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Drain the water from the bilge: The role of the ECB Supervision in European climate transition

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Executive summary

Climate change is the greatest threat humanity has ever faced. To ensure this threat is effectively addressed, Europe will have to reform its financial markets, in order to ensure climate-related financial risks (CRRs) are adequately taken into account by financial institutions. The European Central Bank (ECB) can make a significant contribution to this objective, by strengthening its supervisory function. This thesis will suggest different coordinated activities that the ECB can undertake to improve the resilience of the European financial system to climate risk, thereby also contributing to the transition to a low-carbon economy within its mandate. Part I reviews the state of the art. Part II explains briefly the methodology followed. Part III puts forward a number of proposals to ensure a more proper integration of CRRs into the ECB's supervision under the Single Rulebook and the Single Supervisory Mechanism (SSM). This thesis draws the first outlines of a "climate strategy" for the ECB Supervision, and is in this sense unique as it is the first working paper dealing with the supervision of climate risk in the specific context of European financial markets.

Literature review

1) A risk-based approach to the climate issue

Climate-related financial risk (CRR) is the risk to the stability of the financial system that has its source in climate disruptions. Ensuring the financial system's resilience to these risks in the long term amounts to supporting society in the ecological transition, since it should ensure that the valuation of financial assets better reflects the reality of the threat of climate change, thus providing a powerful incentive for both policy-makers and private actors to do more for climate change mitigation. CRRs are “physical” when they result from weather-related events, including extreme events such as floods or droughts, that have their source in global warming; they are “transition-related” when they have their source in the climate mitigation efforts as societies decarbonize, involving changes in the regulatory and policy frameworks under which economic actors operate. Physical and transition risks materialize for institutions through financial contract defaults (credit risk), repricing of contracts on the financial markets (market risk) or the banks' own operations (operational risk).

2) Climate-related financial risks and prudential regulation: State of a nascent Art

The financial risks posed by climate change now occupies an important place in discussions on financial supervision. Its recognition was late in coming, however, as reflected by the fact that most of the research on this topic dates from after 2014. The bulk of the literature is policy driven. It tends to identify barriers to CRR supervision and suggests avenues to overcome them. In the case of the ability of the ECB to extend its supervisory role, the most relevant barriers are the behavior and incentives within institutions, the inability of institutions to recognize the opportunities and dangers of climate risk, the legal frameworks deconsidering CRRs, the methodological difficulty in modeling CRRs, coordination with supervisors around the world, and the ECB's narrow mandate.

Such barriers are not insuperable. A mapping of CRRs must first be conducted through comprehensive assessments and particularly climate stress tests (although climate stress tests generally take the form of scenario-based analyses rather than stress tests in the more conventional sense of the expression). Following this mapping, capital requirements appear to be the most effective tool to impose the consideration of CRRs, although its practical potential use is very limited for the ECB. Other actions such as the imposition of risk governance or mandatory disclosure of information to improve transparency and guide investors can also be interesting instruments. Moreover, particular exercises may also provide an opportunity to have a more direct grip on the institutions' management of the CRRs: "fit and proper" assessments are a particularly interesting tool for the ECB to consider. Finally, the supervisor can exert influence on the markets more indirectly, by sending signals to the market with the production of economic analyses, the highlighting of best practices, the formation of networks, ... etc.

3) Sovereign debt crisis and SSM: The ECB’s unclear mandate

The context in which the ECB's Supervision currently operates has its roots in the European sovereign debt crisis of 2008-2011, which revealed numerous dysfunctions in the financial supervision of many European Union member States. The SSM was set up in order to severe the link between banking crises and sovereign debt crises once and for all, but it was also a first step towards a European banking union -- a major move towards the deepening of the integreation of the European financial system. The reforms, however, were hurried through in a context characterized by the financial emergency. As a result, they remain very imperfect,

not least since the Treaties remain ill-adapted to support the new architecture that was put in place.

A first limitation lies in the strict separation of monetary and prudential policies of the ECB, particularly since monetary powers were denounced as excessive at the time of the creation of the ECB Supervision and the Single Supervisory Mechanism (SSM). This total separation prevents any coordination of the two functions. For example, it is not possible for the ECB to observe the effects of its monetary policy on the balance sheets of the institutions it supervises.

Secondly, shortcomings also exist in the macro-prudential power of the ECB Supervision in the strict sense. For example, the Treaties do not allow the European supervisor to impose its supervision on OTC derivatives markets or the shadow banking market, nor to impose countercyclical requirements directly on the credit institutions it supervises. The thesis discusses these and other examples of dysfunctionalities.

The potential role of the ECB in climate risk supervision

The final and most important part of the thesis puts forward proposals for the integration of CRRs into the ECB's supervision under the Single Rulebook (the Capital Requirements Directives IV (CRD IV) and the Capital Requirements Regulation 2 (CRR2)) and the SSM. The proposals are grouped into daily reviews (1) and stress tests (2) from which supervisory actions (3) are derived. A final section is devoted to the special case of "fit and proper" assessments (4).

1) Daily Reviews: Individual monitoring (SREP) and deep-dive horizontal analyses

Supervisory Review and Evaluation Process (SREP)

Joint Supervisory Teams (JSTs), composed of members of the ECB and the National Competent Authority (NCA) of the country of the institution concerned, conduct a series of assessments each day directly at an institution. These assessments may lead to additional requests (e.g., an additional audit on a certain exposure) or to proposals for supervisory actions which have to be validated by the ECB's Supervisory Board. CRRs can be included in

the assessment of business models in the face of CRR challenges; in the evaluation of certain remuneration or risk monitoring practices in operations; or in the requalification of certain assets as "very high risk" when considering CRRs. Furthermore, such assessments would allow the ECB to require the setting up of internal methods and models for reporting on CRR exposure.

Thematic reviews

Such "horizontal" reviews could be conducted to collect all reported information on an aggregated basis and to identify reporting gaps, as well as to identify best reporting practices. Thematic reviews are an exercise conducted by JSTs at several institutions on the basis of risks identified as "SSM Supervisory Priorities" (climate risk is one of the priorities for 2020). They are most of the time conducted for strictly informative purposes. This would allow the development of bottom-up reporting where internal models can be coordinated to produce more general risk indicators.

2) Stress Tests

Stress testing is an exercise in which there is ample evidence that the ECB has a central role. The second section proposes to use the ECB's "constrained bottom-up" approach to launch a dialogue with banks on their management of certain climate scenarios, which would be developed using integrated assessment models (IAM). IAMs allow macroeconomic estimates to be made for different transition scenarios.

This exercise presents technical challenges, as it would necessarily require the stress test to be embedded in a more dynamic environment (using agent-based and stock-flow consistent models, among others). The creation of partnerships specifically dedicated to this exercise should help to overcome these challenges. It would at the same time represent an important innovation in supervisory exercises, which the ECB should impose autonomously. Indeed, the stress test results as currently published are the result of a confrontation between the results of the supervisor's model and those of the internal model of the institution.

3) Supervisory actions

The third section elaborates on the actions that the ECB may undertake as a result of the assessments detailed in Sections 1 and 2. Three elements are worth noting concerning such actions, which are elaborated upon in article 9 of the SSM Regulation.

First, the ECB Supervision is a key actor at the level of the institutions it supervises (or decides to supervise) for the implementation of national legislation on CRRs. Secondly, the ECB is encouraged to publish the actions it takes vis-à-vis banks, and no precedent seems to support the idea that banks should benefit from a form of presumption of innocence in the case of administrative banking sanctions. This reinforces to some extent the possibility for the ECB to "name and shame" certain institutions in relation to measures taken following CRR identification. Thirdly, the ECB has an important discretion with regard to the proportionality of measures imposed on banks. In simplified terms, the ECB can decide on the materiality of CRRs in a relatively independent manner.

4) Fit and proper assessments

The ECB Supervision can use the fit and proper assessments to put the climate issue on the agenda. This exercise should first be used as an opportunity for dialogue with management and guidance to ensure awareness and competence with regard to climate risk. Fit and proper assessments are a unique way to include climate risk management in the agendas of the leaders of Europe's most significant institutions. They should be used as a platform for coordinating all activities that the ECB Supervision will engage with institutions to manage CRRs.

Conclusion

Several lessons can be drawn from the proposals of this thesis. Firstly, cultural change within financial institutions is key to the success of the incorporation of CRRs. The role of the teams assigned to oversee the institutions on a day-to-day basis and to dialogue with management is vital in this regard and may be a condition for effective organizational change. This is particularly true given the different national frameworks in which the supervised institutions operate. Second, data on institutions' exposure to CRRs needs to be collected and aggregated in a bottom-up, forward-looking, progressive and didactic approach. Third, the development of climate stress tests requires to incorporate the dynamism of macroeconomic and financial scenarios, a public and autonomous commitment from the ECB, and the creation of

sustainable partnerships specifically dedicated to climate stress tests. Fourth, the credibility of the ECB's oversight initiatives for CRRs is strengthened by its discretionary independence in the technical assessment of its own actions. Finally, new tools such as the fit and proper assessments are extremely useful in approaching a problem that is also novel: new societal problems require social innovations in response.

Introduction

Climate change is most likely the greatest threat humanity has ever faced. The scientific reports of the Intergovernmental Panel on Climate Change (IPCC) leave no doubt that it is caused by the emission of greenhouse gases (GHGs) of anthropogenic origin. In addition, it has been proven that if the trend towards the increase of emissions is not reversed by the end of this decade, it would imply an increase in global temperatures of more than 1.5° Celsius. This, in turn, would mean increasingly frequent extreme weather events and natural disasters that could endanger human life on earth.

Reducing these emissions on a global scale implies that humanity must collectively rethink the way it feeds, moves, houses, clothes and entertains itself as soon as possible. This means transforming the economy as a whole, before reaching a tipping point beyond which further positive feedback loops will accelerate climate change in an uncontrollable fashion. Finance has an essential role to play in this regard, since it decisively influences the direction in which the economy develops. Paradoxically however, while the impact of finance has never been more important than today, the financial system appears to be more disconnected than ever from economic, social and environmental reality. The combustion of fossil fuels without consideration of the costs borne by the collectivity is a market failure, with climate change as a massive negative externality that the market does not internalize. This failure calls for governmental action. Governments themselves, however, are constrained by economic policy considerations regarding the allocation of the burden of change (Andersson, 2020). In the face of the urgency to redirect the economy towards carbon neutrality, the mission of the European Central Bank, Europe's monetary and prudential authority, must be the same as it always has been: to worry.

In particular, the ECB cannot adequately discharge its role as guarantor of financial stability and, to a larger extent, of European prosperity, unless it takes into account the long-term impacts of the choices made today. Ensuring European financial stability for the next three years while humanity is at risk in the coming decades is tantamount to cleaning up the cabins of a sinking ship. To extend the metaphor: the role of the ECB is in the bilge of the ship, trying to plug up the breach in the hull and evacuating buckets of water while waiting for the captains to agree on a plan to repair the boat and, why not, contributing to their deliberations.

The purpose of this thesis is to determine how to fill the breach in the hull and best prepare the arrival of a repair plan. More concretely, it will address the prudential role of the European Central Bank, positioned since 2013 at the center of the supervision of credit institutions in Europe, in the fight against climate change. Specifically, it will set out the activities that the ECB Supervision can undertake under its mandate to proactively integrate climate risk into the activities of the institutions it supervises. This requires answering three questions in a specific order: 1) What is the link between climate risk and financial risk? 2) What are the barriers to internalizing climate change in institutions? 3) How can these barriers best be overcome within the ECB Supervision's legal and political framework?

Chapter 1.1. identifies the link between climate and financial risks. It argues that one cannot be sustainably addressed without the other (and vice versa). This chapter will also introduce the paradox explaining the complexity of the macro-prudential approach to climate change: to borrow from F. Knight's distinction, the supervisor's action is not only risk management, but uncertainty management (Knight, 1921). I submit that the issue can only be addressed with a new approach to financial supervision. I rely on the notion of the Green Swan, introduced in a report by the Banque de France and the Bank for International Settlements in January 2020, as a key epistemological innovation that can move us closer towards understanding the new approach to financial supervision that is now required (Bolton et al., 2020).

Chapter 1.2. then reviews the literature on climate change risk with regard to financial supervisors. It proceeds in two steps. First, based on a very simplified framework of the theory of change, this literature review identifies the barriers to the outcome sought by this paper: integrating climate change into European supervision. Secondly, it considers the different proposals that have been made to overcome one or more of these barriers. Consistent with the aim of this paper however, the restrictions to the ECB's mandate, though an important obstacle to the integration of climate into its supervisory role, will not be addressed: instead, my aim is to explore how, given the political and legal constraints that the ECB currently faces, it can nevertheless do more to incorporate climate change uncertainty.

Chapter 1.3. replaces the ECB's supervisory role in the European context of the Single Supervisory Mechanism (SSM). The SSM framework has its source in the reconstruction of

the European financial system after the 2008-2010 crisis and is crucial to consider in order to understand the appropriateness of the proposals put forward in this paper. I highlight the birth of the Banking Union in the context of the sovereign debt crisis. I describe how the SSM is an imperfect institutional innovation, largely improvised under the pressure of the crisis, and shaped by the constraints of the European treaties. This chapter also identifies the imperfections specific to financial climate risk, thus giving an idea of the sensitivity of the proposals with regard to national sovereignties.

Chapter 2 outlines the methodology used in the construction of the proposals. In particular, it will help to understand how the credibility of the various proposals put forward was assessed.

Chapter 3 brings together the proposals made by this paper. These proposals build on the activities identified in Chapter 1.2., linking them to the current activities of the ECB Supervision, while at the same time amending or complementing them wherever necessary. This will allow each of the ECB's proposals to be addressed to Directorates and other departments already established within the organization. The chapter is divided into four sections, corresponding to four activities of the ECB. The two first sections examine the daily review of institutions and comprehensive assessments, which are the two main risk identification activities. The third section deals with the supervisory actions taken as a result of these assessment activities. The final section is devoted to the special case of fit and proper assessment activities.

Finally, the conclusion will draw key lessons from the research carried out to formulate these proposals, draw attention to some key aspects of them, and identify paths for developments.

I. Literature Review

1. A risk-based approach to the climate issue

The potential role of the ECB Supervision in combating climate change will be addressed through its focus on "climate financial risk". This approach has two a priori drawbacks. The first is that “action against financial climate risk” is different from “action against climate change”. In theory, a development based on financial risk would run the risk of deviating from the objective of this paper: that of assessing the proactive prudential role of the ECB in the European ecological transition. In reality, this approach is the only approach by which the ECB Supervision can address climate change without jeopardizing the fundamental objectives of prudential policy in the eyes of the supervised institutions and, in this sense, the only realistic approach in the context of its supranational function. Climate-related financial risks have been recognized as part of central bank and supervisor mandates by members of the Network of Central Banks and Supervisors for the Greening of the Financial System (NGFS, comprising all major central banks except the Fed) (NGFS, 2019). Moreover, a financial perspective of climate risk is appropriate if it provides long-term mitigation of climate-related financial risk. As Bolton et al. point out, financial supervisors have a key role to play in proposing/adopting new climate policies, which "*private players and policymakers cannot necessarily adopt given their respective interests and time horizons*" (Bolton et al., 2020).

The second drawback is that such a financial risk approach neglects some of the features of the ECB Supervision. The ECB Supervision could, for example, focus its commitment in the fight against money laundering from operations violating environmental standards, as it does currently with the fight against terrorist financing (Mersch, 2019). The functions of the ECB Supervision specifically going beyond the scope of banking-related risk supervision are, however, limited in time and number. The approach chosen is therefore more consistent with the sustainable development-oriented approach that this paper suggests to the organization.

Before entering into the core of the discussion, it is important that the concept of financial climate risk be well understood. The following section will expand on related concepts, which will help to understand the importance of the issue for a financial supervisor such as the European Central Bank.

1.1. Climate-related financial risks explained

Climate risk impacts the stability of the banking system through both a monetary and a financial channel. Although the former is not at the heart of this discussion on the prudential role of the ECB, it is essential to mention it if we wish to have a general perspective.

1.1.1. Monetary risk of climate change

Monetary risk can be understood as a risk of adverse disruptions (more simply "shocks") that take place through variables such as household and business spending or economic output, and which challenge price stability and the employment rate. A distinction is usually made between impacts on the supply-side and demand-side of goods and services (Brainard, 2019).

On the supply side, the literature (currently in construction) mainly identifies an impact on price volatility related to agriculture and energy (Dafermos et al., 2018). These shocks can be transitory (e.g. a flood that affects a very local crop and pushes up the price of the crop until the next harvest, by which time the risk of flooding will have been covered) or permanent (e.g. a certain type of employment could be exercised for fewer hours per day or much less productively due to an increase in heat waves)(Mc Kibbin, 2017). Large variations in household consumption or investment are the demand side of these climate shocks (Batten, 2018). By nature, this aspect is linked to the supply side, but it is also much more difficult to predict, due to the predominance of psychological factors and anticipations of future economic conditions.

Uncertainty about the persistence, size, and scope of climate-related economic shocks makes the monetary response and inflation targets extremely complicated. Against the background of a global trend towards greater reliance on central banks in response to shocks, Bolton et al. identified three unique challenges that climate risks pose to monetary authorities (Bolton et al., 2020):

- Irreversible economic consequences: Climate change and its consequences are long term, so there are stagflationary supply shocks that cannot be reversed with monetary policy. To put it more simply: there are fundamental distortions in the economy that monetary policy cannot counter with "conventional" stimulus measures.

- A global problem: climate-induced inflationary shocks can be global and may require coordinated monetary policies (which is difficult to conceive).
- Cumbersome anticipation: It is very uncertain whether a central bank will be able to take pre-emptive measures in the case of extreme weather shocks.

The risks of inflation and economic recovery through money are however, as stated above, only indirectly related to our topic. Our focus here will be on the financial dimension of climate change-induced risks.

1.1.2. Financial risk of climate change

At the ECB Supervision, it is the contributions of Frank Elderson, member of the Supervisory Board and chairman of the NGFS, that best reflect the institution's perception of Climate-related financial risks (CRRs) (Elderson, 2020). Elderson is also one of the main initiators of the Guide on climate-related and environmental risks published by the ECB in May 2020 (ECB, 2020). Two channels of CRRs are usually differentiated in the literature and in evaluations: physical risks and transition risks.

