Course 2024–2025 in Sustainable Finance
Lecture 16. Climate Stress Testing and Risk Management

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[1]The opinions expressed in this presentation are those of the authors and are not meant to represent the opinions or official positions of Amundi Asset Management.

Agenda

Transmission channels

Figure 1: Publication of the Basel Committee on climate-related financial risks (2021)


Basel Committee
on Banking Supervision

Climate-related risk
drivers and their
transmission channels

April 2021

BANK FOR INTERNATIONAL SETTLEMENTS

Basel Committee
on Banking Supervision

Climate-related financial
risks – measurement
methodologies

April 2021

BANK FOR INTERNATIONAL SETTLEMENTS

Transmission channels

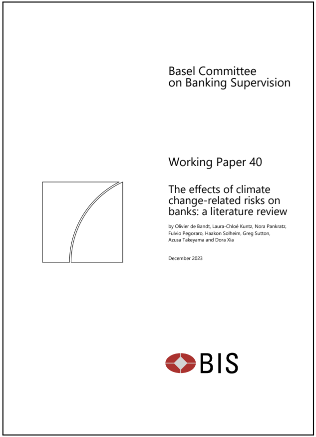
Figure 2: Publication of the Basel Committee on climate-related financial risks (2022, 2023)


Basel Committee
on Banking Supervision

Principles for the effective management and supervision of climate-related financial risks

June 2022

BIS


Basel Committee
on Banking Supervision

Working Paper 40

The effects of climate change-related risks on banks: a literature review

by Olivier de Bandt, Laura-Chloé Kuntz, Nora Pankratz, Fulvio Pegoraro, Haakon Solheim, Greg Sutton, Azusa Takeyama and Dora Xia

December 2023

BIS

Direct and indirect transmission

Credit transmission channel

Market transmission channel

Systemic risk

Financial regulation

Figure 3: Campiglio *et al.* (2018)

Emanuele Campiglio, Yannis Dafermos, Pierre Monnin, Josh Ryan-Collins, Guido Schotten, Misa Tanaka

Climate change challenges for central banks and financial regulators

Article (Accepted version)
(Refereed)

Original citation:
Campiglio, Emanuele and Dafermos, Yannis and Monnin, Pierre and Ryan-Collins, Josh and Schotten, Guido and Tanaka, Misa (2018) *Climate change challenges for central banks and financial regulators.* Nature Climate Change, 8 (6). pp. 462-468. ISSN 1758-678X

DOI: 10.1038/s41558-018-0175-0

Market risk

Figure 4: Impact on the trading book


October 2022

ISDA

EY Building a better working world

Climate Risk Scenario Analysis for the Trading Book

ISDA Safe, Efficient Markets

A Conceptual Framework for Climate Scenario Analysis in the Trading Book

July 2023

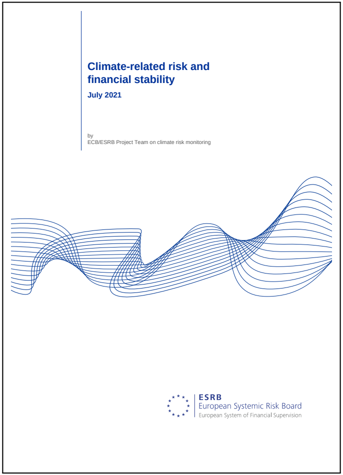
Commodity market

Stock market

Climate value-at-risk

Credit risk

Figure 5: ESRB (2021), Climate-related Risk and Financial Stability



Mortgage portfolios

Loan portfolios

Bond pricing

Structural models

Default barrier models

CDS pricing

Bond portfolios

Introducing climate risk into risk-weighted assets

Stress testing

Figure 6: Battiston *et al.* (2017)

nature climate change
ARTICLES
PUBLISHED ONLINE: 27 MARCH 2017 | DOI: 10.1038/NCLIMATE3255

A climate stress-test of the financial system

Stefano Battiston[1]*, Antoine Mandel[2], Irene Monasterolo[3], Franziska Schütze[4] and Gabriele Visentin[1]

The urgency of estimating the impact of climate risks on the financial system is increasingly recognized among scholars and practitioners. By adopting a network approach to financial dependencies, we look at how climate policy risk might propagate through the financial system. We develop a network-based climate stress-test methodology and apply it to large Euro Area banks in a 'green' and a 'brown' scenario. We find that direct and indirect exposures to climate-policy-relevant sectors represent a large portion of investors' equity portfolios, especially for investment and pension funds. Additionally, the portion of banks' loan portfolios exposed to these sectors is comparable to banks' capital. Our results suggest that climate policy timing matters. An early and stable policy framework would allow for smooth asset value adjustments and lead to potential net winners and losers. In contrast, a late and abrupt policy framework could have adverse systemic consequences.

