiggin, *supra* note 43, at 3, 5 ("In the discussion of the precautionary principle, there has been only occasional reference to the literature on the theory of choice under uncertainty, a literature that spans economics, psychology, and statistical decision theory. The absence of any formal framework for discussion has contributed to the confused nature of the debate").

[46] Nabil Al-Najjar & Jonathan Weinstein, *The Ambiguity Aversion Literature: A Critical Assessment*, 25 ECON. & PHIL. 249, 250 (2009) (suggesting that ambiguity aversion leads to some irrational behaviors, like an aversion to information); However, Itzhak Gilboa, Andrew Postlewaite & David Schmeidler, *Is It Always Rational to Satisfy Savage's Axioms?* 25 ECON. & PHIL. 285 (2009) (suggesting that ambiguity aversion may be an acknowledgement by decision-makers that, under subjective utility theory, more information is needed).

[47] "Wait and learn" was justified 10 years ago by some administrations. See ROBERT MENDELSOHN, PERSPECTIVE PAPER 1.1, IN GLOBAL CRISES, GLOBAL SOLUTIONS 44, 47 (Bjørnø Lomborg ed., 2004); see also Cass R. Sunstein, *Irreversible and Catastrophic*, 91 CORNELL L. REV. 841, 897 (2006) [hereinafter: Sunstein, *Irreversible and Catastrophic*] (describing the approach of the George W. Bush administration. Now we seem to have learned enough about the catastrophic scenarios to act).

[48] Itzhak Gilboa & David Schmeidler, *Maxmin Expected Utility Theory with a Non-unique Prior*, 18 J. MATHEMATICAL ECON. 141, 142 (1989).

"maximin" expected utility with multiple priors.[49]

There have been numerous variations to model this problem[50] (and applications to financial markets problems, for example to explain market incompleteness[51]), but our focus is in ascertaining the effect of this large uncertainty on citizens in order to then draw implications for regulators. These are non-trivial to predict. First, although maxmin preferences build in a certain amount of conservativeness in decision-making, the implications are unclear a priori for our problem. By focusing on the "worst" possible prior, the utility of doing nothing is very low. However, pessimism can also affect "active" policies, because even worse than doing nothing and suffering bad consequences is facing high abatement costs and then suffering the same or very similar consequences.[52] Second, since modelling does not provide conclusive arguments a priori, we study how citizens react to scenarios conceptually similar to climate change and its abatement efforts. We do this by using an experimental design resembling the probable distributions of risks and benefits from climate change and its possible abatement efforts to inform the construction of the decision problems to which the decision makers will be confronted in controlled laboratory conditions.[53]

To this effect, we constructed an experiment with a representative sample of the Spanish population.[54] We confronted them with a set of vignettes about a decision problem where (i) every participant was placed in a group of 5 people, all of whom have an endowment of money; (ii) there is a risk that the whole money of the group will disappear (can be stolen), but (iii) the members can make a voluntary contribution to a fund (to improve the safety of the safe) that, (iv) if sufficiently large may avoid the money from being stolen. The treatments represented the presence of "risk" or "uncertainty" across the *two* dimensions of the problem, i.e., the likelihood of the money disappearing,[55] and the investment needed to prevent the money from being lost.[56] In addition to

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[49] *See generally id.*
[50] *See generally* David Ahn, et al., *Estimating Ambiguity Aversion in a Portfolio Choice Experiment*, 5 QUANTITATIVE ECON. 195 (2014).
[51] *See generally* Sujoy Mukerji & Jean-Marc Tallon, *Ambiguity Aversion and Incompleteness of Financial Markets*, 68 THE REV. OF ECON. STUDS. 883 (2001).
[52] This is compounded in our case because the pathways between the actions of central banks and financial authorities can take to affect climate change are indirect.
[53] *See generally* Pablo Brañas-Garza et al., The Effect of Ambiguity in Strategic Environments: an Experiment (September 23, 2022) (unpublished manuscript) (on file with author).
[54] *See id.* The sample was representative in terms of gender, age, and education levels.
[55] "The probability that money disappears with/without the investment. Under "risk", one out of five times money is lost if a large enough investment is made, and four out of five if the investment is not large enough. Under "uncertainty", money is lost at most two out of five times with enough investment and at least three out of five times without investment. This parameter can be thought of as the climate consequences of doing or not doing abatement." *Id.* at 4.
[56] The other parameter is the amount of investment that is necessary to prevent the money from being lost. Under risk, the necessary amount can be either 5, 10 or 15 euros, all with equal likelihood. Under uncertainty, all that is known is that the necessary amount is larger than 5 or smaller than 15. Again, the analogy with climate is the amount of investment necessary to avoid catastrophic consequences.

the vignettes, the participants were tested with standard measures to evaluate their attitudes to risk, uncertainty, distributional preferences, time preferences and a socioeconomic questionnaire that included all the Eurobarometer questions to gauge their attitudes to climate change and environmental problems.

To generate hypotheses, we constructed a model for the behaviour of experimental participants where agents are endowed minmax preferences.[57] The predictions are clear. Provided there are at least some participants who are risk-loving, the contributions should be largest on average in the treatment with *uncertainty* in the *two* dimensions. Next, in contributions should be the treatment where there is uncertainty only in the probability of avoiding damage, but risk on the investment. The other two treatments are harder to rank in terms of average contributions.[58] The "pessimism" inherent in the minmax formulation of preferences is key to understanding the differences in theoretical predictions and the larger expected contributions where uncertainty dominates.

The results are strikingly, and interestingly, different from the theory. First, there were no differences between the treatments.[59] Second, an important result is that the contributions are significantly smaller for those individuals who are risk averse or ambiguity averse. In other words, it is not the case that risk or uncertainty do not matter. Instead, risk and uncertainty matter the same way in all treatments. Risk and uncertainty diminish the contributions of all participants who dislike it. Third, the final result is that the absence of an average effect of the treatments is not masking effects on different categories of people that go in different directions. When we interact our treatments with variables that could be expected to yield heterogeneous effects, such as gender, mathematic ability, or reflectiveness, we do not find any effects.

We also examined the effect of treatments and other variables on beliefs about others' contributions and found that the treatments did not affect how much individuals believe others are going to contribute. However, the risk averse individuals have a pessimistic belief about the contribution of others.

The policy implications are clear. Policymakers should lower the risk or uncertainty surrounding climate change and communicate in a way that makes it clear that, while there are some unknowns about climate change (and even some unknown unknowns), there are also really bad consequences that cannot be avoided unless energetic action is taken immediately. The good news is that these conclusions support efforts that

[57] In the spirit of Gilboa & Schmeidler, *supra* note 48.
[58] They should be more polarized where there is uncertainty about the threshold and where risk about the probability of avoiding the damage, than where there is risk in the two dimensions.
[59] Given the large sample used for the experiment, 1500 people, the result is not due to an absence of statistical power. We can say that this a very precisely estimated zero effect for all the treatment. Pablo Brañas-Garza et al., *supra* note 53, at 1.

are already underway, such as the NGFS' recent focus on "scenario analysis."[60] This may help to focus attention of citizens and policymakers on plausible outcomes. Furthermore, the results of our analysis suggest that it may make sense to concentrate on best case scenarios that are bad enough to warrant action if we want to have a chance to avoid the most catastrophic consequences of climate change. The bad news is that, to lower the risk/uncertainty of the situation, the responses and message need to be uniform and consistent. This is related to the next point: social norms are relevant for the general population and also for central banks.

3.1.3. Why Now And Not Earlier? (Alternative Explanations For Passivity) (II): The Slow Evolution Of Social Norms.

There is a strong case to integrate climate change into central banks' mandate through a proactive approach, using a strategy for action and communication that tries to reduce the uncertainty associated with climate change by focusing on scenarios. However, central banks could (and should) be doing this already. Climate change science exists, as do the estimates about the costs of doing nothing. Our arguments on contagion in financial networks can (and probably are) easily replicated by the research department of financial regulators. Thus, why has change not happened sooner?

Our hypothesis is that the evolution of social norms is a slow process, and the transmission between different social groups is also complicated due to several factors. First, although climate change considerations fit within central bank mandates legally speaking,[61] central banks have tended to interpret their mandate more narrowly than the legal texts.[62] Second, this framework also applies to the time horizon. This paradigm is not enshrined in legal texts, but, as shown by Mark Carney's famous speech,[63] central banks are bound by their "mandates." Moreover, Mark Carney made reference to time horizons (2-3 years for monetary policy, a bit longer for financial stability[64]) based on central bankers' shared understanding.

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[60] NETWORK FOR GREENING THE FIN. SYS., The Future is Uncertain, Scenarios Portal, https://www.ngfs.net/ngfs-scenarios-portal/ (last visited Feb. 20, 2021).
[61] Ramos et al, *Climate Change and Central Banks (Part 1)*, *supra* note 1, at 220.
[62] After experimenting with different systems of stability, central banks' credibility was cemented in the late 70s and 80s of the twentieth century, when they could tame high inflation, and has formed part of central bankers' "mandate narrative" ever since. See Michael Bordo & Pierre Siklos, *Central Bank Credibility, Reputation and Inflation Targeting in Historical Perspective* 2 (Nat'l Bureau of Econ. Rsch., Working Paper No. 20693, 2014); MICHAEL BORDO & ATHANASIOS ORPHANIDES, THE GREAT INFLATION: THE REBIRTH OF MODERN CENTRAL BANKING 19 (2013).
[63] *See generally* Mark Carney, Governor of the Bank of England & Chairman of the Financial Stability Board, Address at Lloyd's of London City Dinner: Breaking the Tragedy of the Horizon – Climate Change and Financial Stability (Sept. 29, 2015) (transcript available from the Bank of England).
[64] *Id.* at 3 ("The horizon for monetary policy extends out to 2-3 years. For financial stability it is a bit longer, but typically only to the outer boundaries of the credit cycle – about a decade").

If that is the status quo, financial authorities may be reluctant to take a view that encompasses half a century or more, especially in light of attitudes towards uncertain risks.[65] However, even if norms change slow, they do change. This can be seen not only in matters such as gender equality,[66] or same-sex marriage,[67] but also on environmental protection, with farmers and businesses often exhibiting a "beyond compliance" behaviour.[68]

Our project approach to answering the question for how norms change and diffuse between groups starts by proposing a model of norms transmission in social networks, to account for three types of players: Leaders, Crowd-Followers, and Leader-Followers.[69] Players benefit if they play the same strategy, and thus there are two equilibria. The first equilibrium yields higher payoffs to both players (it is Pareto dominant), but the second equilibrium is "safer" since the player loses less if she mistakenly chooses the strategy corresponding to it while the other player chooses the opposite strategy. This game simulates a situation where players want to have the same "opinion" and one of them is "best overall" (say, aggressive climate change action) if mutually accepted, but it is riskier (being the single person holding the "disruptive" view is dangerous in generally conservative organizations).[70] The players adapt their strategy over time following a best-response to the current environment. The strategic structure of this game does not fully match one of the 'classic' models, but it is closest to Stag-Hunt games studied extensively in game theory.[71]

The model's main insight is the large importance of Leaders and their "geographic" situation. The survival of the "disruptive" Pareto superior equilibrium depends on the presence of Leaders that are placed *close to one another*. This clustering of "thought Leaders" is an important consideration and possibly a policy tool. Shifting the minds of prominent individuals closer to others ready to have changed views in

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[65] *Id.* at 7.

[66] A recent study shows that women are now seen as equal or more competent than men, something that did not happen half a century ago. *See* Alice H. Eagly et al., *Gender Stereotypes Have Changed: A Cross-Temporal Meta-Analysis of U.S. Public Opinion Polls From 1946 to 2018*, 75 AM. PSYCH. 301, 310 (2019).

[67] Dawn Michelle Baunach, *Changing Same-Sex Marriage Attitudes in America from 1988 Through 2010*, 76 PUB. OP. Q. 364, 377 (2012).

[68] This can be explained as an interplay between social pressures and economic constraints. Neil Gunningham, Robert A. Kagan, & Dorothy Thornton, *Social License and Environmental Protection: Why Businesses Go Beyond Compliance*, 29 L. & SOC. INQUIRY 307, 328 (2004).

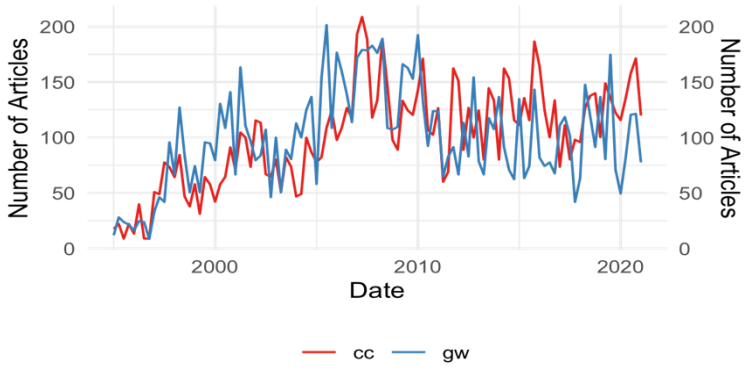
[69] All players are placed in a discrete circle, and they play a two-strategy coordination game with the players that are at a distance less than some value (*k*) in the circle. Antonio Cabrales & Esther Hauk, *Norms and the Evolution of Leaders' Followership* 2 (CESifo Working Paper No. 9845, 2022).

[70] The Leaders choose a fixed strategy. The Leader-Followers experience a discrete increase in utility if they choose the same strategy as the Leaders closest to them, in addition to the ones obtained in the game. The Crowd-Followers experience a discrete increase in utility that depends on the fraction of players using their same strategy. *Id.* at 4–5.

[71] John B. Van Huyck, et al., *Tacit Coordination Games, Strategic Uncertainty, and Coordination Failure*, 80 AM. ECON. REV. 234 (1990).

network space is the road to a Pareto dominant equilibrium convergence. This could explain the "clustering" of central bankers as a precondition for the emergence of consensus views on matters of monetary policy. This applies to the "Jackson Hole" consensuses,[72] but also the extraordinary success of the Network for the Greening of the Financial System (NGFS), where placing thought Leaders together has resulted in a new consensus towards the assimilation of climate change in central banks' mandates.

We complement the analytical progress in the study of the problem with its empirical analysis.[73] The aim of this part of the project is to ascertain the web of influences between different actors in climate change policy. We collected information (using advanced web-scraping methods) about mentions to climate change in mainstream news media,[74] general interest scientific journals (Nature, Science, PNAS, Physical Review Letters), top Economics journals (the so-called top 5), European Parliament questions, and ECB presidential speeches since the 1980s. We are in the process of constructing a Vector Auto Regressive model (VAR) to estimate how the mentions in one of these actors in one period are correlated with lagged mentions by other actors.[75] So far, some results are predictable for an external observer, some are less so, and some are striking. In general, they present a much clearer picture of how concerns about climate change have evolved. The analysis of scientific journals confirms what one could expect: scientists have been concerned with climate change for a long time. Although the mentions begin almost half a century ago, the number of articles referring to "climate change" (cc in Graph 1) or "global warming" (gw in Graph 1) has been steady for the past 20 years.



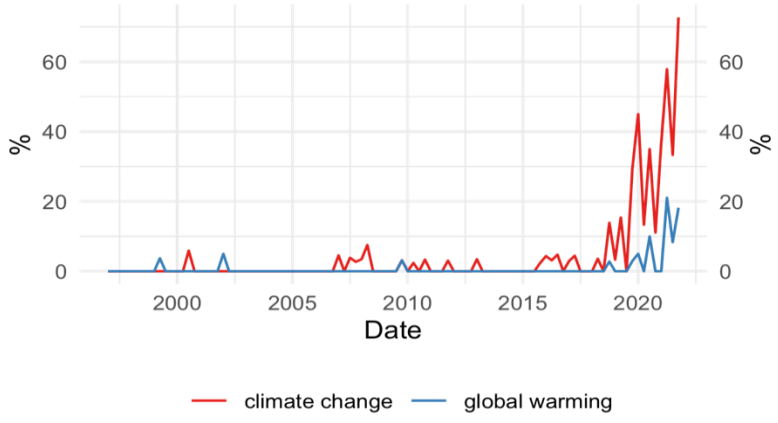
Graph 1. Number of articles with climate change/global warming mentions in scientific journals

[72] Ramos et al., *Climate Change and Central Banks (Part 1)*, *supra* note 1, at 225.
[73] Antonio Cabrales et al., *The Interactions of Social Norms About Climate Change: Science, Institutions and Economics* 17 (CESifo Working Paper No. 9905, 2022) [hereinafter: Cabrales et al, *The Interactions of Social Norms About Climate Change*].
[74] These are from the US, UK, Germany, and Spain.
[75] Cabrales et al, *The Interactions of Social Norms About Climate Change*, supra note 73, at 3–4.

Graph 2. Number of articles with climate change/global warming mentions in main media

The media attention has been much more erratic. There was significant growth after 2006, which peaked in 2009; then there was a significant drop between 2009 and 2010, to levels close to those of 2005, until growth resumed in 2015, and picked up speed after 2019. One possibility is that climate change had to cede the spotlight to other concerns, such as the economic crisis that followed the Great Financial Crisis. This would offer some anecdotal evidence of the public's "time inconsistency," and does not bode well if other (non-climate) crises or turbulences arise in the near future.

The ECB has only been recently concerned with climate change. However, the evolution is striking since it moved from almost no mentions a few years ago to mentioning it in more than 60% of its speeches today. Furthermore, although the ECB's recent concern is correlated with that of the press, this does not happen in general (e.g., the media peaks in 2007 and 2009 were barely registered).



Graph 3. ECB speeches with mentions to climate change/global warming

The more striking observation is that of *economic journals*. While there is no graph to speak of, the main economic journals, and the economists who publish in them, simply do not consider climate change a relevant research topic. Climate change is considered within the sub-field of environmental economics but has not graduated to be a source of study for mainstream economics.

All the evidence put together suggests that the behaviour of central banks *vis-à-vis* climate change does not render itself to simplistic explanations. Central banks' concern over climate change has evolved in parallel to public concern *only recently*. However, if we add the lack of interest of mainstream economics, a possible alternative explanation emerges. Given economists lack of interest in climate change, central banks have had no choice but to go alone and develop both the message to change perceptions about climate change's importance as a mainstream subject and the technical tools to tackle it. Instead of finding central banks at fault for following public opinion, we should ask perhaps ourselves whether central banks might have begun earlier to assimilate climate change if economists had appreciated its relevance also earlier.

3.2. Arguments Of Opportunity ("When"), Proactivity, And Judicial Review.

The above section overwhelmingly suggests that central banks should adopt a proactive approach towards climate change. "Wait and see" is costlier and may hinder central banks' ability to deal with shocks. An asymmetric approach towards risk is inefficient and irrational, and yet individuals tend to invest less than needed on the face of risk *or* uncertainty. Changing social norms about climate change's relevance to central banks can be done through the clustering of thought leaders (as in the NGFS) and central banks' attempt to do so may be seen in light of the reaction by the public/media, or politicians, or in light of mainstream economics' lack of interest, in which case it is a normal, if belated, reaction. Thus, there seems to be a very strong case for central banks being proactive. The question is, can they? This depends on courts' review of such proactive actions. We separate between an analysis based on the precautionary principle (3.2.1.) and other approaches (3.2.2.)