Physical risks are the most straightforward risks to consider when considering CRRs. They are the economic and financial costs resulting from meteorological phenomena related to the climate crisis. The Taskforce on Climate-related Financial Disclosures (TCFD)[1] distinguishes between **acute** risks due to one-off extreme events (such as storms) and **chronic** risks due to changes in climate and landscape (sea acidification or desertification). Physical risks specifically relate CRRs to sectors such as insurance, real estate and other sectors based on physical capital.

Transition-related risks arise from the challenges associated with climate mitigation measures as societies decarbonize. The TCFD classifies these risks into four sub-categories:

- Policy and legal risks: These include policy or regulatory CRRs and therefore depend directly on the exposure to litigation.

[1] The TFCD is a voluntary initiative established by the Financial Stability Board, which is an international body that monitors and makes recommendations about the global financial system, with an aim to develop voluntary, consistent climate-related financial risk disclosures that would be helpful to investors, lenders, insurance companies and asset managers in identifying and managing financial risks (TCFD 2017).

- Technology risks: Technology risks relate to the CRRs of the new investments needed and the costs in general of the transition to low carbon technologies, hence they are directly linked to the companies and communities facing investment uncertainty.
- Preference (market) risks: These risks relate to the uncertainty of consumer behavior which may radically shift towards new standards and preferences. Assessing such risks is challenging, since it requires an interpretation of market signals and supply chains.
- Reputational (social norm) risks: These risks are related to the stigma of some institutions not adapting/ failing to adapt to the new preferences of market players. The growing awareness of these players and the slow organizational transition of institutions make this risk particularly serious.

The table below shows several concrete illustrations of the CRRs:

Physical		**Transitional**			
Acute	**Chronic**	**Policy and legal**	**Technology**	**Preference**	**Reputational**
The bankruptcy of PG&E Corp, a gas and power company, was caused by fires that damaged a large part of its infrastructure (Mui, 2019).	As of February 2015, Canadians experienced a 40% increase in the price of lettuce, as 70% of lettuce comes from an area of California that has been experiencing severe drought for the past 5 years (Leon, 2020).	Murray Energy, a coal mining company, filed for bankruptcy protection following an upgrade of environmental standards requirements (Kowalski, 2020).	The ongoing transition of all car producers to electric cars is shaking up the balance of power in the industry (Galateanu & Avasilcai, 2016).	The sustainable finance sector has boomed between 2013 and 2018 in Europe (Deutsche Bundesbank, 2019).	The image of the Credit Suisse bank has suffered enormously as a result of the work of a number of activists (Merkley, 2020).

Figure 1 . The typology of CRRs: types of physical and transition-related risks

1.1.3. Types of financial transmission channels of physical and transition risks

The financial materialization of CRRs occurs in three main ways. These financial channels were first identified by a supervisory authority in a report of the Bank of England's Prudential Regulatory Authority (PRA) published in September 2018 (Bank of England, 2018). They are intrinsically linked and mutually amplifying. (i.e. second round effect). We may distinguish among these transmission channels between the Pillar 1, where CRRs are already incorporated into the market rating of assets, and the Pillar 2, which would allow a supervisor

to take action on the basis of additional CRRs specific to each institution (Beekhoven van den Boezem et al., 2019) …

Credit risk

There could be a deterioration in the ability of borrowers to repay their debts. The credit risk is linked to the physical risk through the uninsured exposures. For example, a PRA survey shows that many English institutions are particularly exposed to the risk of floods (Bank of England, 2018). CRR increases the probability of default, but also increases the overall Loss Given Default (LGD) (the potential impairment of assets pledged as collateral could be one of the causes). As regards transition risk, the same study states that commercial and investment banks whose business model is not aligned with the scenario of a shift towards a low-carbon economy *"face a higher risk of reduced corporate earnings and business disruption from a low-carbon transition"*(Bank of England, 2018). These are mainly institutions related to agriculture, energy and transport, although, in comparison to these sectors of activity, the transition risk in the real estate sector is significantly underestimated (whereas the physical risk associated with this sector is better integrated). Credit risk associated with CRRs is linked directly to concentration risk

Concentration risk: CRRs as a new diversification factor

Concentration risk is a Pillar 2 risk in the Basel 2 agreements of 2004 (Basel Committee on Banking Supervision (BCBS), 2013). It is a risk for institutions resulting from investment in certain sectors subject to the same CRRs. It is thus a risk due to the lack of diversification. Concentration can be caused indirectly, i.e. by third party institutions that are themselves highly concentrated.

This risk is a double-edged sword in relation to climate change because it could also be a pretext for a limited investment in low-carbon sectors. For example, while investment in renewables provides a good hedge against losses from fossil fuel power plants, this positive portfolio effect could be lost once the transition to renewables accelerates, leading to a loss in diversification and to stand-alone risks of renewables playing a more important function.

Market risk

In a scenario of abrupt transition, the profitability of financial assets could be perceived completely differently in the markets. This could affect an institution as much through its treasury holdings as through its investment advising and asset managing activities. As a matter of fact, certain disruptions or extreme events could trigger a chain revaluation of assets which would be considered "stranded" in record time, creating what Carney described as a "climate Minsky-moment", by reference to a major collapse in asset values marking the end of the growth phase of a cycle in business activity (Carney, 2019) (Minsky, 1992). Institutions that would be excessively affected by such a revaluation could face a significant liquidity problem in the short term (especially if they are exposed to credit defaults), thereby jeopardizing the entire interbank market.

"We cannot burn it all": the stranded assets concept

The existing literature defines climate stranded assets as assets that, before the end of their economic life considered at the time of investment, are no longer able to earn an economic return due to changes associated with the transition to a low-carbon economy (as a result of certain policies; of declines in demand; of technological disruptions; or of the risks of reputational damage)(Carbon Tracker Initiative, 2017). Poor pricing of stranded assets is a real risk to financial stability as it slows the transition to equity capital by making the financial system more sensitive to policy changes (Sen & von Schickfus, 2019). Sen and von Schickfus further demonstrate that investors tend to consider these risks correctly, but often expect financial compensation for these stranded assets, thereby causing a mispricing (Sen & von Schickfus, 2019).

The most carbon-intensive industries are already feeling the effects of market expectations. As a matter of fact, according to a high-visibility study published in Nature in 2015, it is estimated that one third of the oil reserves, half of the gas reserves and more than 80% of the known coal reserves will not be allowed to be burned if the global temperature targets set by the Paris Agreement are to be met (Ekins & McGlade, 2015). Even if one is sceptical about compliance with the targets set in the Paris Agreement, it seems clear that such industries are doomed to decline sharply long before their reserves begin to be depleted, due to policy and regulatory changes associated with climate change mitigation strategies.

Concerning physical risks, special attention should be given to sovereign issues. Moody's, through *Four Twenty-Seven*[2] acquired in 2019, was one of the first major rating agencies to develop a methodology for assessing physical CRRs on sovereign debt (Leaton et al., 2020). It revealed that these assets are among the most sensitive given the impact of climate change on a country's economic activity, infrastructure, social costs and demographic movements caused by climatic shocks (Moody's Investors Service, 2020).

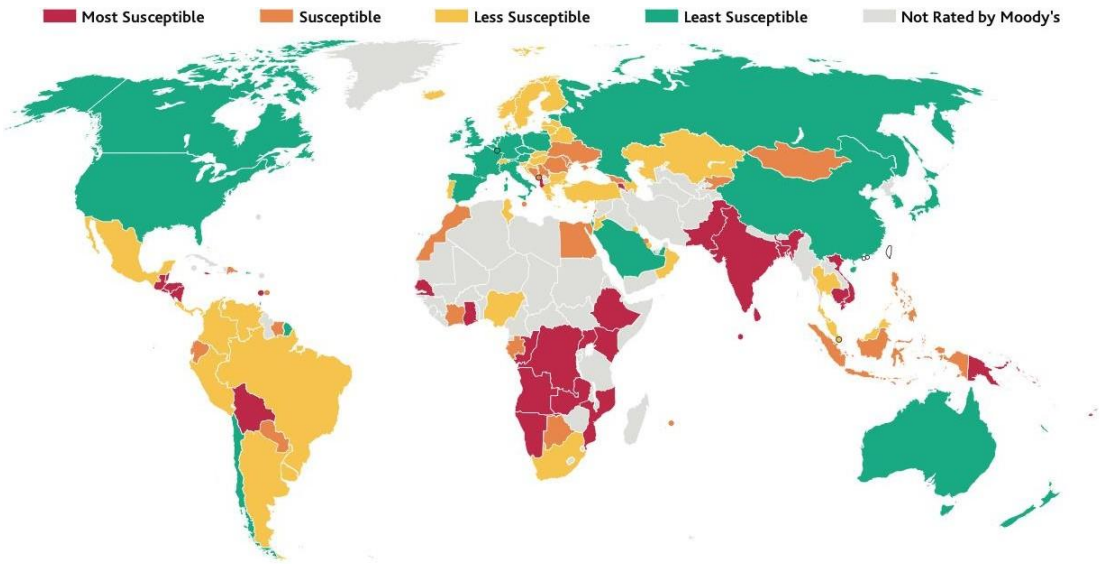

Figure 2. CRRs on sovereign debt.

Source: Moody's Investors Service, 2020

Note: As this map from Moody's shows, the greatest sensitivity to climate risk is found in the sovereign debt of Eastern European countries.

In fact, market risk suggests that the market may consider information that is already available too late or to an insufficient extent. It thus implies that the attention paid to CRRs is especially low compared to other risks. Hugues Chenet explains this mispricing by 5 causes: firstly, the fact that CRRs are linked to unprecedented phenomena in terms of speed and impact and are therefore impossible to identify on the basis of historical data (Chenet, 2019). Secondly, they are radically uncertain. Thirdly, they are not possible to include in ergodic models based on a normal probability distribution. Fourthly, market players have a "bounded rationality" that pushes them to use simple models to confront complex situations. Finally, there is a great mismatch in time between financial strategies that are generally short-term and climatic developments that are more long-term in nature (Chenet, 2019).

[2] A leading provider of data, intelligence, and analysis related to physical climate risks

Operational risks

Namely the risk of losses due to breaches, interruptions and damage due to climatic risk. These risks seem on their face less important for the increasingly dematerialized financial system, but it would be a mistake to neglect them.

As a matter of fact, the exposure to climate-related disruptions of staff members and infrastructure (such as data centers) could directly cause insurance costs or geographic and process reorganization costs. In addition, certain events could indirectly raise the cost of energy and hardware.

In terms of transition risk, the operational channel is also stressed by the banks surveyed by PRA (mainly for its reputational aspect). The organization of operations can in fact be a barrier to the transition of investments to low-carbon activities. For example, the closure of First NBC Bank in 2017 after it failed to maintain sound accounting practices may well be considered in the event of new climate risk disclosure requirements, which some banks may not be able to meet (FDIC Office, 2017).

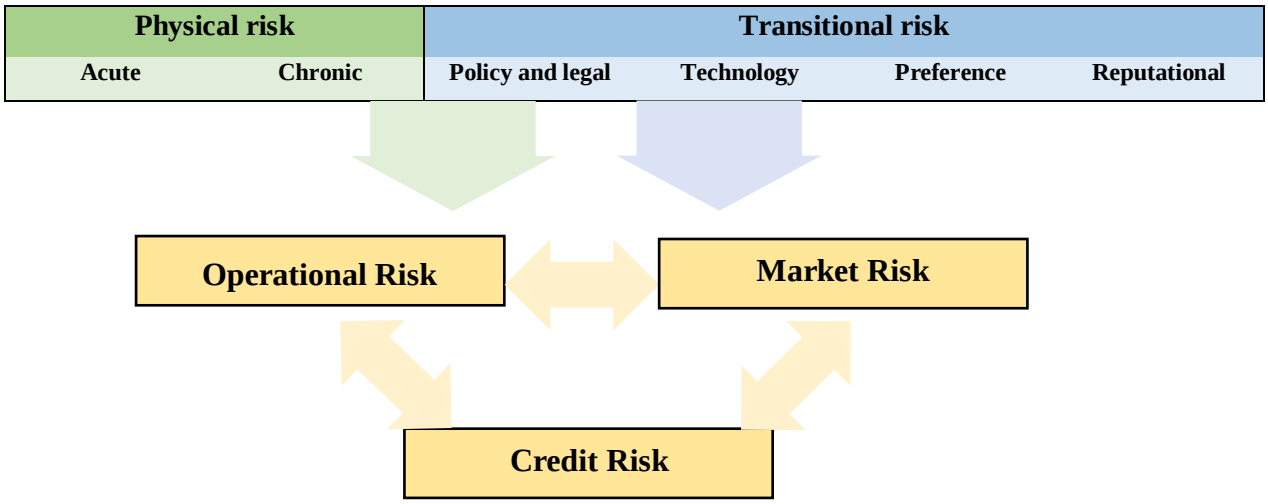

Figure 3. Channels of financial transmission of CRRs

1.2. The Green Swan concept: an epistemological innovation

The concept of "Green Swan", was introduced in January 2020 in the report of the same name by Bolton et al. (Bolton et al., 2020). The concept refers directly to the concept of "black swan" developed by Nassim Nicholas Taleb in 2007, defining an event according to three criteria (Taleb, 2007):

1) Uncertainty: It is rare and unexpected, and therefore excluded from the usual anticipations of concepts such as value-at-risk and other models based on Gaussian-centered distributions. Returning to the distinction made by Frank Knight in 1921, risk applies to situations where we do not know the outcome of a given situation but can accurately measure probabilities; uncertainty, on the other hand, applies to situations where we cannot know all the information we need to make accurate ratings in the first place (Knight, 1921).

2) Magnitude: Its impact is extreme and large (for example the bursting of the internet bubble, the fall of the Soviet Union, ...).

3) Uniqueness: It can only be explained *a posteriori*, not on the basis of past observations. Therefore, black swans can only be covered in a very imperfect and expensive way and are therefore very rarely hedged.

The uncertainty, uniqueness and potential magnitude of a large number of CRRs detailed above allow us to speak of "green swans" events, which will in that respect refer to climate-related financial "shocks" in the remainder of this paper. This comparison with black swans must be nuanced, however, by the fact that green swans are only uncertain as to their nature (their occurrence is certain) and that they are linked to crises whose stakes go far beyond the financial markets and are therefore much more complicated to understand in terms of their economic impact.

2. Climate-Related Risks and prudential regulation: State of a nascent Art

This chapter is a review of the literature on financial supervision in the context of CRRs. It will identify and group the main barriers to the objective sought by this paper, as well as the various activities proposed to overcome them. These barriers and activities will be underlined in the text and grouped together at the end of the sections.

At the global level, central bankers, supervisors and financial regulators have belatedly recognized the importance of the impact of climate change on financial stability. However, once the topic was put on the table, it took the spotlight. Until 2010, the literature on CRRs is practically empty, and the banks' responsibility for climate risks is only considered through the projects submitted to clients or their presence on the carbon markets. Media coverage of the financial “carbon bubble" and "unburnt carbon" released by the Carbon Tracker think tank located in London, as well as the action of NGOs launching the first major fossil fuel divestment campaigns, drew the attention of academics to the link between finance and climate change (Chenet, 2019) (Carbon Tracker Initiative 2017(b) & 2011). The topic was also discussed at the UN Climate Summit of September 2014, which preceded the decisive 21st Conference of the Parties to the United Framework Convention on Climate Change (COP 21), convened under French presidency in December 2015.

In October 2014, Mark Carney, then Governor of Bank of England (BoE) and Financial Stability Board (FSB) Chairman, was the first high-profile personality to speak publicly about climate risks for the financial system (Shankleman, 2014). His widely acclaimed speech in September 2015 at Lloyd's of London, "*Breaking the tragedy of the horizon*" marked the beginning of scientific and regulatory mobilization on this new subject (Philipponnat, 2020).

France, which was preparing to host COP21 in December of the same year, had recently adopted Article 173 of the Energy Transition Law at that time. The law, requiring extra-financial reporting on environmental, social and governance criteria in investment policies, was in its design intended solely to inform investors (Ministère de la Transition écologique, 2015). It was, however, the first legislation in a European jurisdiction on climate reporting, fitting in with the transparency movement launched by the adoption in 2014 of the EU Directive on CSR non-financial reporting (Directive 2014/95/EU of the European Parliament

and of the Council of 22 October 2014 amending Directive 2013/34/EU). In the United Kingdom, where similar legislation did not exist at the time, the Bank of England was the first to announce a consultation on a package of measures to tighten its scrutiny of banks' and others financial firms' readiness for climate change (Hay, 2018).

Two other important milestones should be noted after the adoption of the Paris Agreement: first, the launch in December 2016 by the European Commission of the European High-Level Expert Group (HLEG) and Technical Expert Group (TEG) on Sustainable Finance which, although not only dealing with the prudential aspect of the issue, has led to the proposal of an Action Plan in 2018 to shift the EU's entire financial system towards sustainability. Secondly, the launch at the end of 2017 of the international Network of Central Banks and Supervisory Authorities for the Greening of the Financial System (NGFS).

As the financial risks associated with climate change become increasingly clear, financial regulators (rather than academics) are driving the boom in research on this emerging topic (Monnin, 2018). As a result, even though we are still far from an understanding of CRRs in all their complexity, the burgeoning literature is already essentially policy-driven, dedicating more space to identifying potential regulatory reforms than to the theoretical underpinnings of risk assessment.

2.1. Discussion on barriers to strategic inclusion of CRRs

As early as 2006, a report by Sir Nicholas Stern to the UK government had formally demonstrated that, from a global macroeconomic point of view, the financial costs of delaying action on climate change would be much higher than tackling CRRs today (Stern 2006); these findings were regularly confirmed since (in the Stern 2015 and IPCC 2014 reports for example), despite the controversy surrounding the choice of the adequate discounting rate. (Nordhaus, 2007). Yet, from a microeconomic point of view, financial institutions have so far considered CRRs only as reputational risks (Schoenmaker & Van Tilburg, 2016).

