
Central Banks and Green Finance

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Outline

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3. Central Bank Responses to Climate Risks
4. Greening of Monetary Policy
5. Greening of Prudential Policies
6. Empirical Model
7. Results
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1. Introduction (1)

- ✓ Climate change described both as a “Super-Wicked” problem and a “Green Swan” risk
- ✓ Climate change as a Super-Wicked problem characterized by 4 features (Levin et al., 2012):
 - Time is running out
 - Those who cause the problem also seek to provide a solution
 - Central authority needed to address it is weak or non-existent
 - Policy responses discount the future irrationally
- ✓ Climate change as a “Green Swan” event (Bolton et al., 2020):
 - Extended from the concept of “Black Swan”
 - Systemic risk event with wide-ranging extreme impacts which are difficult to pre-empt
 - There is unanimity on their eventual occurrence though the timing is unknown
 - Will have catastrophic and irreversible consequences
- ✓ Action needed on multiple fronts to adapt to and mitigate its impact including by central banks

1. Introduction (2)

“Climate change is the Tragedy of the Horizon...the catastrophic impacts of climate change will be felt beyond the traditional horizons of most actors – imposing a cost on future generations that the current generation has no direct incentive to fix.”

- Mark Carney, former Governor of the Bank of England, September 2015



“The tragedy of an alleged long horizon is increasingly turning into a tragedy of having too little time to act.”

- Isabel Schnabel, Member of the Executive Board of the ECB, March 2021

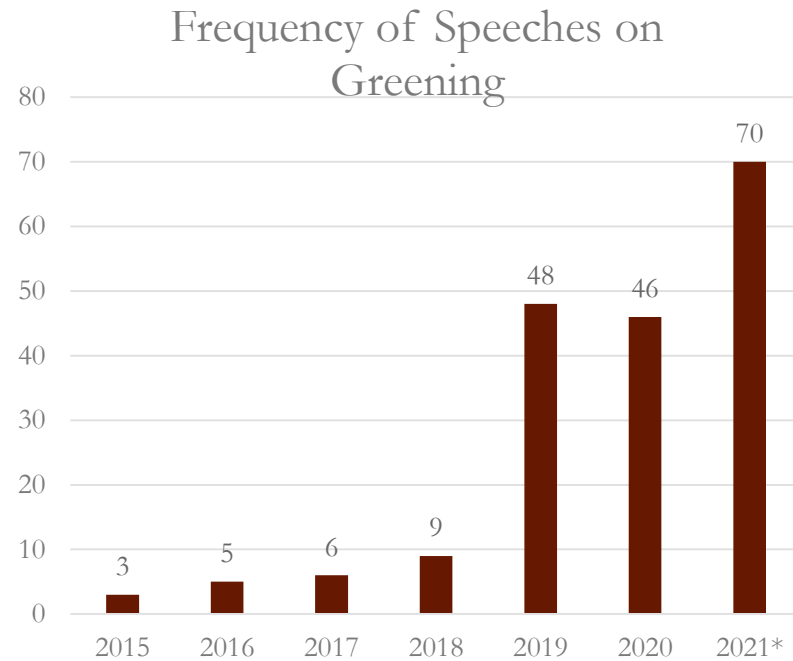
“Central banks are not responsible for climate policy and the most important tools that are needed lie outside of our mandate. But the fact that we are not in the driving seat does not mean that we can simply ignore climate change, or that we do not play a role in combating it.”