3.2.1. Proactive Approaches And Precautionary Principle.

Can public authorities act on the face of uncertainty? In many jurisdictions the answer is a clear "yes". Most systems allow public authorities to act to pre-empt a risk from materializing, even without having all the information about the risk, but they also formulate legal principles to scrutinize such proactive action. The standard that more clearly encapsulates this is the *precautionary* principle.[76] This principle

[76] This originated in Swedish law, see ULRICH BEYERLIN & THILO MARAUHN, INTERNATIONAL ENVIRONMENTAL LAW 47 (2011), and German law, see Didier Bourguignon, *The Precautionary Principle: Definitions, Applications and Governance* 4 (Eur. Parliamentary Rsch. Serv. Working Paper No. PE 573.876, 2015).

is part of European Commission practice,[77] later enshrined in European Treaties,[78] and acknowledged both in case law on human rights[79] and as a general principle of EU Law.[80]As defined by the Court of Justice in *Blaise*:[81]

> That principle entails that, where there is uncertainty as to the existence or extent of risks to human health, protective measures may be taken without having to wait until the reality and seriousness of those risks become fully apparent. Where it proves to be impossible to determine with certainty the existence or extent of the alleged risk because the results of studies conducted are inconclusive, but the likelihood of real harm to public health persists should the risk materialize, the precautionary principle justifies the adoption of restrictive measures.[82]

This is more generous than what is actually needed for climate change, where there is no uncertainty about the "existence" of risks to human health only to the "extent" of those risks (between extremely serious and catastrophic). The main objection is that climate change is an "environmental" principle, which has extended to fields like health, safety, food, and consumer regulation,[83] but has not yet been extended to monetary policy and financial supervision. Yet, the "integration principle" requires that environmental principles, including the precautionary principle, be integrated in the definition and implementation of all EU policies and actions.[84] Furthermore, central

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[77] COMMISSION OF THE EUROPEAN COMMUNITIES, COMMUNICATION FROM THE COMMISSION ON THE PRECAUTIONARY PRINCIPLE, COM (2000) 1 Final (Feb. 2, 2000), at 1.

[78] Consolidated Version of the Treaty on the Functioning of the European Union art. 191, 2008 O.J. (C 115) (May 9, 2008) [hereinafter TFEU] states that: *"*Union policy on the environment shall aim at a high level of protection taking into account the diversity of situations in the various regions of the Union. It shall be based on the precautionary principle and on the principles that preventive action should be taken, that environmental damage should as a priority be rectified at source and that the polluter should pay."

[79] In Tătar v. Romania, App. No. 67021/01, 61 Eur. Ct. H.R. at 3 (2009), the European Court of Human Rights held that, even if the applicants could not establish a causal link between exposure to cyanide and asthma, the Romanian government had a responsibility to act to avoid exposure by the population to dangerous chemicals.

[80] Cases C-333/08, Comm'n v. France, 2010 E.C.R. I-807; C-343/09; *Afton Chemical Ltd v.* Sec'y *of State for Transp*., 2010 E.C.R. I-7030.

[81] C-616/17 Procurer de la Republique v. Blaise ECLI:EU:C:2019:190, ¶ 43 (March 12, 2019). *See* Sabrina Röttger-Wirtz, *Case C-616/17 Blaise and Others: The Precautionary Principle and Its Role in Judicial Review – Glyphosate and the Regulatory Framework for Pesticides*, 27 MAASTRICHT J. EUR. & COMPAR. L. 529, 529 (2020); Sophia Paulini, *Fact or Fiction? Case C-616/17 and the Compatibility of the EU Authorisation Procedure for Pesticides with the Precautionary Principle*, 11 EUR. J. RISK REGUL. 481, 481 (2020).

[82] C-616/17 Procurer de la Republique v. Blaise, 76 ECLI:EU:C:2019:190, ¶ 43 (March 12, 2019).

[83] Commission of the European Communities, Communication from the Commission on the Precautionary Principle, COM (2000) 1 Final (Feb. 2, 2000), at 2.

[84] *See* Ramos et al, *Climate Change and Central Banks (Part 1)*, *supra* note 1, at § 2.1.1.

bank action would not only pre-empt risks to human health, but also pre-empt risks to price and macroeconomic stability.[85]

The precautionary principle's guiding criteria present no great obstacle. In the EU, precautionary measures must be *proportionate*, non-discriminatory, transparent and coherent, and based on a structured decision-making process with detailed scientific and objective information, This process must consider the potential benefits and costs, subject to review, on the face of new scientific data, and be capable of assigning responsibility for producing scientific evidence.[86] Alternative formulations, such as the one used by Australian courts in *Telstra Corporation Limited v Hornsby Shire Council*,[87] show no obstacle either. This test requires (i) a threat of serious or irreversible damage, and (ii) scientific uncertainty as to the extent of the damage[88] (which seems tailored to the definition of climate change), and require measures that are appropriate and *proportionate to the potential threats.*[89]

Thus, we go back to proportionality as the guiding criterion.[90] In EU case law, the standard of review is formed by an initial approach, based on whether the authorities made a "manifest error of assessment," and a proportionality analysis as an added safeguard, to ensure that the measures are necessary and do not go further.[91] In monetary policy decisions, courts tend to be deferential and focus on the justification of the decisions.[92] In financial regulation and supervision, courts tend to be stricter and focus on the substance of the measures, in light of the finality of the legal (statutory) provisions used to support them,[93] and, if fundamental rights are involved, on whether the measures negate those rights.[94]

In principle, we could say that the approach may be stricter when a measure is assessed as a "micro" measure that impacts individual rights as opposed to a "macro" measure. However, courts in jurisdictions that consider "precaution" frame the standard of review in a way that presents no obstacle for central banks' assuming the proactive approach of

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[85] *Id.*
[86] Commission of the European Communities, Communication from the Commission on the Precautionary Principle, COM (2000) 1 Final (Feb. 2, 2000), at 2–3.
[87] *Telstra* Corporation *Ltd v Hornsby Shire Council [2006]* NSWLEC 133 (Austl.).
[88] *Id.* at ¶¶ 128, 156 ("[T]he principle permits the taking of preventative measures without having to wait until the reality and seriousness of the threat become fully known").
[89] *Id.* at ¶ 128.
[90] Ramos et al, *Central Banks and Climate (Part 1)*, *supra* note 1, at § 2.2.2.
[91] *Id.*
[92] This proportionality analysis is based on article 5 of the Treaty of the European Union. Case C-493/17, Heinrich Weiss and others, ECLI:EU:C:2018:1000, ¶¶ 24, 71 (Dec. 11, 2018); Ramos et al., *Climate Change and Central Banks (Part 1)*, *supra* note 1, at § 2.2.2.
[93] Case T-768/16, BNP Paribas v. ECB, ECLI:EU:T:2018:471, ¶¶ 20, 30 (Jul. 13, 2018) (supervision case); Case T-786/14, Bourdouvali v. Council of the Eur. Union, ECLI:EU:T:2018:487, ¶ 244 (Jul. 13, 2018) (crisis management case); Ramos et. al., *Climate Change and Central Banks (Part 1)*, *supra* note 1, at § 2.2.3.
[94] Case C-686/18, ECLI:EU:C:2020:567, ¶ 26 (Jul. 16, 2020).

addressing the causes of climate change and climate risk rather than waiting until its consequences are known. Thus, we should rather proceed to analyze the issue in light of precaution's critics.

3.2.2. Proactive Approaches Under Precaution's Critics, Cost-Benefit Analysis (CBA), And The Unavoidability Of Policy Choices.

Traditional academic objections to the precautionary "principle" criticize that it hinders technological and economic progress[95] and it is paralyzing.[96] Yet, there is no evidence that adjusting policies to account for their carbon footprint inhibits progress.[97] Others argue that while precautionary "attitudes" or "approaches" to specific risks are valid, one cannot be precautionary towards everything.[98] "Precaution" simply focuses policymakers on "salient" risks to the detriment of others; i.e., it is a behaviorally biased and inconsistent principle (one cannot avoid all risks at once).[99] Yet climate change is not just a "salient" risk, but also a real, grave, and increasingly imminent one. Authors who have considered maximin or precautionary approaches critically argue that these approaches can be the more sensible provided certain conditions of uncertainty, catastrophic nature (and minimum plausibility) of one scenario, and lesser importance of avoiding the catastrophic scenario are met,[100] which climate change satisfies.[101]

A different objection is that the precautionary principle is a "European" idea and cannot be used globally. Yet, the precautionary

[95] John D. Graham, *Decision-Analytic Refinements of the Precautionary Principle*, 4 J. RISK RSCH. 127, 138 (2001).
[96] Harsanyi only adresses the maximin principle and not the precautionary principle, but his criticism can be largely extrapolated. See John C. Harsanyi, *Can the Maximin Principle Serve as a Basis for Morality? A Critique of John Rawls' Theory*, 69 AM. POL. SCIENCE REV. 594, 594–95 (1975).
[97] In fact, it can promote innovation. Shaou-Zhou Qi et al., *Influence of a Pilot Carbon Trading Policy on Enterprises' Low-Carbon Innovation in China*, 21 CLIMATE POLICY 318, 318 (2021).
[98] Cass R. Sunstein, *The Availability Heuristic, Intuitive Cost-Benefit Analysis, and Climate Change* 3 (John M. Olin L. & Econ. Working Paper No. 263, 2005).
[99] *Id.* at 4. The biases Sunstein identifies as embedded in the precautionary approach include the "availability heuristic" (which corresponds to Kahneman and Tversky's "object substitution") or "system neglect." *See also* CASS R. SUNSTEIN, LAWS OF FEAR 36–37, 39 (2005).
[100] For John Rawls, these are the inability to assign probabilities (uncertainty), the fact that the additional gain of an option is of no consequence, and/or the unacceptability of the alternative. See JOHN RAWLS, A THEORY OF JUSTICE 132–142 (Revised ed., Harvard University Press, 1999). Stephen Gardiner adds the condition of a minimum plausibility of the catastrophic scenario, and calls this the "core precautionary principle." *See* Stephen Gardiner, *The Core Precautionary Principle*, 14 J. POL. PHIL. 33, 47 (2006). *See also* Cass R. Sunstein, *Maximin*, 37 YALE J. REG. 940, 943 (2020) [hereinafter: Sunstein, *Maximin*].
[101] Stephen Gardiner, *supra* note 100, at 33, 55; Sunstein, *Maximin*, *supra* note 100, at 969.

principle forms part of international environmental[102]and trade law.[103] Additionally, it is part of the UN Framework Convention on Climate Change (UNFCC[104]), and part of the law in countries like the Philippines[105] and Australia, where *Telstra Corporation Limited v Hornsby Shire Council* offers the most detailed analysis made by a court of the precautionary principle.[106]

Thus, a more real objection is that the principle is "un-American" (i.e., it is not accepted in the United States) and that it is a source of Transatlantic (US-EU) trade disputes[107] and tensions.[108] Yet, even in the US, the precautionary principle is present in environmental, health, and safety law,[109] as part of the laws of some local authorities,[110] or courts' approach to preliminary injunctions in cases of environmental damage.[111]

On EU-US differences, some contend that rather than a clash of principles, there is a complex mosaic of rules and approaches, where the

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[102] The 1972 United Nations Conference on the Human Environment in Stockholm paved the way for its introduction in international law, which was done at the 1982 World Charter for Nature G.A. Res. 37/7, ¶ 11(b) (Oct. 28, 1082). This was followed by the 1985 Vienna Convention for the Protection of the Ozone Layer and the 1987 Montreal Protocol on Substances that Deplete the Ozone Layer which was determined to protect the ozone layer by "taking precautionary measures to control equitably total global emissions of substances that deplete it." (Mar. 22, 1985, T.I.A.S. No. 11,097l; 1513 U.N.T.S. 323); Sept. 16, 1987, S. TREATY DOC. NO. 99-9; 1522 U.N.T.S. 3. This is also followed by Principle 15 of the Rio Declaration. UN Conference on Environment and Development, *Rio Declaration on Environment and Development*, U.N. Doc. A/CONF.151/26/Rev.1(Vol. I), annex I (Aug. 12, 1992); *see also* TIMOTHY O'RIORDAN & JAMES CAMERON, INTERPRETING THE PRECAUTIONARY PRINCIPLE 262–89 (1994).

[103] Agreement on the Application of Sanitary and Phytosanitary Measures art. 5.7, Apr. 15, 1994, Marrakesh Agreement Establishing the World Trade Organization, Annex 1, 1869 U.N.T.S. 401.

[104] Article 3 of the UNFCCC states that: "parties should take precautionary measures to anticipate, prevent, or minimize the causes of climate change and mitigate its adverse effects." United Nations Framework Convention on Climate Change, May 9, 1992, S. Treaty Doc No. 102-38, 1771 U.N.T.S. 107, art. 3.

[105] *Greenpeace Southeast Asia v. Environmental and Natural Resources*, CA-G.R. SP No. 00013, at 19–20 (*May* 17, *2013*) (Phil.).

[106] [2006] NSWLEC 133, ¶ 128 (Austl.).

[107] *See* World Trade Organization, *DS26: European Communities — Measures Concerning Meat and Meat Products (Hormones)*, WTO, https://www.wto.org/english/tratop_e/dispu_e/cases_e/ds26_e.htm (last visited Feb. 20, 2022).

[108] "[T]he United States remains deeply concerned by unjustified EU barriers to our agricultural exports. Recently, dozens of WTO Members have expressed concerns in the SPS and TBT Committees and in the Council on Trade in Goods regarding EU pesticide policy, which restricts trade without scientific justification or benefit to human health." U.S. Ambassador Dennis C. Shea, Ambassador to the WTO, Statement as Delivered in the 2020 EU Trade Policy Review (TPR Day 1) **(**Feb. 18, 2020), available at https://geneva.usmission.gov/2020/02/18/u-s-statement-at-the-eu-trade-policy-review/.

[109] Sunstein, *Irreversible and Catastrophic*, *supra* note 47, at 843 (2006); Cass R. Sunstein, *Irreversibility*, 9 L. PROBABILITY & RISK 227 (2010).

[110] *See* Guiding Environmental Principles, SF ENV'T DEPT. https://sfenvironment.org/article/toxics-health/guiding-principles (last accessed Mar. 3, 2023).

[111] Sierra Club v. Marsh, 872 F.2d 497, 497–98 (1st Cir. 1989).

EU or the US may be the more precautionary depending on the risk.[112] Even those who argue that the difference is one-sided and the EU is more risk averse, point out that it has evolved with time. From the 1970s to 1990s the US was more risk-averse, and the EU more risk-averse from the 1990s onwards).[113] Furthermore, different "policies" need not be different legal "principles".[114]

Thus, the main *legal* obstacle is the United States' preference for cost-benefit analysis ("CBA") as part of its *administrative practice* for executive agencies[115] and independent agencies with policymaking/regulatory powers.[116] This need not determine Federal Reserve actions, but case law in the US has warmed to the idea of using CBA as a standard of judicial review. In *Michigan v EPA*, for example, the Supreme Court considered that the EPA's decision to impose minimum emissions regulations ("floor standards") on coal and oil-fired power plants without considering costs was "unreasonable."[117] Lower courts have also embraced CBA as a standard to review EPA environmental regulations, like in *Corrosion Proof Fittings*.[118] They also prefer this standard in cases dealing with financial regulation decisions,

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[112] It is a pattern of particularity, rather than a consistent difference in approaches. DAVID VOGEL, THE POLITICS OF PRECAUTION: REGULATING HEALTH, SAFETY AND ENVIRONMENTAL RISKS IN EUROPE AND THE UNITED STATES 248 (2012).

[113] *Id.* at 248.

[114] Some scholars argue that the precautionary principle is well present in the United States. *See* John. S. Applegate, *The Precautionary Preference: An American Perspective on the Precautionary Principle*, 6 HUM. & ECOLOGICAL RISK ASSESSMENT 413, 438 (2000). Others say that the distinction is futile. *See* Nicholas A. Ashford, *The Legacy of the Precautionary Principle in US Law: The Rise of Cost-Benefit Analysis and Risk Assessment as Undermining Factors in Health, Safety and Environmental Protection*, *in* IMPLEMENTING THE PRECAUTIONARY PRINCIPLE 352, 354 (Nicolas de Sadeleer ed., 2007).

[115] Cabinet departments and executive agencies are often required to perform a CBA for major regulations, as a result of executive orders. Exec. Order No. 12,866, 58 Fed. Reg. 51,735 Sept. 30, 1993) (President Clinton) requiring executive agencies to assess costs and benefits of intended regulation. The CBA is widely acknowledged as a tool to anticipate the consequences of rules. *See generally* Office of Management and Budget, Circular A-4 (Sept. 17, 2003).

[116] Exec. Order No. 13,563, 76 Fed. Reg. 3,821 (Jan. 21, 2011) (President Obama) espouses CBA as a general principle of regulation (See Section 1 (a)). Cass R. Sunstein, a major proponent of CBA, was Administrator of the Office of Information and Regulatory Affairs (OIRA), and responsible for the implementation of this EO. The Administrative Conference of the United States adopted Recommendations suggesting CBA should form part of independent regulatory agencies' policymaking process. See ADMIN. CONF. OF THE U.S., Benefit-Cost Analysis at Independent Regulatory Agencies (June 13, 2013).

[117] Michigan v. Env't Prot. Agency, 135 S. Ct. 2699, 2701–02 (2015). The majority (5-4) opinion by Justice Scalia accepted that "Chevron deference" towards agency acts (after the case Chevron U.S.A., Inc. v. Nat. Res, Def. Council, Inc., 467 U.S. 837 (1984)) was a valid standard of review, but that "Even under this deferential standard, however, "agencies must operate within the bounds of reasonable interpretation." […] EPA strayed far beyond those bounds when it read §7412(n)(1) to mean that it could ignore cost when deciding whether to regulate power plants" 135 S. Ct. at 2707.

[118] Corrosion Proof Fittings v. Env't Prot. Agency, 947 F.2d 1201, 1215 (5th Cir. 1991).

such as decisions by the SEC in *Business Roundtable*[119] or by the Financial Stability Oversight Council (FSOC) in *Metlife v FSOC.*[120]

Using a CBA itself should pose no insurmountable problem for a proactive approach by the Federal Reserve. There is no shortage of estimates of costs and risks associated to climate change,[121] and limiting those costs should yield important benefits. Even those who object to such estimates do not deny the need for action.[122] The actual obstacle is not scientific, economic, or even legal, but rather *institutional* and *political* obstacles. First, at the institutional level, CBA is based on interagency working groups issuing *authoritative* documents,[123] including on the social cost of carbon (SCC),[124] to form the basis for common agency action. Thus, scientific evidence matters less than its administrative processing. Second, CBA is not entirely technical, but often involves political choices. CBA critics point out that in the 80s, it was used to lend scientific credibility to a (partisan) deregulatory agenda.[125] However, even advocates of CBA, like Posner and Masur, criticize some CBA assessments, like the Obama administration's Social Cost of Carbon (SCC), for making "political" choices (e.g., anticipating a reaction by other jurisdictions to the US position on climate change regulation).[126]

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[119] Bus. Roundtable v. Sec. and Exch. Comm'n, 647 F.3d 1144, 1150 (D.C. Cir. 2011) (annulling the SEC's Proxy Regulation for failing to offer a satisfactory CBA).
[120] Metlife v. Fin. Stability and Oversight Council, 177 F. Supp.3d 219 (D.D.C. 2016) (using Michigan v. Env't Prot. Agency, 135 S.Ct. at 2701–02, as the main precedent to consider "arbitrary and capricious"). This case used the "arbitrary and capricious" standard of review under the Administrative Procedure Act (APA) in a decision to subject a large insurer to the supervision of the Federal Reserve due to its systemic importance and without considering the costs. Since the Trump administration decided not to appeal the decision, the ruling stood.
[121] Ramos, et al., *Climate Change and Central Banks (Part 1*), *supra* note 1, at 223–24.
[122] Martin Weitzman, *A Review of The Stern Review on the Economics of Climate Change*, 45 J. OF ECON. LITERATURE 703, 703 (Sept. 2007) ("Concerning this uncertainty aspect, I argue that it might be recast into sound analytical reasoning that might justify some of the Review's conclusions. The basic issue here is that spending money to slow global warming should perhaps not be conceptualized primarily as being about consumption smoothing as much as being about how much insurance to buy to offset the small change of a ruinous catastrophe that is difficult to compensate by ordinary savings").
[123] Cass R. Sunstein, *The Real World of Cost-Benefit Analysis: Thirty-Six Questions (and almost as Many Answers)*, 114 COL. L. REV. 167, 167, 202–03 (2014) [hereinafter: Sunstein, *The Real World of Cost-Benefit Analysis*]. Sunstein's description is based on his own experience as Administrator of the Office of Information and Regulatory Affairs (OIRA).
[124] *See generally* INTERAGENCY WORKING GRP. ON SOC. COST OF CARBON, U.S. GOVERNMENT, TECHNICAL SUPPORT DOCUMENT: SOCIAL COST OF CARBON FOR REGULATORY IMPACT ANALYSIS UNDER EXECUTIVE ORDER 12866 (2010) (available at https://www.epa.gov/sites/default/files/2016-12/documents/scc_tsd_2010.pdf).
[125] *See* Frank Ackerman & Lisa Heinzerling, *Pricing the Priceless: Cost-Benefit Analysis of Environmental Protection*, 150 U. PA. L. REV. 1553, 1557–60, 1580–81 (2001); FRANK ACKERMAN & LISA HEINZERLING, PRICELESS: ON KNOWING THE PRICE OF EVERYTHING AND THE VALUE OF NOTHING 11–12 (2005).
[126] Jonathan S. Masur & Eric A. Posner, *Climate Regulation and the Limits of Cost-Benefit Analysis*, 99 CAL. L. REV. 1557, 1577 (2011).

