Climate financial risk assessment: from research to supervisory practice

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Back to 2015: climate change as a new type of financial risk

- 2015, M. Carney, *Tragedy of the Horizons*: investors face large climate-related losses
  - Short term investment horizon in finance, vs
  - Longer term dimension of climate change
- 2 main channels of climate risk to finance:
  - Physical risk
  - Transition risk
- 2019, Network for Greening the Financial System (NGFS): **climate risk as new source of risk for financial stability**:
  - Climate scenarios for climate stress-test
  - Climate stress test at central banks (e.g. ECB 2021)
Investors have large, heterogeneous exposure to transition risk (beyond emissions: Climate Policy Relevant Sectors)

Losses from a high-carbon investment strategy are high and amplified by network effects

- Battiston ea 2017 NCC: framework for climate stress-test that embedded climate scenarios in a stress test of individual portfolios and the financial system.

Fig. Exposure (USD billion) of equity portfolio of largest banks to Climate Policy Relevant Sectors (CPRS): fossil (black), utilities (grey), energy-intensive (orange), housing (pink), transport (green) (Battiston ea 2017)

Fig. Climate Value at Risk, EU banks, current investment strategy. Dark/light: first/first+second round (Battiston ea 2017)
Climate stress-test framework

- Climate scenarios (physical, transition risk)
- Estimates of sectors’ production by energy technology, cash-flow streams of securities
- Valuation adjustment of issuers’ default probability, bond spread, credit risk etc.
  → Reallocation of capital to less risky assets

Output trajectories

Financial valuation adjustment

Amplifications via financial networks

- Roncoroni et al. 2021

Monasterolo_ ESG_climate_risk_framework_WU_2024
Expectations affect climate financial risk assessment and capital reallocation in the transition.

- Firms make investment decisions (CAPEX) in high/low carbon equipment (e.g. wind vs coal power plants)
  - These decisions give rise to sectors’ output trajectories of process based Integrated Assessment Models (IAM) in the NGFS scenarios
- Financial actors influence these decisions by making capital more/less expensive for firms (e.g. interest rate)
- The feedback btw climate financial risk assessment – investment decisions is not considered by NGFS scenarios

*Source: courtesy of S. Battiston, IPCC lead author*
Investors’ expectations about policy credibility (climate sentiments) affect the transition and climate scenarios:

- **Hampering** (no trust) case: large and sudden price adjustments. **Hampering** role could also lead to higher risk than in NGFS disorderly scenario.
- **Delayed** transition to 2C: if policy deemed credible, investors **enable** an orderly transition: gradual price adjustments.

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**Legend:**

<table>
<thead>
<tr>
<th>Trajectories from IAM scenarios</th>
<th>Trajectories from IAM-CFR framework</th>
</tr>
</thead>
<tbody>
<tr>
<td>Renewable energy</td>
<td>Renewable energy</td>
</tr>
<tr>
<td>Coal</td>
<td>Coal</td>
</tr>
</tbody>
</table>

Source: Battiston et al. 2021, Science
Climate risk challenges standard financial risk assessment

• **Forward-looking:**
  - Non-linearity, tipping points (Steffen ea 2018 S, Lenton ea. 2019 N) → *irreversibility*
  - Compound (Zscheischler ea 2018 NCC, Dunz ea 2021 JBF, Ranger ea. 2022 WB) → *amplification and persistency*
  - Endogeneity (Battiston 2019 BdF, Battiston ea 2021 Sc): *expectations* can make climate risk more material and earlier than we think!

• **Standard risk management approaches are not adequate:**
  - Based on past data (e.g. reported emissions, announcements)
  - But with climate, *statistical properties* of the future differ from the past: less relevant to estimate coefficients based on past info
  - *Incomplete markets* (e.g. insurance) limit hedging strategies.

➢ Thus, we need to assess climate financial risk using scenarios (ex: NGFS)
1 Climate scenarios:
   • Extend the **assessment of acute risks** (droughts, wildfires, etc) and **compound**
   • Include financial **expectations**: they matter for transition risk (see above)

2 Climate risk exposure:
   • Go beyond emissions and **look at technology** (less subjective, Battiston ea 2023)
   • Data granularity: asset-level to avoid underestimation of losses (Bressan ea 2024 NC)

3 Climate risk assessment (econ): **getting both the macro and climate risk right**
   • Traditional macroeconomic models (e.g. CGE, DSGE): equilibrium, rational expectations assumptions→ smooth climate impacts on GDP, no persistency
   • Complemented with models (SFC, AB) that capture climate risk characteristics (persistency, endogeneity, etc, see e.g. Gourdel ea 2023).
Example: limits of GHG emissions for disclosure

• Greening portfolio of corporate bonds (ECB PEPP) based on GHG emissions and alignment plans:
  • Emission intensity (Scope1+2+3)/Revenues, ESG Risk Rating (ESGRR, Sustainalytics) for bonds
• **Results**: reporting discrepancies exist also intra-sector, challenging investors’ evaluation of firms’ sustainability, **portfolio rebalancing and prudential regulation:**
  • Key factor: inconsistency of Scope 3 reporting (see Stellantis vs VW).

Source: Bressan et al. 2022 JPM
Example: asset level info is key for adaptation policies and investment decisions

Heterogeneous assets’ exposure to physical risks hidden by firm level scores

Investor losses underestimated up to 70% when neglecting asset-level info, over 80% when neglecting tail acute risks.

<table>
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<tr>
<th>Case</th>
<th>Underestimation range (%) firm-level vs. asset-level</th>
</tr>
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<tbody>
<tr>
<td>Acute RP250 (tail)</td>
<td>67.4-92.3</td>
</tr>
<tr>
<td>Chronic and acute RP250 (tail)</td>
<td>58.0-70.8</td>
</tr>
</tbody>
</table>

Table: Underestimation of portfolio losses, scenario SSP3-RCP4.5, year 2040 (Bressan ea 2024 NC).
Conclusion

- **Climate stress-tests are important. However, the way we do them is crucial to inform decision making (policy, supervision, investors)**

- **DG REFORM ESG UPTAKE project**: mainstreaming science-based Environmental Social Governance (ESG) and climate risk assessment at national central banks and financial authorities:
  - Data gaps and needs; modelling gaps and needs; insurance protection gap

- **NGFS short-term climate scenarios project**:
  - Develop short term (1 year) scenarios for climate stress test, extending the coverage of hazards and their granularity, soft integration of macro-financial models, investors’ expectations (CLIMACRED), monetary policy response.