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Climate scenario analysis to assess financial risks: some encouraging first steps

A growing number of institutions around the world – spurred on by the Central Banks and Supervisors Network for Greening the Financial System (NGFS) and its reference scenarios – are currently carrying out or planning their first climate scenario analysis exercises to assess financial risks. The Banque de France and the *Autorité de contrôle prudentiel et de résolution* (ACPR – Prudential Supervision and Resolution Authority) are pioneers in the field (Allen et al., 2021). The ACPR recently carried out an unprecedented pilot exercise (and published the results in May 2021) which helped to: (i) raise awareness among financial institutions; (ii) better understand the institutions' reaction function in terms of portfolio reallocation when confronted with the these risks; and (iii) estimate an initial order of magnitude of their risks and vulnerabilities (which were moderate but far from negligible). This exercise thus paves the way to further new initiatives to improve climate scenario analysis methodologies.

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Climate scenario analysis exercises to assess financial risks carried out by central banks and supervisors

31 ongoing or completed exercises

¾ of these stress tests use or build on NGFS[1] scenarios

Analysis carried out by the *Autorité de contrôle prudentiel et de résolution* (ACPR)[2]

9 French banking groups (85% of the total French bank balance sheet covered)

15 French insurers (75% of the total French insurer balance sheet covered)

3-fold increase in cost of risk attached to the sectors most affected by transition risk (mining and quarrying, coking and refining, petroleum products, agriculture, etc.) by 2050

5 or 6-fold increase in cost of claims in certain French departments between 2020 and 2050 according to insurers

1 Central Banks and Supervisors Network for Greening the Financial System.
2 Prudential Supervision and Resolution Authority.

1 A common framework for the first climate scenario analysis exercises to assess financial risks

The financial system is exposed to major and unprecedented risks associated with climate change and the transition to a low-carbon economy. In order to help its members carry out their analyses, the Central Banks and Supervisors Network for Greening the Financial System (NGFS)[1] is examining and developing new tools that are more closely adapted to these risks' characteristics: non-linear dynamics; the existence of tipping points; irreversibilities; and materialisation over short, medium and long-term horizons. The climate trajectory is also subject to significant uncertainty and past occurrences only partially shed light on future climate events.

The NGFS therefore recommends a climate scenario analysis methodology that facilitates the testing of the financial system for its resistance to climate-related risks – climate stress testing. These scenarios represent various plausible futures. They are based on detailed modelling of energy, economy and climate systems, and provide a methodological framework that is better suited

BOX

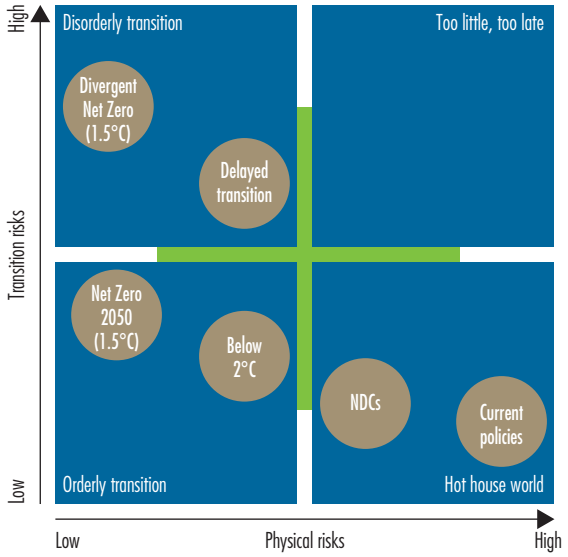
The NGFS climate scenarios

For several years, the Central Banks and Supervisors Network for Greening the Financial System (NGFS) has been developing a reference framework of climate scenarios. The first was published in June 2020 and the second was released in June 2021.[1] These scenarios explore two types of climate risk: physical risks (associated with damage caused by climate change) and transition risks (related to climate change mitigation measures implemented by firms or governments, such as the introduction of a carbon tax).

The NGFS defines four main categories of scenarios:

1. Orderly transition, with ambitious climate policies introduced early and gradually intensified;
2. Disorderly transition, in which climate policies are delayed and the transition then becomes more sudden and disruptive in order to adhere to the Paris Climate Agreement (2015);
3. The "too little, too late" transition, which fails to limit global warming;
4. "Business as usual", with the lack of transition policies resulting in a "hot house world" and climate change causing significant damages.