- Christine Lagarde, President of the European Central Bank, January 2021



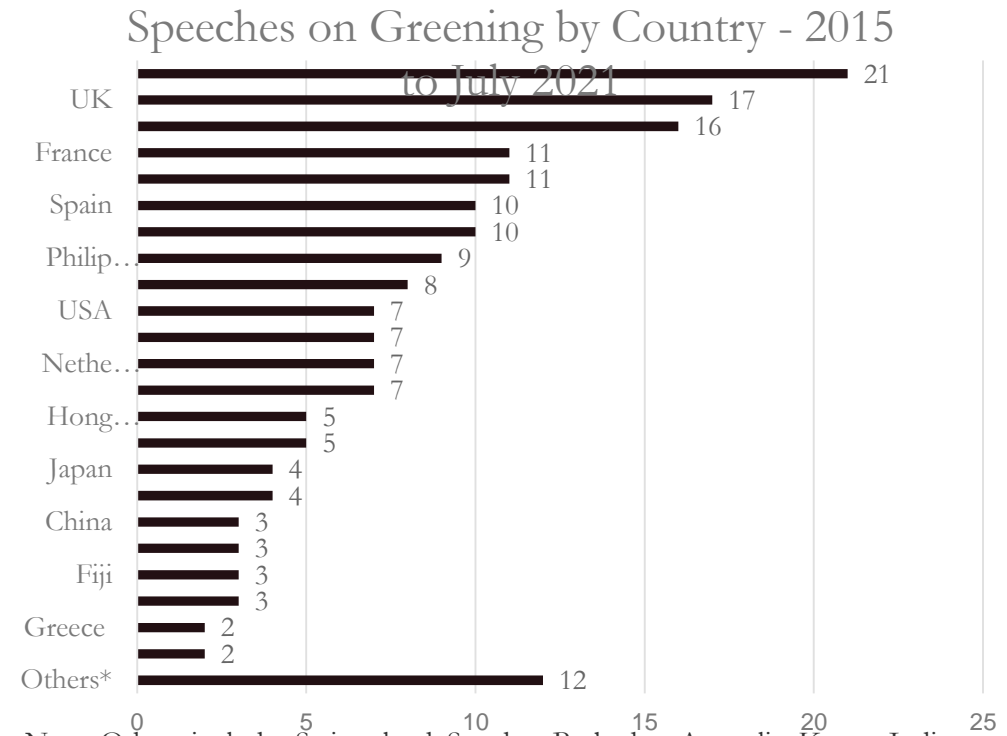
1. Introduction (3)

Frequency of Central Bankers' Speeches on Green Finance



Note: Based on all central bankers' speeches on 'green finance' available on the BIS website between 2015 and July 2021.

Source: Authors



Note: Others includes Switzerland, Sweden, Barbados, Australia, Kenya, India, Canada, Thailand, Lithuania, Serbia, Russia and Portugal with one speech each

1. Introduction (4)

International Collaborations

- ✓ Network for Greening the Financial System (NGFS) – various workstreams on climatic risks and their financial impacts. 92 members and 14 observers covering 5 continents
- ✓ Task Force on Climate-related Financial Disclosures (TCFD) – Established by FSB but Industry-led initiative to develop consistent climate-related financial risk disclosures hosted by BIS
- ✓ Task Force on Climate-related Financial Risks (TCFR) – Established by the Basel Committee to undertake research on climate related financial risks and develop methodologies for their inclusion in existing regulatory and supervisory framework.
- ✓ IOSCO Sustainable Finance Task Force – Co-led by Singapore’s MAS and the US’ SEC to develop a prototype sustainability reporting template for corporate firms
- ✓ International Platform on Sustainable Finance - Comprised of central banks and ministries of 17 member countries. Launched in 2019. Seeks to enhance international coordination to mobilise private capital towards environmentally sustainable investments.
- ✓ Sustainable Banking Network – Created by China and the IFC in 2011 to engage in capacity-building with financial supervisors and central banks on sustainable practices
- ✓ ASEAN Task Force on the Roles of Central Banks in addressing Climate and Environment-related Risks
- ✓ Bankers and Supervisors Climate Training Alliance - Announced in June 2021 with the active role of the BIS and the NGFS, for training and developing skills on climate-related scenario modelling
- ✓ G-20 Sustainable Finance Study Group – Established in 2016 (and worked till 2018) within the G-20 Finance Track. Work restarted in 2021 under Italian leadership of G-20 and elevated to a “working group”

2. Climate Risks and Financial Stability

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Hot take

Could climate change trigger a financial crisis?

The clearer governments are about emissions reduction, the less likely financial turbulence becomes

A photograph showing a flooded street in a residential area. A person is wading through the water, which reflects the surrounding buildings and sky. The water is murky and reaches up to the windows of the houses on either side. The image is credited to Getty Images.

“As guardians of financial stability and as banking supervisors, we central banks see climate change as a source of financial risk. We need to get to grips with the effects of climate change on the stability of individual institutions and on the stability of the financial system overall.”