3.2.3. Judicial Review: Risk-Asymmetry, Political Preferences, And Semantics.

Although there are plenty of scientific and economic arguments to justify central banks' early action on climate change (a lengthening of the time horizon) the previous two points shows that their ultimate position should result from symbiosis with legal arguments.[127] This raises the following issues:

(1) *Law and risk asymmetry.* Critics of precautionary approaches emphasize that the arguments about the "irreversibility" or harm are not too convincing, since all courses of action are, in a sense, irreversible as they limit future choices. We should instead frame the problem in terms of "irreversibilities" and the magnitude and likelihood of costs/damages.[128] Yet, such criticism of precautionary/maximin approaches for lack of "symmetry" (i.e., considering only the irreversibility of one course of action) fails to acknowledge that administrative and judicial practice imposes an asymmetric approach to risks. In this case, such a practice favors inaction over early action on climate change.

Even the precautionary principle, which is "friendlier" towards early action on the face of uncertainty, is framed in asymmetric terms as a *standard of judicial review*. AG Sharpston, with her usual sharpness pointed in *Blaise* that:

> Annulment actions may therefore be brought on the basis of the precautionary principle to challenge an act that is deemed too restrictive, as opposed to an act that is deemed not to be restrictive enough. In the case of the former, the question of whether there has been an infringement must essentially be framed in terms of whether the measure at issue infringes the principle of proportionality. In the case of the latter, arguments concerning infringement of the precautionary principle have tended to 'serve merely to support pleas and arguments expressly raised elsewhere.'[129]

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[127] Carney, *supra* note 63.

[128] Sunstein, *Irreversible and Catastrophic*, *supra* note 47, at 860–61; Arguments that he reiterates in "Irreversibility", Sunstein, *Irreparability as Irreversibility*, *supra* note 9, at 105, 107. *See also* Sunstein, *Maximin*, *supra* note 100, at 957.

[129] Tribunal Correctionnel de Foix [Criminal Court, Foix, France] Foix, France, Mar. 12, 2019, C-616/17, 10. *See* Röttger-Wirtz, *supra* note 81, at 530–31 (this case concerned Regulation 1107/2009 and its alleged benign treatment of glyphosate, which could not be directly challenged by individual citizens for lack of standing under article 263 TFEU, and was brought to the Court of Justice's attention through a case where some individuals were charged with criminal offences for entering and damaging products containing glyphosate in a shop, and (the individuals) alleged that they had adopted a precautionary approach by trying to warn the public about the dangers of glyphosate); *see generally* Paulini, *supra* note 81.

In the US the approach is more asymmetric. CBA, as both a guiding principle of administrative practice and a standard of judicial review, presents clear challenges for climate change since features like catastrophic risk and "fat tails" do not easily lend themselves to "conventional" CBA.[130] Although administrative standards acknowledge Knightian uncertainty[131] and CBA formulations can be interpreted (or amended) to accommodate maximin under certain conditions,[132] CBA advocates fail to integrate the *legal process* (administrative and judicial) in the decision-making framework.

First, we consider the administrative process. Even if scientific and economic models form the basis of CBA, what matters is *not pure* science or economics, but rather the *processed* version of such science or economics by the administration. Thus, what binds the administration are its internal processes, and changes in the approach to a certain issue (including the proactivity towards it) require changes in interagency documents.[133] Authoritative views pointing that cost appraisals or discount rates should be different[134] will be dismissed until incorporated into such documents.

Second, if we consider the courts' review of administrative action, we must take into account the judges' departing presumptions and assumptions. These inform the burden of proof required of the administration to justify a proactive approach, and guide whether the approach will be cost-benefit "symmetric" or asymmetric (with an emphasis on costs). Scholars have not criticized CBA as a standard of review *per se*, but rather for its application in cases like *Corrosion Proof Fittings* or *Business Roundtable* where it demands an excessive burden.[135] In the case of climate change, a proactive approach justified on grounds of uncertainty and risk of catastrophe could be insufficient if courts flatly reject maximin as "irrational" infinite risk aversion[136] or are reluctant towards the idea of "uncertainty."[137] This could place the burden of justification in epistemically unreachable levels.

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[130] Martin L. Weitzman, *On Modeling and Interpreting the Economics of Catastrophic Climate Change*, 91 REV. OF ECON. & STAT. 1, 2 (2009). *See generally* Nicholas Stern, *The Economics of Climate Change: The Stern Review*, LONDON SCH. OF ECON. AND POL. SCI. (Oct. 30, 2006), https://www.lse.ac.uk/granthaminstitute/publication/the-economics-of-climate-change-the-stern-review/.

[131] OFF. OF MGMT. & BUDGET, EXECUTIVE OFF. OF THE PRESIDENT CIRCULAR: A-4 REGULATORY ANALYSIS, 38–39 (Sept. 17, 2003). This refers to FRANK H. KNIGHT, RISK, UNCERTAINTY AND PROFIT (1921).

[132] Sunstein, *Maximin, supra* note 100, at 978–79.

[133] Sunstein, *The Real World of Cost-Benefit Analysis*, *supra* note 123, at 201–02 (giving several examples on climate change).

[134] In fact, they have. *See* WILLIAM NORDHAUS, THE CLIMATE CASINO: RISK, UNCERTAINTY, AND ECONOMICS FOR A WARMING WORLD 188–89 (2013).

[135] Even those who praise the decisions acknowledge that the majority of scholars holds a contrary view. *See* Jonathan Masur & Eric Posner, *Cost-Benefit Analysis and the Judicial Role*, 85 U. CHI. L. REV. 935, 954–55 (2018).

[136] Richard A. Musgrave, *Maximin, Uncertainty, and the Leisure Trade-Off*, 88 Q. J. ECON. 625, 627 (1974).

[137] For an exposition and criticism of this idea, *see* Sunstein, *Maximin, supra* note 100, at 972.

Even if not all courts are the same, there is a non-negligible probability that they will do act as predicted above, and this influences the decision-making frame. Authorities' considering a more proactive stance on climate change must consider not only the costs/benefits of the action itself, but also the "penalty risk" of a contrary judicial ruling. This risk is clearly asymmetric. Whereas a proactive stance on climate change may well be deemed "arbitrary and capricious" for inadequately cost accounting, the legal penalty is practically zero because US courts tend to consider climate change complaints as non-justiciable.[138] Even if they were to review climate actions, there are reasons to believe that courts are reluctant to stop (government) actions that harm the environment on grounds of irreparable harm, such as the Supreme Courts' treatment of preliminary environmental injunctions as an "extraordinary remedy."[139]

We must clarify that there are good reasons for these approaches. Administrative procedure facilitates coordination and legal certainty, and internal discussion and external justification enhance legitimacy. Judicial review ensures the rule of law and prevents excessive government interference. All these are "goods" that have intrinsic value, but we should at least acknowledge that they impose an asymmetric approach towards cost and risk, skewed towards inaction, especially in the face of uncertainty.

(2) *Discretion, policy choices and central bank independence*. Another factor that influences the decision-making framework arises when the public authorities' assessment involves choices that are actually, or allegedly, political. In the US, Posner and Masur criticized the Obama administration's CBA on climate change for assuming "global" benefits and making assumptions about the reaction of other countries over the US adoption of carbon pricing policies. Yet, as the Trump administration took over,[140] it proposed to repeal the Obama Administration's Clean Power Plan (CPP) initiative based on a CBA that only counted CPP's *domestic* climate benefits (i.e., accruing to people living in the United States) and *marginal* benefits.[141] The question is not

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[138] Ramos et al., *Climate Change and Central Banks (Part 1)*, *supra* note 1, at § 2.2.1.
[139] Winter v. Nat. Res. Def. Council, 129 S. Ct. 365, 376 (2008); Monsanto Co. v. Geertson Seed Farms, 130 S. Ct. 2743, 2761 (2010). There is, however, evidence that some circuits do not follow the Supreme Court's approach, such as League of Wilderness Defs. v. Connaughton, 752 F.3d 755, 767 (9th Cir. 2014). *See generally* Lindsay Bregante Myers, *Preliminary Injunctions in Environmental Lawsuits: The Ninth Circuit's Discretionary Approach in* "League of Wilderness Defenders v. Connaughton", 45 ENV'T. L. 793 (2015).
[140] Daniel A. Farber, *Regulatory Review in Anti-Regulatory Times*, 94 CHI.-KENT L. REV. 383, 420 (2019). *See also* Jonathan Masur, *Cost-Benefit Analysis Under Trump: A Comment on Dan Farber's Regulatory Review in Anti-Regulatory Times*, 94 CHI.-KENT L. REV. 665, 669 (2019).
[141] Although particulate matter, sulphur dioxide and other ancillary pollutants were covered by other EPA regulations, scientific evidence showed that some areas of the United States had pollution levels above those regulatory standards. Thus, the CPP counted the *actual* benefits in reductions in those pollutants, whereas the ACE counted only the *marginal* benefits of CPP, *assuming* that polluters would eventually be obliged to reduce emissions under the other existing regulations. Masur, *supra* note 140, at 669.

whether CBA should be criticized or not,[142] but rather what should be our assumption of the "baseline" or "default" policy choice. This can result in administrative paralysis if authorities find that some of their calculations need political choices and such choices have not been made (or are not sufficiently stable to inform the long-term assessment needed for certain policies). This is compounded by the fact that, in US case law, the doctrine of "deference" to administrative authorities finds an exception when the matter in question is not considered "interstitial" but is instead a "major question."[143] In all this discussion, one consideration is missing. A "technical" choice (as opposed to a "political" choice) and an "interstitial" choice (as opposed to a "major" question) are not static categories. They may change with the social norms of the public, the administration, or courts. Furthermore, political polarization may influence this situation by creating different social norms among different groups, with the result that an increasing number of "technical" issues become political. This would, in turn, skew the analysis towards inaction even more.

The EU context presents its own challenges. This comes from clear divergences between the views of the Court of Justice and of some national courts, like the German Federal Constitutional Court ("FCC"), on what is "monetary" and "economic" policy.[144] The reason was not semantic. While the Court of Justice was ready to accept the ECB's technical arguments on the monetary policy transmission mechanism,[145] the FCC saw the *lack of democratic legitimacy* of the EU (and the ECB) and required a strict standard of review. It was the EU version of the "technical/interstitial v. political/major" distinction. Even if technical arguments clearly support early climate change action, labelling a certain choice as "political" tends to be a way to justify inaction.

(3) *Policy choices and central bank "special" status.* Whether the above conclusions, for administrative authorities and agencies can be extrapolated to central banks is a separate question. Monetary policy decisions in the US tend to be seen as non-justiciable, while in the EU they are reviewed under a combination of the statutory interpretation of a central bank's mandate, the "manifest error of assessment" standard, and a proportionality analysis that focuses on the justification (i.e., giving of reasons) of the action.[146] The US approach is more deferential, which is useful if a central bank is venturing into uncharted territory. However, the EU approach has the advantage of conceptual continuity, i.e.,

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[142] *Compare* Daniel A. Farber, *supra* note 140, at 431 (criticizing CBA) *with* Masur, *supra* note 140, at 672 (defending CBA as a safeguard against excesses).
[143] King v. Burwell, 576 U.S. 473, 485 (2015).
[144] Ramos et al., *Climate Change and Central Banks (Part 1)*, *supra* note 1,at § 2.2.2.
[145] Case C-62/14 Peter Gauweiler v. Deutsche Bundestag, [2015] ECLI:EU:C:2015:400 (June 16, 2016) ¶ 50; Case C-493/17 Weiss & others [2018] ECLI:EU:C:2018:1000 (Nov. 11, 2018) ¶¶ 65–69 [hereinafter *Weiss*].
[146] Ramos et al., *Climate Change and Central Banks (Part 1)*, *supra* note 1, at § 2.2.1; Case C-62/14, Peter Gauweiler v. Deutsche Bundestag, [2015] ECLI:EU:C:2015:400 (June 16, 2015) ¶ 74; Case C-493/17, Weiss & others [2018] ECLI:EU:C:2018:1000 (Nov. 11, 2018) ¶ 72.

"proportionality" is common to the "precautionary" principle and central bank case law,[147] and can act as a conceptual bridge. In the United States, on the contrary, there is dissonance between the ultra-deferential approach to Federal Reserve policy making[148] and an increasingly strict standard towards intrusive acts of administrative agencies.[149] This makes the outcome uncertain. If the Federal Reserve benefits from the ultra-deferential standard so far applicable to central bank acts, as seems likely, its discretion will be respected. Yet, there is the risk that, given the issue's controversial nature in the US, courts might decide to apply the more intrusive standard of review consisting in demanding a CBA (see above). For the Fed, this would mean losing its privileged status. Furthermore, unlike monetary policy, prudential regulation and supervision are more rule-bound competences,[150] where central banks are not 'special', or different from other administrative agencies. This makes the intrusive standard likelier, which makes the Federal Reserve more reluctant to openly incorporate climate considerations in the first place.

The special status given to central banks also present some challenges. Typically, administrative authorities trying to assess the risk and harm associated to a course of action may be able to consider the "incommensurability" of certain social goods. In fact, some elements of precaution may be seen less as an acknowledgement of catastrophic (but quantifiable) harm due to uncertainty, and more of a criticism of utilitarian views on ethical grounds.[151] Central banks would not be permitted to do so: they can tackle climate change *if, and to the extent that*, decision making impacts price stability (or the transmission mechanism). Considering other goods is certainly a worthy goal, but they remain outside a central bank's mandate. Acknowledging this is a constructive way to end the confusion of both advocates and critics of central banks' more active role on climate-related issues.

(4) *Loaded words and global dialogue.* Complimenting the scientific and economic perspective with a legal perspective is useful to understand what the actual decisional framework would look like. This is because the resulting analysis includes not only economic costs and risks but also legal risks. This may also influence the framework for international cooperation. Climate change is a global phenomenon that requires global cooperation. Furthermore, central banks tend to have their decisional frameworks shaped by social norms, and acknowledging social norms dynamics is key to enable changes in policy positions. In the case of "proactive" approaches, "precaution" seems to be acceptable in many

[147] Ramos et al., *Climate Change and Central Banks (Part 1)*, *supra* note 1, at § 2.2.2.
[148] *Id.* at § 2.2.1.
[149] *See* text *supra.* at § 3.2.2.
[150] Ramos et al., *Climate Change and Central Banks (Part 1)*, *supra* note 1, at § 2.2.3.
[151] Sunstein, *Irreversible and Catastrophic*, *supra* note 47, at 841.

contexts yet remains controversial in the United States.[152] This may also influence the *language* used in global dialogue. If precautionary approaches are acceptable in all conceptual frameworks given conditions of uncertainty and catastrophic harm, global dialogue can be based on promoting proactive approaches in substance, even if the term "precaution" itself is omitted.

II. INTERVENING HOW? ARGUMENTS FOR SUITABILITY.

The previous sections show that there are strong arguments to support climate change within central banks' mandate and addressing it in a proactive manner. Thus, what remains is to analyze *how* to assimilate climate change into central bank mandates, or put another way arguments on "suitability." First, we examine conventional views about which instruments could be used in the fight against climate change, and the objections to such use (4.1.) Second, we examine some overlooked challenges (4.2.) Finally, we briefly discuss the implications for judicial review (4.3.)

4.1. Climate Change, Central Bank Tools And Conventional Wisdom Challenges.

In this sub-section we first analyze the difficulties of incorporating the fight against climate change in central banks' toolkit and explore some possible avenues for rendering it operational (4.1.1). Then, we analyze potential objections, such as the "market neutrality" principle

[152] In the specific field of financial regulation, the precautionary approach has advocates. *See, e.g.*, FARUK ÜLGEN, COLLECTIVE ACTION AND THE INSTITUTIONALIST APPROACH TO FINANCIAL REGULATION 1 (2018); Hillary J. Allen, *A New Philosophy for Financial Stability Regulation*, 45 LOY. U. CHI. L.J. 173, 173 (2013); Saule T. Omarova, *License to Deal: Mandatory Approval of Complex Financial Products*, 90 WASH. U.L. REV. 63, 84 (2012) (suggesting some measure of application may be "worthwhile, and even necessary"). Furthermore, the CBA has critics. *See, e.g.*, John C. Coates IV, *Cost-Benefit Analysis of Financial Regulation: Case Studies and Implications*, 124 YALE L.J. 882, 886, 887 (2015); Jeffrey N. Gordon, *The Empty Call for Benefit-Cost Analysis in Financial Regulation*, 43 J. LEGAL STUD. 351, 352 (2014). However, "precaution" is controversial as either a principle or an approach and there is not a majority ready to ditch CBA in favor of alternative approaches. Ramos et al., *Climate Change and Central Banks (Part 1)*, *supra* note 1, at § 2.2.2. For additional discussion of the Coates Article, *see* Eric Posner & E. Glen Weyl, *Cost-Benefit Analysis of Financial Regulations: A Response to Criticisms*, 124 YALE L.J.F. 246, 246 (2015); Cass Sunstein, *Financial Regulation and Cost-Benefit Analysis*, 124 YALE L.J.F. 263, 263 (2015); Bruce R. Kraus, *Economists in the Room at the SEC*, YALE L.J.F. 280 (2015). This was followed by a reply. *See* John C. Coates IV, *Cost-Benefit Analysis of Financial Regulation: A Reply*, 124 YALE L.J.F. 305 (2015). For other contributions, see Eric Posner & Glen Weyl, *Benefit-Cost Analysis for Financial Regulation*, 103 AM. ECON. REV. 393, 393 (2013); U.S. CHAMBER OF COMMERCE, CENTER FOR CAPITAL MARKETS COMPETITIVENESS, *The Importance of Cost-Benefit Analysis in Financial Regulation* (2013), https://www.centerforcapitalmarkets.com/resource/the-importance-of-cost-benefit-analysis-in-financial-regulation/. Meanwhile, some circuit and district courts have expressly espoused CBA for purposes of judicial review. *See* Business Roundtable v. SEC, 647 F.3d 1144, 1150 (D.C. Cir. 2011); Am. Equity Inv. Life Ins. Co. v. SEC, 613 F.3d 166, 176–77 (D.C. Cir. 2010); Chamber of Com. v. SEC, 412 F.3d 133, 142 (D.C. Cir. 2005); Metlife Inc. v. Fin. Stability Oversight Couns., 177 F. Supp. 3d 219, 240 (D.C. Cir. 2016). These examples all stand for the principle that there is no general acceptance of "precaution" in financial regulation.