Researchers who have sought to understand this inconsistency suggest that the financial institutions' focus on short-term profits is explained by a combination of behavioral biases and misaligned work incentives that are directly related to the corporate culture in the

financial community (Weber, 2017; Atreya & Ferreira, 2015). In particular, a natural and incentivized tendency to maintain the status quo in a group (at all levels of the hierarchy) could explain short-sightedness even when credible information is available on the risks involved (Campiglio et al., 2018). This deadlock naturally tends to be reinforced when the administrative burden of a change in operations is significant, a factor which could also explain the immobility of the supervisors themselves (Peeters, 2019).

On the other hand, it would be misleading to claim that information on CRRs for institutions should in theory be fully available and quantified. In fact, the lack of consideration of CRRs in the legal frameworks themselves is a second barrier to their oversight. Supervisory requirements set the risk assessment framework used by banks, although banks tend to be more conservative than required within this framework (Thi Thieu Quang & Gan, 2018). At the European level, almost no consideration is given to the transition risk within CRR2 and CRD IV, and the physical risks are very implicit. As a result, many banks do not enter into low-carbon projects because they perceive a higher relative risk (these are often projects with a longer-term profitability) (Campiglio et al., 2018). Park and Kim further argue that "green" projects (i.e. mitigating transition risk) are perceived as commercially unviable by banks because of the business environment that prevents them from offering long-term financing at lower prices (which can only be influenced by public policy), but also because the banks themselves lack the tools to identify the real opportunities of such projects. On this second point, the authors therefore suggest that a financial supervisor (such as the ECB) can make progress as part of its mandate (Park & Kim, 2020).

But human and legal factors are not the only ones to blame. There is also an overall low level of organizational awareness in terms of CRR-related threats and opportunities that are a burden to both the supervisor and the investors themselves[3]. In Chapter 1.1., Thomä and Chenet were cited as evidence that the risk of climate change is poorly priced by the markets, thus calling into question the hypothesis of an efficient market for assessing climate risk (Thomä & Chenet, 2017). In addition to discouraging investment in transition, this mispricing also poses a systemic threat to financial stability (Battiston et al., 2017). Inadequate market consideration of CRRs in fact exacerbates the financial risks already discussed above. Disclosure of climate risk exposure is the key to enabling investors, lenders and insurers to

[3] In other words, it is a barrier that even an institution with good will could not erase.

price CRRs, and is therefore at the center of the FSB's recommendations through the TFCD (TCFD, 2017).

The most important barrier to a comprehensive and reliable disclosure of a bank's exposure to CRRs resides in the methodology required if such disclosure is to be meaningful and to allow to compare institutions with each other (European Systemic Risk Board, 2020) (Campiglio et al., 2017). In fact, this would involve analysis tools that would incorporate factors and data that are entirely new for financial institutions. This technical difficulty is finally worsened by the highly intrusive nature of the requirements with respect to the institutions' partners (Campiglio et al., 2017).

Yet, such a measurement is essential if the effectiveness of any green banking policy aimed at reducing CRRs is to be assessed. A very good example in this respect is reported by the China Banking and Insurance Regulatory Commission, a member of the NGFS, which has succeeded since 2016 in establishing Non-Performing Loan (NPL) ratios for its Green Credit Policy (Cui et al., 2018). On the European side, the report published in March 2020 by the TEG on the taxonomy of financial products is an ambitious initial proposal to measure the environmental impact of investments. This report does not, nonetheless, exclusively aim to identify climate risks (European Commission, 2020).

Fifthly, access to international markets for all carbon-intensive companies and banking institutions is a barrier that cannot be overcome without coordination among major supervisors. In the absence of such coordination, any tightening of prudential policy could potentially be circumvented by borrowers by raising funds on the international financial markets, without the banking system being appropriately protected from the contagion effects of CRRs. Empirical evidence from the analysis of financial spillovers and spill-back effects between international financial markets, however, by no means precludes the possibility of unilaterally increasing the resilience of the European financial system to climate risk (Krogstrup & Oman, 2019; Agénor & Pereira da Silva, 2018).

A final barrier resides in the strict mandate under which the ECB operates. The European institution enjoys a high degree of operational independence to achieve specific objectives, but this independence makes it very tricky to interfere with market dynamics or government policies (Campiglio et al., 2018). This separation between monetary/prudential policy and

economic policy is one of the central principles of German ordoliberalism enshrined in the foundations of the ECB and is in fact an implicit barrier in the proposals made to the supervisor in terms of "disclosure"(Tooze, 2020). Narrow mandates such as that of the ECB are associated with high-income countries in the literature (Weidmann, 2020). In emerging and developing countries, in contrast, supervisors sometimes have additional tools to specifically support the government's sustainable development objectives (Dikau, 2018). Bangladesh and India supervisors, for example, have set specific lending quotas in climate-sensitive sectors (Dikau, 2018). Brazil's central bank is already requiring its commercial banks to integrate environmental risks into their governance framework (Febraban, 2014). And in Lebanon, the Banque du Liban established since 2010 differentiated reserve requirements based on banks' investment in the low-carbon sector (D'Orazio & Popoyan, 2019). However, it would be a mistake to assume that the leeway given to prudential authorities is uniform across all high-income countries. Indeed, the approaches chosen vary even within the European Union itself. France, for example, has taken a much more proactive approach by making disclosure mandatory through Article 173 of the Energy Transition Law. Countries such as the Netherlands or Finland have a more market-driven approach, encouraging disclosure on a voluntary basis (Nykänen, 2020)(Regelink et al., 2017).

A fascinating debate will be noticed for anyone studying the role of financial supervisors in the face of financial climate risk: that of redefining the role of the supervisor. During the 20th century, governments often used regulation and monetary policy to slow down and boost certain sectors (Elliott et al., 2013). In the emerging framework of the SSM in which the ECB operates since 2014, however, a redefinition of its mandate for explicit environmental purposes seems utopian. On the other hand, given the scale of the risks considered, many potential ways of strengthening the ECB's macro-prudential powers are envisaged in the literature (e.g. through coordination with monetary policy) (Alexander, 2016). Considering the European Parliament's vote of support for the inclusion of climate considerations in the ECB's mandate on 12 February 2020, the redefinition of the ECB's mandate is a credible possibility that should be kept in mind when reading the proposals of this paper (Vasto, 2020).

This last barrier is of a purely political dimension, however. It will therefore not be addressed by the activities proposed within the theory of change framework chosen to delimit this thesis (this framework is explained in Chapter 2). One might rightly ask whether the issue of legal

recognition of CRRs is not also political. We will see later that the legal framework in which the ECB operates can be interpreted in a way that recognizes its competence to take into account these risks to a certain extent. For this reason, this thesis shall examine, albeit briefly, whether the legal framework can constitute a potential barrier.

Barriers	***Activities***
Behavioral biases	
Wrong incentives	
Organizational awareness	
Legal Recognition of CRRs	
Methodological challenges	
Data collection challenge	
International coordination	
Narrow ECB mandate	

Figure 4. Barriers to control on CRRs

2.2. Discussion on activities for prudential control of CRRs

This section brings together all the activities that can be found in the literature for the prudential control of CRRs. It therefore responds to the barriers identified above.

2.2.1. Identification and mapping

According to Schoenmaker and Van Tilburg, comprehensive assessments disclosing the climate-related exposures at an individual level and at the systemic level are a fundamental starting point to supervisors' grasp of the subject. A supervisor seeking to deal with ecological financial risk (including climate risk) must thus start with preparing such an assessment, which takes the form of a two-step process: identifying the risks underlying the financial risks and mapping the financial risks (Schoenmaker & Van Tilburg, 2016).

Consistent with this approach, a majority of authors agree with the European Systemic Risk Board Advisory Scientific Committee (ESRB ASC) on the relevance of a carbon stress test to

establish a first measure of the financial institutions' exposures, particularly in a scenario of abrupt and late transition to a low-carbon economy (ESRB Advisory Scientific Committee, 2016). Such stress tests should take into account direct and indirect exposures in a standardized value chain approach for all institutions (Schoenmaker & Van Tilburg, 2016). In addition, they should be conducted in such a way as to promote a better understanding of the financial implications of CRRs by the institutions themselves (Campiglio et al., 2018). The NGFS, in its first comprehensive report, underlines the importance of setting clear supervisory expectations that will enable institutions to improve disclosure on their own (NGFS, 2019).

The current practice of financial institutions in this regard is highly uneven, however. Philipponnat comments as follows on the role of stress tests in the identification of CRRs in the financial industry: "*It has been interesting to hear central banks and supervisors announce with great publicity that they would be stress-testing banks and insurance companies for climate risk before specifying soon after, and usually with more discretion, that the exercise would not consist in a stress test – defined as measuring the impact of climate change on the financial institutions' balance sheet and activity –, but as a scenario-based analysis consisting in understanding the transition risk, and sometimes the physical risk, incurred by financial institutions under different scenarios*." (Philipponnat, 2020).

We will indeed see in the proposals of this paper that it is currently difficult to approach climate stress tests in any other way than scenario-based analyses (which are not stress tests in the strict sense of the term). However, Regelink et al. insist on the fact that these scenario analyses exercises are very interesting for a first mapping of CRR transmission channels (Regelink et al., 2017). On this point clearly related to technical capacity building, the NGFS advocates the role for supervisors as a catalyst for inter-institutional technical assistance and knowledge sharing (NGFS, 2019).

It has also been suggested that the ECB could set an example by assessing its own exposure to CRRs (De Leeuw, 2018). This, however, directly relies on the ECB's separate monetary function, and could prove counterproductive if the ECB has not itself integrated the CRRs into its portfolio management. In fact, it has been proven that the ECB's current market-neutral operations tend to favor investment in large carbon-intensive companies (Campiglio et al., 2017 (b)).

2.2.2. Supervisory Actions

If the stress tests show that the financial risks associated with environmental risks are significant (or not), the supervisory authorities may take supervisory actions. The instruments considered most appropriate to deal with CRRs are large exposure limits and capital adequacy rules (Schoenmaker & Van Tilburg, 2016). As we will see in this paper, there are, within the current legal framework of CRD IV and CRR2 capital requirements, already some small openings for Pillar 1 and 2 requirements on the basis of the consideration of CRRs.

But the supervisory measures proposed in the literature to force the inclusion of CRRs in financial institutions are not confined to exposure limits and capital requirements. Palm-Steyerberg demonstrated, for example, that Dutch financial regulation provides financial supervisors with the necessary tools to address climate-related risks as part of their "fit and proper" assessments (Palm-Steyerberg, 2019). Such assessments of the composition and functioning of the management body have also been integrated into the ECB's and EBA's supervision, drawing on the Netherlands (De Brauw, 2017).

In the United States, the Vice Chairman of the New York Federal Reserve Board has stressed the importance of requiring that climate risk governance be integrated into strategic decision-making, even before other supervisory tools are used (Stiroh, 2020). Most financial institutions supervised by the ECB have already established internal working groups to develop frameworks for the oversight of CRRs (HSBC, 2019) (BNP Paribas, 2019). However, observers of these initiatives point that their work is not taken into account in the boards of directors, owing to, among other things, uncertainty about the quantification of risks and the lack of auditing standards that would allow relevant and comparable indicators to be established across institutions (White, Ali & Rae, 2020; E&Y, 2020). Accordingly, many opinions suggest that it is the supervisor's responsibility to propose new models allowing *"to explore a diversity of possible futures and assess the performance of different management options with regard to this diversity"* (de Haan et al., 2016).

The mandatory disclosure of specific information to ensure that the risk is indeed assessed by the institution, as proposed by the NGFS, is incidentally a supervisory action in itself, which will also be considered in the case of the ECB pillar 3 requirements (NGFS, 2019). The

quality requirements that it will be able to apply to this disclosure are hence directly proportional to the auditing standards that it will propose.

Finally, insolvency procedures were suggested by Sarra as an opportunity for the resolution board and other insolvency professionals to implement climate risk governance mechanisms in Canada (Sarra, 2018)[4]. The ECB's prudential function, however, is limited to determining whether a bank is failing or is likely to fail (FOLTF) and approving the institution's recovery plans, resolutions being handled mainly through the role of the Single Resolution Board (SRB), which has been established within the Single Resolution Mechanism (SRM) as being complementary and independent of the ECB (Single Resolution Board (SRB), 2016). Still, it should be noted that there is a growing pressure to harmonize insolvency rules for banks at European level (Sandbu, 2019). This could strengthen the influence of the ECB's opinions on the consideration of CRRs in restructuring plans. The impact that the ECB can exert on the consideration of CRRs through bank insolvency procedures will therefore be discussed very briefly in this paper.

2.2.3. Supervisory Signaling

In addition to the activities mentioned above and addressed directly to the supervised entities, the literature emphasizes the importance of signaling by central banks and other financial supervisors. The case of De Nederlandsche Bank (DNB), the Dutch financial supervisory authority, is a very comprehensive and frequently cited example to illustrate the different ways of transmitting signals to the market. Four such signalling techniques are most frequently relied upon.

First of all, taking a public stance. The Dutch supervisor for example states directly on its website that "*Financial institutions have the responsibility to price in climate-related risks and opportunities when making their investment decisions*." (De Nederlandsche Bank, 2020). In the case of the ECB, the public stance seems to have strengthened since the election of Christine Lagarde as president (Lagarde, 2020).

[4] It should be noted that the mentioned paper does not specifically relate to bank insolvency procedures.

Second, the production of economic reports and analyses on CRRs can provide an important signal to investors (DNB Research Department, 2020). It is clear that supervisors are in an excellent position in terms of visibility and credibility to strengthen the recognition of CRRs by market participants.

Thirdly, the creation of networks around CRRs also serves a signalling role. The supervisory authority can use its influence to convene financial institutions to participate in platforms and other fora that will push for collaboration on climate change issues (International Association of Insurance Supervisors (IAIS), 2018). The creation of the "Platform on Sustainable Finance" by DNB in 2016 is proof that work on CRRs involves actors with whom financial institutions are not accustomed to cooperating (De Nederlandsche Bank, 2016).

Fourth, international engagement with other supervisory authorities, as the ECB is already doing through the NGFS and the TCFD or by allowing its staff to join international groups of experts on the issue. This is an answer to the need for international coordination in the supervision of CRRs and allows the sharing of best supervision practices.

Barriers	***Activities***
	Risk mapping
	→Scenario-stress testing
	→ Comprehensive assessments
	Capital Requirements
	Fit and proper assessments
	Governance requirements
	Disclosure requirements
	Insolvency procedures
	Supervisory signaling
	→ public stand
	→ reports and analyses
	→ international engagement

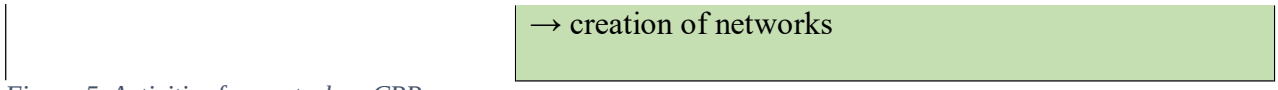

Figure 5. Activities for control on CRRs

3. Sovereign debt crisis and SSM: The ECB's finite and ambiguous mandate

The Single Supervisory Mechanism (SSM), the legislative and institutional framework that gives the European Central Bank single licensing power over all banks in EU member states, has its roots in the sovereign debt crisis that began in May 2010 with Greece receiving its first bailout. After significant failures were gradually being revealed in the banking supervision of a large number of Member States, and with Ireland, Portugal and Spain being added in turn to the list of countries requesting a bailout, Germany initiated a proposal to the Commission for Europe-wide banking supervision (Angeloni, 2016).

With the latter, Europe initiated the project of a centralized supervisory model. This would put an end to regulatory competition, which had proved counterproductive in times of crisis. The European Central Bank, which was occupying a central role given the monetary response to the crisis, was attributed this function almost as an improvised solution because it appeared to be the almost obvious occupant of this position (De Rynck, 2014). The rationale behind the harmonized supervision was clear: it was seen as urgent to break the link between banking crises and sovereign debt crises.

This decision was in fact a first step towards a European banking union. In this sense, it is a fundamentally political proposal, and one that comes at the right time for its advocates. However, the existing dynamics did not allow the SSM to be built up in a comprehensive manner. As Veron explains, the Banking Union is directly dependent on the fiscal and political union (Véron, 2012):
"This [interdependency], *in a nutshell, is because a fully-fledged banking union requires an autonomous European resolution authority and a federal European deposit insurance system, both of which require some sufficient form of backstop from a European level of fiscal authority to acquire credibility (…) The fiscal union that may provide such sufficient backstop, in turn, is difficult to envisage without a political union that would at least partly remedy what Germany's constitutional court once termed the "structural democratic deficit" of the current EU institutions"* (Véron, 2012).

Negotiations between the Parliament, Council and the Commission concerning the mandate and authority of the ECB in its functions, its independence, the geographical scope of its authority and the number of banks directly supervised, but also its governance and

accounting, are a subject in their own right and are outside the ambit of this paper. In particular, very good briefs have been written by Veron, Vant (2014), Howarth & Quaglia (draft) (2015), De Rynck (2014), Skuodis (2014).

There are therefore clear legal and institutional limits preventing the ECB from carrying out banking supervision as effectively as a national supervisor. As Kern rightly points out, these limits are in fact those of Article 127 of the Treaty on the Functioning of the European Union (TFEU) delimiting the ECB's powers (see in particular Article 127 (6) TFEU). Revisiting them would have taken too much time in the context of the establishment of the SSM (Kern, 2020). The law professor underlines the limited capacity of the ECB to act as a macro-prudential supervisor in terms of the tools at its disposal and the separation with its monetary policy.

3.1. Macroprudential limits

For example, the supervisor cannot engage in prudential activities aimed at the financial system at large because it can only supervise 'credit institutions' as defined in European law. Among others, it therefore does not have the competence to supervise the shadow banking market, which is becoming increasingly important in relation to the European banking system (Hodula, 2020). Wholesale debt securities markets, OTC derivatives markets, derivatives clearing houses are other examples cited by Kern.

The impossibility for the ECB to use counter-cyclical capital requirements directly (allowing requirements to vary according to the degree of risk of the assets at specific moments in the economic cycle) is another particularly important example in the case of CRRs. This competence is actually reserved for the National Competent Authorities (NCAs), and can only be activated by the ECB if it provides grounds for intervention. This is the case for a number of macroprudential tools and will limit the proposals made in the rest of this paper.