- Sabine Mauderer, Member of the Executive Board of the Deutsche Bundesbank, October 2019

2.1 Types of Climate Risks to Financial Stability (1)

- ✓ Climate change broadly impacts financial stability through two channels:

1) Physical Risks

- Economic costs and financial losses due to damage to property and infrastructure caused by climate-related extreme weather events
- UN's IPCC Climate Change report highlights evidence of changing weather patterns, more frequent flooding, storms, eroding coastlines, droughts and wildfires due to CO₂ and other GHG emissions in the coming decades
- So far manageable but climate catastrophes appear to be arriving with greater frequency and ferocity – non-linearities

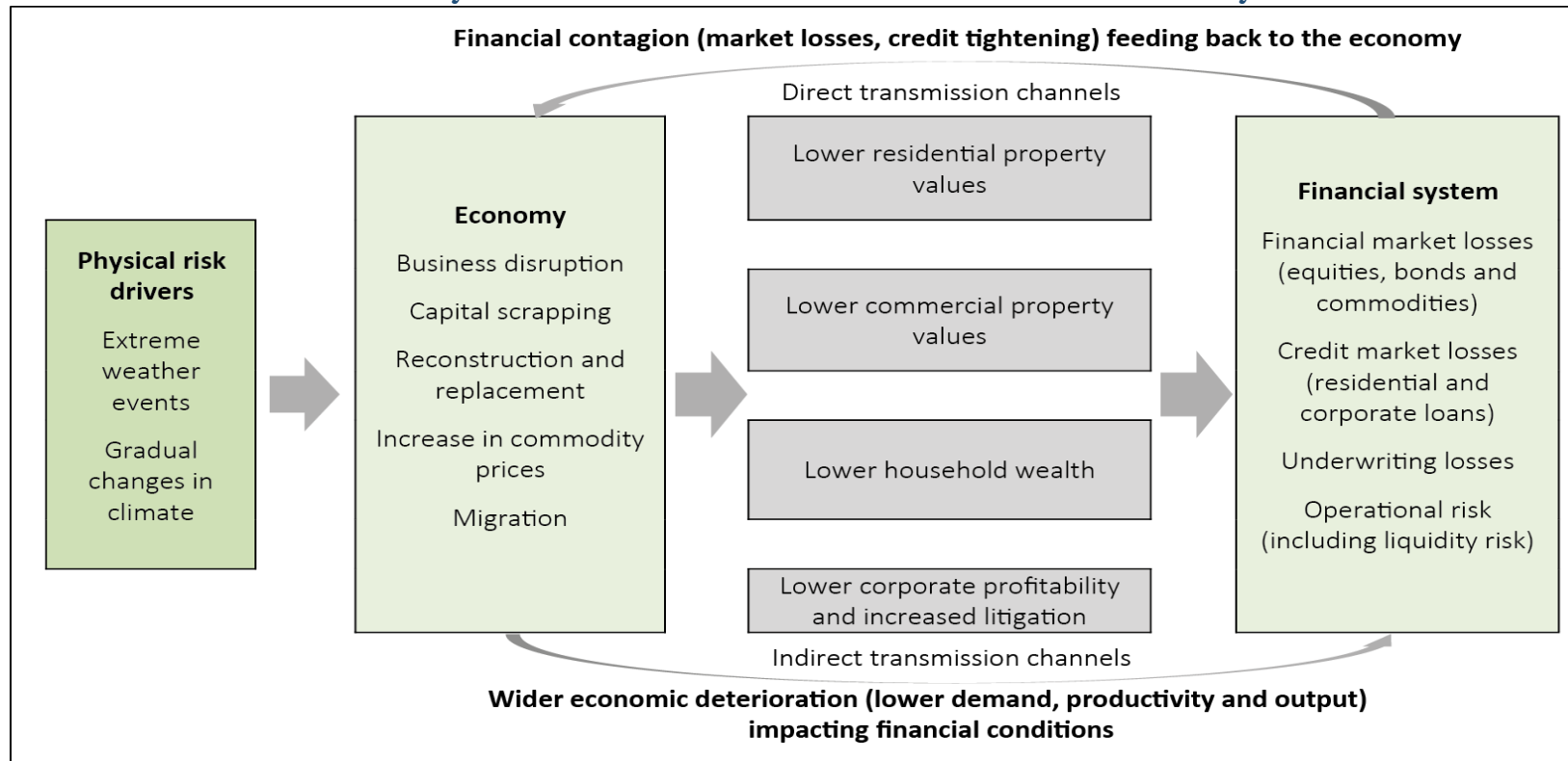
2.1 Types of Climate Risks to Financial Stability (2)