(4.1.2.), and the objections based on independence and legitimacy (4.1.3.).

4.1.1. Climate Change And Central Bank Tools.

Central banks are gradually warming to the idea of incorporating climate change considerations in their mandates, and coming to terms with the fact that this needs to be done sooner rather than later. However, deciding whether to act and how to render this operational are two different things, and central banks are relatively hesitant. A Green Central Banking Scorecard, created by Positive Money (a research and activist NGO), ranked central banks and financial supervisors of 20 jurisdictions. They showed that most central bank green activity has been concentrated in research and advocacy.[153] Little has been done in other fields closer to central bank operations. An example is the ECB, which is one of the more aggressive advocates of the "greening" of central banks' mandates.[154] That central bank recently issued a recent Strategy Review[155] that shows a change in attitude towards climate change, although with reservations. The courses of action indicated in the document would affect: 1. Disclosures, 2. Collateral valuation, 3. Enhanced risk assessment capabilities, 4. Corporate sector purchases and 5. Green targeted longer-term refinancing operations (TLTRO). Of those, only 4 and 5 have a possibility to guide proactive interventions to avoid climate change. Even with those four, the approach is timid, focusing on reducing "the costs related to the green transition by promoting investments in green activities" rather than deterring from climate change-inducing activities.[156]Although this is consistent with our hypothesis that social norms change slowly, as outlined in the previous section,[157] central banks are probably trying to speed up the process of such social norm change, and so the question is what are the aspects susceptible to greater change.

(1) One aspect is *asset purchases, reserves, and investments*. The asset purchase programs (APP) adopted by central banks in the years after the Great Financial Crisis (GFC) and the COVID crisis were

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[153] DAVID BARMES & ZACK LIVINGSTONE, THE GREEN CENTRAL BANKING SCORECARD: HOW GREEN ARE G20 CENTRAL BANKS AND FINANCIAL SUPERVISORS? 5 (Positive Money 2021), https://positivemoney.org/publications/green-central-banking-scorecard/.
[154] The Bank of England, the ECB and the Bank of Greece were identified as prominent central banks supporting the issue in the Official Monetary and Financial Institutions Forum (OMFIF) special report. DANAE KYRIAKOPOULOU, BANKS AND CLIMATE CHANGE 147 (2019), https://www.omfif.org/wp-content/uploads/2020/02/ESG.pdf.
[155] *See generally* Francesco Drudi et al., *Climate Change and Monetary Policy in the Euro Area*, (European Central Bank-Occasional Paper Series, no. 271, 2021).
[156] *Id.* at 153–54 ("At the same time, these operations could raise level playing field issues for participating banks due to their differing ability to obtain and disclose relevant information as well as cross-country differences" the conclusion being that "Given the essential role of TLTROs in supporting the economy and the need to ensure the most effective targeting, and in light of the need to overcome a number of hurdles, it seems premature to concretely envisage targeted green operations at the current juncture").
[157] *See supra* § 3.1.3.

relatively carbon intensive.[158] The Sveriges Riksbank (Sweden) clearly announced that it would adjust its purchases of corporate bonds to include only firms that complied with sustainability criteria, as well as selling off bonds from high carbon emitters in its reserves.[159] The Swiss National Bank also announced an adjustment following sustainability principles.[160] Similar ideas have been floated by the President of the Dutch Central Bank[161] and the French central bank.[162]

(2) A second aspect is *collateral frameworks*. These determine the collateral that is eligible for central bank operations. "Collateral assets" are any assets that can be used by financial market participants to collateralize a creditor's claim in normal market conditions, as well as any other assets that are likely to be used as collateral in a stressed environment.[163] An asset's consideration as "collateral" not only depends on having certain characteristics (identifiability, pledgeability, low legal risk, or the willingness of market participants to accept them), but also on its "eligibility" by the central bank.[164] The interrelationship between collateral markets and central bank collateral frameworks is complex, and central banks can influence collateral markets through either the supply of assets available for use as collateral (a scarcity channel), the pledgeability of assets in private transactions (a structural channel), or both.[165] Thus, a central bank's decision on what assets are eligible for collateral in central bank operations can have a decisive impact on their eligibility in collateral markets. Different central banks have indicated their intention to look into their collateral frameworks for possible

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[158] DAVID BARMES ET. AL., THE COVID CORPORATE FINANCING FACILITY 1 (Positive Money 2020) https://positivemoney.org/publications/ccff/; YANNIS DAFERMOS ET. AL., GREENING THE EUROSYSTEM COLLATERAL FRAMEWORK 3 (New Econs. Found. 2020) https://neweconomics.org/2021/03/greening-the-eurosystem-collateral-framework. *See also* YANNIS DAFERMOS ET AL., DECARBONISING THE BANK OF ENGLAND'S PANDEMIC QE 3 (New Econs. Found. 2020) https://neweconomics.org/2020/08/decarbonising-the-bank-of-englands-pandemic-qe.

[159] Sveriges Riksbank, Annex to the Minutes B: Programme for the Riksbank's Asset Purchases for Monetary Policy Purposes in 2021, Reg. no. 2020-00861 (Nov. 25, 2020) (Swed.) (corporate bonds). *See also* Sveriges Riksbank, Financial Risk and Investment Policy, DNR 2020-01389 (Dec. 19, 2022) (Swed.) (considering the requirements imposed by the Riksbank's remit, management shall take sustainability into account when selecting assets in the foreign exchange reserves). For a summary, *see* The Riksbank Work on Sustainability, https://www.riksbank.se/en-gb/about-the-riksbank/the-riksbanks-work-on-sustainability/ (last visited Feb. 21, 2022).

[160] Thomas Jordan, Introductory Remarks at Swiss National Bank News Conference (Dec. 17, 2020).

[161] Klaas Knot, President of Neth. Bank, Keynote Address at an Open Event Organized by Bruegel: Getting the Green Deal Done – How to Mobilize Sustainable Finance (Feb. 11, 2021) (transcript available at: https://www.bis.org/review/r210217d.pdf).

[162] François Villeroy de Galhau**,** Governor of Banque de Fr., Speech at Paris – Banque de France: The Role of Central Banks in the Greening of the Economy (Feb. 11, 2021) (transcript available at: https://www.banque-france.fr/en/intervention/role-central-banks-greening-economy).

[163] Timothy Lane, *Central Bank Operating Frameworks and Collateral Markets* 4 (Comm. on the Glob. Fin. Sys. and the Mkts. Comm. (CGFS) Papers, no. 53, 2015).

[164] *Id.* at 4–5.

[165] *Id.* at 10–11.

climate-related adjustments, notably the People's Bank of China,[166] or the ECB.[167]

(3) A third aspect concerns *funding operations and reserves*. Central banks began to use this tool in the aftermath of the Great Financial Crisis (GFC) and this continued during the pandemic-related crisis by authorities including the Federal Reserve, the ECB, the Bank of Japan, or the PBoC. Central banks have used Targeted Long-Term Refinancing Operations (TLROs) to promote funding to the real economy. If this could be done to promote funding of Small and Medium- Enterprises (SMEs), some authors have argued that they can be used to promote "green" and sustainable investment (e.g., investment in products that are Taxonomy aligned[168]), The potential for this initiative has, so far, been echoed by some (ECB) members.[169] Another possibility may be to adjust the interest rate of central bank reserves to account for the bank's climate-related risk, which has been proposed by members of the People's Bank of China (PBoC).[170]

(4) A fourth aspect is *prudential regulation and supervision*. For central banks that have responsibilities in prudential regulation or for other prudential authorities,[171] this is a key element of their toolkit. So far, most efforts have focused on an increased disclosure of climate-related and environmental risk.[172] This is because it can help to measure the exposures and risks of financial institutions[173] and to reduce funding for fossil fuels[174] by pointing out the lack of preparedness of financial

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[166] *See* Hilal Atici, *PBoC to Grade Financial Institutions on Green Bonds,* GREEN CENT. BANKING (June 15, 2021), https://greencentralbanking.com/2021/06/15/pboc-grade-financial-institutions-green-bonds/ (The peculiarity is not only that green bonds may be eligible, but also that they are given preferential status). *See also* Camille Macaire & Alain Naef, *Greening Monetary Policy*, (Banque de France, Working Paper no. 812, 2021). For the PBoC's Green Finance Evaluation Plan (in Mandarin), *see* PBoC, http://www.pbc.gov.cn/tiaofasi/144941/3581332/4265383/2021061014205828457.pdf.

[167] *See* Press Release, *ECB Presents Action Plan to Include Climate Change Considerations in its Monetary Policy Strategy*, EUR. CENT. BANK (July 8, 2021), https://www.ecb.europa.eu/press/pr/date/2021/html/ecb.pr210708_1~f104919225.en.html (provides roadmap, including references to collateral).

[168] JENS VAN 'T KLOOSTER & RENS VAN TILBURG, TARGETING A SUSTAINABLE RECOVERY WITH GREEN TLTROS 2 (Positive Money Eur. 2020). *See also* BARMES & LIVINGSTONE, *supra* note 153.

[169] Isabel Schnabel, Member of the Exec. Board of the ECB, Address at the European Sustainable Finance Summit: When Markets Fail – The Need for Collective Action in Tackling Climate Change (Sept. 28, 2020) (transcript available at https://www.ecb.europa.eu/press/key/date/2020/html/ecb.sp200928_1~268b0b672f.en.html) [hereinafter, Schnabel, "When Markets Fail"].

[170] Ma Jun, *Financing Carbon Neutrality in China*, FINANCIAL TIMES (Jan. 28, 2021) https://www.hkgreenfinance.org/ma-jun%EF%BC%9Afinancing-carbon-neutrality-in-china/.

[171] Ramos et al., *Climate Change and Central Banks (Part 1)*, *supra* note 1, at § 2.1.4.

[172] TASK FORCE ON CLIMATE RELATED DISCLOSURES, https://www.fsb-tcfd.org/ (last visited Feb. 21, 2023).

[173] BARMES & LIVINGSTONE, *supra* note 153. *See also* PATRICK BOLTON, ET AL., THE GREEN SWAN: CENTRAL BANKING AND FINANCIAL STABILITY IN THE AGE OF CLIMATE CHANGE, 53 (Banque de France 2020) (available at: https://www.bis.org/publ/othp31.pdf).

[174] *Id.*

institutions.[175] A second avenue consists in incorporating climate-related risks into the Internal Capital and Liquidity Assessment Processes (ICAAP and ILAAP). This would then include it in the Supervisory Review Process,[176] so that climate change is incorporated into the operational departments, risk management units, and senior management. This incorporation is a view adopted by the Bank of England,[177] Central Bank of Brazil,[178] and suggested by the ECB[179] and recent EU normative proposals.[180] At the same time, this incorporation should be accompanied by a better symbiosis with Integrated Assessment Models (IAMs) and by the incorporation of forward-looking approaches. Forward looking approached would include a more incisive emphasis on climate-related scenario analysis and stress tests, which incorporate physical risk, and, crucially (to foster a proactive approach) transition risk.[181] Another avenue consists in incorporating carbon footprints into

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[175] EUR. CENT. BANK, ECB REPORT ON INSTITUTIONS' CLIMATE-RELATED AND ENVIRONMENTAL RISK DISCLOSURES (2020), https://www.bankingsupervision.europa.eu/ecb/pub/pdf/ssm.ecbreportinstitutionsclimaterelatedenvironmentalriskdisclosures202011~e8e2ad20f6.en.pdf.

[176] EUR. CENT. BANK, GUIDELINES CLIMATE RELATED AND ENVIRONMENTAL RISK, BANKING SUPERVISION (2020), https://www.bankingsupervision.europa.eu/press/pr/date/2020/html/ssm.pr201127~5642b6e68d.en.html [hereinafter: ECB, GUIDELINES CLIMATE RELATED AND ENVIRONMENTAL RISK].

[177] BANK OF ENGLAND PRUDENTIAL REGULATION AUTHORITY, LIFE INSURANCE STRESS TEST 2019 – SCENARIO SPECIFICATION, GUIDELINES AND INSTRUCTIONS 3, 17 (2019) https://www.bankofengland.co.uk/-/media/boe/files/prudential-regulation/letter/2019/life-insurance-stress-test-2019-scenario-specification-guidelines-and-instructions-draft.

[178] FEDERAÇÃO BRASILEIRA DE BANCOS, THE BRAZILIAN FINANCIAL SYSTEM AND THE GREEN ECONOMY – ALIGNMENT WITH SUSTAINABLE DEVELOPMENT 12 (2014), https://cmsarquivos.febraban.org.br/Arquivos/documentos/PDF/The%20Brazilian%20Financial%20System%20and%20the%20Green%20Economy_Alignment%20with%20Sustainable%20Development_2014.PDF.

[179] ECB, GUIDELINES CLIMATE RELATED AND ENVIRONMENTAL RISK, *supra* note 176.

[180] Proposal for a Directive amending Directive 2013/36/EU as regards supervisory powers, sanctions, third-country branches, and environmental, social and governance risks, and amending Directive 2014/59/EU, Brussels, 27.10.2021 COM(2021) 663 final 2021/0341 (COD) (which would amend articles 73, 74, or 76, and introduce a new article 87a in Directive 2013/36/EU (Capital Requirements Directive, or CRD), and Proposal for a Regulation, amending Regulation (EU) No 575/2013 as regards requirements for credit risk, credit valuation adjustment risk, operational risk, market risk and the output floor, Brussels, 27.10.2021 COM(2021) 664 final 2021/0342 (COD) (which would amend Regulation 575/2013 by introducing new definitions of relevant risks under article 4 (52d)-(52i)), disclosure duties (article 449a) or empowering EBA to study the prudential treatment of risks (article 501a)).

[181] ESRB ADVISORY SCI. COMM., TOO LATE, TOO SUDDEN: TRANSITION TO A LOW-CARBON ECONOMY AND SYSTEMIC RISK, REPORTS OF THE ADVISORY SCIENTIFIC COMMITTEE (European Systemic Risk Bd. 2016), https://www.esrb.europa.eu/pub/pdf/asc/Reports_ASC_6_1602.pdf. *See also* MARTIJN REGELINK, ET. AL., WATERPROOF? AN EXPLORATION OF CLIMATE-RELATED RISKS FOR THE DUTCH FINANCIAL SECTOR 4 (DE NEDERLANDSCHE BANK 2017), https://www.unepfi.org/psi/wp-content/uploads/2018/08/Waterproof_An-exploration-of-climate-related-risks-for-the-Dutch-financial-sector.pdf; Dirk Schoenmaker & Rens Van Tilburg, *Financial Risks and Opportunities in the Time of Climate Change*, BRUEGEL POLICY BRIEF, Iss. 2, at 1 (Apr. 2016), https://www.bruegel.org/sites/default/files/wp_attachments/pb-_02.pdf; CHANGING COURSE: A COMPREHENSIVE INVESTOR GUIDE TO SCENARIO-BASED METHODS FOR CLIMATE RISK ASSESSMENT, IN RESPONSE TO THE TCFD 10 (UNEP Finance Initiative 2019), https://www.unepfi.org/wordpress/wp-content/uploads/2019/05/TCFD-Changing-Course-Oct-19.pdf.

the risk weights for microprudential regulation, where current rules are very limited.[182] Other more ambitious proposals include: amendments to risk weights for carbon-related assets,[183] the large exposure regime (to cap exposures to carbon-intensive industries[184]), a recalibration of countercyclical capital requirements to account for climate-related risk,[185] or even changing liquidity requirements which currently penalize long-term "green" investments.[186]

However, as some authors have eloquently pointed out, this approach creates a risky bet for financial authorities. They can chose either a purely microprudential approach, where they wait for commercial banks to develop their own risk models, or they can chose a "credit guidance" model, where they impose their own weights.[187]

4.1.2. Conventional Wisdom Objections (I). Central Banks' Suitability For Climate Change (Market Neutrality Argument).

After listing the potential policy shift in central banks' tools and operations currently suggested by the literature, we must analyze the "conventional" objections to suitability. The first of such objections is that central banks are not suitable for the fight against climate change. Proponents of this view argue that the goal of central banks is not to distort the market, but to take it as it is and to merely adjust it in pursuance of price stability.

This objection is encapsulated in the idea of "market neutrality", sometimes referred as a "principle" in policy decisions (e.g., Federal Reserve[188]), operational manuals (e.g., Bank of Japan[189]), or certain legal texts (e.g., European Central Bank[190]). Central bank officials often define

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[182] Council Regulation No. 575/2013, 2013 O.J. (L176) 1.
[183] THIERRY PHILIPPONNAT, BREAKING THE CLIMATE FINANCE DOOM LOOP: HOW BANKING PRUDENTIAL REGULATION CAN TACKLE THE LINK BETWEEN CLIMATE CHANGE AND FINANCIAL INSTABILITY 5 (Finance Watch 2020).
[184] Dirk Schoenmaker & Rens Van Tilburg, *What Role for Financial Supervisors in Addressing Environmental Risks?*, 58 COMP. ECON. STUD. 317, 326 (2016).
[185] Countercyclical capital requirements are meant to be stricter during good times, and relaxed during lean times, but during the COVID crisis, for example, they were relaxed without any consideration for the resulting climate-related impact. Simon Dikau et. al., *A Toolbox of Sustainable Crisis Response Measures for Central Banks and Supervisors* (INSPIRE briefing paper, 2020).
[186] BARMES & LIVINGSTONE, *supra* note 153, at 12; PATRICK A. NARBEL, THE LIKELY IMPACT OF BASEL III ON A BANK'S APPETITE FOR RENEWABLE ENERGY 9 (Dept. of Bus. & Mgmt. Sci., Norwegian Sch. of Econs. 2013), https://reclaimfinance.org/site/wp-content/uploads/2021/03/The-Green-Central-Banking-Scorecard-18.03-under-embargo-1.pdf.
[187] *See* Agnieszka Smolenska & Jens van't Klooster, A Risky Bet: Should the EU Choose a Microprudential or a Credit Guidance Approach to Climate Risk? 1 (European Banking Inst. Working Paper Series, Working Paper No. 104, 2021).
[188] Dino Kos, Manager of System Open Market Account, Statement at Meeting of the Federal Open Market Committee (Oct. 24–25, 2006) (available on pg. 3-6 at: https://www.federalreserve.gov/monetarypolicy/files/FOMC20061025meeting.pdf).
[189] FUNCTIONS AND OPERATIONS OF THE BANK OF JAPAN 49–50 (Inst. for Monetary and Econ. Stud. Bank of Japan ed., 2d ed. 2012).
[190] The third paragraph of article 127 (1) TFEU states: "The ESCB shall act in accordance with the principle of an open market economy with free competition,

it as requiring central bank actions to focus on macroeconomic stabilization, not microeconomic reallocation in an "industrial policy" fashion.[191] Thus, central bank programs should be broad based, abstain from distorting prices[192] or market outcomes,[193] and minimize the impact on share prices, companies, or sectors.[194]

This argument sounds appealing but has major problems. First, legally speaking "market neutrality" is a red herring. It is nowhere to be found in relevant legal texts[195] and lacks *legal* significance.[196] It is more evidence of central bankers' proclivity to abide by "social norms"[197] than of an actual, legal norm.