A final example has already been mentioned: the competence to put a credit institution into resolution is largely reserved to the SRB, limiting the role of the ECB to "assessments".

3.2. Separation of the banking supervision function from monetary policy

The supervisory mandates of central banks are far from unanimous. In the case of the ECB, these functions are strictly separated. This is due in particular to the dispute over certain bond purchases made by the ECB during the crisis. As a matter of fact, the ECB's Outright Monetary Transaction (OMT) program was promptly questioned by German members of the ECB Executive Board (one of whom resigned in protest) and was brought in front of the German federal constitutional court (*Bundesverfassungsgericht*) to debate its legality (Guillaume, 2017). In addition, many observers felt that the ECB was trying to get Ireland, Greece and Cyprus to accept its proposed bailout conditions and even pushed for the resignation of the Italian government (Land, 2016).

In such a climate of questioning about the excessive power that the ECB was taking on, the question that had always existed about the ideal degree of separation between these two functions was not debated for very long. This separation took place even at the organizational (staff) level. It is however suggested, especially in view of the extraordinary measures developed since the 2008 crisis, that the ECB should be able to directly assess the impact of its monetary policy on the balance sheets of the institutions it supervises (Kern, 2020). This institutional limitation would therefore be particularly felt if the ECB wished to develop a monetary policy coordinated with its supervision of climate risks…

With these limitations in mind, the following proposals will show that the ECB's context also has certain advantages in considering CRRs. In particular, many of the suggestions will acquire all of their credibility in the operational independence of the ECB Supervision.

II. Methodology

The review of the literature carried out in Chapter 1 defines the nature of the problem addressed, and describes the background against which this problem arises. It also provides us with some answers -- though these answers are provisional, and remain at a very high level of generality. No article in the literature, however, answers the specific question of this thesis: "*How to integrate the supervision of CRRs into the supervisory activities of the ECB?*".

1. Question Validation

Thus formulated however, the question is based on a hypothesis that needs to be tested: the implicit assumption is that the ECB could supervise the CRRs better or more than it currently does.

In order to do so, it was first necessary to define the limits of what was feasible for the ECB. In other words, it was necessary to evaluate the activities already undertaken elsewhere by other supervisors and to assess whether it was feasible for the ECB Supervision to undertake the same activities. Thus, best supervisory practices in terms of CRR supervision around the world were devised within the legal framework of the SSM, CRD IV (and V) and CRR2.

This allowed the identification of actions which the ECB Supervision could not undertake at all (e.g. requiring a minimum level of lending to renewable energy), those which it could easily undertake (e.g. requiring training of Chief Risk Officers in climate risk), and those which it could undertake to some extent (e.g. giving a higher weighting to assets in the calculation of the minimum capital requirement, due to a perceived high risk through CRRs). As many best practices seemed theoretically adoptable by the ECB, the question was worth asking.

2. Methodological framework

Once the question had been validated, a methodology had to be developed to answer it. The question posed does not call for an explanatory, descriptive or even predictive answer that

would require a scientific methodology. It calls for a strategy and requires a methodology of action…

The method chosen falls within the framework of the theory of change: « *Theory of Change (ToC) is a specific type of methodology for planning, participation, and evaluation that is used in companies, philanthropy, not-for-profit and government sectors to promote social change. Theory of Change defines long-term goals and then maps backward to identify necessary preconditions*." (Brest, 2010).
This framework is very recent and little used in the literature in general. However, it is increasingly present in the proposal-driven literature (Feger & Mermet, 2020).

This framework has several advantages relative to the goals of this thesis:

- It provides a long-term goal from which all the proposed actions will derive. In this way, the potential actual outcomes of all proposed activities can be assessed in terms of their relevance to the long-term goal. Furthermore, it will allow to determine intermediate goals that could also be pursued as part of the larger goal.
- It enables the conditions for the success of certain activities to be established. The framework is designed for designing a strategy, not for building an argumentation. Therefore, it allows the identification of certain conditions necessary for the success of a proposal. Such an approach is more constructive than a demonstration: it is policy-oriented, not advocacy-oriented.
- It allows to consider very different sources (objective and non-objective) and to combine different epistemological domains. The framework of the theory of change is imagined as allowing the dialogue of several actors around a strategy. In other words, each proposal will be constructed in the form of an argument about the potential benefits for the strategy as a whole.

3. Framework Implementation

On the basis of this ToC framework, a very broad review of the literature and interviews with several actors made it possible to identify three elements: 1) intermediate goals to be achieved to enable the ECB's supervision of the CRRs (e.g. the implementation of a new stress testing methodology) , 2) barriers to achieving these intermediate goals or the final goal (e.g. lack of information and skills to put new stress testing methodologies in place) 3)

proposed activities to achieve intermediate (or final) goal(s) (e.g. setting up partnerships dedicated to stress testing).

Intermediate goals and proposals were further assessed in terms of their relevance to the final goal (and in the environment under consideration). A limited number of intermediate goals and proposals were retained based on such assessment, and on the arguments supporting each of the goals and proposals initially listed.

Finally, the proposals brought forward have been integrated into the ECB's activities. This provides the basis for the strategy. Afterwards, the broad outlines of the strategy are drawn up in order to carry out the activities in a coordinated manner. The technical limitations of this paper, however, prevented the construction of a comprehensive and detailed strategy for the entire ECB Supervision, as could be developed at the level of the Supervisory Board in agreement with the Governing Council of the ECB.

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III. The potential role of the ECB in climate risk supervision

An overview of the organization of the ECB Supervision is available in Annex 1.

This chapter discusses the different channels through which CRRs can be incorporated into the ECB's supervisory actions, expectations and guidance under the ECB's current legal framework determined by the **Single Rulebook** (and more specifically the **Capital Requirements Directives IV (CRD IV)**[5]**,** the **Capital Requirements Regulation 2 (CRR2)**) and the regulation of the **Single Supervisory Mechanism.** Building on the simplified theory of change framework introduced in Chapter II, the proposed activities will be integrated across all relevant ECB Supervisory tasks. These proposals are addressed directly and solely to the ECB Supervision as an organisation in its entirety, and therefore not only to the Supervisory Board. They relate either to changes in certain practices to include CRRs or to the extension of certain practices.
As will be explained in their development, the proposals predominantly concern Significant Institutions (SIs) representing more than 4/5ths of European banking assets, which are directly supervised by the ECB under the SSM. The supervision of the Less Significant Institutions (LSIs) is delegated to the National Competent Authorities (NCAs), but with a methodology imposed by the ECB and the possibility for the latter to carry out the supervision itself (SSM Framework Regulation, 2014).

The development is divided into three parts: the first part will deal with **supervisory reviews**, in other words the risk assessments that are carried out daily and individually for each bank. These assessments, once aggregated, also make it possible to establish supervisory priorities and lead to "horizontal" missions around particular risks. Openings to address climate risks will be developed there for SIs.
The second part will deal with the **comprehensive assessment**, which is an annual exercise to assess the resilience of supervised banks to financial and macroeconomic shocks. We will pay particular attention to stress tests, as the ECB has very little impact on the consideration of CRRs in the Asset Quality Review (AQR, the other part of the comprehensive

[5] Some defended arguments are based on articles written in the context of CRD IV (Directive 2013/36/EU) but are still valid following the amendments to CRD V published by the European Council and the European Parliament on 17 May 2019 (DIRECTIVE (EU) 2019/878).

assessments). AQRs are basically a very strict accounting exercise where the ECB merely provides the NCAs with principles for interpreting the accounting rules.
As a follow-up to these two assessment activities, the third part will consist of a discussion on the **supervisory actions** that the ECB can take when considering climate risk.
Finally, a fourth section will be dedicated to the special case of fit and proper assessments, which allow the ECB Supervision to control if the board and department managers are fit for their function.

1. Individual monitoring and deep-dive horizontal analyses

The SSM Regulation and the SSM Framework Regulation entrusted the ECB with powers of prudential micro-supervision of credit institutions in the 19 euro area countries. The ECB has full decision-making powers in the SSM, and may even require NCAs to use some of their powers. This was confirmed when the EU General Court considered the ECB's competence in terms of supervision as “exclusive” in Case T-122/15 (*Landeskreditbank Baden-Württemberg v ECB*), in which it delivered a judgment on 16 May 2017 (later confirmed by a judgement delivered by the Court of Justice on 8 May 2019 in Case C-450/17 P) (General Court of the EU, 2017).

Hence, the ECB Supervision determines on its own whether minimum capital requirements are met (Pillar 1), what the precautionary recapitalizations are (Pillar 2), and what additional disclosures of information and transparency efforts are required (Pillar 3). It also decides on access to certain common financial support measures and approves the restructuring plans. The rigorous fulfilment of these tasks is very difficult to assess as they are multiple, often conflicting, not always quantifiable and made with a multiplicity of tools (in contrast to its monetary policy) and are part of the vague mandate of "financial stability" (Beroš et al., 2019). Finally, these decisions are made on the basis of data that are predominantly not accessible to the public (to protect the banks). We will see that this context is an institutional open door to activism in the ECB Supervision's day-to-day actions (Amtenbrink et al. 2017).

However, the various policies of ECB supervision have not yet really been questioned by the institutions, either in terms of objectives or in terms of transparency towards them. On the other hand, the lack of information on the supervisory toolbox (the methods used for the assessments) is regularly criticized (European Court of Auditors, 2016).

Beroš illustrated this lack of transparency very well in her comparison of three Italian banks subject to increased prudential supervision due to lack of capital and low liquidity : two banks in the Veneto region, Veneto Banca and Banco Popolare di Vicenza, and one bank in Tuscany, Monte dei Paschi di Siena, which was much larger and potentially posed a significant risk to the Italian financial system as a whole. The material elements on which the ECB took its recapitalization decision for only de Monte dei Paschi bank were clearly based on a "Too Big To Fail" logic, but the ECB remained very vague on the assessment methodology behind each of its decisions. (Beroš et al., 2019)

It is precisely on the basis of this methodological freedom that this first section will be built. It will identify key activities through which the ECB can strengthen its commitment to CRRs in its day-to-day supervision. The first part will focus on the individual supervision of banks as part of the supervisory review and evaluation process and will therefore concentrate on the work of the joint supervisory teams. The SREP is part of Pillar II, which was introduced into the regulatory framework by the Basel II Accord (BCBS, 2003). Next, the selection of SSM supervisory priorities and thematic reviews will be discussed.

1.1. Supervisory Review and Evaluation Process (SREP)

Summarized technical description of the supervisory review under the SSM (the full methodology of the ECB can be found in its Guide to Banking Supervision) (ECB, 2020):

1. The ECB is directly in charge of day-to-day supervision of the so-called "Significant Institutions" (SIs), whose criteria are renewed monthly, and which in March 2020 covered 117 banks and 82% of bank assets in the euro zone.

2. Supervision is carried out individually at each SI by Joint Supervisory Teams (JSTs) composed of staff from both the ECB and the NCAs, ranging from 15 to over 50 employees depending on the complexities. JST coordinators (appointed for a period of three to five years) are ECB staff members and coordinate the organization of the JST, the representatives of the NCAs are determined by the NCAs themselves. The composition of the JSTs is determined by the Directorate General Microprudential Supervision I and II (DG MS I and II) (Sporenberg, 2018).

3. The JST establishes a *Supervisory Examination Program (SEP)*, based on a methodology of dialogue, investigation, ... etc. prescribed by the SREP, to assess the risk incurred by the institution on a daily basis according to its business model, risk profile, risk management, control and internal governance systems. This programme also includes the control of the follow-up measures to be taken by the bank.

4. This process monitors compliance with Pillar 1 capital requirements (covering standard risks to which all banks are exposed) and identifies additional risks specific to the supervised institution that will add Pillar 2 capital buffers. A central role is given to internal models in the Basel regulatory framework. The JST is evaluating and adapting this internal process. It has the authority to unilaterally request the further development of certain aspects of the evaluation.

5. DG MS I and II coordinate this day-to-day supervision, assisted by the ECB's horizontal and specialized divisions. They constitute the link between the JSTs, submitting their reports and draft decisions/operational acts[6], the Supervisory Board and the Governing Council.

6. The supervisory decision drafts are approved, amended or rejected by the Supervisory Board and eventually submitted to the Governing Council under the "non-objection procedure". This procedure implies that draft decisions can in principle be challenged by the Governing Council within a strict time limit (10 days).

7. The addressees of draft ECB decisions are free to comment on them in advance, in accordance with due process requirements, thus ensuring that all decisions are taken on a fully informed basis. Where appropriate, the decision may be reassessed internally by the **Administrative Board of Review (ABoR**) of the ECB. This procedure is of course without prejudice to the addressees' right to bring proceedings to the Court of Justice of the European Union (CJUE).

[6] Operational acts are general information guidelines, supervisory decisions are constraints and sanctions imposed on the institutions.

The reminder of this process is essential because it allows to highlight the key role of the JST as a front-line actor in the supervision of banks and as the sole source of continuous information for the prudential authorities.

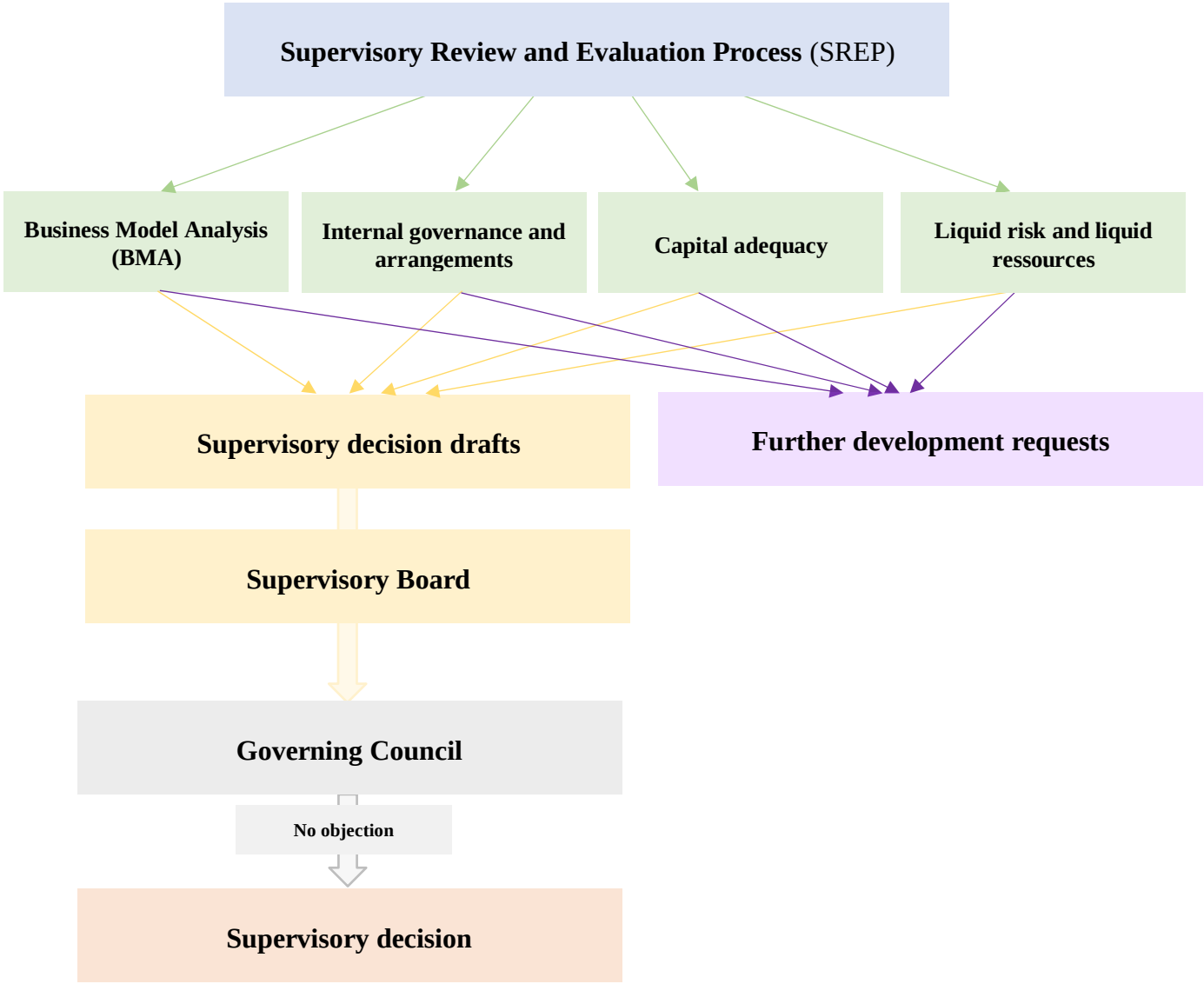


Figure 6. Supervisory Review and Evaluation process

1.1.1. JSTs as a central actor in the integration of CRRs

Given the national contexts and the different profiles of supervised banks, the working method of the JSTs is flexible within the SREP framework.[7] Nonetheless, JSTs are always divided into clusters or risk subgroups, independently determined by the JST manager. Nothing in the SSM legal framework and the EBA guidelines on the SREP methodology would therefore prevent the organization of part of a JST around CRRs (European Banking Authority (EBA), 2020).

While such decisions are taken at the level of the JSTs, it is interesting to note the ECB's willingness to standardize procedures through the work of the Supervisory Policies Division (Baglioni, 2016). Accordingly, a second channel of influence for the JSTs consists in the benchmarking of supervisory processes. Requirements imposed on an institution, if assessed as relevant by the Methodology and Standards Development Division (MSD), will have an increasing chance of being imposed on similar institutions (ECB, 2020).

The role of the NCAs in the emergence of best assessment practices, in particular through the JSTs, but also through the national supervision of the SIs and the supervision of markets outside the SSM framework, is not to be discredited either (Nouy, 2018). In particular, this paper will later discuss the influence of De Nederlandsche Bank in the consideration of governance risk.