2) Transition Risks

- So-called Stranded assets – asset valuations that end up being much less than initially expected due to changes associated with decarbonisation of societies towards cleaner energy sources
- Arises for various reasons including the evolution of climate policies, new technologies, and changes in consumer preferences/market sentiments or litigation
 - “BP and Shell Write-Off Billions in Assets, Citing Covid-19 and Climate Change” (Inside Climate News, July 2, 2020 – Unextractable carbon?)
 - “Value of world’s largest coal mine slashed by \$1.4bn” (FT, August 2020)
 - Royal Dutch Shell ordered by a court in the Hague to cut carbon emissions by 45 percent compared with 2019 levels by the end of 2030
 - “The world’s oil tankers risk losing almost a third of their value should a shift away from fossil fuels gain momentum in the coming decades” (FT, July 17, 2019)
 - Gradual depreciation or sudden tipping point and repricing of risks – “Climate Minsky moment”
 - *Carbon capture and storage, transition to renewables (energy vs oil companies), greenwashing*

2.2 Transmission Channels of Climate Risks to Financial Stability

From Physical and Transitions Risks to Financial Stability Risk

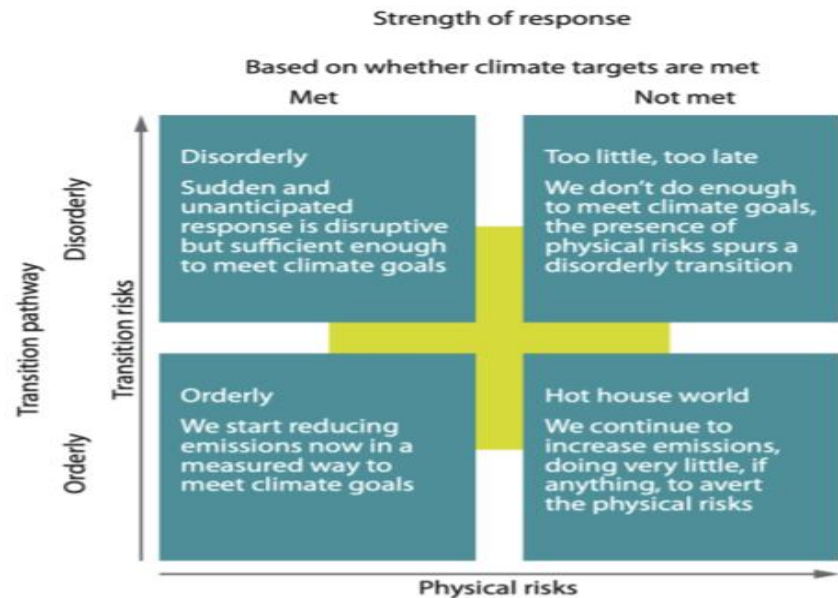


Source: NGFS (2021)

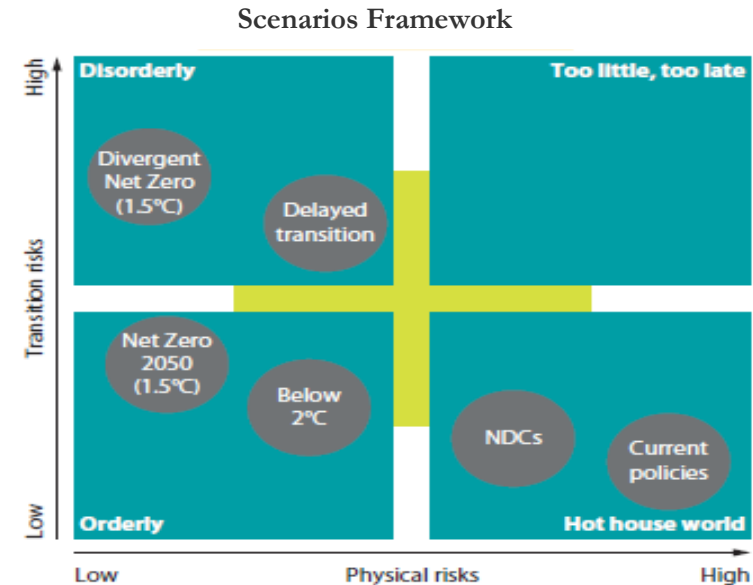
2.3 Interconnections between Transition Risks and Physical Risks

- ✓ Based on the degree and type of response by policymakers and central banks to mitigate climate change-related financial risks, four different outcomes are possible

Scenarios of Interconnected Physical and Transition Risks



Source: NGFS (2021)

