EUROPEAN CENTRAL BANK
BANKING SUPERVISION

Macro-financial scenarios for the 2022 climate risk stress test

This note describes the narratives of the transition and physical risk scenarios used for the 2022 climate risk stress test.

1 Introduction

The 2022 climate risk stress test is a complex exercise based on three different modules. Module 1 consists of a questionnaire designed to get an overview of the institution's internal stress-testing capability and capacity. Module 2 focuses on two climate risk metrics, providing an insight into the sensitivity of banks' income and exposures to transition risk. **Module 3 comprises bottom-up stress testing, focusing both on transition risk and physical risk**.

In this context, it is important to emphasise that the scenarios described in this note are to be treated as exploratory climate risk stress scenarios, which are designed exclusively to serve the purpose of Module 3 of the 2022 climate risk stress test. Crucially, these are to be considered hypothetical and do not reflect the ECB's, the Eurosystem's or supervisory expectations about possible future outcomes.

The scenarios are largely based on Phase II of the Network for Greening the Financial System's **(NGFS) model outputs released in June 2021.** The overlays and additional calibrations were subsequently tailored to the specific needs of this exercise. Transition risk is modelled under long-term and short-term scenarios, whereas the physical risk scenarios are designed to be instantaneous.

This note comprises two sections outlining the underlying narratives of the scenarios:

- Section 2 for transition risk scenarios
- Section 3 for physical risk scenarios

2 Transition risk

2.1 Long-term transition risk scenarios

The narratives underlying the long-term transition risk scenarios are based on Phase II of the NGFS climate scenarios released in June 2021. First, the orderly scenario assumes that climate policies are introduced early and implemented gradually. It is based on the **NGFS "Net Zero 2050" scenario**, in which global warming is limited to 1.5°C through stringent climate policies and innovation, reaching net zero CO_2 emissions around 2050. Some jurisdictions reach net zero for all greenhouse gases by this point in time. Both physical and transition risks are relatively subdued: the smooth and gradual nature of the transition ensures that the costs incurred by the energy transition are minimised, while achieving global warming of only 1.5°C helps mitigate increases in physical risk.

The disorderly scenario explores higher transition risk due to policies being delayed. It is based on the **NGFS "Delayed Transition" scenario**. This scenario assumes new climate policies are not introduced until 2030, as in the years prior to this policymakers do not provide the right incentives for a green transition to take place. Strong policies are subsequently needed to limit warming to below 2°C and to compensate for lost time: for instance, carbon prices must be set typically higher to achieve an outcome that is aligned with the Paris Agreement. As a result, emissions temporarily exceed the carbon budget and decline more rapidly after 2030 to ensure a 67% chance of limiting global warming to below 2°C. This leads to higher transition risks than under the orderly transition scenario. Compared with an orderly transition, physical risks are also higher, as the delay in implementing climate policies leads to a higher temperature increase, subsequently leading to a rise in the frequency and magnitude of extreme weather events.

The hot house world scenario assumes that no new climate policies are implemented and that the current global efforts are insufficient to halt significant global warming. The scenario calibration is based on the **NGFS "Current Policies" scenario,** which captures the long-term physical risk to the economy and financial system if the world continues on the current path to a hot house world. Even though European emissions gradually decline under this scenario, global emissions rise until 2080, leading to global warming of around 3°C. Critical temperature thresholds are exceeded, leading to severe physical risks and extreme costs arising from the increase in frequency and magnitude of natural catastrophes. Under this scenario, the transition to a carbon neutral economy is assumed to never take place and thus transition risks are negligible. However, the absence of transition costs is more than offset by the adverse impact over time of extreme physical risk on the economy.

2.2 Short-term disorderly transition risk scenario

The short-term disorderly transition risk scenario assesses banks' short-term vulnerabilities triggered by a sharp increase in the price of carbon emissions over a time horizon of three years. The objective of this analysis is to identify potential vulnerabilities connected to a disorderly transition. This scenario aims to capture tail risks and should thus be considered as a severe but plausible representation of a disorderly transition.

The scenario calibration is based on the NGFS "Delayed Transition" scenario. Under this scenario, policy measures to reduce carbon emissions are delayed. For governments to still meet the Paris Agreement targets, a sharp and unexpected increase in the price of carbon emissions is assumed. While under the long-term disorderly transition scenario the sharp carbon price increase takes place around 2030, this scenario assumes that the increase in carbon prices occurs in 2022, along with the associated effects on the economy. Importantly, this event needs to be considered as a tail risk scenario suitable for stress testing. The aim of the hypothetical tail risk event is to assess the sensitivity of banks' current balance sheets to unexpected sharp measures to curb carbon emissions in the near term.

3 Physical risk

3.1 Drought and heat risk

This scenario models the economic effects of a severe drought and heatwave in Europe. Extended periods of hot weather can lead to sizeable output losses across several economic sectors, for example through the decrease in labour productivity for outdoor professional activities. Through their exposure to these vulnerable industries, banks could sustain losses.

The heatwave is assumed to hit Europe on 1 January 2022. While this is arguably not a realistic date for a heatwave to occur, it has the advantage that end-of-year data can be used as the starting points and the projection horizon can be limited to one year ahead. To limit the scope of the exercise, the scenario only models the shocks to sectoral gross value added growth.

The scenario calibration is based on NGFS estimates for labour productivity shocks due to heat stress across relevant countries in 2050. Thus, the key transmission channel of heatwave risk to the economy is through labour productivity. For example, a severe heatwave can weaken the output of construction workers who need more breaks and/or to work fewer hours in these conditions. It can also affect the productivity of farmers who face harsher conditions working on the land.

3.2 Flood risk

River flooding has historically been a major source of physical risk in Europe and, with a rise in extreme levels of precipitation being associated with climate change, this risk is expected to increase. The recent floods during the summer of 2021 show the consequences of heavy rainfall on both human lives lost and physical capital being destroyed or severely impaired.

Under this scenario, it is assumed that severe floods sweep across Europe on 1 January 2022. While the probability of such an event is low, it allows relevant flood risk scenarios to be created across the European Union. Flood risk is different across Europe and can vary significantly even within a few kilometres. Therefore, the flood risk scenario accounts for within-country variation in risks. As such, shocks to residential and commercial real estate are estimated at NUTS3 regional level, according to a specific flood risk level.

The flood risk scenario was developed based on insights from the work carried out by the European Commission's Joint Research Centre on flood risk, **as well as from granular geospatial flood risk data collected for the purposes of the ECB economy-wide climate stress test** based on the Four Twenty Seven dataset.

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For specific terminology please refer to the ECB glossary (available in English only).