NGFS scenarios reference framework



Source: NGFS (2021a and b).
Note: "Net zero" refers to the target of net zero emissions by 2050; NDCs are Nationally Determined Contributions (under the Paris Agreement).

The NGFS scenarios are intended to provide a common analytical framework for central banks and supervisors, as well as for the entire financial system.

1 Portal to the NGFS scenarios: *https://www.ngfs.net/ngfs-scenarios-portal/*

1 The Central Banks and Supervisors Network for Greening the Financial System (NGFS) was created in December 2017 at the initiative of the Banque de France and seven other central banks and supervisors. The teams working in the Banque de France's Climate Change Centre act as permanent secretary to the NFGS.

to incorporating climate risks. In its guide to climate scenario analysis (NGFS, 2020), the NGFS makes the following recommendations:

- identify the objectives of a scenario analysis, stress test financial institutions, identify structural changes to the economy, and assess risks to own portfolios;
- choose the climate scenarios, and assess economic and financial impacts on the basis of these scenarios;
- publish the results, even at an aggregate level, notably to help increase awareness among financial institutions.

Test results can also be used as a basis for implementing prudential measures, although currently the authorities' focus is on improving methodologies.

All the NGFS' climate, energy and economic data and variables modelled for the 132 countries covered are made freely available. This database can be consulted via two portals,[2] which cover transition risk and physical risk, respectively. It thus particularly aims to step up financial institution mobilisation by facilitating data collection and processing and modelling initiatives.

2 A growing number of central bank and supervisors are engaged in climate exercises based on these scenarios

In October 2021, the NGFS published a progress report on the different climate exercises carried out by NGFS-member central banks and supervisors (NGFS, 2021c). The report shows that the financial community is exceptionally motivated. In total, 31 NGFS members (see Appendix) are using climate scenarios to identify, assess and understand the climate risks that their economies and financial systems face. Three-quarters of the exercises use or build on NGFS scenarios to carry out their analysis. For most of them, results are expected in 2022. Most of the institutions surveyed (including the ACPR – see below) use three NGFS climate scenarios, while five members use more than five. Some members focus instead on domestic risk factors and therefore do not use NGFS scenarios.

The report identifies the key features of climate exercises. Their objectives vary and include the assessments of macroprudential and microprudential risks and macroeconomic risks. For most institutions, this is their first climate exercise, and they feel that the goal of raising awareness and developing expertise (both of the institution and the financial players under its supervision) is at least as important as the risk assessment results themselves. All the exercises, most of which cover the period to 2050, encompass the banking sector. About half also include the insurance sector or other financial institutions.

Top-down (conducted entirely by the supervisors) and bottom-up (involving financial institutions directly) approaches are both applied. Bottom-up approaches have a number of benefits for financial authorities: they allow them to gain insight into institutions' own methods and abilities to analyse climate-related risks; they improve institutions' own capabilities to perform climate scenario analysis; they foster data collection within institutions; and they increase awareness of the economic and financial implications of climate-related risks. As for top-down approaches, they ensure a consistent methodology across financial institutions, provide room for sensitivity analysis as assumptions and parameters can be easily adjusted, and reduce resource costs. In practice, approaches vary considerably, and sometimes elements of bottom-up and top-down exercises are combined.

To assess the impacts of climate risks on financial institutions' balance sheets, analyses are mainly based on the assumption of a static balance sheet, which is easier to use than a dynamic balance sheet. Static balance sheets mainly assume that financial institutions' portfolios are frozen in time for the duration of the exercise. To a certain extent, this approach means that financial impacts are not underestimated as financial institutions cannot mitigate risks through management actions that they assume they would take. By contrast, dynamic balance sheets may offer more realism to the results as they incorporate changes to financial institutions' exposures over time, but their use is fraught with methodological

2 NGFS IIASA Scenario explorer for transition risk and NGFS CA Climate impact explorer for physical risk.

difficulties. In the case of a bottom-up approach, it is important to ensure that the methods applied by the different financial institutions are consistent. Certain exercises adopt a hybrid approach, for example by using a static balance sheet for the first few years and then a dynamic balance sheet for the medium and long-term horizon. In some cases, bank balance sheets may be constrained to be consistent with projected changes to the sectoral structure of the economy.