Second, in addition to not being legally binding, "market neutrality" is elusive in central bank practice. Central bank programs have not been

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favouring an efficient allocation of resources, and in compliance with the principles set out in Article 119". Consolidated Version of the Treaty on the Functioning of the European Union art. 127, Jan. 3, 2020, O.J. (C 202).

[191] "[F]ocusing purchases on green bonds would run counter to the requirement to respect the workings of an open market economy and be tantamount to industrial policy. The APP is a tool for macroeconomic stabilisation, not for microeconomic reallocation. Deviating from market neutrality and interfering with economic policy risks exposing the ECB to litigation. It is not up to the central bank but to elected governments to decide which industry is to be closed and when. As central bankers, we have to respect and implement legitimate decisions in this context. And the effectiveness of monetary policy has been bolstered by abstaining from normative judgments on the morality of markets and industries." Speech by Yves Mersch, Member of the Executive Board of the European Cent. Bank, Speech at Workshop Discussion: Sustainability is Becoming Mainstream, (Nov. 27, 2018), https://www.ecb.europa.eu/press/key/date/2018/html/ecb.sp181127.en.html.

[192] "In conducting its policies, the Bank makes every effort to maintain the soundness, liquidity, and neutrality of its assets. […] The Bank makes every effort to ensure that its holding of assets does not influence their market prices. If the Bank were to hold a large amount of specific financial assets, the Bank could influence the market price and impair the neutrality of resource allocation, depending on the market size of the assets. In order to maintain neutrality, the Bank, in conducting open market operations, makes it a rule to purchase financial assets with high liquidity from a deep market". FUNCTIONS AND OPERATIONS OF THE BANK OF JAPAN 49–50 (Inst. for Monetary and Econ. Stud. Bank of Japan ed., 2d ed. 2012).

[193] "To be effective, the programmes need to be broad-based. Our purchases of private bonds are thus guided by the principle of "market neutrality". It aims to ensure that a broad-based approach is taken and to prevent us from distorting market outcomes. This is why we have to check whether we have unintentionally allowed bias to creep into our securities portfolio, compared to the universe of eligible bonds". Jens Weidmann, Speech at the European Banking Congress, Combating Climate Change – What Central Banks Can and Cannot Do (Nov. 20, 2020), https://www.bis.org/review/r201120e.pdf.

[194] "The equity portfolio, by contrast, is managed as neutrally and passively as possible. We buy and hold equities of a particular company in proportion to its weighting in the country's stock index. In this way, we ensure that our activities have as small an impact as possible on the relative share prices of individual companies or sectors. Equally, this prevents specific biases towards or against certain companies or sectors from influencing our investment policy." Thomas Jordan, Chairman of the Governing Board of the Swiss Nat'l. Bank, Comments on the SNB's Monetary and Investment Policy at the 109th Ordinary General Meeting of Shareholders of the Swiss National Bank (Apr. 28, 2017).

[195] RENE SMITS, MEMO ON MONETARY POLICY AND CLIMATE CHANGE, BIODIVERSITY LOSS 2, https://renesmits.eu/wp-content/uploads/2021/03/Memo-on-monetary-policy-and-climate-change-biodiversity-loss_210221.pdf.

[196] STANISLAS JOURDAN & ALESSIA DEL VASTO, WHY AND HOW THE ECB SHOULD GO BEYOND 'MARKET NEUTRALITY' 4 (Positive Money Eur. 2021).

[197] *See supra* § 3.1.3.

market-neutral, nor have they tried to be. Some programs had the goal of smoothing the volatility in sovereign debt markets (e.g., in cases of Quantitative Easing, or QE) and thus sovereign debt and relatively similar assets benefitted more from these programs.[198] Other programs tried to revive or deepen markets in certain assets (e.g., securitization markets).[199] In cases where central banks have allegedly engaged in "market neutral" or, more accurately, market-wide purchases, they have been far from neutral. The ECB's market wide Corporate Sector Purchase Program (CSPP) focused on an extremely narrow subset of such bonds,[200] thus benefitting firms with access to capital markets,[201] benefiting non-financial over financial firms,[202] and benefiting "bonds" over other securities.[203] Purchases of securitized assets favor covered bonds (and their issuers).[204] The Bank of Japan included equities in its asset purchase programs in a way disproportional to market capitalization, leading to distortions in corporate governance of affected companies.[205] Thus, far from replicating the market, central bank transactions have sought to systematically correct deviations in those markets when they were harmful for central bank objectives, e.g., favoring the holders of certain assets.[206]

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[198] Andrew Haldane et al., *QE: The Story So Far* 1 (Bank of Eng., Staff Working Paper No. 624, 2016); Arvind Krishnamurty & Annette Vissing-Jorgensen, *The Aggregate Demand for Treasury Debt*, 120 J. POL. ECON. 233, 259, 261 (2012).

[199] *Asset-backed Securities Purchase Programme (ABSPP)- Questions and* Answers, EUROPEAN CENT. BANK (June 28, 2021), https://www.ecb.europa.eu/mopo/implement/app/html/abspp-faq.en.html.

[200] Eligibility criteria included investment grade assets, which were eligible as collateral for central bank operations, denominated in euros, from issuers established in the Euro area, which were not credit institutions or asset management vehicles. *Corporate Sector Purchase Programme (CSPP) – Questions & Answers*, EUR. CENT. BANK (Sept. 19, 2022), https://www.ecb.europa.eu/mopo/implement/app/html/cspp-qa.en.html. This narrowed the range of eligible bonds from a universe of about 80,000 euro-denominated bonds to 1,156, of which 846 were chosen. EMANUELE CAMPIGLIO ET AL., THE CLIMATE IMPACT OF QUANTITATIVE EASING 14 (Ctr. for Climate Change Econs. and Pol'y 2017).

[201] RENS VAN TILBURG & ALEKSANDAR SIMIĆ, LEGALLY GREEN CLIMATE CHANGE AND THE ECB MANDATE 21 (Sustainable Finance Lab 2021).

[202] Schnabel also acknowledged that ESCB purchases did not reflect market capitalization. *See* Isabel Schnabel, Member of the Exec. Bd. of the European Cent. Bank, Address at the ECB DG-Research Symposium "Climate Change, Financial Markets, and Green Growth": From Market Neutrality to Market Efficiency (June 14, 2021) (transcript available at: https://www.ecb.europa.eu/press/key/date/2021/html/ecb.sp210614~162bd7c253.en.html) [hereinafter: Schnabel, "Climate Change, Financial Markets, and Green Growth"].

[203] SEAN KIDNEY, ET AL., PUBLIC SECTOR AGENDA FOR STIMULATING PRIVATE MARKET DEVELOPMENT IN GREEN SECURITISATION IN EUROPE 8 (Ctr. for Climate Change Econs. and Pol'y 2017), https://www.cccep.ac.uk/wp-content/uploads/2017/02/Kidney-et-al_policy-paper_Feb-2017.pdf.

[204] The eligibility criteria means that purchases do not mirror the market. CAMPIGLIO, ET AL., *supra* note 200, at 13.

[205] Anna Kitanaka et al., *The Tokyo Whale's Unstoppable Rise to Shareholder No. 1 in Japan*, BLOOMBERG.COM (Aug. 14, 2016, 11:00 AM), https://www.bloomberg.com/news/articles/2016-08-14/the-tokyo-whale-s-unstoppable-rise-to-shareholder-no-1-in-japan.

[206] *See generally* Michael Aklin et al., *Does Central Bank Independence Increase Inequality?* (World Bank Grp. Pol'y Rsch., Working Paper No. 9522, 2021). *But see* Agustin Carstens, Gen. Manager, Bank for Int'l Settlements, Remarks at the Markus' Academy of Princeton University's Bendheim Center for Finance (May 6, 2021).

Insistence on market neutrality is sometimes a way to justify controversial moves. The ECB's most emphatic use of market neutrality in recent times was in a speech by Mr. Benoit Coeure, which was titled "Embarking on public sector asset purchases."[207] This speech was delivered in the wake of the Public Sector Purchase Programme (PSPP) massive purchase of sovereign bonds. The language of the speech seems to reply to critics and allay fears that the ECB might not consider side effects.[208] After the ECB was criticized for purchasing sovereign bonds, it expanded its purchases of corporate bonds, thus suggesting that the shift was not based on a "market-driven" rebalancing.[209] Therefore, insisting on market neutrality may not so much bolster central banks' market credentials but rather present them as insincere.

As a result, the discussion around market neutrality is rapidly evolving. What was once a minority view is now becoming a mainstream view against "market neutrality" (or at least a rigid conception of it) that an increasing number of officials position themselves against. This includes the Presidents of the Bank of Japan,[210] the Dutch Central Bank,[211] the French Central Bank,[212] and Isabel Schnabel at the ECB. Furthermore, Isabel Schnabel proposed a clear policy shift from market neutrality to "market efficiency". [213] Market neutrality makes sense if one assumes that markets are pricing risk properly. If evidence suggests that very large risks are not being priced properly, it may not be such a good idea to adapt asset purchases to market capitalization.[214] Evidence overwhelmingly suggests that central bank corporate purchases often

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[207] Benoît Cœuré, Member of the Exec. Bd. Eur. Cent. Bank, Speech at the Second International Conference on Sovereign Bond Markets: Embarking on Public Sector Asset Purchases (Mar. 10, 2015) (transcript available at: https ://www.ecb.europa.eu/press/key/date/2015/html/sp150310_1.en.html).

[208] "On 9 March the Eurosystem launched its public sector purchase programme (PSPP). On that day the ECB and the national central banks of the euro area purchased €3.2 billon of public sector bonds, putting the programme on track to reach a total of €60 billion in March. Monetary policy is implemented in normal times in money markets. Stepping into bond markets creates challenges and might have unintended consequences. One key principle underlying the implementation of the PSPP is the minimisation of unintended consequences, which can be ensured by obeying the concept of market neutrality." *Id.*

[209] Jens van 't Klooster & Clément Fontan, *The Myth of Market Neutrality: A Comparative Study of the European Central Bank's and the Swiss National Bank's Corporate Security Purchases*, 25 NEW POL. ECON. 865, 873 (2020).

[210] Haruhiko Kiroda, Governor, Bank of Japan, The Bank of Japan's Strategy on Climate Change, Speech at the Japan National Press Club (July 27, 2021) (transcript available at: https://www.boj.or.jp/en/announcements/press/koen_2021/data/ko210727a.pdf).

[211] Knot, *supra* note 161.

[212] de Galhau, *supra* note 162.

[213] Schnabel, "Climate Change, Financial Markets, and Green Growth," *supra* note 202.

[214] "In the presence of market failures, market neutrality may not be the appropriate benchmark for a central bank when the market by itself is not achieving efficient outcomes." Schnabel, "When Markets Fail," *supra* note 169; *see also* EUROPEAN SYSTEMIC RISK BOARD (ESRB), POSITIVELY GREEN, MEASURING CLIMATE CHANGE RISKS TO FINANCIAL STABILITY (Euro. Cent. Bank 2020) (insisting that climate risks are consistently underpriced by the market).

favor carbon-intensive industries,[215] and favoring those industries does not seem to be "market neutral" nor contribute to proper risk pricing.

Principles like "market efficiency" have the advantage of being adjustable. Market neutrality is maximalist and uncompromising. However, given that central banks' asset purchases cannot and will not fully replicate market structure, market efficiency is impossible to fulfil since market efficiency depends on whether the market is leading to efficient results or not.[216]

4.1.3. Conventional Wisdom Objections (II): Climate Change's Suitability For Central Banks (Arguments Of Independence And Legitimacy).

While the previous objection analyzed the argument that central banks are not suitable for climate change because they have to be "market neutral", other conventional objections take the reverse view. These objections claim that climate change is not suitable for central banks because this will compromise their independence and undermine their legitimacy.

One view is that, we ask central banks to make the trade-offs that should be reserved for political bodies when asking central banks to pursue climate or environmental goals.[217] The flip side of this argument is that the very existence of central banks as independent institutions lacking democratic legitimacy is premised on the fact that their remit is narrow. and seek to avoid the time inconsistency problem of democratically legitimate authorities. This is a controversial claim, and as central bank policies grow, so will the controversy undermining central banks' legitimacy.[218]

While these arguments are persuasive, they are not conclusive. First, one must understand the relationship between central bank independence and accountability. "Independence" is not protected *in spite of* accountability; it is acceptable *because* there is accountability (including political, legal and administrative accountability).[219] Using an aprioristic idea of "independence" to rank central banks may be useful to

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[215] Javier Solana, *The Power of the Eurosystem to Promote Environmental Protection*, 30 EURO. BUS. L. REV. 547, 568 (2019).
[216] In the specific, regional setting of the EU, "market economy" also has the advantage of being expressly acknowledged in the Treaties. Consolidated Version of the Treaty on the Functioning of the European Union art. 127, 2016 O.J. (C 202) 102.
[217] PAUL TUCKER, UNELECTED POWER. THE QUEST FOR LEGITIMACY IN CENTRAL BANKING AND THE REGULATORY STATE 101–02 (Princeton University Press 2018).
[218] Nik de Boer & Jens van 't Klooster, *The ECB, the Courts and the Issue of Democratic Legitimacy After* Weiss, 57 COMMON MKT. L. REV. 1689, 1695 (2020).
[219] MARCO LAMANDINI & DAVID RAMOS MUÑOZ, EUR. PARL., SSM AND SRB ACCOUNTABILITY AT EUROPEAN LEVEL: WHAT ROOM FOR IMPROVEMENTS?, 45 (2020); Otmar Issing, *Communication, Transparency, Accountability: Monetary Policy in the Twenty-First Century*, 87 FED. RSRV. BANK OF ST. LOUIS REV. 65, 67 (2005).

give a stylized perspective,[220] but it is deceivingly simplistic. Independence is not an "absolute right," but rather a conditional one. The rightness lies in granting a central bank the greatest degree of independence *in light of* what is acceptable in terms of accountability. Such arguments of accountability are closely linked to arguments of legitimacy.[221] In evaluating legitimacy, we differentiate between different types as the main challenge for central banks: *legal*, *sociological,* and *moral* legitimacy,[222] "input and output" legitimacy,[223] or a focus on democratic legitimacy.[224]

Second, in light of the above, the criticism based on central bank "independence" is one-sided. It focuses on the risk to central bank independence that arises from doing something about climate change. However, this downplays or altogether overlooks the risks that arise from ignoring it. Given the current carbon-bias of central banks' portfolio, a traditional approach could compromise central bank independence even more.[225] Without adequate foresight and proactivity, central banks may be beholden to industries and public finances dragged by the transition costs of becoming carbon neutral and may end up having to subsidize them.

Third, if instead of a univocal view of independence, we analyze independence-legitimacy as part of the same equation, a central bank that sidesteps climate change would seriously jeopardize its legitimacy both by failing to deliver long-term stability (output legitimacy) and by failing to assimilate factors that are increasingly perceived by society as relevant to justify the role of central banks' themselves.

Fourth, there is a conceptual problem with both the critics of central banks' climate-related actions[226] and the supporters who advocate for more "democratic guidance" by political bodies.[227] Both seem to

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[220] Rodolfo Dall'Orto Mas, et al., *The Case for Central Bank Independence: A Review of Key Issues in the International Debate* 15 (Euro. Cent. Bank, Occasional Paper Series No. 247, 2020).
[221] Boer & Klooster, *supra* note 218, at 1690.
[222] For the distinction between legal and sociological legitimacy we rely primarily on Richard H. Fallon, Jr., *Legitimacy and the Constitution*, 118 HARV. L. REV. 1787, 1791 (2005).
[223] FRITZ W. SCHARPF, GOVERNING IN EUROPE: EFFECTIVE AND DEMOCRATIC? 6-13 (1999); Richard Bellamy, *Democracy Without Democracy? Can the EU's democratic 'outputs' be separated from the democratic 'inputs' provided by competitive parties and majority rule?*, 17 J. EUR. PUB. POL'Y 2, 3 (2010).
[224] FABIAN AMTENBRINK, THE DEMOCRATIC ACCOUNTABILITY OF CENTRAL BANKS 2 (1999).
[225] Patrick Honohan, *Should Monetary Policy Take Inequality and Climate Change into Account?* 14–15 (Peterson Instit. for Int'l Econ., Working Paper No. 19-18, 2019); *see generally* Frank van Lerven & Josh Ryan-Collins, THE NEW ECON. FOUND., CENTRAL BANKS, CLIMATE CHANGE AND THE TRANSITION TO A LOW-CARBON ECONOMY (2017).
[226] *See* John H. Cochrane, Hoover Inst., Stanford Univ., Challenges for Central Banks, Comments at the ECB Conference on Monetary Policy: Bridging Science and Practice (Oct. 20, 2020). Reprinted with few modifications as John H. Cochrane, *Central Banks and Climate: A Case of Mission Creep*, HOOVER INSTITUTION (Nov. 13, 2020), https://www.hoover.org/research/central-banks-and-climate-case-mission-creep.
[227] Boer & Klooster, *supra* note 218, at 1695.

accept that there is a fixed idea of what is "inside" and "outside" central banks' mandate. Yet, neither central banks' founding legal texts nor central bank practice suggests that this idea is immutable. Rather, although there may be a "core" concept, a central bank mandate evolves in line with scientific knowledge, economic modelling, and social norms,[228] which each shape what phenomena impact price stability and must be duly accounted for.[229] As knowledge, models, and norms evolve, so do the ideas of legitimacy and accountability.[230]

4.2. Climate Change, Central Bank Tools And Actual Suitability Challenges.

Even if conventional wisdom objections do not seem convincing, that does not mean that assimilating climate change into central banks mandates has no actual challenges. We use some findings of previous sections to assert that climate change offers plenty of analogies to the ideas behind central banks' mandates (4.2.1.), but this poses challenges related to the friction between credibility and legitimacy (4.2.2.), credibility and proactivity (4.2.3.), and to credibility and conflict (4.2.4.).

4.2.1. Climate Change And Central Banks' Mandates: More Analogies Than Differences.

The description of the challenges to central banks' instruments depends on whether one believes that climate change will have a great impact on price, macroeconomics, and financial stability. If one does believe, like we do, that in light of scientific and economic evidence climate change presents a great economic impact,[231] then climate change does not present central banks with a new problem, but rather with a different version of the same problem that frames their mandate. Let us consider climate change in light of a traditional conception of the role of central banks:

> (i) Certain phenomena affect price stability. This happens with climate change, as it happens with exchange rates, supply and demand of goods, etc.
>
> (ii) Most phenomena fall outside the central bank's remit and tools, and central banks can only influence a narrow sub-set of those factors through a limited set of tools. This happens with carbon pricing (which is more directly shaped by taxes and regulation than by asset purchases and collateral frameworks), as it happens with wage setting (mode directly influenced by labor regulation or bargaining dynamics than interest rates).
>
> (iii) Central banks must make a wise use of the tools at their disposal as well as their communication strategy to

[228] Ramos et al., *Climate Change and Central Banks (Part 1)*, *supra* note 1, at 221.
[229] *Id.*
[230] *See supra* § 3.2 for the implications of this idea.
[231] *See supra* § 3.2.1.

chart a *credible* pathway for market players to adjust their behavior. This applies to traditional central bank policy as well as to a version that integrates climate change.