In concrete terms, climate risk can be integrated into the four main assessments of the SREP process, respectively the Business Model Analysis (BMA), the assessment of internal governance and control systems, the capital adequacy analysis and the analysis of liquidity risk and liquid resources. A set of key indicators for each of these four elements is given in the EBA guidelines. Then, a rating ranging from 1 (no risk) to 4 (high risk) provides the "monitoring view" for each of the elements.

[7] *"overall composition and organisation of a JST varies depending on the nature, complexity, scale, business model and risk profile of the supervised entity."* ECB in the *SSM Supervisory Manual*, March 2018.

1.1.2. Business Model Analysis (BMA)

The BMA methodology considers a large number of key drivers (considered in light of risk appetite) that demonstrate profitability in the short (1 year) and medium/long term (3 years). The assessment is made in the context of the business environment and in relation to the institution's peers.

As such, the first potential channel for integrating climate risk into JST assessments is the business environment. The business environment is assessed through technological, regulatory and macroeconomic key trends of specific territories and products. So, for example, institutions concentrated on mass agriculture or involved in water-heavy manufacturing productions have a business model that is sensitive to droughts. In terms of transition risks, one could give as an example the involvement of an institution with car producers whose research and development is clearly lagging behind in the development of the electric car. In this way, the JST can take into account indicators related to climate risk to assess the profitability of the business model. This would identify business models that present too great a risk of concentration. The Business Environment analysis, however, offers a fairly comprehensive view, and the CRRs are generally not underestimated in the trends identified (Deloitte, 2018).

Once the business environment has been established, the bank's strategy must be assessed on a quantitative and qualitative basis. If the bank's business model is at maturity, it may appear profitable and riskless, but its later decline might be very difficult to counter. The bank's ability to modify or transform its business model (business model innovation capacity) in line with identified trends must be assessed in relation to its current commitments and its ability to clean up its balance sheet, in relation to its previous management, its appetite for risk (assessed through the risk appetite framework (RAF)), the reasonableness of its future prospects, and so on (Deloitte, 2018). In this analysis, the presence and relevance of a transition strategy based on the business threats and opportunities of climate-related changes will have to be assessed. Establishing the latter is clearly not an easy task in the current business environment, if one recalls for instance the banks' short-term and high-cost modes of financing, which are a barrier to low-carbon investments (Park & Kim, 2020).

The launch of this specific strategic planning can therefore definitely be required without delay. A good strategic approach requires consideration of the "inside out" aspect linking the impact of the company's activities on the climate and the "outside in" aspect to understand the reverse relationship. Its assessment involves the use of a peer group immersed in a similar business environment in terms of exposure to climate risk.

1.1.3. Internal governance and control arrangements

Like the BMAs, internal governance & control arrangements show a significant decline in its SREP 2019 scores (Schweiger, 2020).

This aspect of SREP is especially important for three reasons. The first is that it is the most qualitative element of SREP supervision and is therefore one of the best ways to approach a risk that is difficult to quantify such as CRR management. The second is that it helps to approach the risk management culture within a bank. Management culture is a key to considering climate change risk at the organisational level (Granderson, 2014). The internal governance and control arrangement review would, for example, make it possible to adapt compensation policies if they appear to conflict with the management of CRRs, or to ensure that managers at all levels are informed about climate risk. It would also allow mechanisms to be put in place to avoid conflicts of interest with the management of CRRs within the board or its advisers (we will return to this last aspect in section 4 on fit and proper assessments) (ECB, 2020 (b)).

Third, the JST may require systematic audits and reporting of CRR exposure if these are significant for the institution. The implementation of such mechanisms would be the first step in the collection of data on CRRs, which is extremely useful in risk mapping (we will also come back to this point).

1.1.4. Capital Adequacy

Several mechanisms have been proposed so far to integrate climate risks into capital requirements. A very interesting debate is emerging on the appropriateness of a green support factor (GSF) versus a brown penalty factor (GMP) or the use of both in the asset weighting for capital requirements. Most (objective) observers have tended to favor the use of the latter,

as the GSF has a low effectiveness relative to the additional risks it generates (Boot & Schoenmaker, 2018). For the time being, however, regulation on asset weighting based on environmental considerations is only at the consultation stage at the European level and is therefore beyond the scope of this memorandum (HLEG on Sustainable Finance, 2020). The Basel III Accord, in addition, makes no mention of a climate risk assessment in the capital requirements (BCBS, 2016).

At present, the ECB can only try to improve its consideration of climate risk in the regulatory framework of the CRR2 and the CRD IV. These establish the capital adequacy ratio, CAR, with a measure of a bank's available capital expressed as a minimum of 8% of risk-weighted assets (common equity tier 1, the highest quality of Tier 1 capital, should make up 4.5%; and Tier 1 capital 6 %). In a nutshell, the riskier an asset is considered to be, the more capital will be needed to cover its risk (to stay above the Capital/Asset ratio of 8%). The risk weighting of assets in this legislation is established almost incontrovertibly, leaving little room for interpretation.

Article 128 of the CRR2, dealing with "particular high risk" is an exception (Art. 128 CRR2):
"1. Institutions shall assign a 150 % risk weight to exposures that are associated with particularly high risks.
2. For the purposes of this Article, institutions shall treat any of the following exposures as exposures associated with particularly high risks:
· (a) investments in venture capital firms, except where those investments are treated in accordance with Article 132;36
· (b) investments in private equity, except where those investments are treated in accordance with Article 132;
· (c) speculative immovable property financing."

The rest of the article can be found in the CRR of 2013, which remains unchanged after CRR2:
"3. When assessing whether an exposure other than exposures referred to in the paragraph 2 is associated with particularly high risks, institutions shall take into account the following risk characteristics:
(a) there is a high risk of loss as a result of a default of the obligor;
(b) it is impossible to assess adequately whether the exposure falls under point (a).

EBA shall issue guidelines specifying which types of exposures are associated with particularly high risk and under which circumstances.
Those guidelines shall be adopted in accordance with Article 16 of Regulation (EU) No 1093/2010."

Thierry Philipponnat, in a report published in June 2020, rightly notes that this third paragraph fits perfectly in points (a) and (b) with the known situation of stranded assets (which, for reminder, are related to transition risk)((Philipponnat, 2020).
(a) There is, indeed, a high probability of default linked to the fact that some borrowers will go bankrupt as a result of the transition. The likelihood that such companies will face transitional green swan events or that their indebtedness is disproportionate given the longer-term outlook for the industry can be estimated. As a result, a certain number of assets could be registered as "particularly high risk" assets.
b) The aforementioned risk of default is impossible to assess with certainty, although its existence is certain (green swan).

The penultimate line of the article states that the final qualification of risks as "particularly high" belongs to the EBA, which will decide whether a 150% risk weight should be assigned to the identified assets. The role of the JSTs in the case of this third point would therefore be to propose such a qualification to the European institution and to prove that the current weight of 100% is at variance with the precautionary principle of Article 191 of the TFEU. The validation of such an assertion would furthermore generate "caselaw" in the qualification of risks.

2.1.1. Liquidity risk and liquid resources

In a guide published in May 2020, the ECB states that it expects direct and indirect climatic and environmental impacts to be taken into account in the liquidity reserves and thus in the forecast of cash outflows. It supports its point by mentioning Article 86(1) of CRD IV., which stipulates that institutions are expected to have robust strategies, policies, processes and systems to identify, measure and manage liquidity risk over an appropriate set of time horizons (ECB, 2020 (b)).

This last pillar of the SREP framework is one of the most relevant axes for addressing climate risk as it includes internal stress tests that are confronted by the supervisor. The methodology of these individual stress tests conducted within the SREP framework is very similar to the micro-prudential stress tests conducted every two years at the European level by the ECB and the EBA, which we will discuss in the next chapter. The conclusions drawn for the latter are to a large extent applicable to the SREP stress tests, except that they are not published and therefore have no signaling effect on the markets. Stress tests enable the combination of an idiosyncratic stress situation and a market stress situation following a climate-related event to be considered (ECB, 2020 (b)). SREP stress tests are the most useful tool to enable an institution to report data on its exposure to climate risk on a regular basis.

With regard to Individual Liquidity Adequacy Assessment Processes (ILAAPs), the JSTs are responsible for assessing the appropriateness of the internal models used. ILAAPs are supposed to identify all material risks, going beyond regulatory risks (ECB Supervision, 2018). However, liquidity risk is, by definition, short-term. ILAAPs therefore represent a very weak relevance for the management of CRRs.

2.1.2. Comment: EBA guidelines already support the consideration of CRRs.

The EBA's SREP guidelines are at the heart of its cooperation with the ECB in this exercise. These provide two clear openings for the inclusion of CRRs through credit risk supervision (Beekhoven van den Boezem et al., 2019):

- Specialized lending risks must be considered from the perspective of future cash flow changes related to regulation and market demand (i.e. transition risks) (SREP Guidelines 160-162).
- Geographical risks (country risks) of a customer's exposures must be taken into account in view of natural and/or political and social events, among other things. (SREP Guideline 154). It should also be noted that the CRD IV allows the ECB to require a methodology from the EBA to cover geographical risks (Art. 140 CRD IV). Nonetheless, these risks should be considered on a 12-month horizon.

And two openings through operational risk supervision:

- Model risks should be sanctioned by capital requirements as long as these models are too imprecise to make fully informed decisions, including long-term perspectives. (SREP Guidelines 262-267).

- Reputational risks should be considered in SREP assessments (SREP Guidelines 268-271). Given that all SIs are listed on the stock exchange, this risk is very relevant in their case because they could be exposed to disproportionate reactions.

1.2. Thematic reviews

1.2.1. Thematic reviewing process and CRR mapping

Thematic reviews are conducted on the basis of the key priorities to banks identified by the JSTs themselves, reports from external international organisations, and the ECB's microprudential and macroprudential analyses (ECB, 2019). In principle, they are initiated for information purposes only. DG Micro-Prudential Supervision IV (DG MS IV) coordinates these specialised tasks (sometimes conducted in collaboration with SREPs activities of DGs l and ll) (SSM Framework Regulation, 2014).

The SSM supervisory priorities are the outcome of a discussion between the ECB's horizontal microprudential and macroprudential functions, the JSTs and NCAs. They are established for 1 year or more, and often grouped into priority areas (in 2020, 3 areas) so that “horizontal” JSTs can address them in a symbiotic approach. The thematic reviews are requested by the JSTs themselves, confirmed by the Supervisory Board according to the priorities set for the period, and validated by the Governing Council only under the no-objection rule. SSM supervisory priorities for 2020 are represented in the figure below (ECB Supervision, 2020).

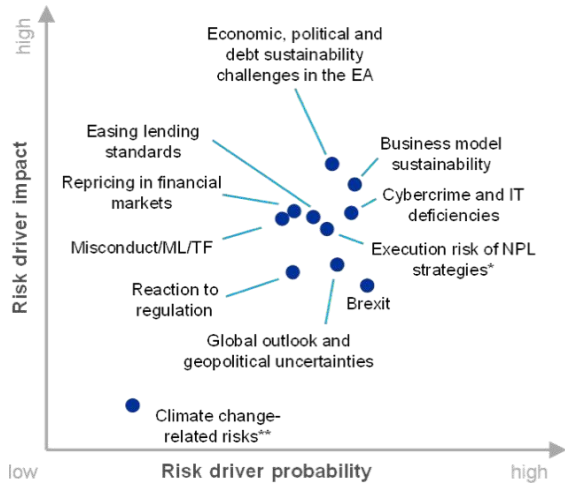


Figure 7. SSM supervisory priorities 2020

CRRs immediately appear in this figure as an outsider. This risk mapping clearly illustrates the difficulty the ECB has in grasping CRRs, which cannot be considered as "short-term" and therefore financial risk with real priority. They have been present on the map since 2019, but have not yet been the subject of a thematic review.

An in-depth thematic review of climate risk could still be launched quite easily on the initiative of a few heads of division (or by direct order of the supervisory board). The real difficulty lies in defining the focus and methodology of a mapping exercise. Climate risk mapping is, nonetheless, one of the main recommendations of the NGFS to supervisors (NGFS, 2019). The implementation of a

horizontal climate risk mapping process could be a key priority for DG MS IV in coordination with the first CRR audits imposed on institutions under the SREP. The rest of this section will try to provide some possible answers for the setting up of such a process.

1.2.2. Avoiding power without control: the implementation of a bottom-up approach through thematic reviews

The thematic review of the CRRs should be established with a twofold objective. Firstly, it should allow an aggregation of risk transmission channels and key risk indicators (KRIs) identified during the SREP internal stress tests, as well as aggregated data from reports and other audits. As a matter of fact, the complexity of climate risk makes it impossible to adopt a top-down approach under which a uniform model would be adopted for risk assessment across banks, as the ECB does, for example, to assess IT weaknesses in supervised banks (Lautenschläger, 2018). A thematic review of is what would allow a bottom-up model to be put in place at SREP level.
Second, it will document the best practices of institutions in implementing new SREP requirements and will identify obstacles to climate reporting at a comprehensive level. This seems to be the intention behind the first guide on climate-related and environmental risks published on 20 May 2020 by the ECB (for information purposes only) (ECB, 2020 (b)). This second output of the thematic review will rapidly increase the adoption of new models.

a. First objective: CRR mapping

CRR mapping firstly requires a distinction to be made in terms of physical risk and transition risk. These two risks need to be divided into a limited number of event categories that will classify all causes of financial contract exposure:

- The physical risks can be broken down into the 6 main climatic physical risks identified by the Global Research Institute (GRI) as potentially affecting portfolio exposures. However, this paper will divide the GRI's "Heat stress" risk into "increase in heatwaves" and "average temperature increase": i.e. (1) an increase in average temperature, (2) increase in heatwaves, (3) an increase in droughts, (4) changes in rainfall patterns, (5) an increase in heavy rainfalls, (6) an increase in sea level rise and floods and (7) an increase in storms.

- For transition risks, the division set out in Chapter 1 is sufficient, i.e. (1) political and legal factors, (2) market pricing parameters (preference), (3) production and technology trends, (4) reputational risks. However, a fifth indicator should be added for so-called "non-conventional" transition risks, i.e. risks that cannot be classified in one of these 4 categories. For example, this category would include risks of legal cost overruns in an institution's insurance activities due to physical risks.

It should be noted that direct operational risks for banks are not worth taking into account in the thematic review, as they are extremely specific to institutions.

Exposure to each of these 12 risks could be broken down into each of the sectors to which the bank is linked (energy, construction, transport, industry, agriculture, third sector, etc.) at the most granular level possible (sub-sectors and with sector-specific measures, e.g. thermal efficiency measures in real estate loans). This would make it possible to define which risks banks are most exposed to, and to identify the main transmission channels and portfolios. Risk mapping will enable Key Risk Indicators (KRIs) to be established, which are extremely important for the supervisor. An example of a KRI could be the number of days of heat wave near Almeria, Spain, which could have an impact on the price of fruit and vegetables and thus endanger all retail chains in Europe.

b. Second objective: improving CRR disclosure

It is clear that this exercise will produce extremely incomplete results at the outset. These gaps are useful information in their own right, as they will allow to identify gaps in terms of data and approach. On this basis, a second part of the review will report on existing, expensive or simply missing information. The gaps may be grouped by type of banking business model, assets, legislation or by climate risks and the sectors invested in as such. The Bank of England's Prudential Regulatory Authority's 2020 thematic feedback clearly identifies measurement and quantification as "*the most difficult aspect of assessing climate-related financial risks*" (Woods, 2020). The thematic review by ECB Supervision will help to clarify the limits of this challenge at the European level.

Second, best practices, i.e. the methods providing the most complete data, will be highlighted through the horizontal review.

1.2.3. Prospection as a key to success

The mission of the JST in charge will have to be prospective at first. Surveys will make it possible to establish the banks' preferences and difficulties in terms of input reporting. To this end, studies by the FSB's TCFD or the Basel Committee's High-Level Task Force on Climate-related Financial Risks (TFCR) provide a good methodological basis (FSB, 2020) (BCBS, 2020). The latter could also be good partners for conducting them.

Moreover, the GHG Protocol, established following the Kyoto Protocol in 1997, published corporate accounting and reporting standards for a second time in 2006. In response to the clear lack of transparency in the financial sector in particular, it also published a first guidance in 2018 for developing metrics to measure the extent to which their activities contribute to or hinder the transition to a low-carbon economy (Cummis et al., 2018). The progress of the GHG protocol with the WRI on the subject of climate reporting should also be taken into account by the ECB teams for the development of a reporting framework on CRRs.

1.2.4. Reporting as a key to sustainability

During the course of the year, the JST itself will have to report specifically on the status of its review within the institutions and its coordination with the SREP. This is key to the long-term integration of the reviews as a way of collecting relevant data in a bottom-up approach.

1.2.5. A gradual approach as the key to coherence

There is no doubt that the administrative burden of the exercise will fall largely on the institutions. These will have to report their internal audits and tests within the standardized framework imposed by the horizontal review. It might be appropriate to carry out this test only with a limited number of institutions in the first instance.

1.3. Key message

It is proposed that the JSTs focus a specific part of their team on climate risk to institutions under the SREP. The CRRs can be considered within the 4 indicators of the SREP.

Firstly, Business Model Analysis could allow CRRs to be taken into account in strategic considerations if these have shortcomings in terms of the sustainability of activities. Similarly, internal governance and control arrangements could require that remuneration, audit or employee information mechanisms (among others) be rethought if these are incompatible with the reduction of CRRs for the institution. These two indicators are clearly the most interesting for the long-term adaptation of the functioning of institutions.
Third and fourth, Capital Adequacy and Liquidity risk assessments necessarily rely on some degree of quantification of CRRs. The first requires proof that certain assets are exposed to "particular high risks", and the second needs to prove that one or more CRRs threaten the institution's short-term liquidity. These last two indicators allow the use of tools that are much more restrictive for institutions, but they are directly confronted with the technical barrier of the uncertainty of climate risk.
Day-to-day supervision is the main channel for the organizational transformation of institutions. Fit and proper assessments, in which JSTs also play a central role, are a complementary tool that we will see in the last section.

In conclusion, it is interesting to note that the heterogeneity of the national frameworks offers a lot of independence to the JSTs, which are composed of ECB members and NCAs (but organized by ECB's foremen). Their individual role is therefore crucial, particularly in the emergence of best practices among other JSTs.