The report identifies the main methodological difficulties met by NGFS members carrying out their climate exercises and highlights the need to continue developing climate analyses approaches. In particular, members pointed out the need to expand and adapt the NGFS climate scenarios to their domestic contexts. They also noted that these exercises help them identify methodological and data issues and to gradually resolve them. As climate scenario exercises continue to develop, knowledge of the financial impacts of the transition and physical risks will improve, based on an increasingly consistent body of methodological practices and access to a larger data set. The NGFS will assist this development by regularly improving its scenarios and by gradually bridging any data gaps. It will also continue to act as a platform for sharing knowledge between central banks and supervisors (NGFS, 2021d).

3 The French case: innovative methodology and encouraging conclusions

The pilot climate exercise carried out by the ACPR was unprecedented as it was organised with the banking and insurance groups under its supervision and assessed climate-related risks over a 30-year horizon. This bottom-up exercise (see above), carried out between July 2020 and April 2021, involved 9 banking groups and 15 insurance groups, accounting for 85% of the total French bank balance sheet and 75% of the total French insurer balance sheet, respectively. It illustrates the driving role played by the French financial authorities and the Paris financial centre in the fight against climate change since the adoption of the French law on Energy Transition for Green Growth and the signing of the Paris Agreement in 2015. The results were published on 4 May 2021 (ACPR, 2021).

An innovative methodology combining NGFS and IPCC scenarios

The ACPR had three objectives for its climate exercise:

- **raising awareness among financial institutions** and galvanising their resources and efforts in the implementation of climate-related risk assessment methodologies;
- ascertaining the **institutions' reaction function** in terms of portfolio reallocation when faced with these risks;
- measuring the scale of the **risks and vulnerabilities** to which these institutions are exposed over a long-term horizon, mainly by using the scenarios developed by the NGFS.

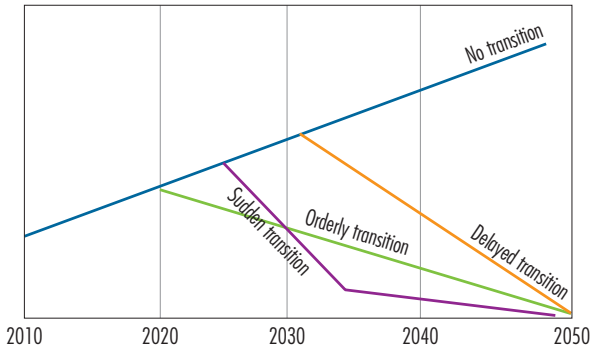
In order to assemble the scenarios necessary for the exercise, the ACPR and the Banque de France used three NGFS transition scenarios (Allen et al., 2021): a baseline scenario of orderly transition and two adverse scenarios referred to as "delayed transition" and "sudden transition". Each of these scenarios combined different assumptions on carbon tax trajectories and total factor productivity levels. The ACPR also introduced innovative methodological assumptions, particularly by adopting a hybrid projection approach, with a static balance sheet in the short term (until 2025) and a dynamic balance sheet over the long term (from 2025 to 2050). The banks and insurers that participated in the exercise were thus able to incorporate management decisions and reallocate their portfolios as of 2025 when the dynamic balance sheet is applied.

Physical risk, on the other hand, was assessed on the basis of the RCP8.5 scenario from the Intergovernmental Panel on Climate Change (IPCC, 2014) that assumes a temperature increase of 1.4°C to 2.6°C in 2050. RCP8.5 was the most pessimistic scenario presented by the IPCC in 2014. The physical risk considered during this climate exercise was based on two assumptions:

- With regard to the risk of natural disasters, it is first assumed that the frequency of extreme events and their associated costs will increase as a result of global warming. Using forecasts prepared by the *Caisse centrale de réassurance* (CCR – the French

Transition and physical risk scenarios included in the pilot exercise of the ACPR

(y-axis: net greenhouse gas emissions)



