Climate systemic risk
Central banks and the climate fragility hypothesis

December 12, 2019
Introduction
Future of economic activity and emissions…

Sources: Intergovernmental Panel on Climate Change (IPCC) Fifth Assessment Report scenario database, 1.5 °C scenarios from scientific literature (see footnote 19), IPCC historical emission database and intended nationally determined contribution quantification.
... and a diversity of impacts ...

**Extreme sea level events**

Due to projected global mean sea level (GMSL) rise, local sea levels that historically occurred once per century (historical centennial events, HCEs) are projected to become at least annual events at most locations during the 21st century. The height of a HCE varies widely, and depending on the level of exposure can already cause severe impacts. Impacts can continue to increase with rising frequency of HCEs.

(a) Schematic effect of regional sea level rise on projected extreme sea level events (not to scale)

- Historical Centennial extreme sea-level Events (HCEs) become more common due to sea level rise
- 1/century
- 1/decade
- 1/year
- 1/month
- mean sea level
- sea level rise
- recent past
- future

(b) Year when HCEs are projected to recur once per year on average

RCP8.5

RCP2.6

(c) Difference between RCP8.5 and RCP2.6

The difference map shows locations where the HCE becomes annual at least 10 years later under RCP2.6 than under RCP8.5.
... and a diversity of impacts …
Which theoretical framework for central banks, regulators and supervisors?
The standard climate-economy nexus

Price the externality
The problem(s) with IAMs

- Economy
  - GHG emissions
  - Damages
- Atmosphere
  - Radiative forcing
  - Carbon cycle
  - Atmosphere
- Biosphere and surface ocean
- Deep ocean
- Oceanic temperature

Atmospheric temperature
Oceanic temperature
GHG emissions
Radiative forcing
Damages
Carbon cycle
A strong uncertainty over optimal carbon values …

Source: Moyer et al. (2014)

Source: Stern and Stiglitz (2017)
... Coming mainly from uncertainty about discount rate ...

In 2300, +6°C and a very marginal impact on GDP!!!
... And the form of the damage function

Or forced degrowth before the end of the century?
The problem(s) with IAMs

A single tool: the unique optimal carbon price

Strong uncertainties on pricing the future and the for of the damage function

No role for central banks (except through usual inflation targeting), regulators or supervisors

Economy

GHG emissions

Damages

Atmospheric temperature

Oceanic temperature

Atmosphere

Radiative

Biosphere and surface ocean

Ocean

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Monetary policy and climate change

Climate change might induce supply and demand side shocks

- Supply-side shocks (McKibbin, 2017):
  - might affect central banks’ price stability mandate (through agricultural and energy products mainly)
  - after extreme events in the SR,
  - but also by reducing productive capacity in the LR

- Demand shocks:
  - investment or consumption behaviours are changed with uncertain impacts

- Price and output may go in different directions, letting the CB to choose between two essential objectives (Debelle, 2019)

- **BUT:**
  - Climate change is not a cyclical phenomenon (Coeuré, 2018)
The « greatest market failure the world has ever seen » (Stern, 2007)

The difficult risk management approach
A need to explicitly represent financial actors

Economy
- GHG emissions

Atmosphere
- Radiative forcing

Finance
- Biased financing decisions
- Damages
- Imperfectly anticipated damages

Atmospheric temperature

Biosphere and surface ocean
- Carbon cycle

Deep ocean

Oceanic temperature
An important precursor

Mark Carney: climate change is a « tragedy of the horizons » (Sept. 2015) for the financial system

- Monetary policy: 2-3 years
- Financial stability: 5-10 years
- Climate change: 2030, 2050, 2100

‘..once climate change becomes a defining issue for financial stability, it may already be too late’

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Physical risks
« those risks that arise from the interaction of climate-related hazards [...] with the vulnerability of exposure to human and natural systems » (Batten et al., 2016)

Source: PRA (2015), based on Munich Re NatCat SERVICE data.