It is also proposed to conduct thematic reviews, called "horizontal" reviews of CRRs. These reviews could be conducted in a coordinated manner with the new reporting mechanisms that would be developed under SREP. They would allow the collection of all reported information on an aggregated basis over time. In addition, they would allow for a clearer identification of existing gaps in terms of CRR reporting and to share best reporting practices. The primary objective would be to set up a system for collecting data on CRRs from institutions while allowing them to develop their own reporting methods internally.

2. Stress tests

"Embracing radical uncertainty requires people to overcome the belief that uncertainty can be confined to the mathematical manipulation of known probabilities" (Mervyn King (former BoE Governor), 2017).

2.1. Overview of the current stress test process

Annual stress tests (ST) at European level are initiated biannually for a sample of 51 banks (of which 35 are in the SSM) representing 70% of assets on the European. The EBA establishes the final version of the methodology, the scenarios and the basic hypotheses. However, to this end, it interacts with the ECB, the European Commission and the European Systemic Risk Board (ESRB) (EBA, 2020) (ECB, 2020 (c)).

The tests are conducted at the institutions. A certain methodology and scenario are laid down by the EBA, and banks then conduct their stress test projections based on their own model (which gives them much greater flexibility to use their internal resilience models). The results are confronted by the top-down model of the ECB's Risk Analysis and Supervision Division (in coordination with the NCAs), also based on a methodology prescribed by the EBA. This approach is known as the "*binding bottom-up approach*". It ensures that banks' forecasts of their reactions to stress situations can be compared on an aggregated and objective basis. The publication of the final adjusted results is the result of a bilateral and confidential "discussion" between the institution and the ECB (de Guindos, 2019) (EBA, 2018).

These tests are based on a reference scenario provided by the NCAs, and on an adverse scenario established by the materialization of the financial risks identified by the ESRB, as well as certain risks considered by the EBA[8]. It is worth underlining that the ESRB is a body independent of the ECB but which relies for all its analyses, reports and assessments on the data reported by the ECB (ECB, 2009). For 2020, the adverse scenario (in broad outline) is as follows:

> *"By 2022, the EU real GDP would decline by 4.3% cumulatively, the unemployment rate would rise by 3.5 percentage points, equity prices in global financial markets would fall by 25% in advanced economies and by 40% in emerging economies, residential real estate prices would decline by 16%, and commercial real estate prices would decline by 20%."*[1]

[8] This test is based on a reference scenario provided by the NCAs, and on an adverse scenario established by the materialisation of the financial risks identified by the ESRB, as well as certain risks considered by the EBA.

It should also be noted that the results of these annual stress tests are subsequently used for **macroprudential stress testing**. These tests for macroprudential purposes are an aggregated analysis conducted without the banks. It attempts to capture the interdependencies between banks and the real economy, and thus departs from the assumption of a static balance sheet (i.e., it assumes that banks adjust their balance sheets in response to shocks)(Budnik et al., 2019). Macroprudential stress tests are published in the ECB's Macroprudential Bulletin, using inter alia (Budnik et al., 2019):

- Assets represented at a sectoral and geographical level. This representation needs to be sufficiently granular to reflect differences among banks in terms of vulnerability to macroeconomic shocks, an objective that cannot be met in all countries.
- Behavioral responses estimated on an aggregated historical basis. The influence of asset quality, profitability and funding structures is taken into account.
- A feedback loop between the banking system and the real economy, expressed through the adjustment of loan bids, profit distribution, and increased lending margins.

The objectives of this test are (1) to provide a measure to assess the resilience of the banking sector in general, (2) to induce banks and regulators to reflect on the systemic consequences of decisions that would likely be taken in response to certain events, and (3) to feed into a counterfactual analysis to assess the system's response to certain macroprudential policies (Budnik, 2019). This type of analysis emerged in the wake of the 2007-2009 crisis.

2.2. The role of the ECB in practice

Article 32 of the SSM amended the powers of the European Banking Authority and established a 'collaborative' relationship with the ECB in this exercise (Official Journal of the European Union, 2013). The methodology prescribed by the EBA is in fact rather the result of a dialogue between the two institutions within a relatively unclear legislative framework. A Deloitte study of this relationship even highlighted the "*opportunities for divergences* (which) *make cooperation between the ECB and the EBA imperative*" (Deloitte, 2013). For example, at the very level of stress testing, the Central Bank unilaterally decided to conduct its own stress tests under the SREP (as discussed above). Until now, the decision to conduct stress tests had only been taken by the EBA. Another example cited by the study points out some inconsistencies between two supervision manuals issued by the two institutions respectively (Deloitte, 2013).

In this context, there are also a number of indications that the ECB is in fact the real authority at the center of the stress testing exercise:

- The confidential dialogue with the banks after the comparison of internal results and top-down results is ultimately conducted by the ECB. This responsibility has already given rise to scandals such as the Deutsche Bank scandal, privileged during the 2016 stress test (Binham et al., 2016).
- The ECB has the disciplinary role; it decides on sanctions/redelegations and other supervisory actions. Its standards and judgements are therefore ultimately those considered by the banks subject to the stress test.
- The EBA has 159 employees, while the ECB has 1,119 employees in charge of supervision. In this respect the EBA has been designated as an "overarching umbrella with no teeth" in legal journals (Del Gatto, 2015).

This balance of power in the framework of the SSM confirms that the European Central Bank has a central role to play in the implementation of CRR-stress tests.
Moreover, it should be noted that Article 23 of the EBA Regulation contains a specific (albeit brief) reference to the inclusion of climate-related risks in the stress testing regime (Article 23, Regulation (EU) No 1093/2010 of the European Parliament and of the Council).
Additionally, the EBA has declared its intention to conduct certain tests for CRRs with certain volunteer banks in 2020 (European Banking Authority, 2019). The rest of this argument is therefore based on the assumption that the EBA will not oppose an ECB initiative for the inclusion of CRR-stress tests in the annual stress testing exercise.

2.3. Why should the ECB conduct climate stress tests?

It is unlikely that the use of CRR-stress tests can alter supervisory actions in the short term. As a matter of fact, this is one of the main objections to them. On the other hand, it is certain that they will contribute to the understanding of climate financial risk at the European macro-prudential level. Gaps in this specific area are regularly highlighted by the Intergovernmental Panel on Climate Change (IPCC), the main developer of economic/policy scenarios of climate change at the international level (IPCC, 2018). For example, it would allow

- to refine the interconnections between assets in relation to climate risks, which would greatly facilitate their taxonomy (Deloitte, 2020).

- to identify the main stress transmission channels, which will allow to establish the different exposure KPIs of the CRRs (EAD, LGD, PD) (Deloitte, 2020).
- to identify amplification effects caused by interbank contagion, or feedback loops with the real economy (Adrian et al., 2020).
- to provide the basis for anticipated action plans and requirements based on adverse case scenarios.

2.4. Why is it so difficult to conduct climate stress tests?

- The majority of risks are spread over longer time horizons than those usually considered by financial supervisors.
- CRRs are non-linear, “fish-tailed” (Bolton et al., 2020), and irreversible (also called “tipping-point”) (Solomon et al., 2009).
- Climate risks lead to domino effects with feedbacks loops with the real economy (they are much harder to predict than classic financial shocks) (Steffen et al., 2018).
- They are "endogenous": they depend on political decisions as well as investment decisions, which are fundamentally unpredictable (Battiston & Monasterolo, 2019).

Hence, there are a lot of potential scenarios. It is important to keep in mind, however, that the scenarios are by no means a rough prediction of the future, but only establish different developments on certain identified key factors, all other considerations being equal. These key factors could therefore be derived from a number of scenarios depending on different transition policies context, considering that there is agreement on the most likely climate scenario.[9] Will Europe's transition policy be coordinated? Will it be ambitious? Will it be adopted in 5 or 15 years? This leads us to the IAMs…

2.5. An introduction to Integrated Assessment Models (IAMs)

Integrated Assessment Models (IAMs), as they are referred to in the literature, allow linking climate risks/temperature increases to political, social and economic scenarios, and suggesting different economic outputs to these scenarios. They are a collection of different models attempting to establish the energy technologies, energy use choices, land-use changes

[9] As a matter of fact, the climate scenario is regularly scientifically estimated by the IPCC, whereas the transition scenario is much more uncertain and has a more direct impact on macroeconomic shocks.

or societal trends that cause and are caused by greenhouse gas emissions (Evans & Hausfather, 2018). They allow to identify key trends and key factors, by linking integrated assessment studies to numerical models, to quantify future developmental pathways with respect to climate change. IAMs are already being used by some financial institutions to assess the impact of certain aspects of climate change on assets. For example, the investment firm BlackRock estimated in 2019 the impact of certain extreme weather events on their portfolios linked to the United States. In particular, they took into account the impacts through "*labor productivity, heating and cooling demand, agricultural productivity for bulk commodity crops, expected annual losses from coastal storms, and changes in crime and mortality rates*" (Deese et al., 2019).

In theory, therefore, IAMs could be used to quantify different paths of sectoral developments in climate policy scenarios for all portfolios of all European institutions. In other words, they would make it possible to provide economic outputs for the different transition scenarios, and thus to estimate Default Probabilities (DPs) for institutions' financial contracts (Battiston et al., 2017). It is important to remember that these DPs would be based on a single climate scenario (as established earlier). Finally, these DPs could themselves be transferred into financial metrics to be proposed as a scenario to the banks (Monasterolo, 2020).

IAMs are based on estimates. They generally include biogeochemical, sociological, political, cultural, technological factors whose interpretation is not always an exact science (Hare et al., 2018). This high degree of uncertainty explains the current absence of CRRs assessments in stress tests but it is also an important argument for the ECB to gradually develop IAMs. Failure to consider IAMs as a source of additional information for understanding climate risk could in fact amount to turning a blind eye to a fundamental aspect of financial stability. IAMs have furthermore been formally recognized as a model to be used in the stress-testing of climate scenarios by the NGFS in June 2020 (NGFS, 2020).

2.6. How could a climate-related stress-test take place?

Given the particularity of CRRs, CRR stress testing needs to be approached separately from conventional stress testing. On the other hand, given the ECB's method of "bottom-up" stress-testing followed by macro-prudential analysis, climate stress-testing can be carried out in parallel with traditional stress testing.

The creation of a climate stress test should follow the following creation process, recommended by the first-of-its-kind "*Guide on climate scenario analysis"* of the NGFS (NGFS, 2020):

1. Define the objective of the stress test: In our case, estimate company-specific and systemic risks.
2. Define Scenarios: As explained, it would make more sense to first establish a single climate scenario to consider only transition policy scenarios. The scenarios will depend on climate policy, the socio-economic context and technological developments.
3. Assess impacts: This is where the use of IAMs leads to financial metrics. The financial data resulting from the probability of default of the identified contracts must be drawn by the institutions tested (for example, what will be the 99,99% Value-at-Risk of a debt contract on Boeing if there is a 50% drop in air travel? What mechanism would be triggered in the face of such a risk?... etc).
4. Communicate and use results. We will come back to this. The results will of course have to be used for the analysis of CRRs at the macroprudential level (macroprudential stress testing).

This exercise will first have to be carried out on a very simplified basis (i.e. on a limited number of sectoral indicators). The DNB "Waterproof" test example is currently the only real example of CRR stress-test. However, three lessons can already be drawn from this case which will be useful in the application of this proposal.

There is a first time for everything: Overview of the Nederlandsche Bank "Waterproof" test (Regelink et al., 2017).

Procedure

The report "*Waterproof? An exploration of climate-related risks for the Dutch financial sector*" explores the physical[10] and transition risks of more than 80 Dutch financial institutions, on the basis of the work of Batiston et al. (2017) (Battiston et al., 2017). It is based on four disruptive and relatively simple scenarios, different from each other in two ways, namely the role of climate policy (here imagined through a carbon tax) and the

[10] It is a minor risk, in the case of the Dutch financial sector.

availability of alternative technologies that will make fuel-dependent technologies potentially obsolete. These scenarios vary according to the delay and intensity in these two factors, estimated at the "granular" level (these assumptions in fact replace the use of a more complete IAM).

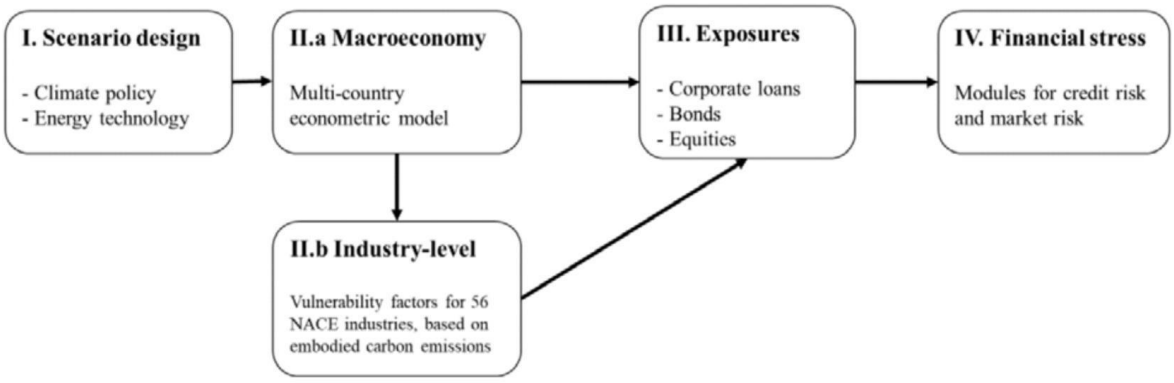


Figure 8. DNB Waterproof tests

Source: DNB

The report covers the three main themes concerning the Dutch banking sector's exposure to climate risk, namely:

- The consequences of climate change for **insurers**: the report reveals, for example, that the increase in insurance premiums is mainly based on catastrophe models provided from outside and not well adapted to the Dutch context, leaving many real risks uncovered (particularly floods).
- Risks related to **carbon-intensive investments**: a particular exposure to transition risk is revealed through buildings used as collateral.
- Risks associated with **green financing**: technological transitions and greenwashing are identified as the two main sources of speculative bubbles.

Furthermore, although the report still shows a high degree of uncertainty in the assessment of these risks, it also identifies and quantifies the **specific vulnerabilities** of certain Dutch institutions.

Conclusions

In a second step, the identification of the risks also allows DNB to set out the broad outlines of a transition path for policymakers. The findings identify, for example, particular adjustments that need to be made at an early stage to reduce the risk of disruption, as well as

the disclosure standards that should be imposed in priority (the latter contribution significantly enriched the work of the FSB's Task Force on Climate-related Financial Disclosures (TCFD) on climate risk).

Lastly, this survey makes it possible to identify the real flaws in the current models and processes that would not have been clear without practical application. This confirms the epistemological usefulness of such tests carried out in a formative way.

Comments

The statement by Frank Elderson, DNB's executive director for supervision, after the release of the report encapsulates the symbolic aspect of the stress test, yet sends a clear signal of the Dutch central bank's commitment: "*We now really are going to incorporate sustainability in our supervisory methods, … The institution's efforts won't have formal consequences such as sanctions for banks this year, but that will change at "a given moment,*""(Vermeulen et al., 2019). Also Chair of the NGFS, Elderson recalled the second fundamental principle of the NGFS, co-signed by the ECB: "*lead by the example*".

DNB has in its recent history adopted a pragmatic, even idealistic approach to regulation. This tendency to explore ways of approaching risk beyond textual rules has already proved its worth and has even led to new regulations at the European level. It is the case of the assessments of *conduct and culture in the board room* and *suitability of board members* (in other words the fit and proper testing) that it started in 2010 (DNB, 2015) (ECB, 2018). These new approaches to risk have even prompted the Dutch supervisory authority to include psychologists in its supervision, for example to assess the absence of critical challenge caused by group pressure, or the ability of leadership to adapt to market changes. The success of this approach in revealing the root causes of certain organizational problems has placed the DNB at the center of attention of other European supervisors. The integration of CRRs through fit and proper testing will be discussed in the last point of this chapter.

It should be noted that the accuracy of the conclusions of this study will probably not be equaled on a European scale in the short term, even with a more comprehensive approach and with the use of scenarios derived from IAMs. This is due to the fact that the Netherlands, like France, has national provisions for the disclosure of climate risk by companies. However, the

ECB can already draw three lessons from this exercise: first, the publication of results should be done independently (DNB has done so). Second, the results need to be considered in a dynamic macroeconomic environment if they are intended to be relevant over the time horizons considered (DNB did not do so). Third, the scenarios will remain limited if they are not developed with partners (DNB did not use partnerships to elaborate scenarios).

2.7. Three key activities to ensure the success of climate stress-tests

2.7.1. Independent publication as a guarantee of banking compliance

As described in section 2.1., the stress tests carried out on banks (microprudential in nature) use the "constrained bottom-up approach". The advantage of this method is that it provides comparable results across banks on an equal footing and enhances their ability to identify vulnerabilities by fostering the development of in-house stress testing models. This approach naturally involves a confrontation of results by a supervisor. However, Luis de Guindos himself acknowledged that certain aspects of this approach limited the realism of the exercise (de Guindos, 2019). In particular, top-down confrontation does not capture market dynamics when it takes the form of a confidential dialogue, as it is almost equivalent to a negotiation where banks de facto start from a underestimation of risks. There is no doubt that this shortcoming will be all the more glaring in the case of risks that are very complicated to estimate, such as CRRs. The Vice-President of the ECB furthermore affirmed in September 2019 the willingness to use the top-down model challenge in a more binding manner to counter the systematic underestimation of vulnerabilities by banks (de Guindos, 2019).

A new top-down confrontation could be imagined as follows: the ECB would publish the report of the discussion rather than an agreed-upon publication. The test results will be aggregated and compared between institutions and will therefore affect the reputation of the banks. In the specific case of CRR-stress tests, this alternative offers a number of advantages:

- It will increase investor awareness of the CRRs (signalling). The ECB's publication will be a credible reference of aggregated information that will be taken into account by market participants. The lack of formal information is the main reason for the underestimation of CRRs in the composition of portfolios (BlackRock, 2019). In addition to the non-negligible uncertainty related to climate risk, the Paris agreements signed by all member countries of the supervised banks specifically request that "*financial flows [be made] consistent with a pathway towards low greenhouse gas*

emissions and climate-resilient development" (United Nations, 2015). Investors in these banks have a general responsibility to consider this risk.

