

May 10, 2024  
Financial Services Agency  
Bank of Japan

## **Climate-Related Scenario Analysis**

– Next Step in the Banking Sector<sup>1</sup> –

### **1. Background - Pilot exercise conducted in FY 2021**

As measures to climate change are increasingly adopted worldwide, it is important for financial institutions to take a forward-looking view of the opportunities and risks that climate change may bring to their clients and their own business. By supporting their clients' effort to address climate change, financial institutions would be able to help their clients establish business foundations that are resilient to the change. This also enables financial institutions to ensure sustainable business foundations.

The impacts of climate change are likely to materialize over the medium to long term, and how and to what extent they materialize are highly uncertain. For this reason, scenario analysis is considered to be effective for forward-looking analysis and assessment of financial institutions from both an opportunity and risk perspectives. It uses simulations to assess the timing and magnitude of impacts on financial institutions' earnings and financial soundness via plausible transmission mechanisms under certain scenarios about the future rise in temperature and policy responses by governments.

The Financial Services Agency (FSA) and the Bank of Japan (BOJ), in cooperation with three major banks, conducted a pilot exercise of scenario analysis using common scenarios in FY 2021, and published the results and issues to be considered in August 2022.<sup>2</sup> The

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<sup>1</sup> This paper covers only the banking sector, not the insurance sector.

<sup>2</sup> "[Pilot Scenario Analysis Exercise on Climate-Related Risks Based on Common Scenarios](#)" (August 2022, Financial Services Agency and Bank of Japan). The exercise revealed that the estimated results of each bank were affected not only by banks' analytical models and the selection of variables for the models, but also by variations in assumptions due especially to a lack of information and data on future prospects. In order for financial institutions to utilize scenario analysis for risk analysis, there is considerable room for the enhancement of analytical techniques, and challenges are posed by insufficient data and uncertainties.

pilot exercise analyzed the impacts of climate-related risks (transition risks and physical risks<sup>3</sup>) on banks' financial conditions through credit risk, covering loans as of the end of March 2021.

## 2. Initiatives related to scenario analysis after the pilot exercise

Since the pilot exercise, the FSA and BOJ have been engaging in dialogue with financial institutions, including the three major banks. In addition, the FSA and BOJ have been conducting the following research, exchanging information and collaborating with relevant organizations,<sup>4</sup> and sharing insights on scenario analysis with overseas financial authorities at various international fora.

- The FSA<sup>5</sup> has published the review on the characteristics and usage of scenarios published by the Network for Greening the Financial System (NGFS),<sup>6,7</sup> which were used as common scenarios in the pilot exercise (see Box 1 for NGFS climate scenarios).
- The BOJ staff members published research papers about their top-down scenario analysis based on short-term scenarios and about issues in designing scenarios, in

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<sup>3</sup> Climate-related risks are generally classified into transition risks and physical risks. The former refers to the risks posed by changes in regulations, technology, and market environments associated with the transition to carbon neutrality. The latter refers to the risks posed by the intensification of natural disasters and changes in temperature and precipitation. The physical risks are further divided into acute risks and chronic risks. Acute risks arise from increases in the frequency and intensity of natural disasters, such as typhoons. Chronic risks gradually emerge in response to long-term fluctuations, such as rising temperatures and rising sea levels.

<sup>4</sup> Through dialogues between data users, including financial institutions, and data providers in the public and private sectors, the FSA is examining issues for data utilization with a focus on physical risks at "Advisory Council on Scenario Data for Climate Change Risk and Opportunity Assessment", which is co-hosted by the Ministry of Education, Culture, Sports, Science and Technology (MEXT), the Ministry of Agriculture, Forestry and Fisheries (MAFF), the Ministry of Land, Infrastructure, Transport and Tourism (MLIT), and the Ministry of the Environment (MOE), and in which the BOJ participates as an observer.