<table>
<thead>
<tr>
<th>INFL</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>H_t</td>
<td>1.311**</td>
<td>1.336**</td>
<td>1.325**</td>
</tr>
<tr>
<td></td>
<td>(0.233)</td>
<td>(0.244)</td>
<td>(0.248)</td>
</tr>
<tr>
<td>H_{t-1}</td>
<td>1.058**</td>
<td>1.060**</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.264)</td>
<td>(0.267)</td>
<td></td>
</tr>
<tr>
<td>H_{t-2}</td>
<td>0.0618</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.253)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>F_t</td>
<td>0.119*</td>
<td>0.123*</td>
<td>0.122*</td>
</tr>
<tr>
<td></td>
<td>(0.0574)</td>
<td>(0.0590)</td>
<td>(0.0599)</td>
</tr>
<tr>
<td>F_{t-1}</td>
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<td>0.0295</td>
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</tr>
<tr>
<td></td>
<td>(0.0672)</td>
<td>(0.0686)</td>
<td></td>
</tr>
<tr>
<td>F_{t-2}</td>
<td>-0.0454</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.0624)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Transition risks
risk associated with a massive shift from carbon-intensive (or brown) assets to greener ones

Table 1 | The present value at risk of global financial assets from climate change between 2015 and 2100—the climate VaR.

<table>
<thead>
<tr>
<th>Emissions scenario</th>
<th>1st pctl.</th>
<th>5th</th>
<th>Mean</th>
<th>95th</th>
<th>99th</th>
</tr>
</thead>
<tbody>
<tr>
<td>BAU (expected warming of 2.5 °C in 2100)</td>
<td>0.46%</td>
<td>0.54%</td>
<td>1.77%</td>
<td>4.76%</td>
<td>16.26%</td>
</tr>
<tr>
<td>Mitigation to limit warming to 2 °C with 2/3 probability</td>
<td>0.35%</td>
<td>0.41%</td>
<td>1.18%</td>
<td>2.92%</td>
<td>9.17%</td>
</tr>
</tbody>
</table>

Source: Dietz et al (2016)

Source: Battiston et al. (2017)
Legal risks

regulations and punitive damages. But claims related indirectly to climate change against energy and/or construction companies involving professional indemnity and directors’ and officers’ – D&O – liability will emerge. In addition, many US environmental statutes contain tools to develop adequate risk management measures. Proof of causality thus remains a virtually insurmountable challenge for claimants seeking compensation for damage allegedly caused by GHG emissions.

Source: Munich Re (2010)

Source: Heede (2014)
A need to explicitly represent financial actors

The single carbon price tool cannot be achieved for eco/social reasons

Target a thin path between transition and physical risks

A natural role for central banks, regulators and supervisors

Economy

Finance

Biased financing decisions

Imperfectly anticipated damages

Atmosphere

Radiative forcing

Atmospheric temperature

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Climate change as a threat to financial stability

Channels

- **Channels (DG treasury, 2017):**
  - **Credit risk:**
    - borrower’s ability to repay their debt, leading to higher probability of default
    - Potential depreciation of assets used for collateral could increase credit risk
  - **Market risk:**
    - Fire-sale of assets due to rapid transition and/or physical exposure
  - **Liquidity risk:**
    - Difficult refinancing of banks in the SR, leading to tensions on the interbank lending market
  - **Operational risk:**
    - Direct exposure of financial institutions to physical risks
Institutional initiatives

Tools

• **FSB : Task Force on Climate related Financial Disclosure**
  • Voluntary information related to climate change (December 2016 report)

• **G20 : Green Finance Sub Group (GFSG) directed by BoE and PBoC**
  • Recommendations on greening the banking system, institutional investors, on the risk analysis and the measure of progress

• **Studies by central banks and prudential authorities:**
  • De Nederlandsche Bank, Swedish Financial Supervisory Authority, UK Prudential Regulation Authority, Banque de France, Banque du Liban, …
  • Creation of the NGFS
Institutional initiatives

Tools

- **FSB : Task Force on Climate related Financial Disclosure**
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- **G20 : Green Finance Sub Group (GFSG) directed by BoE**

  Axis 1: restore market efficiency:
  - Transparency of information
  - Support to the development of green bonds

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Institutional initiatives

Tools

If stress tests ultimately find that systemic risks are material, research and consultation would be necessary in order to assess which policies are best suited in light of the pre-existing prudential stance. The role of prudential policy is to mitigate excessive financial assets. The PRA also notes the possibility of more near-term impacts through potential changes in investor sentiment or market expectations around climate risk, and the extent to which the systemic risks that arise from climate change may, at least in part, be challenging to diversify. Insurance firms could be expected to be affected by these factors in the same way as other major investors.