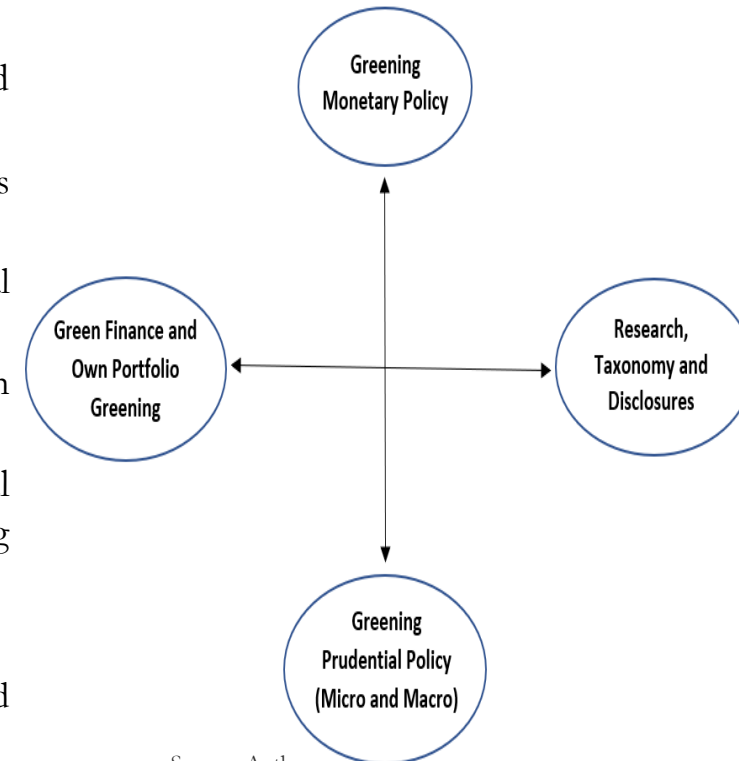


3. Central Banks' Responses To Climate Change (1)

✓ Central banks are positioning themselves to deal with climate change in at least four broad ways:

- i. Mainstreaming Green Finance: Research, Taxonomy and Disclosures
 - Bridging data, definitions and taxonomies (what is Green?; how to measure Green-ness?)
 - Developing consistent climate-related financial disclosures
 - Knowledge sharing on climate change impacts on macroeconomic and financial stability
- ii. Greening own portfolios, reducing own environmental footprints and financing decarbonisation by facilitating Green Finance (green bonds, green loans, etc)
- iii. Greening Monetary Policy
- iv. Greening Prudential Policies (Integrating climate-related risks into financial stability monitoring and supervision)

