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)

Carney warns of risks from climate change 'tragedy of the horizon'

Bank of England governor tells Lloyd's insurers that 'challenges currently posed by climate change pale in significance compared with what might come'

Should central banks worry? Yes

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

Investors have large, heterogeneous exposure to transition risk (beyond emissions: Climate Policy Relevant Sectors

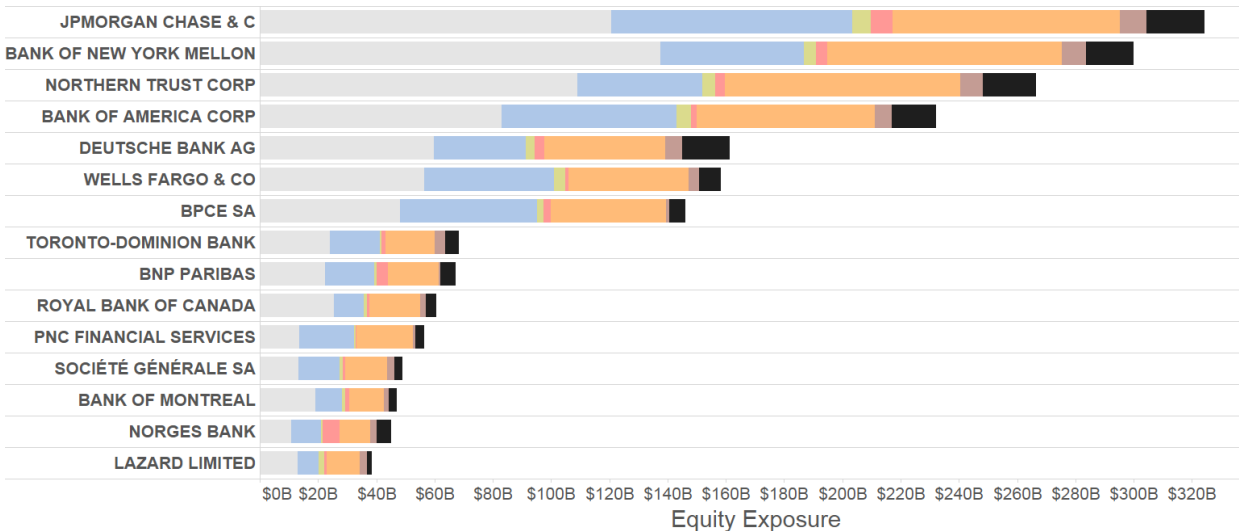Losses from a high-carbon investment strategy are high and amplified by network effects

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)
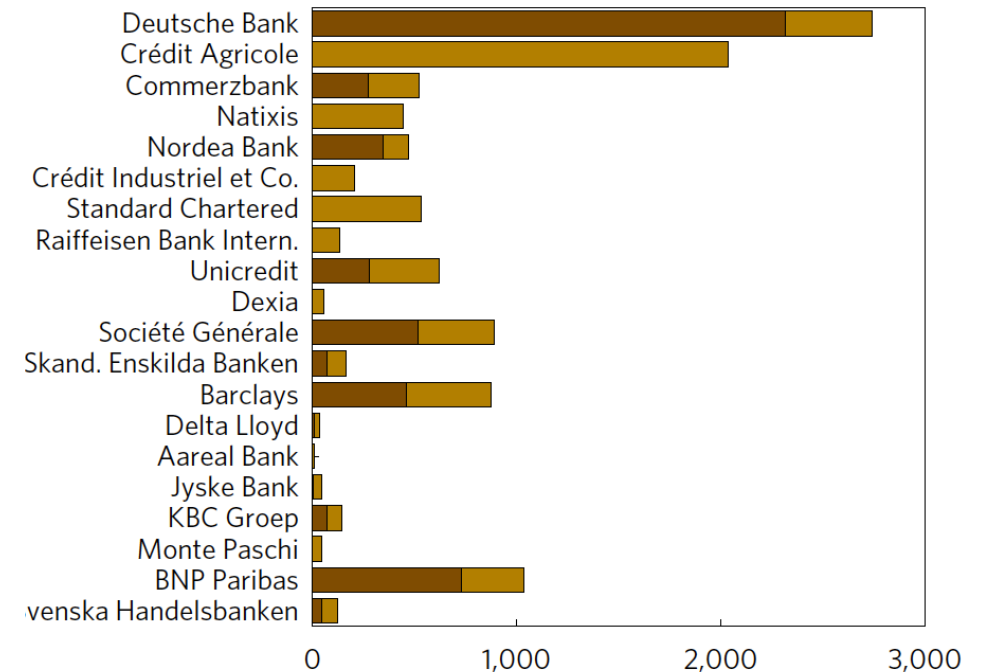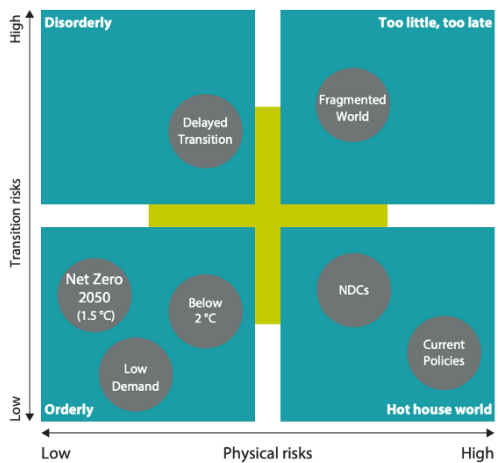