Source: ESRB (2016)

Source: UK Prudential regulation authority (2015)
Institutional initiatives
Tools

If stress tests ultimately find that systemic risks are material, research and consultation would be necessary in order to assess which policies are best suited in light of the pre-existing prudential stance. The role of prudential policy is to mitigate excessive financial instability.

Source: ESRB (2016)

Axis 2: acknowledgement of the impossible diversification of climate risk and need to use:
- Climate stress-tests
- Climate related macroprudential policies

Source: UK Prudential regulation authority (2015)
• **BUT:**

  - The combination of risks and the related uncertainties probably make the risk management approach insufficient (Aglietta and Espagne, 2016)
  
  - Climate change calls for measures to hedge against fat-tail climate risks (Weitzman, 2009)

• The combination of risks may lead to a « climate Minsky moment » (Carney, 2015; Pereira da Silva, 2019).
More than a market failure

The climate fragility hypothesis
Climate fragility ➔ Financial fragility

Economic agents ➔ Finance
GHG emissions ➔ Carbon risk ➔ Radiative forcing ➔ Damages ➔ Extreme events

Atmosphere ➔ Atmospheric temperature
Carbon cycle ➔ Deep ocean

Biosphere and surface ocean ➔ Température océanique

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Climate fragility ← Financial fragility

Economic agents

- GHG emissions

Atmosphere

- Radiative forcing
- Carbon cycle

Biosphere and surface ocean

Finance

- Financial regulation
- Financing decision

Atmospheric temperature

- Température océanique

Deep ocean

Damages

- Wrongly anticipated damages

Monetary policy

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Financial cycle and technical system

An institutional mismatch between the financial structure and the (required) technical system

<table>
<thead>
<tr>
<th>Type d’innovation</th>
<th>Émergence</th>
<th>Diffusion</th>
<th>Crise d’adaptation</th>
<th>Maturité</th>
<th>Période totale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Machine à vapeur et textiles</td>
<td>1762-1774</td>
<td>1794-1834</td>
<td>1834-1843</td>
<td>1844-1861</td>
<td>1762-1861</td>
</tr>
<tr>
<td>Rail et sidérurgie</td>
<td>1831-1847</td>
<td>1847-1888</td>
<td>1888-1895</td>
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A multiplicity of (technical) equilibria can arise in the long run.

Debt dynamics and the financial system as a whole play a key role in discriminating between the possible futures.

Calls for a much more proactive role of central banks, supervisors and regulators

Policy consequences

- More than a market failure (Svartzman et al., 2019)
  - The social cost of carbon does not imply a single carbon tax tool, but could be translated into a more complex policy mix combining monetary, prudential and fiscal instruments (Krogstrup and Oman, 2019):
    - Increased role for fiscal policy, especially at the zero lower bond (« green new deal » and beyond)
    - Increased cooperation on climate issues among international financial authorities (NGFS, Coalition of finance minister for climate action, Basel committees, …) for strengthened regulations and carbon valuation tools (SCC, value of avoided emissions, …)
    - Systematic integration of climate and sustainability in corporate and national accounting.
  - The debt emitted by the central bank is the ultimate asset provider for private and economic actors.
    - CB as a collective insurer within the LCT dynamics?
Bibliography

- Cœuré, B. (2018, November). Monetary policy and climate change. In Speech by Benoît Coeuré, Member of the Executive Board of the ECB, at a conference on “Scaling up Green Finance: The role Central Banks”, Berlin (Vol. 8).
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