(iv) The above does not exclude government responsibilities (which encompass carbon pricing as well as wage-setting rules), but the rationale of entrusting central banks with *some* responsibility over this area is that citizens and political bodies are "time inconsistent". This time inconsistency is stronger with regards to climate change, where the time horizon is longer (and there are more opportunities to be inconsistent) and time inconsistency is compounded by uncertainty and ambiguity aversion.[232]

(v) Central banks should only opt for waiting and dealing with the shock after it arises if they are confident that they can control it better, but "cleaning" as the preferred option can be a mistake. This is the case for climate change and carbon intensive assets, as it was with leveraged asset bubbles.[233]

Once seen in more abstract terms, the similarities between climate change and other phenomena that affect price stability are striking. What is required is an adjustment of the mindset and the social norms underpinning reductionist views of central bank practice. However, this requires reconciling central banks' ability to chart a *credible* pathway, with their effort to change perceptions of what they can legitimately do.

4.2.2. Credibility, Effectiveness And Legitimacy: Persuasion V. Assertion, And Precommitment.

If the obstacle to assimilate climate change into central banks' mandate is not monetary policy but rather social norms, the answer to changing the mandates is to change those social norms. This process of change is partly driven by central banks themselves and by other political and social actors who must take into account a changed set of factors. This is linked to the idea of *legitimacy*, and its link with discussion and disagreement.[234]

At the same time, central banks need market players and society to change their expectations and adjust to the pathways set by central banks for actual change to happen. This accords with the idea of "central bank credibility" as "a commitment to follow well-articulated and transparent rules and policy goals"[235] or an expectation that deeds will follow

[232] *See supra* § 2.1.2
[233] Ramos et al., *Climate Change and Central Banks (Part 1)*, *supra* note 1, at 221 (§2.1.1).
[234] JEREMY WALDRON, LAW AND DISAGREEMENT 149-51 (Oxford Univ. Press 1999). *See also* Boer & Klooster, *supra* note 218, at 1689.
[235] *See generally* Michael D. Bordo & Pierre L. Siklos, *Central Bank Credibility: An Historical and Quantitative Exploration*, (Nat'l Bureau of Econ. Rsch., Working Paper No. 20824, 2015).

words.[236] Central banks' communication is relevant for central banks' effectiveness[237] and credibility,[238] and it helps to achieve results with a less intensive use of instruments.[239] We differentiate it from "transparency," which is part of the central bank's accountability.[240]

Although communication is an effective central bank tool, there is still no conclusive evidence on what constitutes an optimal communication strategy. It is not clear that saying more is necessarily more effective.[241] Furthermore, in the long-run communication with the aim to change social norms about what is "fit," "opportune," and "suitable" for central banks to do and communication to adjust market players' expectations may be aligned. However, during the (current) transitory period, central banks need to simultaneously convey that (i) what central banks do is correct (an exercise in *persuasion*), and (ii) that market players must adjust their expectations (an exercise in *determination*). This is challenging, as shown by the following examples.

(1) *Discussion vs. assertion.* First, when the goal is *persuasion*, it is normal to send "trial balloons" to gauge reactions, to present a plurality of views, and to start the discussion. The Federal Reserve has been doing that by including references to climate change in its November 2020 Financial Stability Report[242] or through a climate-vocal member, like Governor Lael Brainard[243] (similar examples are Mr. Ma Jun, for the PBoC,[244] or Mr. Elderson[245] or Mrs. Schnabel[246] for the ECB). ECB President Lagarde tends to express different arguments[247] in an

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[236] Monetary authorities are credible if "people believe it will do what it says." *See* Alan S. Blinder, *Central-Bank Credibility: Why Do We Care? How Do We Build It?*, 90 AM. ECON. REV. 1421, 1422 (2000) [hereinafter: Blinder, *Central-Bank Credibility*]. *See also* Grégory Levieuge et al., *Central Bank Credibility and the Expectations Channel: Evidence Based on a New Credibility Index*, 154 REV. WORLD ECON 493, 494 (2018).
[237] Alan S. Blinder et al., *Central Bank Communication and Monetary Policy: A Survey of Theory and Evidence* 55–56 (Nat'l Bureau of Econ. Rsch., Working Paper No. 13932, 2008) [hereinafter: Blinder et al., *Central Bank Communication*].
[238] Michael D. Bordo & Pierre L. Siklos, *Central Bank Credibility Before and After the Crisis*, 28 OPEN ECONS. REV. 19, 44 (2017).
[239] *See* Selva Demiralp & Oscar Jordá, *The Announcement Effect: Evidence from Open Market Desk Data*, 8 FED. RSRV. BANK N.Y. ECON. POL'Y REV. 21 (2002). If communication is good, they do not have to move policy rates too much to influence the yield curve in the desired direction. Levieuge et al., *supra* note 236, 494.
[240] *See* text *supra* at § 3.3.
[241] Blinder et al., *Central Bank Communication*, *supra* note 237, at 57–58.
[242] BD. OF GOVERNORS OF THE FED. RSRV. SYS., FINANCIAL STABILITY REPORT – November 2020 58–59 (2020).
[243] Lael Brainard, Why Climate Change Matters for Monetary Policy and Financial Stability, at the Economics of Climate Change, a Research Conference Sponsored by the Federal Reserve Bank of San Francisco (Nov. 8, 2019).
[244] Ma Jun, *Financing Carbon Neutrality in China*, China Daily (Jan. 26, 2021, 8:12 AM), http://www.chinadaily.com.cn/a/202101/26/WS600f5e79a31024ad0baa4ff7.html.
[245] Frank Elderson, *Greening Monetary Policy*, THE ECB BLOG (Feb. 13, 2021), https://www.ecb.europa.eu/press/blog/date/2021/html/ecb.blog210213~7e26af8606.en.html.
[246] Schnabel, "When Markets Fail," *supra* note 169.
[247] *See, e.g.*, Christine Lagarde, President of the ECB, "Climate change and central banking", (Speech at the ILF Conference on Green Banking and Green Central Banking) (Jan. 25, 2021) (transcript available at

academic, seminar-like fashion. This may be useful if the goal is to persuade or to show the public that the central bank's view benefits from diverse views, extensive debate, and a careful weighing of all arguments.[248] However, the lack of a univocal message or single-minded focus can affect credibility,[249] and not all messages by high-ranking officers need to be equally credible.[250] It may also be co-dependent with the institutional context. For example, the Federal Reserve has traditionally spoken more with a plurality of voices,[251] while the ECB (at times) more with a single voice.[252] Changing communication policy for climate change purposes can also affect the general predictability and credibility of the central bank.

(2) *Positive v. negative messages*. Second, when the goal is *persuasion*, it is preferable to send a *positive* message to the public in order to sum arguments in a certain position's favor and to show alignment with the values of society and its elected representatives. However, when it comes to *credibility*, a central bank often signals its independence by giving negative or otherwise unpopular messages[253] as long as the central bank is clear and transparent.[254] This is something that can be obscured if the bank lumps together multiple arguments to support its actions. Worse still, a central bank that is "too supportive" of society's values and government aims can undermine its own credibility. Consider, for example, the focus on "promoting" ESG, or "value-driven" investment. This may be good for persuading a more active role on

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https://www.ecb.europa.eu/press/key/date/2021/html/ecb.sp210125~f87e826ca5.en.html) ("Clearly, central banks are not the main actors when it comes to preventing global heating...We are seeing a new political willingness among regulators and fiscal authorities to speed up the transition to a carbon neutral economy...This increased action is often considered as a source of transition risk, which we need to take into account and reflect in our policy framework. This is not "mission creep", it is simply acknowledging reality").

[248] *See* Governor Ben Bernanke, Remarks at the Meetings of the American Economic Association (Jan. 3 2004) (transcript available at http://www.federalreserve.gov/boarddocs/speeches/2004/200401032/default.htm).

[249] This is the so-called "cacophony problem" See ALAN BLINDER, THE QUIET REVOLUTION: CENTRAL BANKING GOES MODERN 61 (2004) [hereinafter: BLINDER, THE QUIET REVOLUTION]. *See also* Michael Ehrmann & Marcel Fratzscher, *Communication by Central Bank Committee Members: Different Strategies, Same Effectiveness?* 39 J. OF MONEY, CREDIT, & BANKING 509, 511–12 (2007).

[250] Studies on central bank communication suggest that there is little evidence that the timing, sequencing, or content of communication matters in immediate response by financial market operators. The market seems to concentrate on the communication of key members within the central bank. *See generally* Pavel Gertler & Roman Horvath, *Central bank communication and financial markets: New high-frequency evidence*, 36 J. OF FIN. STABILITY 336 (2018) and authorities cited therein.

[251] *See* BLINDER, THE QUIET REVOLUTION, *supra* note 249, at 35.

[252] *See* Otmar Issing, *The Eurosystem: Transparent and Accountable, or 'Willem in Euroland* 10 (European Central Bank, CEPR Policy Paper No. 2, 1999) (explaining this single voice communication in light of the ECB's institutional context). However, for evidence that showing diverse preferences was more common in the initial years of the EMU see David-Jan Jansen & Jakob De Haan, *Look Who's Talking: ECB Communication During the First Years of EMU*, 11 INTL. J. OF FIN. & ECON. 219 (2006).

[253] Bordo & Siklos, *supra* note 238, at 19–45.

[254] *See* Blinder, *Central-Bank Credibility*, *supra* note 236, at 1429–31. See also from the same author, *Financial Crises and Central Bank Independence*, 48 BUS. ECON. 163 (2013).

climate change, but it dilutes a clearer focus on climate change and price stability.[255]

In fact, central banks and their officials are doing little to separate arguments on risk and stability from broader arguments on sustainability. This can be seen in a recent speech by ECB President Lagarde.[256] This can also be seen even more clearly in the Swiss national Bank (SNB) Annual Report for 2020,[257] which includes "Climate change – a challenge for monetary policy, financial stability and investment policy," in its chapter on monetary policy. In that chapter, the SNB indicates climate change's relevance for the SNB's *mandate*,[258] but the only precise consequence is dealt with in the chapter on "investment policy." There climate change is mixed with "environment," "human rights" and "values,"[259] and indicates that "[t]he reason for expanding the environmental criterion is that there is a broad consensus in Switzerland in favour of phasing out coal."[260] This sounds like a company's Corporate Social Responsibility policy (and has similar credibility) and, even worse, suggests that the SNB changed due to public pressure. As a third example, the Bank of Japan's recent program of "Climate Response Financing Operations"[261] fulfils the BoJ's earlier pledge to promote

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[255] A 2020 publication under the aegis of Banque de France and the BIS highlights as a key response to climate change, "Promoting sustainability as a tool to break the tragedy of the horizon – the role of values" and suggests that central banks should "disseminate the adoption of so-called environmental, social and governance (ESG) standards in the financial sector, especially among pension funds and other asset managers". BOLTON ET AL., *supra* note 173, at 53. The Report accurately points that "one should not confuse ESG- or green-tilted portfolios with hedging climate related risks", and that "The main benefit of promoting a sustainable finance approach, including through ESG, may actually not lie in the greater impetus for asset managers to reduce their exposure to climate-related risks, but rather in broadening the set of values driving the financial sector". *Id.* at 54. Yet, it is unclear whether market participants will be able to tell the difference.

[256] EUR. PARL. DEB. (13) (Feb. 8, 2021) (remarks of Christine Lagarde).

[257] SWISS NAT. BANK, *113th Annual Report Swiss National Bank 2020* (Feb. 26, 2021), https://www.snb.ch/en/mmr/reference/annrep_2020_komplett/source/annrep_2020_komplett.en.pdf.

[258] "The assessment of possible consequences of climate change for the economy and thus for monetary policy, for financial stability and for the management of currency reserves is important in order for the Swiss National Bank to be able to fulfil its statutory mandate." Climate change affects monetary policy via structural economic changes, political and regulatory changes, and their impact in price stability and financial stability, as well as in investment policy, triggering or amplifying market fluctuations, and affecting the attractiveness of the assets. *Id.* at 14.

[259] In the investment section, the Report states that the Swiss National Bank has excluded companies that "seriously violate fundamental human rights, systematically cause severe environmental damage or are involved in the production of internationally condemned weapons" and then adds that "At the end of 2020, the SNB expanded the exclusion criterion pertaining to the environment by additionally taking climate-related issues into consideration. Shares and bonds of companies primarily active in the mining of coal are now also excluded." *Id.* at 17, 57. These ideas are developed in Chapter 5.3. on "Asset management", under "Non-financial aspects of managing securities of private sector issuers", where the SNB puts together the exclusion of systemically important banks, of weapons manufacturers, and companies causing severe environmental damage.

[260] *Id.* at 94.

[261] The idea is to supply funds, "so that financial institutions that disclose a certain level of information on their efforts to address climate change can receive funds from the

climate disclosures,[262] but it is built to be a subsidy scheme, which may cause distortions and resource misallocation. More importantly, if this is seen as part of the BoJ's role of "following" government initiatives,[263] it may undermine its long-run credibility.

(3) *Credibility now and future.* The third, and perhaps the most difficult challenge from both a persuasion and credibility perspective, is to convince the public that a proactive approach is needed, because acting "too late" may be worse. However, for a central bank this means acknowledging that it should deal with the problem now, because it may be unable to do so later.[264] Admitting impotence (even if it is future impotence) is hard for a central bank.[265] Perhaps this is why the more climate-vocal central bank officials often refer to "the costs" of acting too late.[266] The use of the term is logical if the aim is to *persuade* about the benefits of early action. However, it does not clarify why central banks can, and should, act early. Thus, the effects of this message on *credibility* are unclear.

Conclusion: precommitment and communication. Is there a way to reconcile these competing needs? The optimal strategy would, again, draw from the lessons of traditional central banking. Central banks can use precommitment[267] as a way to reduce *both* the time inconsistency associated with price stability phenomena and the uncertainty of climate change through mitigation and adaptation pathways.[268] By pre-committing to assimilate climate change mitigation and adaptation strategies into its policy toolkit, central banks can help economic actors to adjust their own expectations.[269] This precommitment can also address

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Bank against their investment or loans made as part of such efforts." *Outline of Transactions for Climate Response Financing Operations*, BANK OF JAPAN (Nov. 26, 2021), https://www.boj.or.jp/en/mopo/measures/mkt_ope/ope_x/opetori22.htm.

[262] *The Bank of Japan's Strategy on Climate Change*, BANK OF JAPAN (July 16, 2021), https://www.boj.or.jp/en/about/release_2021/rel210716b.pdf.

[263] As reported by the public broadcaster NHK, "Until recently, the BOJ seemed almost reluctant to support green loans. The bank had taken the view that fighting climate change does not fall within its traditional mandate of achieving price stability and ensuring financial stability. But with the Suga administration endorsing measures to tackle climate change and reach net-zero carbon emissions by 2050, the BOJ has quickly changed tack." Sakurai Reiko, *Why the Bank of Japan is going Green*, NHK WORLD – JAPAN (Aug. 3, 2021), https://www3.nhk.or.jp/nhkworld/en/news/backstories/1730/.

[264] Ramos et al., *Climate Change and Central Banks (Part 1)*, *supra* note 1, at 259.

[265] When it comes to credibility, two important factors are the ability of a central bank to fulfil its commitments, and the transparency of its communication and decision-making. With traditional monetary policy the two aspects tend to be aligned. Blinder, *Central-Bank Credibility*, *supra* note 236, at 1422–23.

[266] "Delayed actions to tackle climate change entail higher costs." Schnabel, "When Markets Fail," *supra* note 169.

[267] *See generally* Richard Clarida et al., *The Science of Monetary Policy: a New Keynesian Perspective*, 37 J. ECON. LITERATURE 1661 (1999); Luc Maresta & Thom Thurston, *Measuring the value of central bank commitment in the benchmark New Keynesian model*, 58 J. MACROECONOMICS 249 (2018).

[268] Ramos et al., *Climate Change and Central Banks (Part 1)*, *supra* note 1, at 226.

[269] *See, e.g.*, Dan Ariely & Klaus Wertenbroch, *Procrastination, Deadlines, and Performance: Self-control by Precommitment*, 13 PSYCH. SCI. 219 (2002); Nava Ashraf et al., *Tying Odysseus to the Mast: Evidence from a Commitment Savings Product in*

the ambiguity aversion problem by showing that behavioral adjustments are needed because, even on a best-case scenario, climate change can have drastically negative effects.[270] Arguably, the ECB is an example of this. In its Strategy Review, accomplished in 2021, it included climate change as one of its main pivotal points.[271] What is more, it formulated a "climate change action plan" to include climate change considerations into its monetary policy.[272] This action charted a roadmap that was both reasonably comprehensive[273] and, above all, *long-term* (encompassing the period 2021-2024). This is a way to clearly signal that the central bank is "all in," and thus economic agents should begin adjusting their behavior accordingly.

At the same time, it is important not to conflate "commitment" and "communication."[274] Part of central banks' strategy must consist in more communication in order to make room for updates or changes of course, as policy will become prone to errors:[275] Long-term commitment needs to be fixed, while communication needs to make room for flexibility.

4.2.3. Credibility, Uncertainty And Fallibility: Coming To Terms With Trial-And-Error Central Banks.

The previous point emphasizes central banks' challenge to reconcile "credibility" with "legitimacy" in their communication strategy. That focuses primarily on the idea of "input legitimacy." However, central banks are also (some would say, primarily) dependent on "output legitimacy,"[276] i.e., their lack of democratic credentials is tolerated due to their ability to "deliver the goods" or achieve their goals more reliably than political bodies. This would be significantly harder if climate change is incorporated into their mandate. Conditions of deep uncertainty make it difficult to anticipate climate-related shocks, as well as the effects of central bank operations and tools will have in the economy.[277] Merely because the effect of central banks' tools on climate change is uncertain does not mean they should abstain from using them altogether. The reality of climate change is here and represents a risk for credibility and output legitimacy either way. As social norms evolve among central banks and public opinion, the safer bet is to do something.

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the Philippines, 121 Q. J. ECON. 635 (2006); Seffano DellaVigna & Ulrike Malmendier, *Paying Not To Go To the Gym*, 96 AM. ECON. REV. 694 (2006).
Ramos et al., *Climate Change and Central Banks (Part 1)*, *supra* note 1, at 226.

[271] The ECB's monetary policy strategy statement, EUR. CENT. BANK, *The ECB's monetary policy statement*, (last visited Mar. 15, 2023) https://www.ecb.europa.eu/home/search/review/html/ecb.strategyreview_monpol_strategy_statement.en.html.

[272] ECB presents action plan to include climate change considerations in its monetary policy strategy. *See* EUR. CENT. BANK, *supra* note 168.

[273] *Id.* (the action plan includes disclosures, climate risks, operations, collateral frameworks and corporate sector purchase programs).

[274] Bordo & Siklos, *supra* note 238, at 20 n.1.

[275] Blinder et al., *Central Bank Communication*, *supra* note 237, at 9.

[276] Richard Bellamy, *supra* note 223, at 9.

[277] Isabel Schnabel, *Climate Change and Monetary Policy*, INT. MONETARY FUND (Sep. 2021) https://www.imf.org/en/Publications/fandd/issues/2021/09/isabel-schnabel-ECB-climate-change.

The question is what. In this regard, the number of issues and variations is very large, but some elements are particularly relevant.

(1) Modeling. There is a disconnect between climate and central bank macroeconometric models.[278] Some important advances have been made, such as Dynamic Integrated model of Climate and the Economy (DICE).[279] Other authors have pointed at wide discrepancies on costs and discount factors,[280] or stress the risk of misspecification.[281] Small details can result in wide changes, limiting the accuracy of central bank models.