Assessing the impact of climate risks and climate policies on the financial system is currently seen as one of the most urgent and prominent policy issues[1,2]. In particular, there is a debate on whether the implementation of climate policies to meet the 2 °C target generates systemic risk or, instead, opportunities for low-carbon investments and economic growth. However, data are scarce and there is no consensus on the appropriate methodologies to use to address this issue. The magnitude of so-called stranded assets of fossil-fuel companies (in a 2 °C economy) has been estimated to be around 82% of global coal reserves, 49% of global gas reserves and 33% of global oil reserves[3]. Moreover, several studies have investigated the role of stranded assets in specific sectors and countries[4–9]. By investing in fossil-fuel companies, financial institutions hold direct 'high-carbon exposures', which for European actors have been estimated to be, relative to their total assets, about 1.3% for banks, 5% for pension funds and 4.4% for insurances[10]. One can compute the value at risk (VaR) associated with climate shocks[11] in the context of integrated assessment models[12] in which aggregate financial losses are derived top-down from estimated GDP (gross domestic product) losses due to physical risks resulting from climate change. Yet, assessing the financial risk of climate policies (often referred to as transition risks) requires estimations of the likelihood of the introduction of a specific policy. However, the likelihood that a climate policy is introduced depends on the expectations of the agents on that very likelihood. Thus, the intrinsic uncertainty of the policy cycle undermines the reliability of the probability distributions of asset returns, also due to the presence of fat tails[13]. Further, it is now understood that interlinkages among financial institutions can amplify both positive and negative shocks[14–16] and significantly decrease the accuracy of our estimation of default probabilities in an interconnected financial system[17]. As a result, calculations of expected losses/gains from climate policies carried out with traditional risk analysis methodologies have to be taken with caution. Here, we develop a complementary approach, rooted in complex systems science, and consisting of a network analysis of the exposures of financial actors[18,19] to all climate-policy-relevant sectors of the economy, as well as the exposures among financial actors themselves, across several types of financial instruments. This analysis is meant as a tool to support further investigations of the potential impact and the political feasibility of specific climate policies[20,21]. To go beyond the mere exposure to the fossil-fuels extraction sector, we remap an existing standard classification of economic sectors (NACE Rev2) according to their relevance to climate mitigation policies, and we analyse empirical microeconomic data for shareholders of listed firms in the European Union and in the United States. We find (see Supplementary Table 6) that while direct exposures via equity holdings to the fossil-fuel sector are small (4–13% across financial actor types), the combined exposures to climate-policy-relevant sectors are large (36–48%) and heterogeneous. In addition, financial actors hold equity exposures to the financial sector (13–25%), implying indirect exposures to climate-policy-relevant sectors.

Results

By targeting the reduction of greenhouse gas (GHG) emissions, climate policies can affect (positively or negatively) revenues and costs of various sectors in the real economy with indirect effects on financial actors holding securities of firms in those sectors. However, the existing classifications of economic sectors such as NACE Rev2 (ref. 22) or NAICS (ref. 23) were not designed to estimate financial exposures to climate-policy-relevant sectors. Therefore, we define a correspondence between sectors of economic activities at NACE Rev2 4-digit level and five newly defined climate-policy-relevant sectors (fossil fuel, utilities, energy-intensive, transport and housing) based on their GHG emissions, their role in the energy supply chain, and the existence in most countries of related climate policy institutions (see Methods and Fig. 1).

The exposures of financial actors (classified according to the standard European Systems of Accounts, ESA (ref. 24)) can be decomposed along the main types of financial instruments: equity holdings (for example, ownership shares including both those tradable on the stock market and those non-tradable), bond holdings (for example, tradable debt securities) and loans (for example, non-tradable debt securities). By combining the breakdown of exposures across instruments with the reclassification

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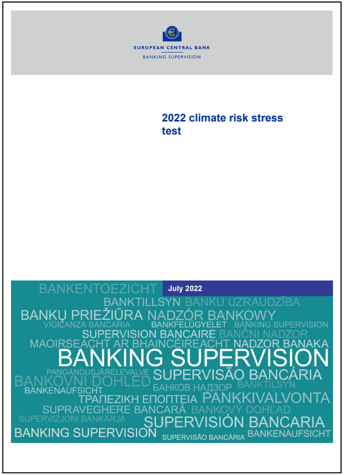
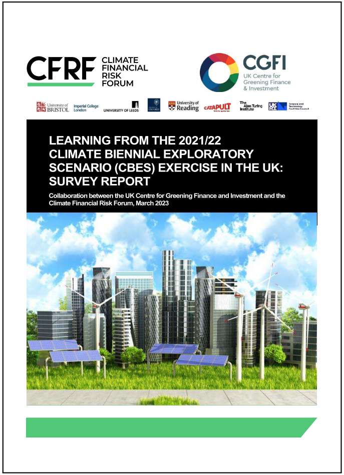
Earnings' risk

Banking

Figure 7: Climate risk stress test

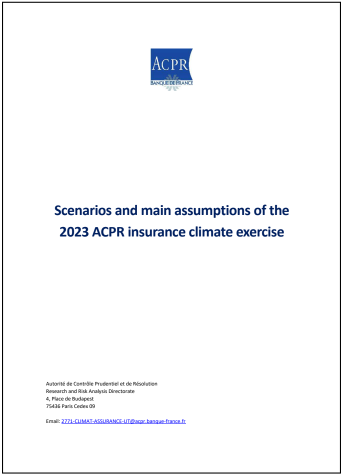




Banking

Insurance

Figure 8: 2023 ACPR insurance climate exercise



ACPR
BANQUE DE FRANCE

Scenarios and main assumptions of the 2023 ACPR insurance climate exercise

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Insurance