Fig. Climate Value at Risk, EU banks, current investment strategy. Dark/light: first/first+second round (Battiston ea 2017)

Climate stress-test framework

Climate scenarios

NGFS 2023

- 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

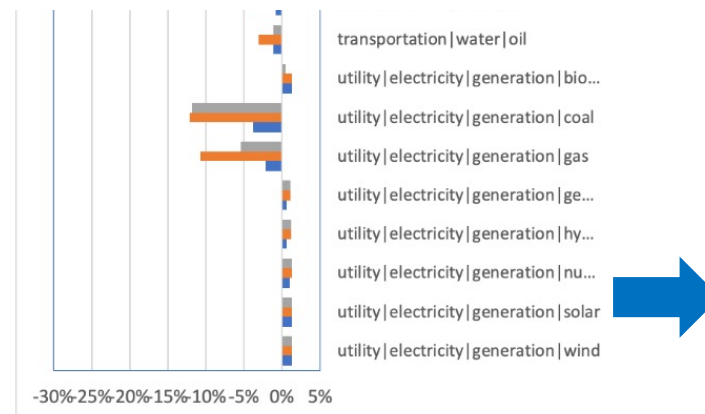## Amplifications via financial networks
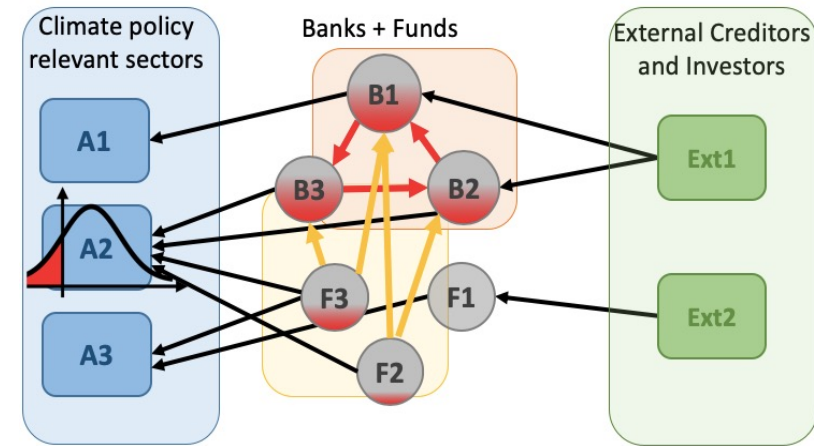
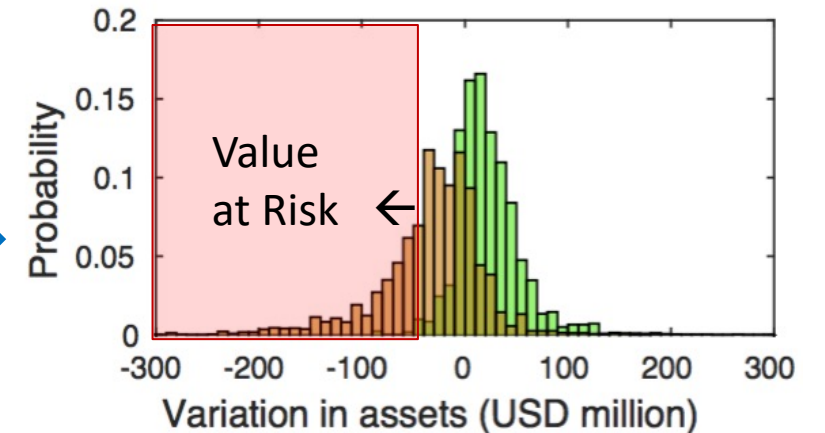Roncoroni et al. 2021