<sup>5</sup> In addition, the FSA conducted trial analyses to better understand the characteristics of climate-related risks (transition risks and physical risks) at regional banks, using granular data, such as details of transaction-level corporate loans collected from 49 regional banks ("[FSA Analytical Notes: Analysis of climate-related financial risks](#)"; June 2023, Financial Services Agency).

<sup>6</sup> A network of central banks and financial supervisory authorities established in December 2017 to consider financial supervisory responses to climate-related risks.

<sup>7</sup> "[Survey on the Use of NGFS Scenarios](#)" (April 2024, Financial Services Agency) (Available in Japanese)

order to conduct a more multifaceted risk analysis.<sup>8,9</sup>

As for market risk, which was not included in the analysis of the pilot exercise, the FSA and BOJ conducted a preliminary analysis of the impact of climate-related risks on banks' financial conditions from a decline in the market value of their securities holdings. The results indicate that, in considering the scope of scenario analysis, the impact on loans (credit risk) is more material than the impact on securities holdings (market risk), given the magnitude of the potential financial impacts and the challenges in the preparation and development for the use of scenario analysis (see BOX 2).

### **3. Next step - Initiation of the second exercise**

Currently, the FSA and BOJ, in cooperation with the three major banks, are preparing to conduct the second exercise of scenario analysis based on common scenarios for climate-related risks in FY 2024 to continuously improve the methodology and framework of scenario analysis. The following frameworks are being considered.<sup>10</sup>

The pilot exercise was a long-term scenario analysis with a target time horizon of the year 2050 for transition risks and the year 2100 for physical risks. Although climate-related financial risks are expected to manifest over the medium to long term, significant short-term changes in climate-related financial risks may occur due to policy changes, technological and resource constraints, and consequent changes in the behavior of firms and households. Therefore, the target time horizon in the second exercise will be set at a relatively short time frame,<sup>11</sup> which may facilitate banks' risk management.

Based on the results of the preliminary analysis of market risk, the FSA and BOJ intend to focus on the impact on loans (credit risk) and its assessment in the second exercise. The

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<sup>8</sup> ["Top-Down Scenario Analysis of Climate-Related Financial Risks: Perspective from Time Horizon and Inter-Industry Spillovers"](#) (December 2023, Abe et al.)

<sup>9</sup> ["Designing scenarios for climate related risk analysis –Applications and challenges of integrated assessment models"](#) (December 2023, Takeyama et al) (Available in Japanese)

<sup>10</sup> Similar preparations are under way in the insurance sector (non-life insurers) as well.

<sup>11</sup> In recent years, foreign financial authorities and central banks have tended to conduct short-term scenario analyses. For example, the European Central Bank (ECB) conducted a short-term scenario analysis in conjunction with a long-term scenario analysis in 2022 ("[2022 climate risk stress test](#)" (July 2022)). The French Prudential Supervision and Resolution Authority (ACPR) is preparing a short-term scenario analysis for the insurance sector ("[Scenarios and main assumptions of the 2023 ACPR insurance climate exercise](#)" (July 2023)). The U.S. Federal Reserve Board (FRB) has set a slightly shorter time frame for scenario analysis (until 2030) to make it a more realistic time frame for risk management ("[Pilot Climate Scenario Analysis \(CSA\) Exercise: Participant Instructions](#)" (January 2023)). The NGFS published its views on short-term scenarios in October 2023 ("[Conceptual note on short-term climate scenarios](#)" (October 2023)).

FSA and BOJ also plan to consider, on a trial basis, using a scenario analysis framework to examine the impact of financial institutions' effort to achieve the emissions reduction targets of investee and borrower companies attributable to financial institutions (financed emissions) and its impact on banks' loans and other portfolio management.

### Box 1: NGFS climate scenarios

Since the publication of its first climate change scenarios in 2020, the NGFS has undergone a series of revisions, publishing its fourth edition in November 2023. The fourth edition of the NGFS scenarios consists of seven scenarios under four categories, depending on the degree of transition risk and physical risk (Figure 1). For each scenario, a path of variables (e.g. carbon prices) is provided from 2022 to 2100 (2050 for some variables) that describes the structural socio-economic changes associated with climate change, consistent with the underlying narrative.

