

Stress-testing carbon risks: a network-based methodology.

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Acknowledgments

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- E.U research projects Dolfins and Simpol as well as WWF.

Outline

- Growing concern about the impact of carbon and climate risk on macro-economic and financial stability.

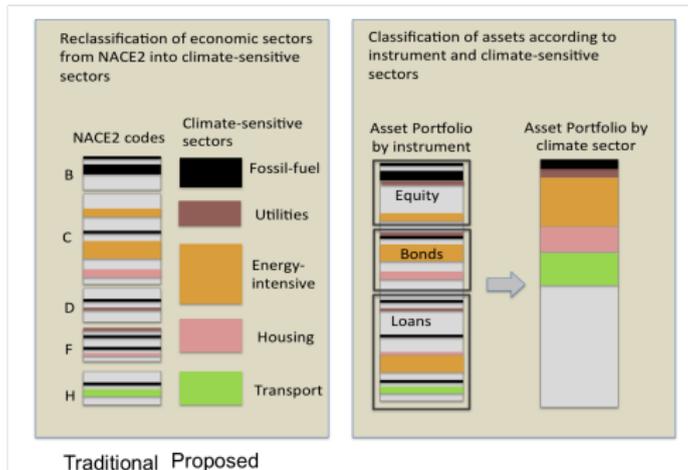
(Carney, 2015; Lagarde, 2016; McGlade 2015 ; Oxford's stranded assets initiative WRI, 2016)

- Carbon risk: risks related to the implementation of climate policy, in particular mitigation.
- Interactions between policy, expectations, real and financial sectors: uncertainty.
- Uncertainty about the range of risks: fossil-fuels, utilities, energy intensive...
- We propose a methodology to:
 - 1 Quantify the risk for individual institutions and the system as a whole.
 - 2 Disentangle intrinsic uncertainty from lack of data and/or wrong models.

Methodology

- 1 Identify sectors possibly facing carbon risk.
- 2 Identify exposures of financial institutions to carbon risky sectors (data-availability).
- 3 Define distribution of shocks on carbon risky sectors (scenarios).
- 4 Compute resulting distribution of shocks on financial institutions (first-round losses).
- 5 Compute propagation of shocks within the financial system (second-round losses).

Identifying sectors facing carbon risk



- Climate-policy relevant sectors identified based on their GHG emissions, their role in the energy supply chain, and existence of related climate policy institutions.
- Sectors: fossil fuel, utilities, energy-intensive, transport and housing.
- Remap standard classification of economic activities (NACE) into climate-policy relevant sectors.

Identifying Exposure of financial institutions

- Only equity data available (to academics)
- Bureau Van Dijk Orbis database 2015.
- Assessing exposure through equity ownership network.

Table 1 | Absolute (first row, in US\$ billions) and relative (second row, percentage of aggregate equity portfolio) exposure of each financial actor type in each sector.

	OCIs (955)	GOV (125)	Individuals (33,733)	Banks (798)	IPFs (6,392)	OFSS (3,081)	NFCs (14,851)	IFs (5,124)
Fossil-fuel (767)	31.17 6.02%	66.17 11.43%	98.17 3.77%	173.29 6.34%	230.21 7.09%	185.15 5.33%	377.30 8.06%	549.85 6.05%
Utilities (216)	19.32 3.73%	63.58 10.99%	21.16 0.81%	77.02 2.82%	55.53 1.71%	65.46 1.88%	93.09 1.99%	249.32 2.74%
Energy-intensive (3,956)	172.84 33.40%	147.53 25.49%	766.33 29.47%	708.30 25.92%	865.87 26.68%	1,019.84 29.36%	1,408.65 30.08%	2,701.69 29.71%
Housing (797)	13.26 2.56%	15.88 2.74%	100.57 3.87%	59.07 2.16%	85.28 2.21%	76.60 2.21%	146.72 3.13%	189.36 2.08%
Transport (224)	11.43 2.21%	18.48 3.19%	55.38 2.13%	47.67 1.74%	54.48 1.68%	69.96 2.01%	106.67 2.28%	173.02 1.90%
Finance (2,659)	127.01 24.54%	95.33 16.47%	419.63 16.14%	684.72 25.06%	609.11 18.77%	669.82 19.29%	702.44 15.00%	1,532.08 16.85%
Other (6,259)	142.44 27.53%	171.80 29.68%	1,139.53 43.82%	982.46 35.95%	1,345.08 41.44%	1,386.27 39.91%	1,847.40 39.46%	3,698.41 40.67%

Numbers in brackets indicate the number of firms in this group of actors or sectors. OCIs, Other Credit Institutions; GOV, Government; IPFs, Insurance and Pension Funds; OFSS, Other Financial Services; NFCs, Non-Financial Corporations; IFs, Investment Funds.