Output trajectories
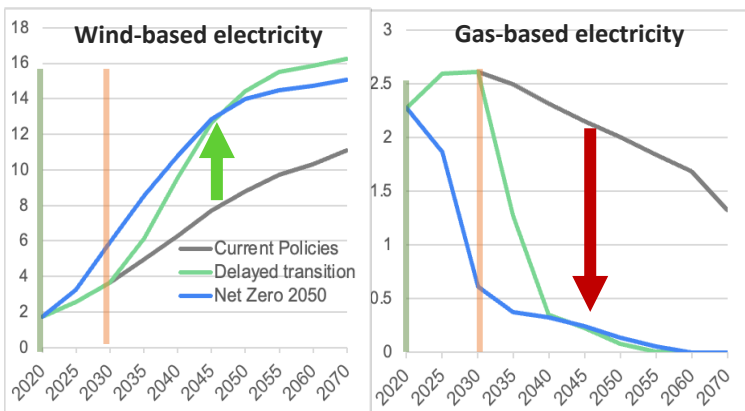
Own elaborations on NGFS database explorer

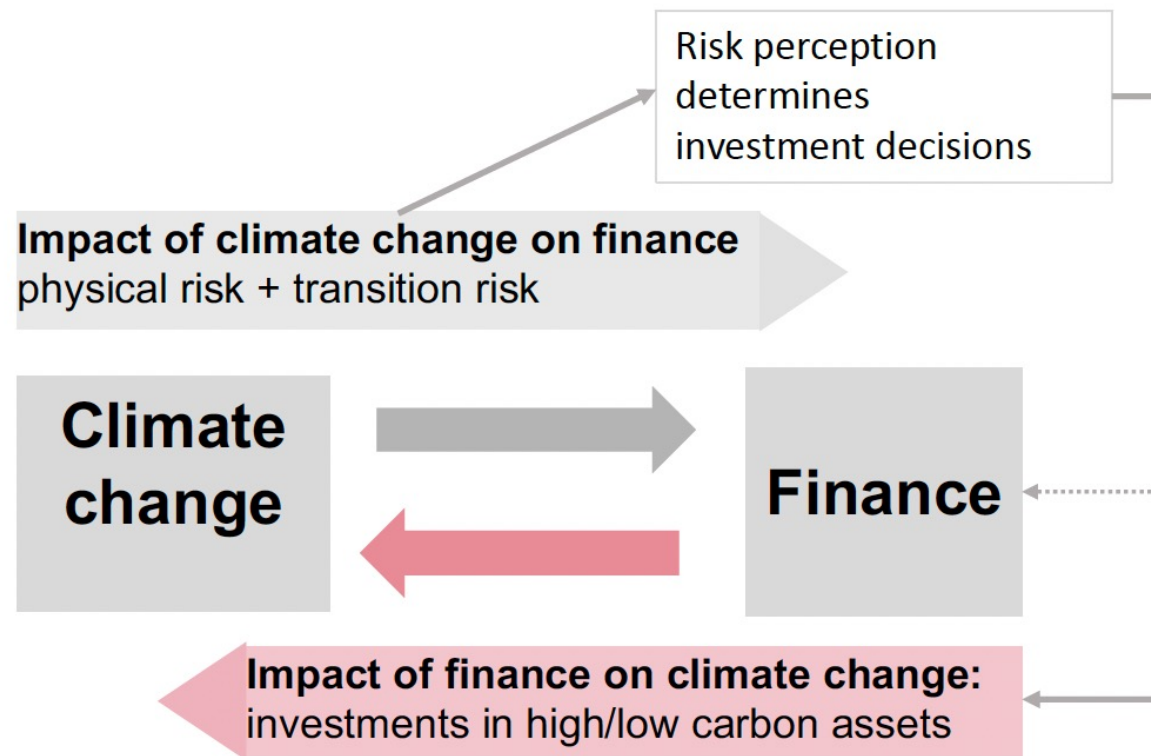## Financial valuation adjustment

Monasterolo_ ESG_climate_risk_framework_WU_2024

Adjustment of gain/losses distribution

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

Risk perception determines investment decisions

Impact of climate change on finance
physical risk + transition risk

Climate change

Finance

Impact of finance on climate change:
investments in high/low carbon assets