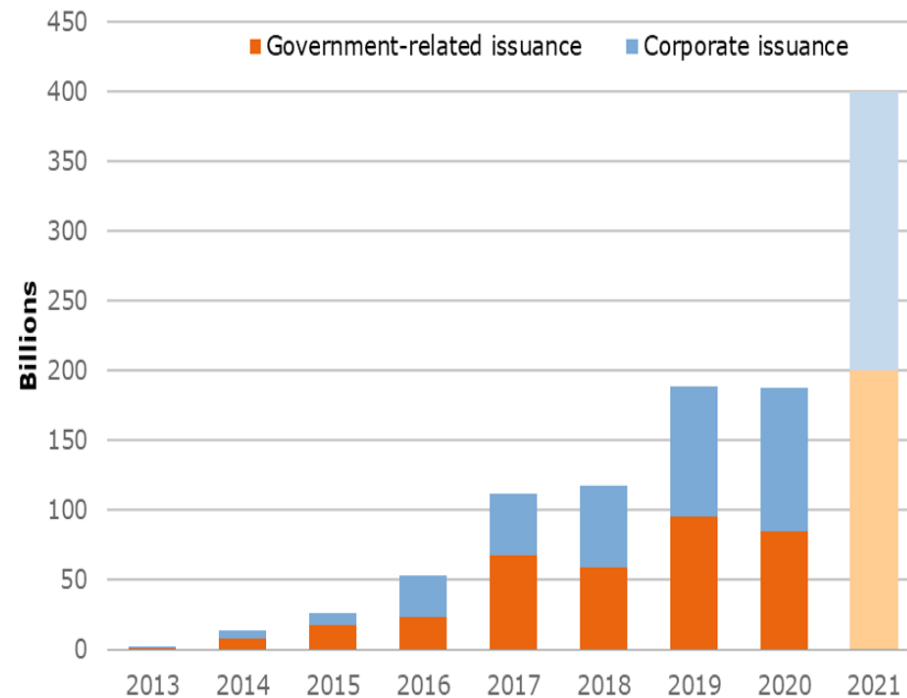
Central banks' Roles in Climate Change



Source: Authors

3. Side-Note (1): Flow of Funds into ESG Investments

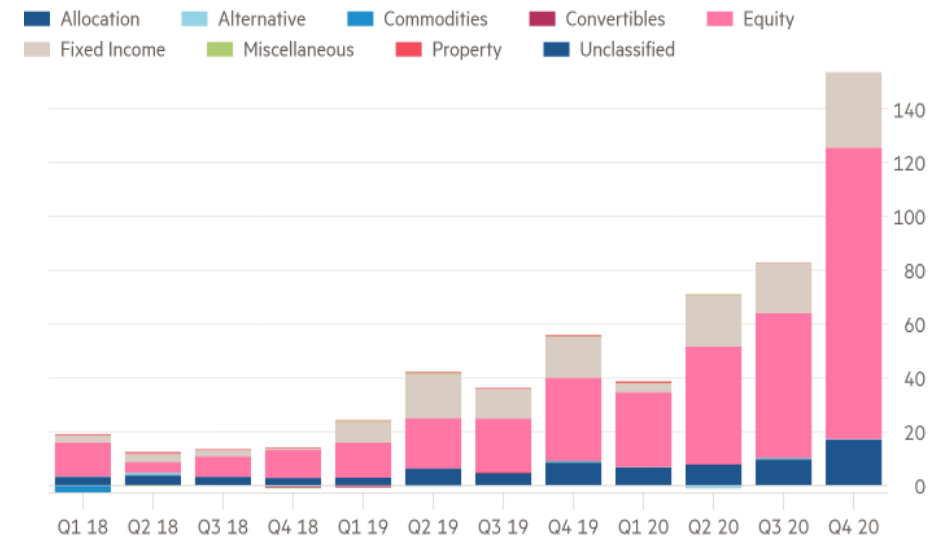
✓ Green Bubble? Green washing?



Source: NNIP

Sustainable equity funds soar in 2020

Flows by category (bn)



Source: Morningstar Direct

© FT

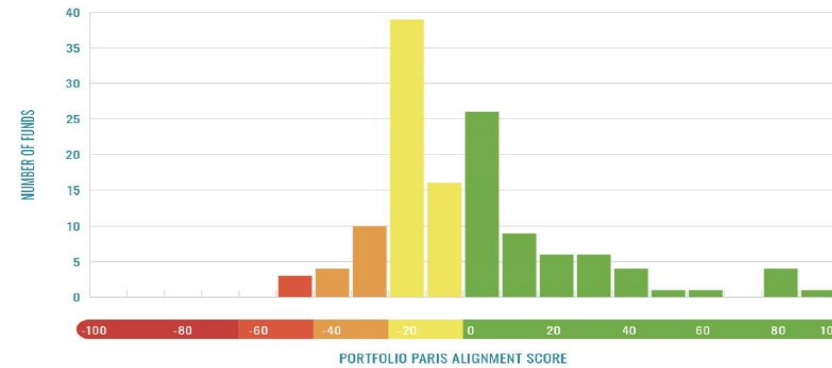
3. Side-Note (2): Bubbles and Greenwashing