- Direct exposure to fossil fuel sector is limited.
- Exposure to the combined climate-policy relevant sectors is large (fossil-fuels+ energy intensive+ utilities+ transport +housing)

Identifying Exposure of financial institutions II

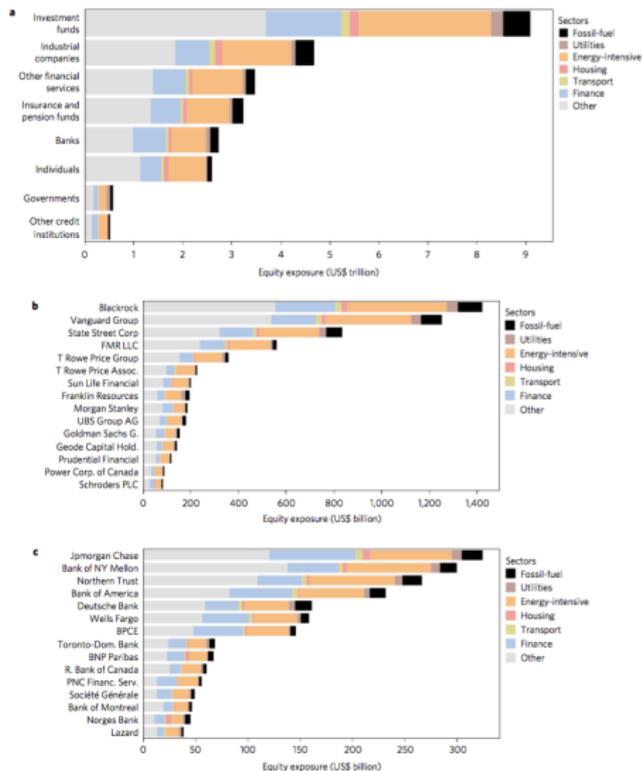


Figure 2 | Equity holdings in EU and US listed companies in 2015 (data from Bureau Van Dijk Orbis). a. Exposures to climate-policy-relevant sectors of aggregate financial actors worldwide. b. Exposures to climate-policy-relevant sectors of selected investment funds worldwide (top 15 by size of equity portfolio in the data). c. Exposures to climate-policy-relevant sectors of selected banks worldwide (top 15 by size of equity portfolio in the data).

Defining distribution of shocks

- Climate policy very likely affect negatively fossil fuel exposure.
- Climate policy impact on "climate relevant" sectors more ambiguous (green vs brown utility, \uparrow or \downarrow housing value...)
- Scenario 1: 100% shock on equity holdings in fossil-fuel+ utility (allows to compute an upper bound).
- Scenario 2 : distribution of shocks on climate relevant sectors inferred from ensemble of economic models (allows to compute value-at-risk).

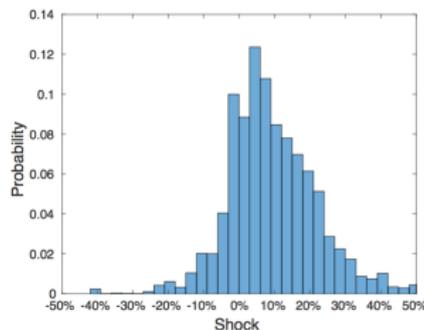
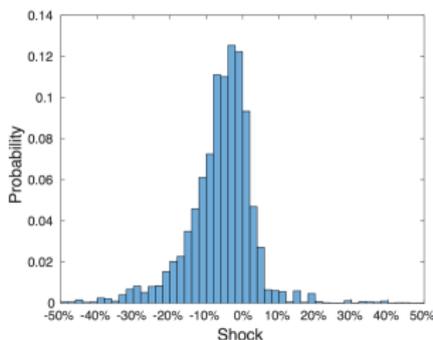


Figure: Distr. of shocks on fossil (left) and renewable (right) utilities.