- It reinforces the feeling of equal treatment. The good faith of the actors is impacted, among other things, by the fact that they are sure that they will be treated the same as the others. Disclosure ensures this.
- It imposes a shift from a 'business-as-usual' approach to a 'climate-stressed' approach. This point relates directly to the obstacle of organizational awareness. Having to fully comply with the rules set by the supervisor forces organizational engagement. The slowness of institutions to comply with new requirements has already been felt when the ECB tried to introduce a more dynamic stress testing exercise in 2016 (Danièle Nouy, Chair of The Supervisory Board) "*In particular, the ceilings and floors usually applied to the evolution of key variables are no longer relevant when considering unstable balance sheets. The "one-off exemptions" recently introduced to offer a partial solution to this problem are proof of the difficulty in pushing banks to re-imagine their process"* (Nouy, 2016).
- It would allow the disclosure of new useful data. Confidentiality is an obstacle to the dissemination of certain information on the relevant sectoral and geographical vulnerabilities of certain counterparties. This new disclosure will be addressed with the "comply or explain" approach to disclosure under the SSM (de Guindos, 2019).
- It is a long-term compliance tool. It has been proven that the more predictable a methodology becomes the more banks can develop technical skills to minimize the impact of the exercise. The joint publication of results accentuates this phenomenon of "gaming" of the exercise (Niepmann & Stebunovs, 2018).

It is important to bear in mind that this exercise represents an additional burden for the coordination of European stress-testing. European-wide stress-testing is only 10 years old and its process is still far from being standardized across different supervisory cultures (banks regularly complain about a very burdensome exercise) (Wilkes, 2018). In order to maintain the credibility of this exercise, it is therefore essential that the confrontation is constructive and above all allows banks to understand their performance in order to improve it. Therefore, the comparability of banks' performance cannot take precedence over the representation of a true and fair view. This is particularly important in view of the large gap that already exists between the publication of stress test results and follow-up actions (Enria, 2019). Separate publication should ultimately provide, on the one hand, an objective and comparative

aggregate basis and, on the other hand, a complementary individual basis that captures idiosyncratic risks in more detail.

2.7.2. Embedding climate-scenarios in a dynamic macroeconomic environment.

Tests such as the "*Waterproof*" test offer a good sensitivity analysis but are by no means likely to influence the requirements imposed on banks. As explained above, this is due to the approximation of the scenarios and their temporality.

With respect to the DNB, the institution had to proceed on the assumption that their balance sheets were frozen for ten (or more) years and establish technical risk management techniques based on the macroeconomic scenario imposed on them (including market reactions and the reactions of their borrowers) (Regelink et al., 2017) … This single hypothesis presupposes four elements that are becoming irrelevant in the face of the structural implications of climate risks: it implies (1) a return to equilibrium: in other words, the bank is trying to stabilize and return to business-as-usual, (2) homogeneous agents on the long term and in times of structural change, (3) rational expectations in times of climate-related crisis and (4) a static balance sheet during a period of stress (Breuer, 2015). The first three elements are also inherent in all the dynamic stochastic general equilibrium (DSGE) models used in the EBA/BCE prudential stress tests (more precisely, the models of Darracq Pariès et al. 2011 and 2015) (Campiglio et al., 2018).[11]

Andrea Enria, Chair of the European Central Bank's Supervisory Board (and former EBA Chair), particularly highlighted these first two weaknesses in September 2019 and advocated stress tests based on dynamic balance sheet assumptions (Enria, 2019). This intervention was followed by an announcement of consultation in January 2020 of the EBA for its future stress test framework (EBA, 2020 (b)).

[11] "*In the context of the EU wide stress tests, the different approach – the dynamic balance sheet assumption – was only applied in those cases where banks had previously been bailed-out of financial troubles with public money and have subsequently become subject to a restructuring plan approved in a State Aid decision by the European Commission*." Andrea Enria.

In the specific case of CRRs, the integration of the scenarios in a dynamic environment will be a particularly important challenge. There are already some leads that can be put forward for this:

- Agent-based models (ABMs): they simulate the (inter)actions of autonomous and heterogeneous agents (individual or collective entities such as organizations or groups) (Turrell, 2016). These have been used by the BoE, and even in some ECB working papers (on funding risk, for example) (Drehmann & Nikolaou, 2009). They could be well suited to extend the scope of the market responses considered to certain climate scenarios.
- Stock-flow consistent models (SCMs): Dafermos et al (2017) have already used this model to study the relationship between environmental, macroeconomic and financial variables as a function of environmental policies. This model is acknowledged as a credible model in the evaluation of financial regulations throughout the literature and allows the role of governments and central banks to be incorporated (Dafermos et al., 2017). SCMs are complementary to ABMs, as they make it possible to integrate behavioral dynamics of financial institutions in an environment with frequent unbalancing phenomena.
- Case studies: These would allow the assessment of certain shocks in specific sectors and geographical regions. Case studies necessarily involve partners as they go beyond the ECB's activities (Bolton et al., 2020). However, the case studies need to be coordinated with hindsight by the ECB, as they could be perceived as a source of unequal treatment for institutions.

Of course, these models are not to be mistaken for IAMs. ABMs and SCMs allow institutions to be confronted with a dynamic financial environment that changes over the long term in the face of the macroeconomic trends that IAMs identify. These new approaches are interesting to adopt in the case of stress testing for the ECB, even beyond climate risk.

2.7.3. No one can whistle a symphony: Partnerships at the heart of the challenge

For the time being, the ECB has already announced that it will conduct macro-prudential analyses to identify specific systemic climate risks (without the participation of institutions) (de Guindos, 2019). Clearly, it does not have the resources to develop in-house IAMs specifically aimed at identifying the DPs of financial contracts in relation to climate risk,

which would allow it to conduct a realistic climate stress-testing with institutions. However, the simple announcement of a consultation for a climate stress testing project could already boost the (very limited) academic research on this subject (such an announcement has already been made in order to carry out stress tests on more dynamic models than the balance sheet assumption) (Aymanns et al., 2017)[12].

Secondly, the conduct of climate stress tests in itself will require a staff capable of conducting stress tests of a radically different nature and establishing a completely new methodology with institutions (remember the particularity of the climate stress tests detailed in point 2.4.). Such a mobilisation seems almost impossible within the ECB's mandate... This last consideration regarding human capital was particularly highlighted during an interview with Gilles Van Rijckevoorsel, Associate Asset Manager at Rotschild & Co, in the context of this thesis: (in French) *"You could have stress tests to evaluate, with more or less efficiency, the risk of a change in the yield curve due to a sudden structural change... The problem is that these are extremely complex tests requiring climatologists, economists, political scientists, sociologists* (IAM development) ... *All this has a cost that the ECB is unable to bear on its own, especially given the willingness of the Governors to limit the staff of the ECB in order to maintain a certain prudential independence at the national level. And besides, in the case of risks linked to climate change, by the time you build an effective model, it may be obsolete... This would require countless researchers working in a coordinated manner, and all this for an exercise* [the stress test] *that is already being contested for its cost-effectiveness."*

If it does not want to be forever limited to conducting "pilot" stress tests (such as the Waterproof test), the ECB must imperatively start developing a network of partners dedicated to climate stress testing. Four different types of potential partners need to be distinguished:

1. International organizations specialized in the collection of qualitative/quantitative macroeconomic and financial data, such as the International Monetary Fund and the World Bank (more specifically through their Financial Sector Assessment Program (FSAP), which is conducted by the IMF alone in advanced economies).

[12] This could technically be the subject of a call for projects from a European Union program similar to Horizon 2020.

2. International and European public bodies specifically dedicated to providing scientific information relevant to understanding the socio-economic and financial risks of climate change. These are mainly the United Nations bodies (IPCC, the World Meteorological Organization), the European Commission's Energy and Climate Working Group, the EU High Level Expert Group on Sustainable Finance[13], the G20 Green Finance Study Group, the NGFS. They are the most obvious partners for the ECB and EBA in the development of IAMs.
3. Scientific Independent institutes and organizations bringing together civil society (such as the Climate Action Network (CAN) and the Institute for European Energy and Climate Policy (IEECP)), national institutes (such as the French National Centre for Scientific Research (CNRS)) or schools and universities. These organizations are considerably more flexible on the subjects they work on and are often a source of innovation (van Dam et al., 2013). The majority of key players are already represented in the Integrated Assessment Modeling Consortium (IAMC) established in 2007 at the initiative of the IPCC. The work of this scientific organization has not so far addressed the subject of financial stress testing (Integrated Assessment Consortium, 2020).
4. Supervised institutions: main stakeholders

2.8. Key message

Stress testing is an exercise in which there is ample evidence that the ECB has a central role. In accordance with the EBA, the ECB could undertake a stress test strictly related to climate risk in parallel with these stress tests.

These additional stress tests would be based on scenarios derived from Integrated Assessment Models (IAMs), allowing some macroeconomic estimates to be drawn for different transition scenarios. The ECB would use the existing "constrained bottom-up" approach to establish a second confrontation with banks on their management of certain climate scenarios.

[13] Extended in the form of a 'Platform on sustainable finance' by Article 20 of the Taxonomy Regulation on 18 June 2020.

This additional exercise, if it is to be relevant, should lead to an independent publication of the results on a comparative basis, while allowing banks to understand how to increase their own resilience to CRRs.
Moreover, the uniqueness of climate scenarios reinforces the (already existing) need to embed stress scenarios in a more dynamic environment. This is vital if climate stress tests are to lead to concrete actions in the longer term.
Finally, the technical challenge of climate stress tests cannot be met by the ECB alone. It has been proposed as a first step to launch a public consultation to narrow the existing epistemological gap. In addition, it is recommended that the ECB develops a network of partners specifically dedicated to climate stress testing.

Climate stress tests are by far the most important exercise in understanding CRRs for the financial sector in Europe. For this reason, they should be a priority for the ECB Supervision.

3. Supervisory actions

Supervisory actions considered from the prudential perspective of climate risk is to be addressed with two clarifications…

First, the SSM was conceived as a cooperative mechanism, not a single controlling entity. As a result, a certain amount of national sovereignty has been assigned to decide what actions can be taken with respect to an institution. In other words, many of the measures that the ECB can take depend directly on national provisions. Art. 9(1), 2nd & 3rd indent of the SSM Regulation (SSMR) states that the ECB may exercise the powers available to the NCAs under applicable Union law in addition to the powers directly conferred upon it under the SSM (Art. 9 SSM Regulation):

"For the same exclusive purpose, the ECB shall have all the powers and obligations set out in this Regulation. It shall also have all the powers and obligations, which competent and designated authorities shall have under the relevant Union law, unless otherwise provided for by this Regulation. In particular, the ECB shall have the powers listed in Sections 1 and 2 of this Chapter.

To the extent necessary to carry out the tasks conferred on it by this Regulation, the ECB may require, by way of instructions, those national authorities to make use of their powers, under and in accordance with the conditions set out in national law, where this Regulation does not confer such powers on the ECB. Those national authorities shall fully inform the ECB about the exercise of those powers."

It is worth noting that the SSM Regulation is the first regulation giving the power of an EU institution to implement national law.

Second, the legal framework for the ECB's actions distinguishes between **measures** and **penalties**, although the borderline between the two is rather unclear in terms of the nature of their consequence (Allegrazza & Voordeckers, 2015). Yet this distinction differentiates the actions that the ECB may or may not, respectively, take in the name of climate risk in the prudential requirements of CRD IV and CRR. The remainder of this chapter will be divided on the basis of this distinction to explore the ECB's judicial power as a follow-up to the two assessment activities discussed in sections 1 and 2.

3.1. Measures that are not considered to be administrative penalties

3.1.1. Legal Framework

Art. 16(2) of the SSMR sets out the actions that the ECB may take if a bank fails to comply with the prudential requirements of the CRR (and national legislation using an option conferred by it), the national implementation of the CRD IV; or if it is at risk of failing, or to do so within the next 12 months (as a reminder, this status is determined by the ECB) (Art. 16 SSM Regulation):

For the purposes of Article 9(1), the ECB shall have, in particular, the following powers:

(a) to require institutions to hold own funds in excess of the capital requirements laid down in the acts referred to in the first subparagraph of Article 4(3) related to elements of risks and risks not covered by the relevant Union acts;
(b) to require the reinforcement of the arrangements, processes, mechanisms and strategies;
(c) to require institutions to present a plan to restore compliance with supervisory requirements (...) and set a deadline for its implementation, including improvements to that plan regarding scope and deadline;
(d) to require institutions to apply a specific provisioning policy or treatment of assets in terms of own funds requirements;
(e) to restrict or limit the business, operations or network of institutions or to request the divestment of activities that pose excessive risks to the soundness of an institution;
(f) to require the reduction of the risk inherent in the activities, products and systems of institutions;
...
(h) to require institutions to use net profits to strengthen own funds;
...
(l) to require additional disclosures;

Finally, Art. 16(1) (c) gives the ECB the right to undertake these actions on the basis of the Pillar 2 assessments (i.e. the stress tests and the SREP). This is incidentally a reminder of the important role of the JST in providing information and considering CRRs through its monitoring.

3.1.2. CRR naming and shaming

The measures imposed can be disputed in front of the General Court of Justice of the Union, which in theory has unlimited jurisdiction over any ECB measure. However, this certainty must be nuanced by two observations: First, according to Art. 132 SSMR, the ECB has the right to publish measures and sanctions against which there is an appeal (although the appeal must be mentioned), unless this publication "*causes, insofar as it can be determined, disproportionate damage to the supervised entity concerned*" (Art. 132 (b) SSM Regulation). It should also be noted that the publication of administrative banking sanctions is even a duty for Member States[14] "*without undue delay after that person has been informed of the penalties*" (Art. 68 CRD IV).

The case (T-203/18) opposing bank VQ and the ECB is a very good example of this. VQ was fined EUR 1.6 million for having bought back its shares between 2014 and 2016 without having requested authorization from the competent authority and brought the case in front of the European Court requesting, among other things, an anonymized or postponed publication of penalties. This request was rejected because the evidence of the "disproportionate" nature of the publication's damages had not been considered sufficient. The judgment further established that the disproportionate nature must be assessed only in relation to the consequences of the publication, and not in relation to the seriousness of the penalty or breach (EU General Court, 2020).

Hence, this evidence suggests that there is only a vague, if not weak**, provision for the presumption of innocence** in the SSM Regulation for the legal person of the supervised banks considering the climatic risk. In reality, the European legal framework is uncertain, because so far neither the European Court of Justice nor the European Court of Human Rights has given a clear answer to the question of the extent to which damage to a bank's reputation violates the presumption of innocence (Allegrazza & Voordeckers, 2015). This is particularly true as the reputational cost of publication of measures in relation to CRR exposition is very difficult to prove as "disproportionate". This freedom to "name and shame" is in itself a powerful incentive through reputational risk for banks to remain attentive to the

[14] All SSM countries are in the EU.

ECB's requirements with regard to its policy approach on climate. This is particularly important with regard to the publication of the results of the climatic stress tests previously discussed.

3.1.3. CRR discretionary freedom

Secondly, the **principle of proportionality** plays an important role in the control measures, as it is proportionality which is the condition for the legality of a legislative act and a control measure based on it. This principle is written into the Treaty on European Union in Article 5, where it states that "*the content and form of Union action shall not go beyond what is necessary to achieve the objectives of the Treaties*" (Art. 5 TFEU). In the case of prudential rules, however, we see that EU law provides for supervisory discretion which severely limits the power of the General Court of Justice of the Union in assessing this proportionality. For many claimants across Europe accustomed to a strong scrutiny of administrative decisions, this is rather bad news (Berger, 2019). On the other hand, in the ECB's activities for the recognition of CRRs, it is rather good news.

A very good example of this discretion is provided by the double judgment on appeal of Crédit Mutuel Arkéa v ECB on 13 December 2017…

SSM passes the robustness test: the Crédit Mutuel Arkéa/ECB case

The European Central Bank (ECB) had, at that time, organized its prudential supervision of the entities of the Crédit Mutuel Group - including Crédit Mutuel Arkéa - on a consolidated basis through the CNCM. It took the view that Crédit Mutuel Arkéa should have additional core capital (CET 1 capital), bringing its core capital ratio to 11% and then to 10.75% (this reduction gave rise to the second judgment). The case referred to the fact that the Crédit Mutuel Group was considered as a group in its supervision. Article 10 of the Capital Requirements Regulation in that case made reference to national law (in this case French law) which had to be interpreted by the European Central Bank. The contested decision, which was confirmed by the ABoR, required these additional funds due to a potential separation of the bank Arkéa from its Crédit Mutuel group (Smits, 2018).

Crédit Mutuel Arkéa therefore claimed that the ECB's requirements were (1) an error of law and an error of assessment by the ECB, (2) which gave rise to a disproportionate decision in the context of its function. The judgment, which saw the ECB win the case, is remarkable in two respects (General Court of the European Union, 2017) :

- *(paragraph 178 of the judgment)* The Court gives the ECB a very broad margin of discretion, and states that it cannot alter its decision if (1) the rules on procedure and the statement of reasons have been complied with, (2) the facts have been accurately stated (3) there has been no manifest error of assessment or misuse of powers.

  In other words, the Court can only alter the ECB's decision on the form, and not the substance, of its assessment (i.e. its consideration of the risks, the likelihood of Arkéa's separation), as long as the basic assumption is not completely unfounded. General Court of the European Union, 2017)

- *(paragraph 200 of the judgment)* The principle of proportionality invoked (in fact directly linked to an interpretation of the ECB's objective) is tested under a series of principles of European law, including the **obligation to provide reasons**. In the case of Arkéa, there was firm and public opposition to a separation on the part of Crédit Mutuel's management, Arkéa's shareholders and its trade unions. In fact, the plan was only put forward by the bank's management for reasons of personal ambition, although it was not financially credible. The demerger had not gone beyond the decision-making stage (Lederer, 2018) (Let us note that 3 years later, no separation project has been launched). The reasons put forward in defense of the ECB's assessment of the likelihood of separation could therefore at least be regarded as weak. As a matter of fact, the required increase in the core capital ratio is based on a complete interpretation of a scenario (that of Arkéa's demerger) and its probability.