*Source: courtesy of S. Battiston, IPCC lead author*

- 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**

…leading to different climate trajectories and financial risk
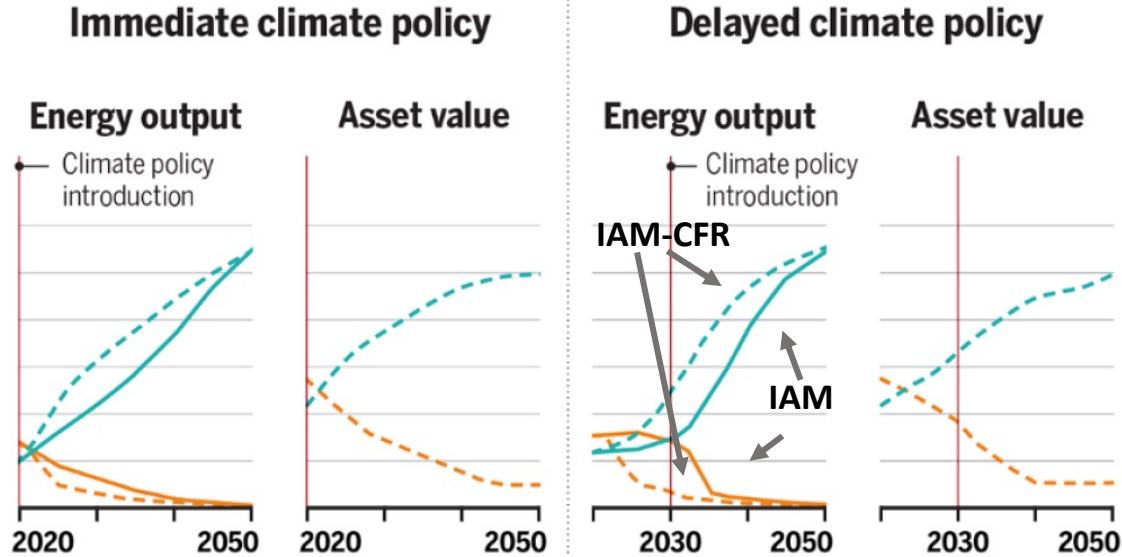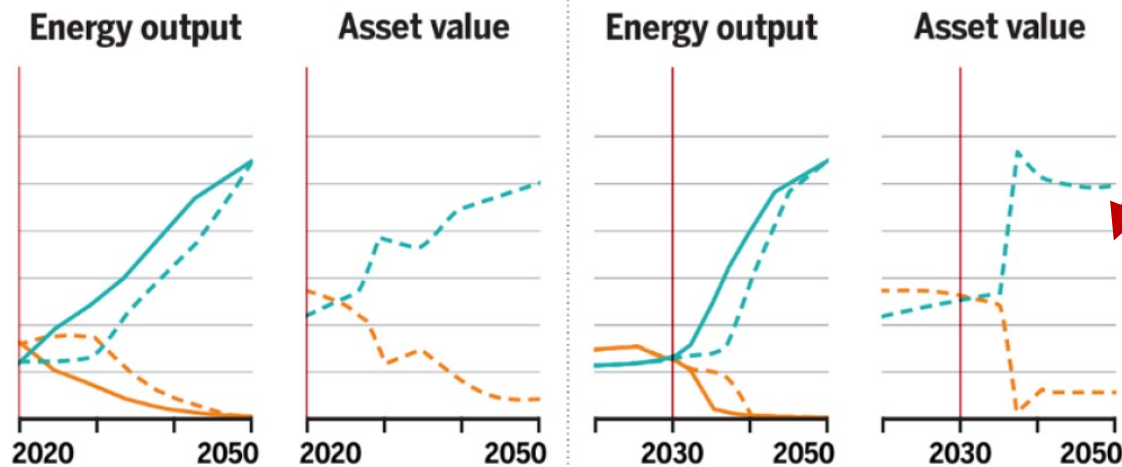
Investors' expectations about policy credibility (climate sentiments) affect the transition and climate scenarios:

- 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.

Legend:

Trajectories from IAM scenarios		Trajectories from IAM-CFR framework	
— Renewable energy	— Coal	- - Renewable energy	- - Coal