(2) Green-micro, v. brown-macro. In line with their aim to *persuade* the market and the public, central banks are creating programs to incentivize climate risk disclosures, green lending, or to increase their portfolio of "green" assets. Such credit allocation (or guidance[282]) may be a path of minimum resistance, but it may undermine central banks' credibility. It could do this by: (i) placing into question their sincere belief that climate change is a systemic phenomenon which affects *all* issuers; and (ii) engaging central banks in a micro-level allocation of funds, a subsidy-like process that can create important distortions,[283] which places central banks dangerously close to fiscal policy[284] and exposes them to new challenges (legal and otherwise). Studies suggest a "brown" factor across the board is more effective.[285] It would be particularly effective to bolster central banks' credibility. It would help to see climate change as just another price stability challenge (with unique, but also common features), which must be tackled by charting an adequate plan, and sticking to it.

(3) Network theory implications. We have argued that climate-related shocks can be amplified and shaped by financial markets' network structure. This, in our view, makes the case for early action, as it reinforces the argument that central banks may be unable to rein in the instability once the shocks strike, not just manipulating the network

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[278] Drudi et al., *supra* note 155, at 62.
[279] William D. Nordhaus, *Revisiting the Social Cost of Carbon*, 114 PROC. OF THE NAT'L ACAD. OF SCIS. 1518, 1518 (2017).
[280] GERNOT WAGNER & MARTIN L. WEITZMAN, CLIMATE SHOCK: THE ECONOMIC CONSEQUENCES OF A HOTTER PLANET xiii (2015); Martin L. Weitzman, *GHG Targets as Insurance Against Catastrophic Climate Damages*, 14 J. OF PUB. ECON. THEORY 221, 239 (2012).
[281] Simon Dietz et al., *Are Economists Getting Climate Dynamics Right and Does it Matter?* 27–28 (Ctr. for ECON. Stud., Working Paper NO. 900, 2020).
[282] Agnieszka Smoleńska & Jens van't Klooster, *A Risky Bet: Should the EU Choose a* Microprudential or *a* Credit Guidance *Approach to Climate Risk?* 18 (Eur. Banking Inst., Working Paper No. 104, 2021).
[283] Credit guidance was typical in post-World War II planned economy. *See* Dirk Bezemer et al., *Credit Where It's Due: A Historical, Theoretical and Empirical Review of Credit Guidance Policies in the 20th Century* (UCL Inst. for Innovation and Pub. Purpose Working Paper Series 2018–11, 2018).
[284] Ramos et al., *Climate Change and Central Banks (Part 1)*, *supra* note 1, at § 2.2.1.
[285] "Although additional research is needed, it seems that discussions are evolving towards favouring a "brown penalising factor" as more appropriate. Exposure to "brown" assets can increase financial risks, but it is not obvious why being exposed to "green" sectors would necessarily reduce non-climate-related financial risks, and thereby justify lower capital requirements". BOLTON, ET AL., *supra* note 159, at 52.

topology. The network structure is somewhat inevitable in financial markets, and central banks know more about the causes of climate change than about how different network structures shape (in)stability and are, in turn, shaped by monetary/prudential policy.[286]

That does not mean that central banks cannot tackle climate change's *causes* while simultaneously addressing *network externalities* as a source of fragility. The insights of network theory can also help with some issues. For example, it cautions about the use of certain prudential tools, such as the "large exposures" regime, which cap the maximum exposure to specific parties[287] if that exposure leads to more interconnectedness beyond what is efficient.[288] The insights of network theory can also be used to craft policies to isolate the "browner" nodes into large, but isolated components. This promises to be conflictive.[289]

(4) Monetary-prudential coordination. All the above will, in turn, require a better coordination between monetary policy and prudential supervision. The impulses given through asset purchases, operations or collateral frameworks need to be consistent with the approach by macroprudential requirements, or microprudential risk weights. This may be relatively easier in integrated structures, where prudential regulation and supervision is exercised by the same authority as monetary policy; harder when the tasks are dispersed across different institutions.[290] It may be the hardest in the EU, where there is a horizontal *and* vertical dispersion of competences, and judicial review also operates on two vertically differentiated levels (supranational and national[291]):

Conclusion: central banks, climate change … and humility? The above are but examples of what comes next: central bank tools need to be re-fitted to account for climate change, and climate-related risks. However, the most important challenge is that there is not only uncertainty about climate change, but also about the effect of central bank instruments used to tackle it. Setting a credible pathway involves central bank tools working well and economic agents adjusting their preferences accordingly. In practice, this process of adjustment will involve blunders and frictions. Authors suggest that central banks' communications can undermine their credibility if projected developments do not materialize,[292] if forecasts are confused with commitments,[293] or if biases impact the interpretation of central bank

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[286] Ramos et al., *Climate Change and Central Banks (Part 1)*, *supra* note 1, at § 2.2.1.
[287] Schoenmaker & Van Tilburg, *supra* note 184, at 326–27.
[288] Equilibrium networks are more interconnected than what is efficient. A cap on individual (or industry-wide) exposures may result in replacing a few large exposures with a greater number of small exposures, thus increasing interconnectedness. This can mean that it will be likelier for large shocks to find their way to all the nodes of the network. *See supra* § 3.1.1.
[289] Ramos et al., *Climate Change and Central Banks (Part 1)*, *supra* note 1, at § 2.2.3.
[290] *Id.* at § 2.1.5.
[291] *Id.* at §§ 2.1.5, 2.2.1, and 2.2.2.
[292] Issing, *supra* note 219, at 71.
[293] Charles A.E. Goodhart, *Monetary Transmission Lags and the Formulation of the Policy Decision on Interest Rates*, 83 FED. RSRV. BANK OF ST. LOUIS REV. 165, 175

communications. However, they also suggest that more communication can improve guidance in times of great uncertainty,[294] and that the success of communication can also depend on the quality of information disclosed.[295]

Thus, climate change strategy may be framed as a "foundational moment." It entails central banks' "precommitment" strategy as part of a new, broader social contract, where societal and governmental actors accept that an unelected body (like a central bank) precommits to a long-term strategy for climate change. This process can be prone to errors, but it is done in exchange for central banks being part of the conversation and the public being regularly updated with high-quality information. So far, no central bank has dared to be candid enough to say that fallibility and trial-and-error need to be part of the new social contract for central banks. In our view, given that this requires a change of mindset, they should start to do so, and quickly.

4.2.4. Credibility And Conflict: "Engaged" And "Stern" Central Banks.

Central banks' credibility depends on communication, and even more on a history of delivering on their promises.[296] For climate change, central banks must be particularly determined to deliver on their proposed promises. Their communication must balance persuasion and assertion, and their implementation will be mired with uncertainty and the risk of mistakes, considering that there is no valid precedent for climate change's impact. Success will depend on central banks' ability to face and withstand conflict, of which we outline at least three examples.

(1) First, *conflicts with industry*, which should result from the weighing of climate-related factors in asset purchases, collateral frameworks, or prudential assessment of risks. Once central banks realize that a "green supporting factor" is insufficient and may be distortive, they may start using varying shades of brown penalizing factors. This will create conflicts with industry, and raise allegations of discrimination.

(2001). *See generally* Frederic S. Mishkin, *Can Central Bank Transparency Go Too Far?*, *in* THE FUTURE OF INFLATION TARGETING 48–65 (Christopher Kent & Simon Guttmann eds., 2004). Caution against announcing the path of the policy rate because the public may not understand that the projection is conditional, and may be mistaken for a commitment. However, in favor of publishing projections of future paths of rates, see Lars E.O. Svensson, *The Instrument-Rate Projection under Inflation Targeting: The Norwegian Example*, *in* STABILITY AND ECONOMIC GROWTH: THE ROLE OF CENTRAL BANKS 175–98 (Banco de Mexico, 2006); Michael Woodford, *Central-Bank Communication and Policy Effectiveness*, *in* THE GREENSPAN ERA: LESSONS FOR THE FUTURE 399–474 (Fed. Rsrv. Bank of Kansas City, 2005).

[294] David-Jan Jansen & Jakob de Haan, *Talking Heads: The Effects of ECB Statements on the Euro-Dollar Exchange Rate*, 24 J. OF INT'L. MONEY & FIN. 343, 359 (2005).

[295] ANDREA FRACASSO ET AL., HOW DO CENTRAL BANKS WRITE?: AN EVALUATION OF INFLATION REPORTS BY INFLATION TARGETING CENTRAL BANKS 11 (Int'l Ctr. For Monetary and Banking Stud. & Ctr. for Econ. Pol'y Rsch., 2003).

[296] Blinder et al., *Central Bank Communication*, *supra* note 237, at 22.

(2) Second, *conflicts with governments.* Transition risks depend on the pace and intensity of governments' climate-related policies. Thus, a central bank that genuinely believes that climate change impacts price stability needs to assess their effects in light of what is needed.

This contrasts with the picture given by critics of central banks' involvement in climate change, who see it as a sort of subordination to government policies. In our view, a central bank's actual role is that of the impartial spectator, objective valuer, and stern disciplinarian. *If* a central bank believes that climate change has an impact on price, financial, and macroeconomic stability, its duty is (i) to set its stability goals; (ii) to identify the pathway to achieve them; (iii) to use that yardstick to assess the credibility of government policies (like, for example, finding that currently disappointing abatement efforts must be balanced by greater efforts in the future); and then (iv) to adjust its tools accordingly. This includes, in extreme cases, discounting the assets of governments (or companies affected by the policies). Far from alien, this is business-as-usual for central banks. They constantly cast judgment on policies that fall outside their remit (e.g., labor and employment policies), but have an impact in their objectives, and adjust their instruments in light of them. Accepting the idea of conflict with governments, and using communication to air that conflict, is part of what leads to central bank credibility.[297] The public image of central bankers is not "rosy", but rather it is stern. All this is needed for climate change.

(3) Third, there are *multipolar conflicts*, resulting from the insights of complexity and network theory. The ideas of complexity indicate that action from central banks cannot wait, and they allow to understand which goals interventions should pursue and even what type of intervention may be required. Thus, it can be shown that the distribution of shocks plays an important role in the configuration of optimal financial networks.[298] If the solution that is rational for individual players

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[297] Linda Goldberg & Michael Klein, *Establishing Credibility: Evolving Perceptions of the European Central Bank* 4 (Nat'l Bureau of Econ. Rsch., Working Paper No. 11792, 2005) (finding that the ECB's credibility in financial markets improved after it went into its first tightening cycle), and Michael Bordo et al., *Three Great American Disinflations* 37 (Nat'l Bureau of Econ. Rsch., WORKING PAPER No. 12982, 2007) (finding that it is particularly important for a central bank to communicate an aggressive policy stance, if it starts with relatively low credibility). *See* Bordo & Siklos, *supra* note 62, at 36 and citations therein, including a quote from Karl Blessing, President of the Bundesbank from 1958 to 1969, who said that: "A central bank which never fights, which at times of economic tension never raises its voice . . . that central bank will be viewed with mistrust."; Tobias Adrian & Ashraf Khan, *Central Bank Accountability, Independence, and Transparency*, IMF BLOG (Nov. 25, 2019), https://blogs.imf.org/2019/11/25/central-bank-accountability-independence-and-transparency/.

[298] Antonio Cabrales et al., *Risk-Sharing & Contagion in Networks*, *supra* note 21, at 3112–13. The model focuses on inefficiencies that arise in the process of decentralized network creation, because of contracting externalities that arise through transmission of climate shocks. Specifically, we consider a financial network with borrowers and investors. The borrowers need the support of an investor to take to fruition a risky opportunity. The investors provide the capital to the borrowers, as well as insurance and

leads to a network topology that is over connected and exposes the network to systemic collapse, the optimal intervention may consist in severing the ties with some components of the network. In other words, if some components of the network could be overexposed to climate risks and a proactive approach is insufficient, the solution for the central bank would be to force other players to cut the ties to the specific component. This would clearly raise conflict with the corresponding agents (e.g., banks or industries) and their jurisdictions, and the response to it would be key to bolster the central bank's credibility.

4.3. Arguments Of Suitability ("How"): Legitimacy, Accountability And Judicial Review.

The previous sections shows that both critics and advocates of central banks' active role in climate change look at the matter backwards. If a central bank *does not believe* that climate change has anything to do with its mandate, then it will have to address climate change once it becomes an active threat. Thus will either be dragged into it reluctantly or use it as an opportunity to seize more power, both disingenuous reactions. Instead, if a central bank *genuinely* believes (like we do) that climate change (1) presents a major problem of price, financial, and macroeconomic stability, and (2) that central banks are more "time consistent" than governments, the natural reaction should be to treat the issue matter-of-factly, adjust the horizon for the use of certain tools (asset purchases, operations, collateral frameworks, and prudential tools), and stick to its commitment, crafting an adequate message to that effect. This, in turn, will inevitably lead to conflicts with industry and governments.

In this latter scenario, the institutional reaction should be to bolster the central bank's legitimacy and accountability.[299] This requires a

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hedging opportunities to one another. As a result, investors enjoy direct and indirect benefits from linking with one another. Borrowers, on the other hand, benefit from having a connection with an investor, which provides with the opportunity to realize their opportunity. However, there is a cost to both direct and indirect connections, as they can create a chain of financial shocks and defaults if their investment fails to deliver. The key assumption we will make is that contracting is bilateral, so that a borrower can compensate her investor for the possible direct harm inflicted, but indirect connections do not get a compensation.

[299] *See generally* AMTENBRINK, *supra* note 23; MENELAOS MARKAKIS, ACCOUNTABILITY IN THE ECONOMIC AND MONETARY UNION: FOUNDATIONS, POLICY AND GOVERNANCE (2020); Jakob De Haan & Sylvester C.W. Eijffinger, *The Democratic Accountability of the European Central Bank: A comment on Two- Fairy Tales*, 38 J. COM. MKT. STUD. 393 (2000); Chiara Zilioli & Martin Selmayr, *The European Central Bank: An Independent Specialised Organization of Community Law*, 37 COMMON MKT. L. INT'L. 591(2000); Fabian Amtenbrink & Kees van Duin, *The European Central Bank before the European Parliament: Theory and Practice after Ten Years of Monetary Dialogue*, 34 EUR. L. REV. 561 (2009). On financial supervision, see Eva Hüpkes et al., *The Accountability of Financial Sector Supervisors: Principles and Practice* (Int'l Monetary Fund, Working Paper No. WP/05/51, 2005); Rosa Lastra & Heba Shams, *Public Accountability in the Financial Sector*, *in* REGULATING FINANCIAL SERVICES AND MARKETS IN THE 21ST CENTURY 165–88 (Eilís Ferran and Charles Goodhart eds., 2001). On the issues of the EU Banking Union, see Marco Lamandini & David Ramos Muñoz, *Banking Union's Accountability System in Practice. A Health Check-Up to Europe's Financial Heart* (Nov. 16, 2020), http://dx.doi.org/10.2139/ssrn.3701117 and the references cited therein.

renewed focus on two aspects. First, information needs to flow more freely to justify the independence needed. Yet, we must not conflate effective communication[300] with transparency and accountability.[301] Both are based on information but they are different. Communication is about what serves the goals of the central bank; transparency about what serves the interest of the public and the constitution.

The US offers the more extensive experience. The Freedom of Information Act (FOIA) provides that administrative agencies must make reasonable efforts to search for the requested information *unless* specific statutory exceptions apply.[302] The agency bears the burden of proving the exception,[303] but the courts have the power to review the matter *de novo* (i.e., strict standard of review), examining the information *in camera*.[304] Although often the reasons given by the agency for denying the FOIA request are logical or plausible, parties can bring contrary evidence.[305] If an exception applies, the agency will still often disclose a separable part of the document.[306] With regards to the US central bank, the courts have not granted the Federal Reserve's bodies a special treatment.[307] Although they have respected the exception for internal documents (Exception 5[308]), they have not granted the Federal Reserve full discretion to decide what is confidential.[309] They have also interpreted strictly allegations that disclosure could undermine the effectiveness of the program.[310] However, they have applied more liberally the exception of confidentiality of information relating to the regulation or supervision of financial institutions.[311]

The EU picture is more troublesome.[312] The general provisions on transparency and access to documents are article 15 of the TFEU. Access

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[300] Ramos et al., *Climate Change and Central Banks (Part 1)*, *supra* note 1, at § 2.2.1
[301] *Compare* Lamandini & Ramos Muñoz, *supra* note 299, and Issing, *supra* note 219, at 65–83 (focusing on what is an "efficient level of information"), *with* Deirdre Curtin, *Accountable Independence of the European Central Bank: Seeing the Logics of Transparency*, 23 Eur. L. J. 28, 28−44 (2017) (considering transparency to be a good in itself, and criticizes the "transparency as communication" view of the ECB which seems also present in Issing's view).
[302] 5 U.S.C. § 552(a)(3)−(b).
[303] Ball v. Bd. of Governors of Fed. Res. Sys., 87 F.Supp.3d 33, 40−41 (D.D.C. 2015).
[304] 5 U.S.C. § 552(a)(4)(B).
[305] Ball, 87 F.Supp.3d at 42.
[306] 5 U.S.C. § 552(b).
[307] Fed. Open Mkt. Comm. of Fed. Red. Sys. *v.* Merrill, 443 U.S. 340, 340−65 (1979) (the court treated the FOMC as an "agency").
[308] 5 U.S.C. § 552(b)(5) (providing an exemption for matters that are "inter-agency or intra-agency memorandums or letters").
[309] Merrill, 443 U.S. at 355.
[310] Fox News Network, LLC v. Bd. Of Governors of the Fed. Res. Sys., 639 F.Supp.2d 384 (S.D.N.Y. 2009); Bloomberg L.P. v. Bd. Of Governors of the Fed. Res. Sys., 649 F. Supp. 2d 262 (S.D.N.Y. 2009); *aff'd* 601 F.3d 143 (2d Cir. 2010).
[311] Mermelstein v. SEC, 629 F. Supp. 672, 673–75 (D.D.C. 1986); Feshbach v. SEC, 5 F. Supp. 2d 774, 781 (N.D. Cal. 1997); Consumers Union of the U.S., Inc. v. Heimann, 589 F.2d 531, 533 (D.C. Cir. 1978).
[312] *See* Lamandini & Ramos Muñoz, *supra* note 299.

to documents is subject to Regulation 1049/2001 (Access Regulation).[313] However, the ECB has relied on its special constitutional status to issue its own Decision on Access to Documents.[314]Although inspired by the Access Regulation, it presents clear differences,[315] including on: (i) framing (Access Regulation regulates "principles, conditions and limits" on access to documents; ECB Decision only "conditions and limits");[316] (ii) absolute exceptions (the Access Regulation includes a short list of "public interest exceptions", and does not refer to "confidential information"; the ECB Decision includes a long list of exceptions, and expressly protects confidential information);[317] and (iii) treatment of internal documents and deliberations (conditional exception in the Access Regulation, absolute exception in the ECB Decision).[318]

In addition, different EU financial regulatory rules, including the Markets in Financial Instruments Directive (MiFID), the Capital Requirements Directive (CRD), etc., have their own specific provisions on "confidentiality" or "secrecy."[319] This results in a patchwork quilt of rules that hinders any attempt to have a "general law of financial transparency" with exceptions, and often seems more a "law of secrecy" with concessions to transparency. In our view, although the ECB has become a more communicative institution, being transparent means providing information also when it is inconvenient to do so. EU courts have sought to promote consistency and rely on general principles by using the Access Regulation to interpret MiFID confidentiality provisions, like in the 2018 case of *Buccioni*.[320] Other ways EU courts have ruled were using a MiFID-based case like *Buccioni* as a valid precedent to weigh transparency against confidentiality in a case based on a different legal text (such as CRD) in the 2018 case of *Baumeister*,[321] and using fundamental rights like judicial protection as background principles as in the 2018 case of *UBS*[322] (as well as in *Buccioni*). So far, however, the Courts have been quite deferential to institutions like the ECB when it comes to accepting their reasons for non-disclosure, as it

[313] Regulation (EC) No. 1049/2001 of the European Parliament and of the Council of 30 May 2001 (regarding public access to European Parliament, Council and Commission documents).
[314] European Central Bank Decision on public access to European Central Bank documents (ECB/2004/3) (March 4, 2004) as modified by ECB Decisions ECB/2011/6 and ECB/2015/1.
[315] For a general (critical) approach towards the ECB/2004/3 see, e.g., Päivi Leino-Sandberg, *Public Access to ECB Documents: Are Accountability, Independence and Effectiveness an Impossible Trinity?*, ECB LEGAL CONF. PROCEEDINGS (2019) at 195.
[316] Access Regulation Article 1; ECB Decision Article 1.
[317] Access Regulation Article 4(1); ECB Decision Article 4(1).
[318] Access Regulation Article 4(3); ECB Decision Article 4(3).
[319] René Smits & Nikolai Badenhoop, *Towards a single standard of professional secrecy for supervisory authorities – A reform proposal*, 44 E. L. REV. 295, 298 (2019).
[320] C-594/16, Enzo Buccioni v. Banca d'Italia, 2018 EU:C:2018:717.
[321] C-15/16, Bundesanstalt für Finanzdienstleistungsaufsicht v. Ewald Baumeister, 2018 EU:C:2018:464.
[322] C-358/16, UBS Europe and Alain Hondequin and Others v. DV and Others, 2018 EU:C:2018:715.

happened in the cases of *Banco Espirito Santo (I* or *II*[323]) or *De Masi.*[324] Furthermore, even if the Courts took a decisive step towards transparency, amending the existing framework, which was formed by dispersed and disparate rules, would probably be a necessary step.