Source: ACPR (2020).
Interpretation: In the baseline scenario of an orderly transition, net greenhouse gas (GHG) emissions reduce at a steady pace from 2020. In a sudden and severe transition, the reduction of GHG emissions occurs later and abruptly in order to materialise maximum transition risk. In a delayed transition, GHG reductions begin in 2030, following a steady pace but quicker than in an orderly transition. Lastly, the "no transition" scenario extrapolates the projected emissions if no further action is taken by the public authorities.

central reinsurance fund) and based on *Météo France* simulations, insurers were able to estimate the damages they would have to cover by type of peril (droughts, floods, marine submergence and cyclones in the overseas territories), as these perils fall within the French natural disaster compensation regime. Participants were required to adhere to the characteristics of the RCP8.5 scenario but using the CCR forecasts was optional.

- The second assumption relates to scenarios developed by the insurance broker AON. The first scenario allowed insurers to assess the impact of the spread of vector-borne pandemics on healthcare-related claims. The second scenario was based on assumptions associated with the development of respiratory diseases prompted by longer and more regular heatwaves, and notably correlated with increased air pollution.

Overall risk exposure is moderate, but far from negligible

Based on the scenarios and assumptions used, the pilot exercise first of all showed that exposure and vulnerabilities were "moderate" overall, as the ACPR had already demonstrated in its previous work. France, which accounts for around 50% of French financial institutions' exposures, and Europe, which accounts for around 75%, are relatively less affected by climate-related physical and transition risks than other geographical areas. On the other hand, according to the NGFS projections used in this exercise, exposures in geographical areas such as the United States (which accounts for about 9% of exposures) seem to be more sensitive to transition risk. **Furthermore, French institutions' exposures to the most transition-risk affected sectors identified in this exercise (mining and quarrying, coking and refining, petroleum products, agriculture, etc.) are relatively low.** Banks and insurers have tried to reduce these exposures over the period to 2050. Nonetheless, it is in these sensitive sectors that the cost of risk and probabilities of default have risen most, with a threefold increase in the cost of risk. In interpreting these results, it is important to bear in mind that, contrary to the normal stress test approach, none of the analysed scenarios results in an economic recession by 2050. They only lead to lower growth in activity in the adverse scenarios.

The pilot exercise also showed that vulnerabilities associated with physical risk were far from negligible. Thus, based on information provided by insurers, the cost of claims could rise by a factor of five to six in certain French departments between 2020 and 2050. The main hazards contributing to this increase in claims are the risks of drought on the one hand and flooding on the other, as well as the greater risk of cyclones in the overseas territories. The increase in claims highlights an insurability risk in certain parts of the country.

However, the results should be put into perspective in view of the uncertainties associated with the speed and impact of climate change.

A pilot exercise that demonstrates the need for methodological improvements

The conclusions of the ACPR's pilot exercise also depend on the assumptions, scenarios analysed and the methodological difficulties met by the participating institutions.

In terms of methodology, the exercise highlighted a certain number of limitations that require improvement. Firstly, with regard to the assumptions used to develop the scenarios and identify sensitive sectors, one difficulty encountered by the participating institutions was the small degree of variability between the different scenarios put forward by the ACPR. The models used by banks to quantify risks are not adapted to incorporating extremely smooth developments in macroeconomic and financial variables over a long period. The same applies to insurance companies, which are used to dealing with extreme climate shocks rather than smooth deterministic impacts over a long period. Taking into account physical risk, particularly for the corporate credit portfolio, is a key area for improvement that requires collective action and that incorporates interdependencies and value chains (knowledge of which is still highly inadequate). One of the main reasons for this is that the information published by non-financial corporations is either lacking or incomplete. **This difficulty could in part be gradually alleviated with the disclosure requirements for extra-financial information, at least at the European level.** Lastly, questions were also raised about sectoral granularity, allocation of exposures or counterparties to given classifications (especially when several sectors of activity are covered), improvements to the models used and the data sources available.

The ACPR's pilot climate exercise thus represents the starting point for further work to improve climate stress test methodologies. Consequently, in 2021, the ACPR set up a first working group to discuss the ways in which the scenarios and microfinancial variables can be improved, as well as another working group focused on the modelling of physical risk and the integration of the protection gap (lack of insurability) in long-term projections. This second group will deal with different issues such as the dynamic balance sheet, data availability and the modelling of extreme events. Banks and insurers are invited to participate in these working groups on a voluntary basis and the uptake has been considerable. Their objective is to best prepare for the next climate-related financial risk assessment exercise planned for 2023-24.