The variables included in the scenarios and technical descriptions of the scenarios are available on the NGFS portal. In addition, the FSA published a report entitled "Survey on the Use of NGFS Scenarios" in April 2024, which provides an overview and characteristics of NGFS scenarios.

Figure 1: Narratives behind the NGFS scenarios (4th edition)

Category	Scenarios	Underlying narrative
Orderly Transition	Low Demand	Achieve net zero global GHG emissions by 2050, limiting the global average temperature rise to 1.5°C, driven by lower energy demands due to significant behavioral changes and the adoption of carbon pricing and technology.
	Net Zero 2050	Achieve net zero global GHG emissions by 2050, to limit the global average temperature rise to 1.5°C through rigorous emissions reduction policies and innovation.
	Below 2°C	Policies to reduce emissions gradually become more stringent, limiting the global average temperature rise to 2°C.
Disorderly Transition	Delayed Transition	Not starting to reduce emissions until 2030; strong policies to limit the global average temperature increase to 2°C from 2030.
Hot House World	Nationally Determined Contributions (NDCs)	All policies that countries have committed to implement, including those that are currently not being implemented, are assumed to be implemented.
	Current Policies	Assumption that only the policies currently in place will be retained; physical risks will increase.
Too-little, too-late	Fragmented World	In countries where GHG reduction targets have not been set, the setting of targets will be delayed. Even in countries where targets have been set, GHG reductions will be 80% of targets. As a result, both physical risks and transition risks will increase.

Source: Compiled based on "Survey on the Use of NGFS Scenarios"

## Box 2: Market risk under NGFS scenarios

Compared to other climate scenarios, such as the International Energy Agency (IEA) scenarios, NGFS scenarios are unique in that they provide not only climate change-related variables, such as greenhouse gas emissions and carbon prices, but financial and economic variables as well. Therefore, in addition to credit risk, market risk can also be analyzed using NGFS scenarios.

In the fourth edition of the NGFS scenarios, short-term interest rates, long-term interest rates, exchange rates, and stock prices (market indices) are provided as market risk-related variables. For these financial asset price variables, the transition risk impact can be regarded as the difference between the Net Zero 2050 scenario or the Delayed Transition scenario and the Current Policies scenario, which assumes the lowest transition risk.

Looking at the impact of transition risks on financial asset prices, the level of interest rates assumed in 2024 differs between scenarios due to the impact of changes assumed before 2023. However, for 2024 and beyond, the spread of interest rates between scenarios reflecting the impact of transition risks is assumed to widen only in a part of scenarios, reflected over several years (Figures 2 and 3). The difference of exchange rates between scenarios is small and is not assumed to widen (Figure 4). For stock prices, a decline is assumed in the 2020s and early 2030s immediately after the introduction of carbon pricing, but the decline is only around 5-10%, which is not necessarily large compared to normal market fluctuations (Figure 5).

As described above, the impacts of the NGFS scenarios on climate-related financial risks after 2024 are assumed to emerge mainly through stock prices. However, the impacts are not so large compared to the previous stock price fluctuations. In addition, the asset composition of the three major banks is not large for stocks compared to loans.