Computing distribution of losses

- First round losses: direct exposure through external assets.
- Second round losses: reverberation of shocks in the financial system (value of a financial actor's liability decrease with its equity value).
- In general, second-round effects are comparable in magnitude to first-round effects.

Distribution of Losses

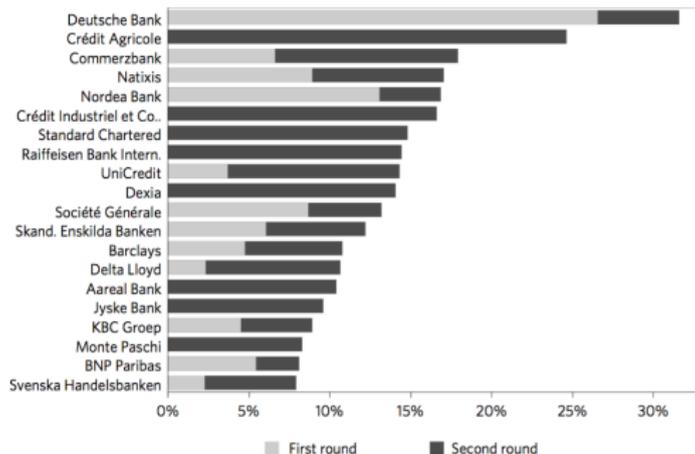
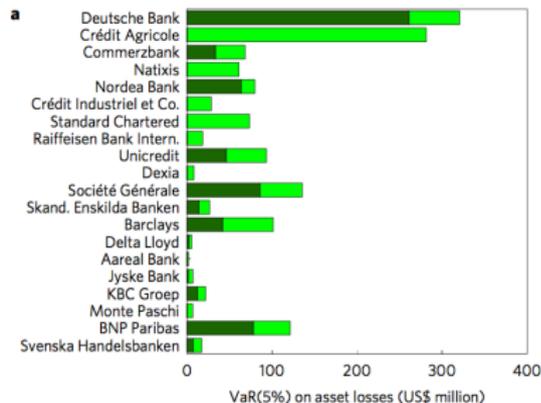
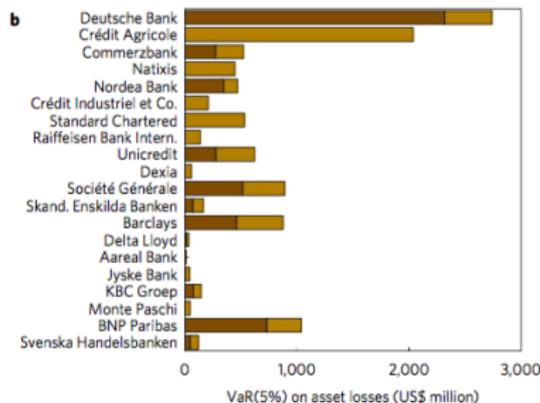


Figure 3 | First- and second-round losses in banks' equity for the 20 most-severely affected EU listed banks, under the Fossil fuel + Utilities 100% shock. Subsidiaries have not been taken into account.

Figure: First and Second round losses for 100% fossil+utilities shock

Distribution of Losses



- 95% value at risk of the 20 most affected EU banks.
- Brown/Green=exposure to fossil/renewable utilities.
- Light/Dark= 1st/2nd round losses

Conclusion and Extensions

- If shocks/losses are contained in core carbon sectors (fossil+utilities), systemic risk unlikely to materialize.
- More precise analysis can be performed if more detailed data is available.
- True uncertainty about which policy/economic scenario will unfold:
 - Green: Clear climate policy framework, little/positive exposure to climate policy, abundant capital available for the energy transition.
 - Brown: volatile policy framework, abrupt price adjustments, scarce capital available for the energy transition.
- With increased policy uncertainty, increased market uncertainty.
⇒ higher risk that shocks spillover from core carbon to other sectors.