Furthermore, the French Conseil d'État has aligned itself with the ECB's interpretation of French law as a group consideration and has also recognised its full discretion in assessing a possible separation (Sarmiento, 2019).

Crédit Mutuel Arkéa/ECB is a relevant precedent for affirming the supranational solidity of the banking supervision established by the SSM, which was initially perceived as fragile and questionable (Sarmiento, 2019). In the case of CRRs, it demonstrates the discretionary power

of the institution in their appreciation and in the powers of Article 9 (1) that it uses. In particular, this case law seems to confirm the use of "what if" scenarios as prescribed by the TCFD for CRRs as long as they can be proven to be scientifically and financially realistic as part of the SREP (Faas, 2017).

Lastly, it is interesting to note the comment by Allegrazza and Voordeckers on the role of the ABoR, which is supposed to review the legality of decisions "independently and in the public interest" from a technical point of view. Its operational integration into the ECB and its role limited to expressing opinions for the ECB prevent, according to the authors, the ABoR's powers from being regarded as "judicial review" (Allegrazza & Voordeckers, 2015). Its presence, however, explains why European justice is limited to procedural assessments.

3.2. Measures that are considered to be administrative penalties

The Dubus case law has established a separation of the functions of investigation, prosecution and judgment in the context of the SSM for administrative sanctions (Délégation des Barreaux de France, 2013). The rules applicable to determine the decision-maker depend directly on the requirement violated (a decision, a regulation, a law, ...) and the legal person to be sanctioned. Article 18 SSM Regulation makes a formal distinction between three types of sanctions (detailed in the SSM Framework Regulation): fines and periodic penalty payments, administrative monetary sanctions and sanctions for "other breaches" (Art. 18 SSM Regulation).

3.2.1. Fines and periodic penalty payments

They may be imposed by the ECB itself in the event of non-compliance with regulations and decisions of the ECB Supervision and make it possible, for example, to effectively compel institutions to comply with the Pillar 2 capital measures mentioned above. These capacities are, however, given to a body independent of the ECB's other functions (although operating within the ECB), and sanctions are determined by Article 120 of the SSMR. The size of the fines is detailed in Articles 123-127.

3.2.2. Administrative pecuniary penalties

They cannot be imposed if the infringement does not directly relate to a Union law and are therefore not relevant to the ECB's supervisory actions.

3.2.3. Sanctions for other breaches

Many cases are not covered by the two types of administrative penalties referred to above, for example penalties directly applicable to a natural person, for which pecuniary penalties are not relevant or for violations not related to CRR 2 or CRR IV. Art. 134(1) of the SSM framework regulation states that, in such cases, the ECB may require NCAs to initiate proceedings on the basis of national law.

The last point is particularly important as it establishes that the ECB can use its privileged position as a supranational supervisor to carry out the work of the NCAs. In countries such as France (French law on energy transition and its art. 173), the ECB is therefore the gatekeeper of unilateral legislative developments in terms of CRR. This status contributes in theory to the effectiveness of 8 recent (or soon to be implemented) laws across the European "Supervisory" Union and comprising requirements in terms of management/disclosure of financial climate risks (European Climate Foundation, 2020) :

Country	Law Title (English)	Adoption date
Denmark	Climate Act	June 2019
France	Energy Transition Green Growth Act	August 2015
Germany	Federal Climate Protection Law	December 2019
Netherlands	Climate Act	July 2019
Spain	Climate Change and Energy Transition Law (public draft)	February 2019
Sweden	Climate Law	June 2017

Figure 9. European laws with financial disclosure requirements

3.3. Key messages

This section elaborates on the actions that the ECB may undertake as a result of the assessments detailed in Sections 2 and 3. Three important messages should be drawn from it.

First, although the ECB has basic powers under the SSM, an SSM country may unilaterally favor the consideration of CRRs in the supervision of its institutions. The ECB Supervision will then be a key actor at the level of the institutions it supervises (or decides to supervise) for the implementation of national legislation.
Second, the ECB is encouraged to publish the actions it takes vis-à-vis banks, and no precedent seems to support a strong presumption of innocence in the case of administrative banking sanctions. This reinforces to some extent the possibility for the ECB to "name and shame" certain institutions in relation to measures taken following CRR identification.
Thirdly, the ECB has an important discretion with regard to the proportionality ofmeasures imposed on banks. In simplified terms, the ECB can decide on the materiality of CRRs in a relatively independent manner.

4. Fit and proper assessments

As mentioned above, the ECB's fit and proper assessment is an exercise whose integration into the evaluations of JSTs has been strongly inspired by Dutch supervisory practices. They are all as young as the SSM, and were therefore a real innovation that was introduced to a majority of the 19 euro area member states in 2014. Because of their particularity, fit and proper assessment are considered an unconventional supervisory activity by the NCAs (Deloitte, 2015). Yet their usefulness is unanimously acknowledged and may lead to decisions affecting institutions at the highest level of their hierarchy (ECB Supervision, 2018 (b)). For example, they can lead to the restriction of the powers of any member of its management board, or even to her or his exclusion (Andersson et al., 2020). This decision is made jointly by the Authorisation Division of the Directorate General of the Supervisory Board Secretariat, the JST affected to the institution and a division of the NCA for fit and proper assessments if such a division exists (ECB Supervision, 2018 (b)).

The uniqueness of fit and proper assessments resides above all in the fact that these evaluations are entirely qualitative. For example, if one of the managers is prosecuted for private tax fraud, what criteria should be considered for the measures imposed? Should she be deprived of her right to vote in management decisions? Should the bank be asked to impose additional monitoring of her activities within the bank? Or should she be excluded altogether because she represents a reputational risk for the bank? These decisions rely on

skills that historically have not been recognized to a very technocratic financial supervisor such as the ECB.

Failure to make these assessments, however, would be tantamount to neglecting a fundamental aspect of banking supervision. In the case of CRRs, it is even an opportunity because it allows uncertainty to be addressed on a qualitative basis. In other words, it is a new practice that perfectly embodies the paradigm shift needed to internalize CRRs (Palm-Steyerberg, 2019). Yet the literature on its relevance to tackling CRRs is extremely limited in Europe. The Palm-Steyerberg report "*Climate change and fit and proper-testing in the Dutch financial sector*", which will be the sole inspiration for the proposals set out in this section, is proof of this. The report emphasizes that the integration of CRRs cannot be achieved with the sole commitment of a legal entity such as a financial institution. The commitment of the "*people of flesh and blood*", and particularly those who take the decisions, must also be ensured (Palm-Steyerberg, 2019). This of course does not mean that all executive and supervisory members should be experts in climate risk. Instead, each of the institutions' management bodies should internalize the CRRs, through one or more persons. It is with this approach that the proposals below should be approached.

4.1. Fit and proper assessments at the ECB Supervision

Fit and proper assessments are carried out by the ECB for all institutions under its supervision (i.e. the ISs and LSIs that it requires to be supervised) and are explicitly required by Article 4(1)(e) of the SSM Regulation as part of the governance assessments of institutions (Art. 18 SSM Regulation). Article 91 CRD IV also mentions them, but none of the texts provide details on the procedure for these assessments, nor on the different criteria to be taken into account (Art. 91 CRD IV). The latter were therefore established on the basis of the EBA guidelines, and in coordination with the NCAs, and reported in a Guide for JSTs (ECB Supervision, 2018 (b)). The proposals detailed here are mainly aimed at the Authorisation Division, which is the ECB body that can impose new requirements in these assessments in coordination with the EBA (Resti, 2020).

The tests focus on the members of the management body, both in the management function (executives) and the supervisory function (non-executives) and may concern all levels of management. This exercise is structured around 6 principles and 5 criteria for the evaluation of the managers: (i) experience; (ii) reputation; (iii) conflicts of interest and independence of

mind; (iv) time commitment; and (v) collective suitability. We will review how the assessments of 3 criteria can help integrate the consideration of CRRs into management, excluding the criteria of time commitment and collective suitability which are not relevant in our case.

4.2. Experience

The evaluation of experience ensures that executive and supervisory managers have sufficient experience (theoretical and practical) for the function they perform. Often, the method used attempts to establish minimum thresholds, chosen according to the specific nature of the function. In particular, the notion of risk management is required in almost all cases but can be explored in greater depth in various ways (ECB Supervision, 2018 (b)).

The assessment of this criterion for CRRs should ideally require two elements: 1) that management has a thorough understanding of the CRRs incurred by the organization, and 2) that it has knowledge of the strategy undertaken (or to be undertaken) to deal with them. This second point is crucial because it allows to verify whether management is capable of going beyond the simple recognition of risk.

The inclusion of CRRs in the experience criteria should be assessed in terms of the ability to choose and explain a mitigation strategy, the ability to follow up on actions to statements in general (Palm-Steyerberg, 2019), the capacity and energy spent to impose the climate strategy in particular to the bank's activities.

4.3. Conflicts of interest and independence of mind

Organizational independence must be assessed in relation to the elaboration and execution of its climate strategy. In addition, there should be a specific mechanism in place for *« identifying, disclosing, assessing, mitigating, managing and preventing conflicts of interest*» (ECB Supervision, 2018 (b)).

For example, a conflict of interest in terms of CRR mitigation could be disclosed if one of the board members accepts a position in a carbon-intensive company. A measure should be

proposed by the institution itself to limit as much as possible its conflict of interest vis-à-vis the institution's mitigation strategy (Palm-Steyerberg, 2019). This measure will have to take into account the risk of long-term conflict of interest for the mitigation strategy, and not only the short-term risk.

4.4. Reputation

This criterion is not directly related to the internal strategy for CRR mitigation. It is also the only criterion where the principle of proportionality is not applied. In other words, the integrity of the members does not depend on the size or activities of the institution (ECB Supervision, 2018 (b)).

The ECB Supervision requires that it be notified of any event that may affect the reputation of a member of management. It is up to the ECB Supervision to decide on the measures to be taken following such an event to mitigate any risk at the level of the institution.

In the majority of cases, the events are (pending) legal proceedings directly or indirectly affecting one of the members of the management (ECB Supervision, 2018 (b)). In order to include CRRs in the assessment of this criterion, the notion of reputation should be broadened to include not only non-compliance with certain rules, but also "*non-compliance, dishonest behaviour, untruthfulness and not meeting commitments*", particularly in relation to climate commitments (Palm-Steyerberg, 2019).

4.5. Key message

In conclusion, the ECB Supervision can use the fit and proper assessments to put the climate issue on the agenda. This exercise should first be used as an opportunity for dialogue with management and guidance to ensure awareness and competence with regard to climate risk. Fit and proper assessments are a unique way to include climate risk management in the agendas of the leaders of Europe's most significant institutions. They should be used as a platform for coordinating all activities that the ECB Supervision will engage with institutions to manage CRRs.

Conclusion

This thesis has put forward various proposals to enable the integration of the supervision of CRRs into the activities of the ECB Supervision. These proposals were either aimed at improving processes already under way or were as such completely new (e.g., the use of fit and proper assessments as a platform for coordinating all CRR efforts). All of them sought to address the identified barriers to CRR oversight. Although a policy-oriented, proposal-driven literature has emerged recently on the supervision of climate risk at the financial level, no in-depth study had hitherto attempted to guide these recommendations in the specific case of the ECB Supervision as an organization.

Yet the environment in which the European supervisor operates is unique in the world: its supervision is supranational yet constrained by national frameworks. It also faces a number of limitations. For instance, it can impose its rules on credit institutions but has no say in the shadow banking market or derivatives clearing houses; it has considerable operational and discretionary independence, but is confronted with limits on disclosure, among other things to avoid any coordination with its monetary policy; etc. The uniqueness of this situation makes it particularly important that research be specifically dedicated to the coverage of CRRs in the specific case of ECB Supervision.

Several lessons can be drawn from these proposals. Firstly, the role of the teams assigned to oversee the institutions on a day-to-day basis and to dialogue with management is vital for changes in organizational culture and operations. This is particularly true given the diversity of the national frameworks in which they operate. Second, data on institutions' exposure to CRRs needs to be collected and aggregated in a bottom-up, forward-looking, progressive and didactic approach. Third, the development of climate stress tests requires to incorporate the dynamism of macroeconomic and financial scenarios, a public and autonomous commitment from the ECB, and the creation of sustainable partnerships specifically dedicated to climate stress tests. Fourth, the credibility of the ECB's oversight initiatives for CRRs is strengthened by its discretionary independence in the technical assessment of its own actions. Finally, innovative tools such as the fit and proper assessments are extremely useful in approaching a problem that is also novel.

This thesis also has certain limitations that are important to acknowledge, and that could be a departure point for future research in this emerging area. First, the scope of the activities covered in the proposals limits the detail of the proposals offered. Whether it concerns risk assessments of assets, internal governance or stress tests, each of the activities carried out by the ECB Supervision follows a very complex technical process which this paper only outlines. For this reason, the proposals should be understood as an overview of a strategy for the supervision of CRRs. They deliberately focus on certain key aspects, drawn from a literature that generally addresses certain activities in much greater detail.

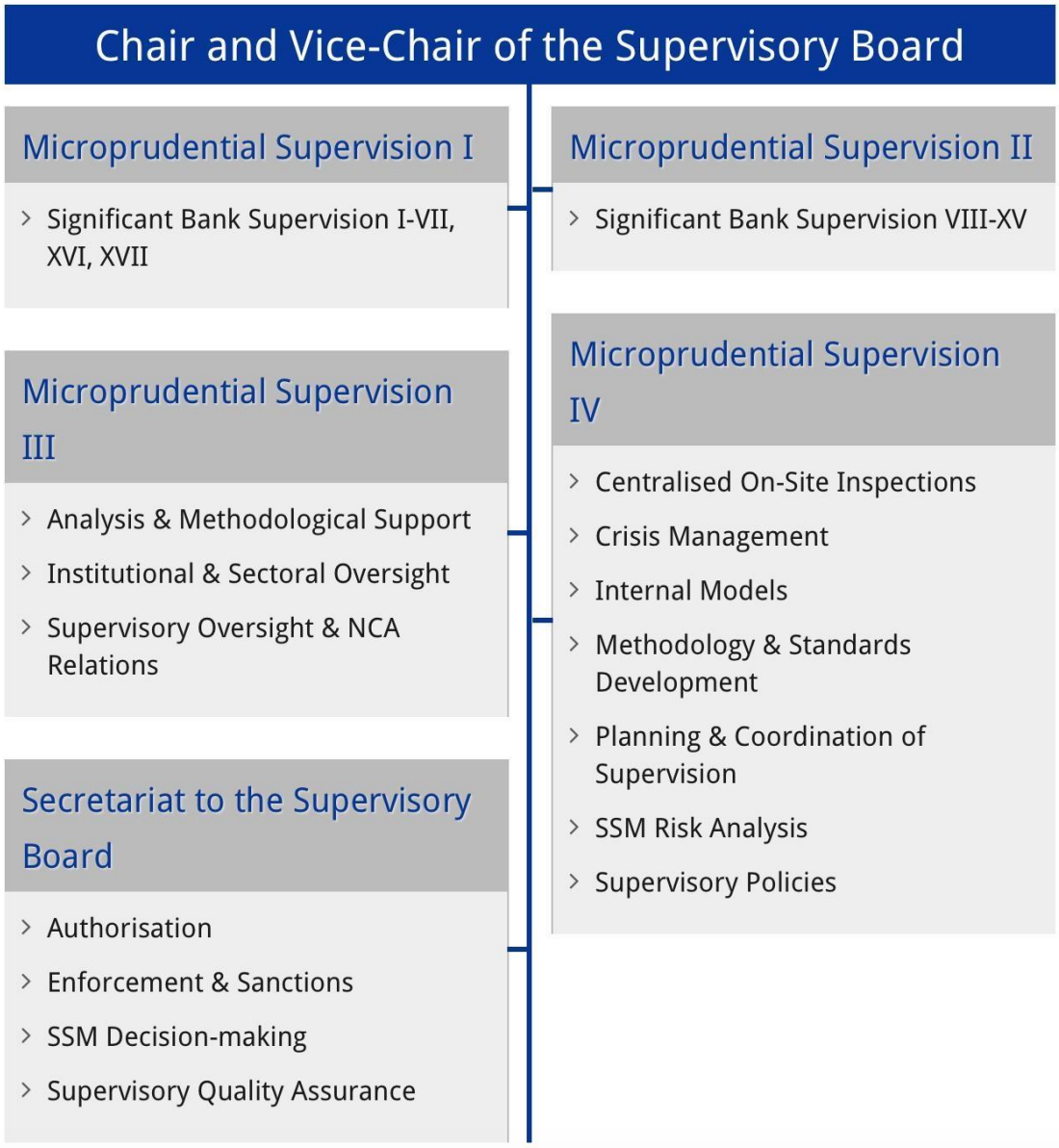
Secondly, this paper does not deepen the ECB Supervision's collaboration with other supervisors around the world, in particular through the NGFS. This aspect should imperatively be integrated into a strategy for the supervision of CRRs, as international coordination has been identified as one of the barriers to address.

Thirdly, the proposals established take into account the legal and political frameworks that currently define the ECB's mandate and powers. These frameworks may be changed, however, in the light of the growing threat stemming from climate risks. Returning to the methaphor which introduced this thesis, we must not forget that the ECB is a seaman trying to plug the breach in the hull of his boat while waiting for a rescue plan from the captains. Such a rescue plan, which governments ultimately shall have to design, could lead the seaman to a completely different task than the one proposed in this thesis.

In many ways, financial climate risk is unique in the history of financial supervision. For this reason, the ECB Supervision should approach it with a special and coordinated strategy, using all the options available. This thesis has attempted to establish the basis for such a strategy and has shed light on the potential role of each of the supervisor’s bodies.
The ECB Supervision must initiate this concrete action with all its partners and supervised institutions as soon as possible. It cannot wait until the time when it shall have become obvious to all observers that climate change has become a defining issue for financial stability : by then, it may already be too late (Carney, 2015).

Appendices

Appendix 1. Organisation chart of the ECB Supervision
Source: European Central Bank (link)



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