Source: Battiston ea 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)**

Lessons learned for supervisory practice

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)
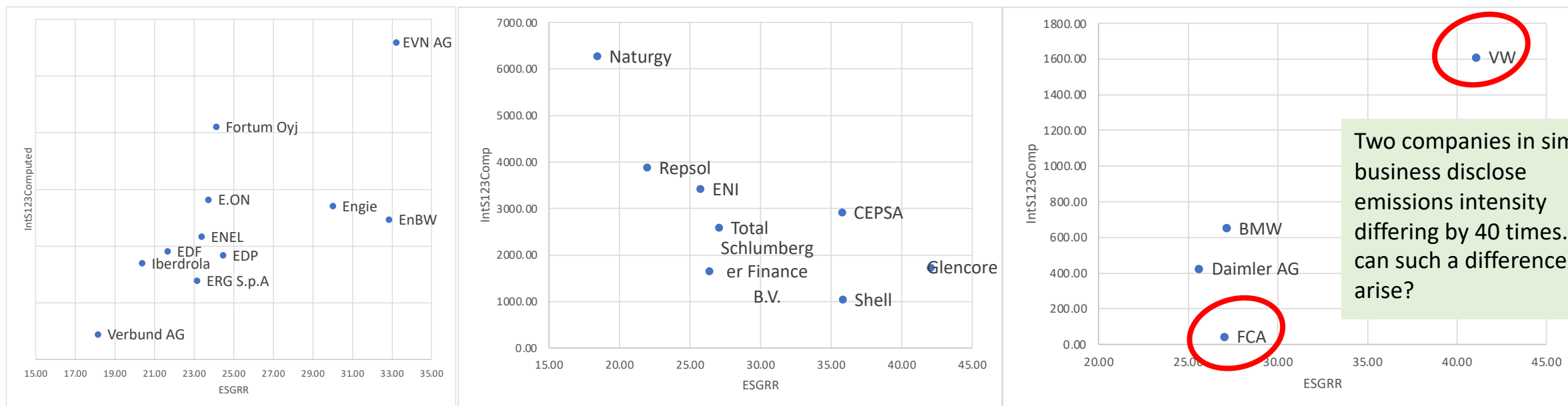
3 Climate risk assessment (econ): getting both the macro and climate risk right

- 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).**

Two companies in similar business disclose emissions intensity differing by 40 times. How can such a difference arise?

Source: Bressan et al. 2022 JPM

Example: asset level info is key for adaptation policies and investment decisions

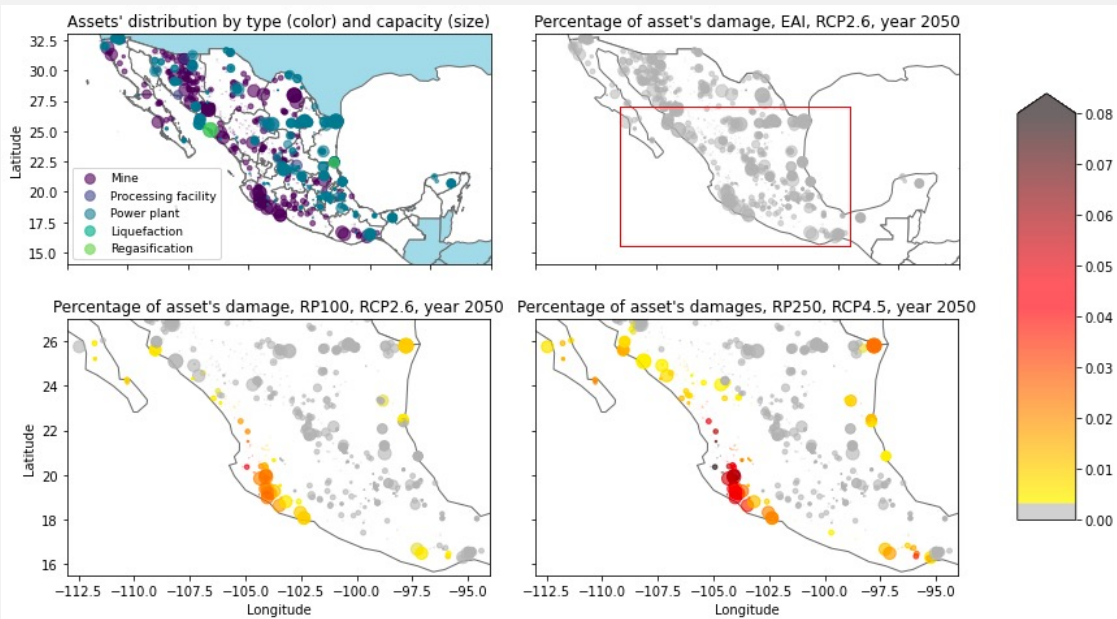Heterogeneous assets' exposure to physical risks hidden by firm level scores

Figure: Assets' distribution and direct impact of hurricanes on assets, MX (Bressan ea 2024 NC)

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

Case	Underestimation range (%) firm-level vs. asset-level
Acute RP250 (tail)	67.4-92.3
Chronic and acute RP250 (tail)	58.0-70.8

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.