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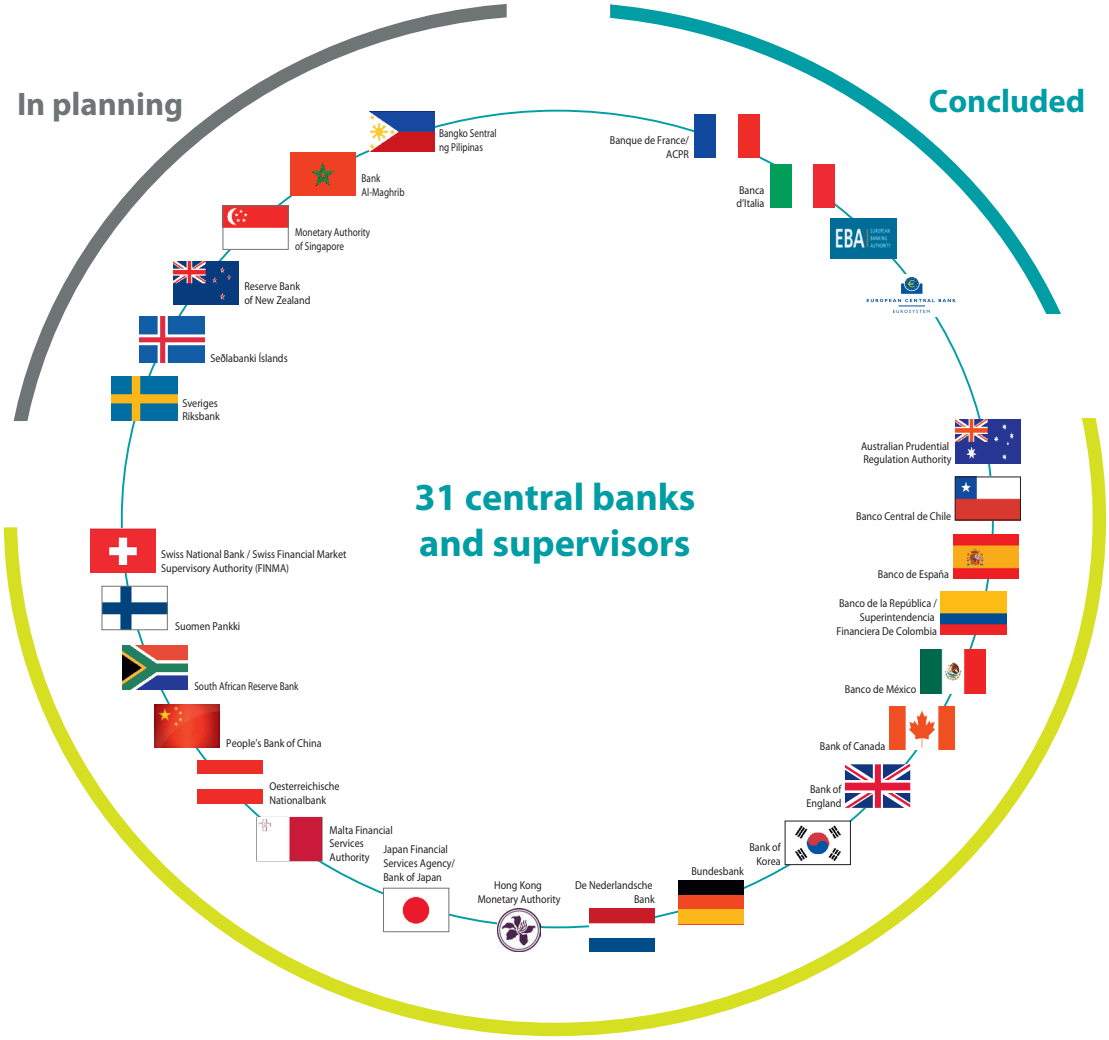
Appendix

Central banks and supervisors that have planned, begun or completed climate scenario analysis exercises to assess financial risk



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