Figure 2: Short-term interest rate scenarios

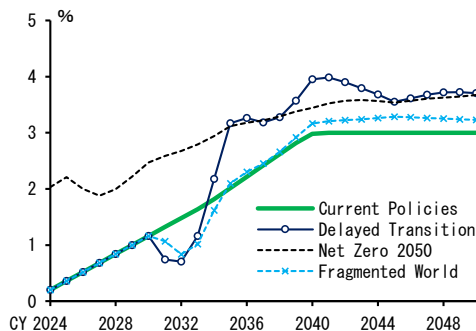


Figure 3: Long-term interest rate scenarios

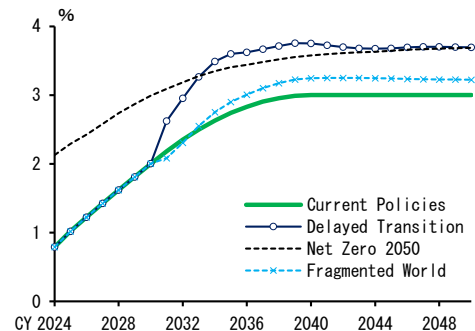
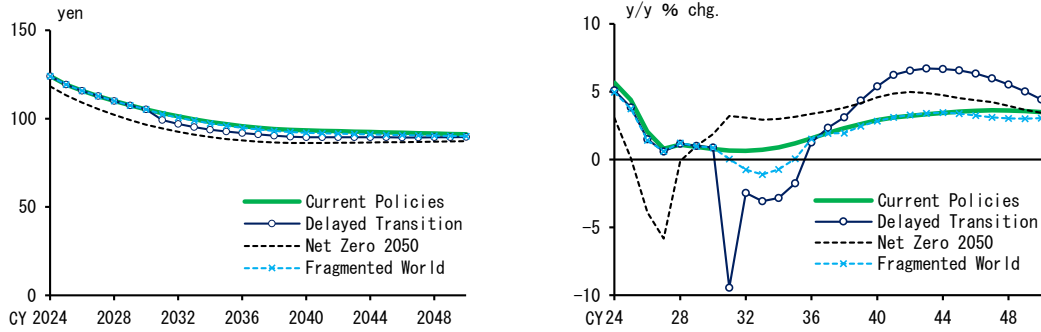


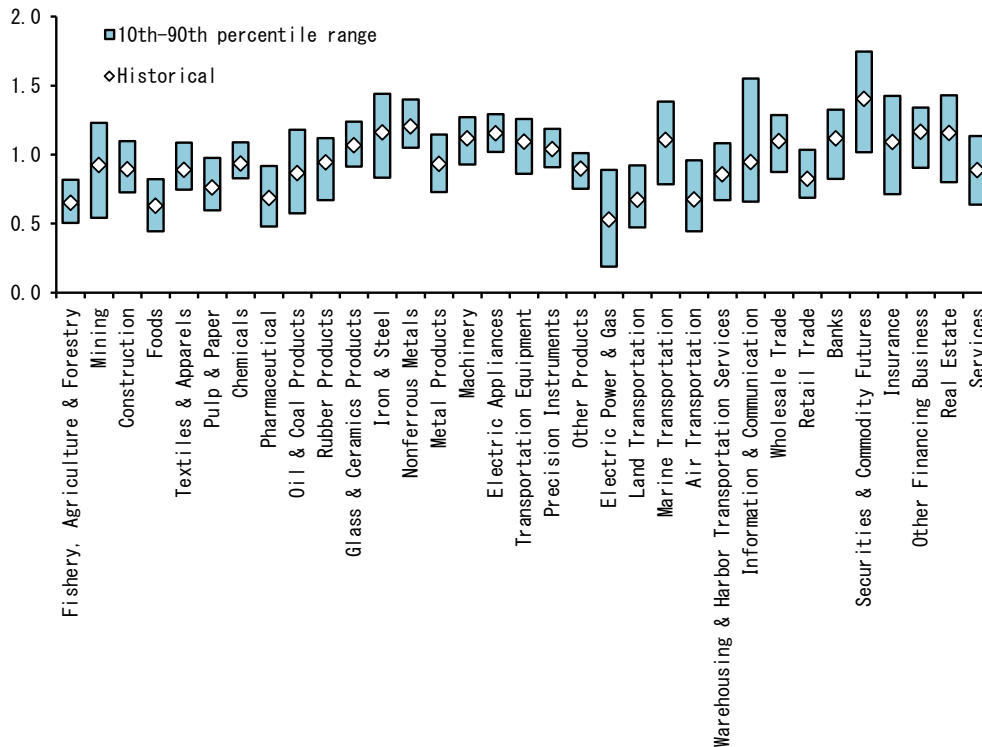
Figure 4: Exchange rate (USD / JPY) scenarios      Figure 5: Stock price scenarios