Second, the relationship between central banks and political bodies must be reconsidered. "Accountability", after all, entails a forum, the giving of explanations, and a "judgment."[325] Some authors propose a greater emphasis on "democratic guidance" by political bodies.[326] For example, this can be seen with the Bank of England's objectives of both price stability and the government policies that the central bank has to support.[327] Yet, we have serious doubts about this. If independent central banks are less time inconsistent than elected governments,[328] we should not seek to undermine central banks' independence and make them more political. Rather, central banks should play to their strengths, and be an impartial arbiter over potential costs and risks, as well as the credibility, of government policies.

Furthermore, an argument often made in the EU is that the ECB's lack of democratic credentials were exposed in the *Weiss* case,[329] and it created a schism between the Court of Justice and the German Federal Constitutional Court (FCC). As a result, however the system evolves should address those concerns.[330] Yet, the German FCC's concerns about democratic legitimacy are framed in terms of a national *demos*.[331] It is unclear how greater involvement *by EU institutions* like the Parliament would allay those fears.

Finally, although the judicial review of central bank actions by EU Courts has been arguably limited and deferential, it would be simplistic to conclude that this gives central banks a free hand in what they can and cannot do. As discussed above, the definition of central banks' operations has evolved with central banks' social norms,[332] which in turn

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[323] T-251/15, Espirito Santo Financial v. European Central Bank, 2018 EU:T:2018:234; T-730/16, Espirito Santo Financial Group v. European Central Bank, 2019 EU:T:2019:161.
[324] T-798/17, Fabio De Masi and Yanis Varoufakis v. ECB, 2019 EU:T:2019:154.
[325] Mark Bovens, *Two Concepts of Accountability: Accountability as a Virtue and as a Mechanism*, 33 WEST EUROPEAN POLITICS 946, 947–48 (2010). From the same author, see also Mark Bovens, *Analysing and Assessing Public Accountability. A Conceptual Framework*, EUROGOV (2006). *See also* Deirdre Curtin, *Holding (Quasi-)Autonomous EU Administrative Actors to Public Account*, 13 EUR. L. J. 525, 527–28 (2007).
[326] Boer & Klooster, *supra* note 218.
[327] Ramos et al., *Climate Change and Central Banks (Part 1)*, *supra* note 1, at § 2.1.2.
[328] *Id.* at § 2.1.1; Boer & Klooster, *supra* note 218 (authors are skeptical of independence and time inconsistency. Their paper is otherwise enlightening, and their arguments compelling).
[329] Ramos et al, *supra* note 1, at § 2.1.1.
[330] *Id.* at 249–52.
[331] BVerfGE 89, 155, (Maastricht judgment) 182 et ss; BVerfGE - Case 2 BvE 2/08, 2 BvE 5/08, 2 BvR 1010/08, 2 BvR 1022/08, 2 BvR 1259/08, 2 BvR 182/09 (Lisbon judgment).
[332] Ramos et al., *Climate Change and Central Banks (Part 1)*, *supra* note 1, at 232 (§ 2.1.3).

are informed by advances in science and economics.[333] This sets limits on the kind of actions that a central bank may undertake by determining the strength of the arguments that a central bank may use to justify those actions. If the justification is manifestly erroneous, courts could find it unlawful. EU Courts, despite their deference, are the only ones who engage with the merits in order to see if the justification is manifestly mistaken and to assess if the measures are clearly unwarranted for the end sought (or fail to consider harmful side effects) using the principle of proportionality.[334]

In light of this, the EU may require amending some *rules*, but they will have to amend existing *practices*. With regards to the ECB's accountability practice, it consists of the Monetary Dialogue[335] and the hearings on banking supervision[336] with the European Parliament. Another dialogue on "Climate change" or "Transition" could be used to specifically address the issues related to the costs of transition and evaluating the impact of government policies (and their credibility) on future price and financial stability. At the same time, including these aspects would require a renewed commitment to central bank independence to ensure that the central bank remains credible and honest.

The risk lies in the view of more reluctant courts, like the German FCC.[337] However, the real implications of this review are not fully clear and provide a pause for thought. The FCC's departing point to justify a stricter scrutiny is the importance of the principle of democratic legitimacy.[338] This, in turn, requires a clear and careful weighing of the goals of a policy and its side effects. Such side effects could include the potential creation of asset bubbles,[339] risks to banks' balance sheets,[340] and loss of independence of a central bank due to having a portfolio loaded with government bonds.[341]

In the case of climate change, the ECB would be acting to *prevent* such effects from materializing. Furthermore, if it does so in the way we suggest above (proactively, rather than reactively), this would strengthen its independence rather than undermine it. In fact, if one combines the FCC's case law on central bank review with its case law on climate change, the resulting law indicates actionable constitutional principle

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[333] *Id.*
[334] *Id.* at 251.
[335] COMMITTEE ON ECONOMIC AND MONETARY AFFAIRS MONETARY DIALOGUE WITH CHRISTINE LAGARDE, PRESIDENT OF THE EUROPEAN CENTRAL BANK (last visited Feb. 21 2022), https://www.europarl.europa.eu/committees/en/econ/econ-policies/monetary-dialogue.
[336] *Banking Supervision Accountability Practices*, EURO. CENT. BANK, https://www.bankingsupervision.europa.eu/organisation/accountability/html/index.en.html (last visited Feb. 21, 2020),
[337] BVerfG, 2 BvR 859/15, May 5, 2020, https://www.bundesverfassungsgericht.de/SharedDocs/Entscheidungen/EN/2020/05/rs20200505_2bvr085915en.html [hereinafter BverfG *Weiss*].
[338] BverfG *Weiss* at ¶¶ 100-115.
[339] BverfG *Weiss* at ¶173.
[340] BverfG *Weiss* at ¶172.
[341] BverfG *Weiss* at ¶ 161.

that burdens need to be spread proportionally across generations.[342] Thus, the ECB would simply be adjusting its policy to better align it with that principle.

Conversely, if the ECB "sits and waits," it could find itself in an uncomfortable position. As the costs and risks of climate change become more obvious, climate change's fundamental rights dimension could filter into the courts' analysis (as it is already doing[343]). In that case, the ECB's actions could well be reviewed under a "fundamental rights proportionality" standard, which involves the direct weighing of factors by the courts.[344] This review would certainly be stricter, and therefore, less deferential.[345]

The scenario is less predictable in the case of the United States. On one hand, there is little experience with the adjudication of central banks' monetary acts.[346] On the other hand, courts seem increasingly willing to analyze regulatory acts on cost-benefit grounds.[347] Furthermore, a third element makes the future even more uncertain. The US Supreme Court made a series of rulings from 2010 to 2020 where it considered the validity of the framework of independent agencies such as the the Public Company Accounting Oversight Board (PCAOB), the Consumer Financial Protection Bureau (CFPB), and the Federal Housing Finance Agency (FHFA)in light of the Appointments Clause of the Constitution.[348] It found that the statutory rules designed to enhance agency independence by making it harder to remove some high-ranking members (the sole director in the case of the CFPB and the FHFA) were unconstitutional since executive agency heads ultimately served at the will of the US President.[349]

It is unclear whether this Appointments jurisprudence may affect the Federal Reserve. However, some authors have suggested that the system for the appointment and removal of some of the members of the Federal Reserve System is as questionable as those declared unconstitutional for other executive agencies.[350] While in cases like *Free Enterprise Fund v*

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[342] Ramos et al., *Climate Change and Central Banks (Part 1)*, *supra* note 1, at 252.
[343] *Id.*
[344] Case C-686/18, OC v. Banca d'Italia, ECLI:EU:C:2020:567, ¶¶ 70, 86, 105 (July 16, 2020).
[345] *Id.* at ¶ 96.
[346] Ramos et al., *Climate Change and Central Banks (Part 1)*, *supra* note 1, at 247.
[347] *Id.* at 246.
[348] U.S. CONST., art. II, § II, cl. 2.
[349] *See* Free Enter. Fund v. Pub. Co. Acct. Oversight Bd., 561 U.S. 447, 484 (2010) (concerning the members of the Public Company Accounting Oversight Board); Seila Law LLC v. Consumer Financial Protection Bureau, 140 S. Ct. 2183, 2204 (2020) (concerning the "for cause" removal of the director of the Consumer Financial Protection Bureau); Collins v. Yellen, 141 S. Ct. 1761, 1767 (2021) (concerning a similar appointment/removal regime for the director of the Federal Housing Finance Agency).
[350] *See* PETER CONTI-BROWN, THE POWER AND INDEPENDENCE OF THE FEDERAL RESERVE 254–55 (2016); Peter Conti-Brown, *The Institutions of Federal Reserve Independence,* 32 YALE J. ON REGUL. 257, 261 (2015); Peter Conti-Brown, *The Twelve Federal*

PCAOB[351] or *Seila Law LLC v. CFPB*[352] the Court ruled on relatively technical grounds, in the more recent case of *Collins v. Yellen* the Supreme Court held:

> [T]he Constitution prohibits even 'modest restrictions' on the President's power to remove the head of an agency with a single top officer (citation omitted). The President must be able to remove not just officers who disobey his commands but also those he finds "negligent and inefficient," . . . those who exercise their discretion in a way that is not 'intelligen[t] or wis[e],' . . . those who have "different views of policy," . . . those who come "from a competing political party who is dead set against [the President's] agenda," . . . and those in whom he has simply lost confidence.[353]

This is even more consequential for our purposes. It is unclear whether the above should be read as an *obiter* statement (with little relevance beyond the specific case), as a statement of the law with regards to only appointments, or as a more ambitious announcement about a new approach towards the accountability of independent agencies and bodies. However, the statement signals a clear preference for a *presidential* system of accountability for "independent" agencies, crowned by the President's ample appointment and removal powers.

In earlier sections we have shown that seemingly technical assessments, like Cost-Benefit Analysis (CBA), can nonetheless entail political judgments. Whether a choice is technical or political is not a completely immutable distinction, and matters like the Social Cost of Carbon (SCC) or, generally, climate change policies are perceived in intensely political (and partisan) terms.[354] If the line of reasoning established in the "Appointments Clause" cases develops beyond its boundaries, an implication could be that on matters characterized as "political", agencies and bodies (including Federal Reserve bodies, like the FOMC for monetary policy, or the Board of Governors for financial supervision) must abstain from developing their own strategies for dealing with climate change unless they receive a nod in a specific direction by the political branches of government. This could apply even if evidence suggests that it affects price or financial stability. This would certainly hinder the Federal Reserve's ability to determine how climate change affects its mandate in light of scientific and economic evidence.

Reserve Banks: Governance and Accountability in the 21st Century (Hutchins Ctr. on Fiscal and Monetary Pol'y at Brookings, Working Paper No. 10, 2015). He focuses mostly on the appointments of the Federal Reserve Banks' presidents and vice presidents.

[351] Free Enterprise Fund v. PCAOB, 561 U.S. at 474

[352] Seila Law, 140 S. Ct. 2183, 2211.

[353] Collins v. Yellen, 141 S. Ct., at 1787.

[354] *See supra* text accompanying notes 121–26.

We should not get ahead of ourselves. The "Appointments Clause" case law case law is relatively specific and belongs to a different strand than the case law on agency discretion.[355] This distinction notwithstanding, one thing we have learned about complex systems is that small changes can be a catalyst for larger changes in the system. And we should not forget that the law is also a complex system as well.

III. CONCLUSIONS.

In this article we have used the arguments that justify why climate change fits within central banks' mandates from Part 1 to consider when is it correct for central banks to act (opportunity), and how they should act (suitability).

Arguments of "opportunity" are key. Since there is no conceptual objection against assimilating climate change within a price stability mandate, the question becomes why should central banks do so now and change their time horizon (or complement the short-term time horizon for general monetary policy with a longer one for climate-related aspects) instead of using a "wait and learn" strategy. This looks at risks in an asymmetric way, i.e., it assumes that central banks can better fulfil their mandate once climate shocks strike. Since conceptually this looks very much like the "clean" or "mop up" approach of the Greenspan era, we would be remiss not to point out that such an approach is today considered mistaken. Overly proactive central bankers face many risks, but passive ones who let an impending crisis build up are not looked at benevolently. Looking at the potential costs and risks, the costs of catastrophic climate change (including the impact on price stability) should be evident enough to warrant action.

Less evident is the fact that finance is a complex system characterized by a network structure, which means that its topology (or pattern of connections) shapes central banks' and financial authorities' ability to deal with large shocks. Unfortunately, both theory and evidence suggest that networks in equilibria tend to show a pattern of connectivity that is *not efficient*. Moreover, they are not well prepared to withstand the kind of shocks that climate change can generate. Furthermore, the pattern of connectivity is something that central banks cannot control (at least not fully) and is subject to the logic of complex systems, which makes them less predictable. Thus, the safest bet seems to be to focus on the causes of climate change and reason forwards, rather than just focusing on the shocks and reasoning backwards (although this can be a complementary course of action).

Central banks' proactivity can also help to steer the (so far insufficient) abatement efforts of economic agents due to "uncertainty" or "ambiguity aversion" in the right direction. They can do this by helping to strengthen the idea that, even in a best-case scenario, the consequences of climate change will be quite bad. Proactivity is also

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[355] *See* argument *supra* § 3.2.2.

needed to change the conventions or "social norms" that shape central banks' actions (which include the time horizon). In fact, rather than arguing that central banks are acting too early, it is more likely that they are actually arriving pretty late. This is due to reasons that seem less scientific and more social or conventional. These may, in turn, be influenced by the lack of attention to climate change in mainstream economics.

Proactive approaches under conditions of uncertainty have a robust backing in the law under doctrines of "precaution" in many jurisdictions. In jurisdictions like the United States, which do not formally acknowledge precaution as a valid principle and instead adhere to Cost-Benefit Analysis (CBA), the framework is flexible enough to account for issues of uncertainty or "fat tails." The legal obstacles are less conceptual than institutional, including the way courts may apply these standards. Court review is framed in an asymmetric manner, where the risk of a contrary legal ruling is much higher for doing too much than for doing too little. On the other hand, the principle of "proportionality" in the EU is a common basis for the review of central banks' actions. The "precautionary" analysis can help draw a conceptual bridge between arguments of "fit" and "opportunity." In the United States, the ultra-deferential review of central bank actions is very different from the review of *agency* action under CBA, which makes legal developments fully dependent on the way courts decide to frame the issue.

Finally, arguments of "suitability" are also fundamental, but often confusing when framed in maximalist terms. True, some of the most important measures to fight climate change (such as carbon taxes) are far away from a central bank's remit, and climate-related measures can be distortive and politically controversial. However, that does not so much render central banks fully unsuitable for climate change as much as it shows that caution is necessary in how to tackle it. In abstract terms, climate change presents a major problem of time inconsistency and of market failure. These are the kinds of problem that independent central banks are better placed to deal with, which means that the risk of distortionary effects should be weighed against the risk arising from climate externalities. Central banks have never been strictly "market neutral", nor have they avoided political controversy. Neither have they abstained from questioning the wisdom or credibility of policies beyond their remit (e.g., fiscal, energy, or labor policies). Seen in this light, climate change seems more a case where central banks must extrapolate the basic ideas pervading their mandate to a new scenario rather than being an expansion of their core competences.

This does not mean that there are no challenges. There are plenty. But, the challenges are different (and less obvious) than those presented by critics (and some advocates) of central banks' climate action. One major problem is central banks' credibility to fight climate change, which hinges on their ability to reconcile a communication strategy that needs

both to "assert" their unflagging commitment to it. Thus, central banks should design a strategy that combines a clear precommitment to address climate change with flexibility about its intermediate goals and a means to incorporate new information as it becomes available. A second challenge is operational. We point to several aspects where major changes are needed. These shifts are actions such as shifting from traditional central bank models to "green micro-allocation" of funds with a "brown macro-labelling" of assets, a better coordination between monetary and prudential policies, or the integration of network theory insights. In third place, we look at central banks' renewed role not as reluctant actors dragged into climate change, but as objective agents who offer an unbiased picture and chart a course for adjustment. This raises a third challenge resulting from the conflict with industry (if their assets are penalized), governments (if their policies are deemed "not credible"), or even both at the same time (if, e.g., a central bank concludes that, for some recalcitrant actors, the safest course of action is de-coupling). Yet, the reaction to this would be to strengthen central banks' independence, not to weaken it, because only then can they be trusted to offer an impartial view.

These challenges suggest that central banks may need a "new social contract," where old ideas are simply re-dimensioned in light of current challenges. Central banks may need to strengthen their legitimacy to justify their independence, which requires some adjustment in rules and in practices. Deeper involvement in climate change will first require greater transparency. This transparency should not only be in the form of communication, but also in public access to information as a matter of right and not of convenience. Second, it will require more dialogue with political bodies. We are reluctant to believe that this should translate into greater guidance by those bodies, since, in our view, this would expose central banks to greater time inconsistency and undermine their independence.

This social contract will have softer contours formed by renewed social norms and practices, but it will also have hard edges that will be enforced by courts. Courts should be stricter with central banks on matters of transparency and access to documents, or alternatively apply a stricter, less deferential standard of review to central banks' acts, demanding clearer and more detailed justifications for their actions, including the consideration of side effects. Fortunately, in the EU the different strands of case law can be connected quite easily and principles like transparency and judicial review are connected to proportionality or precaution. In the US, the courts have developed very detailed approaches to issues like the review of administrative acts (including through Cost-Benefit Analysis), transparency and access to documents, the tension between an agency's independence, and the constitutionality of its system of appointments. However, these are separate strands of case law, and it is unclear how to combine them.

In summary, climate change presents central banks with an extraordinary challenge. This is not because climate change does not affect central bank objectives, but rather because making sure those objectives are fulfilled in the long run requires adapting their mindset to a radically different set of circumstances. This requires extensive input from many disciplines, including physics and economics, but also complex science, or decision theory. Yet, it also requires input from the law. As much as central banks are studied mostly in macroeconomics, they are institutions and extremely procedural ones at that. This means that, beyond the legality of their acts, rules and processes matter for the self-perception of central banks themselves. Changing the current mindset is not a job for a single discipline, but for many of them working in lockstep.