Source: NGFS scenarios (4th edition) (Figures 2, 3, 4 and 5)

However, transition risks may concentrate on sectors with high greenhouse gas emissions (high-emission sectors). There are various uncertainties in inter-industry correlations (Figures 6 and 7), but these are not fully taken into account in the NGFS scenarios. It is still an ongoing challenge to improve market risk analysis that takes into account the possibility that impacts concentrate on specific industries.

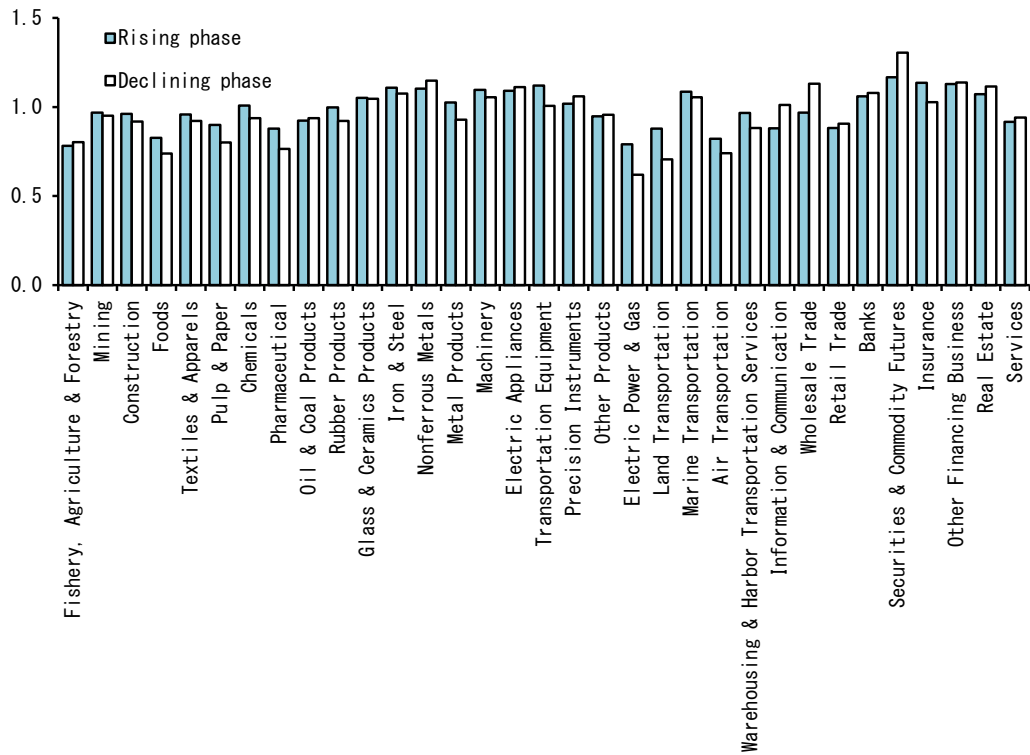
Figure 6: Sensitivity of industry indices to TOPIX and their dispersion



Note1: Sensitivities of industry indices to TOPIX indicate what percentage each industry index tends to change when the stock market as a whole (TOPIX) changes by 1%.

Note2: Sensitivities of industry indices to TOPIX are shown; the entire period (November 30, 1998 to February 2, 2024) is the marker and the end of bands marks the 10<sup>th</sup>/90<sup>th</sup> percentile for 250 days.

Figure 7: Sensitivity of industry indices to stock market rallies and declines



Note: Sensitivities (see Note1 of Figure 6) are estimated separately for when TOPIX rallies and when it declines.

Source: Nikkei Inc., "NEEDS-Financial QUEST" (Figures 6 and 7)