- ✓ Concerns about lack of consistent data and Greenwashing

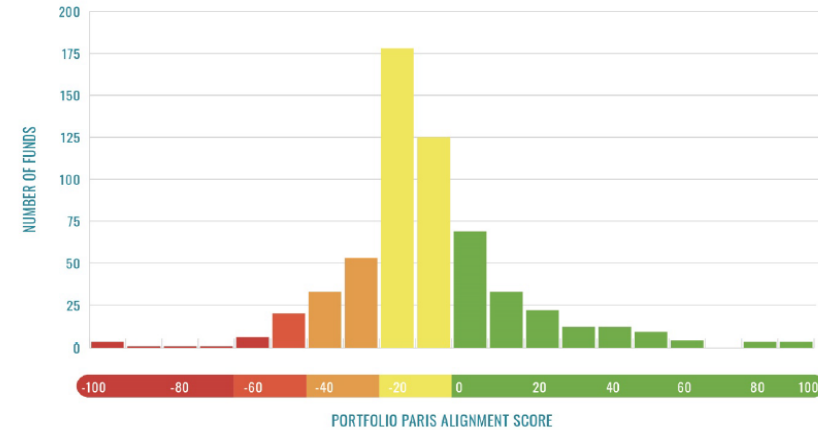
Fund Type	Fund Subtype	Search Terms in Fund Name
Broad ESG	-	"ESG", "sustainability", "sustainable", "SRI", "global impact"
Climate-Themed	Broad Climate	"climate", "environment", "environmental"
	Transition	"carbon transition", "energy transition", "climate transition", "environmental transition", "environment transition", "sustainable transition"
	Paris Aligned	"Paris aligned"
	Carbon Restricted	"low carbon", "carbon neutral", "carbon aware", "carbon constrained", "carbon efficient"
	Fossil Fuel Restricted	"fossil fuel free", "fossil fuel reserves free", "fossil free", "fossil fuel screened"
	Clean Energy	"clean power", "clean energy", "green power", "green energy"

Source: InfluenceMap (2021)

Distribution of Portfolio Paris Alignment Scores for 130 climate-themed funds



Distribution of Portfolio Paris Alignment Scores for 593 broad ESG funds



3. Central Banks' Responses To Climate Change: Singapore (2)

Research, Taxonomy and Disclosures	Green Finance and Own Portfolio Greening (and Reducing Own Carbon Footprint)	Greening Prudential Policy
Work with international organisations – NGFS (on disclosures and environmental risk analysis); International Platform on Sustainable Finance (on taxonomy); IOSCO Sustainable Finance Task Force (on improving securities issuers' sustainability-related disclosures); Basel Committee Task Force on Climate-Related Financial Risks (on research/quantifying the impact of financial risks); Work with ASEAN to develop ASEAN Sustainability Bond Standards	Grant scheme initiated in 2017 to promote issuance of green, social, and sustainability-linked bonds aligned with international standards; followed up with a similar scheme for green and sustainability-linked loans in 2020	MAS issued guidelines on environmental risk management to all financial institutions
Establishing centers to catalyse research, outreach and education – Singapore Green Finance Centre, Sustainable Finance Institute Asia, Sustainable and Green Finance Institute (to be established by NUS)	MAS-Singapore government to issue green bonds to finance green public infrastructure	Leading the workstream on micro-prudential supervision under the NGFS, which provides guidance for supervisors in incorporating environmental risk management
Green Finance Industry Taskforce set up by MAS to work on green taxonomy	Project Greenprint - aims to harness technology and data to support the green finance ecosystem	Conducted climate –related stress testing for the insurance sector in 2018. Plans to expand to financial industry-wide stress tests by end-2022 (using NGFS scenarios)
MAS and SGX to set out standards for mandatory climate-related financial disclosures by financial institutions and listed entities	MAS has earmarked S\$50 million to support Green FinTech innovations	
	MAS developing a climate risk overlay programme for its equity portfolio – recalibration towards green sectors and those carbon-intensive companies which are likely to have minimized transition risks	
	MAS allocating US\$1.8 billion of its reserves to climate-related investment opportunities – Green Investment Programme and committing to continual assessment of the exposure of its foreign reserves to climate risks	

3. Central Banks' Responses To Climate Change: Singapore (3)

- ✓ Green Prudential policies are evolving:
 - Making climate-related disclosures mandatory
 - Banks needing to conduct scenario analysis or stress testing to see how segments of the bank's assets hold up under different climate scenarios

- ✓ What is missing is greening of monetary policy

4. Greening of Monetary Policy: Reactive (1)

Some Open Questions on adaptation to climate change:

- ✓ What are the macroeconomic impacts of more frequent and sharper weather and climate events on inflation and output gaps?
- ✓ How might climate factors be incorporated into standard macroeconomic and forecasting models?
- ✓ How does transition to a low-carbon economy various sectors and overall macroeconomy?
- ✓ What are the longer-term effects of climate change and global warming on productivity and potential output and inflation expectations?
- ✓ How does climate change affect the transmission channels of monetary policy?
 - E.g. Losses from stranded assets could impair bank balance sheets with rising NPLs limiting domestic credit growth

4. Greening of Monetary Policy: Proactive (2)

- ✓ Proactive monetary policy responses to mitigate the effects of climate-related financial risks:
 - “Green collateral framework” i.e. use different haircuts for corporate bonds used as collateral depending on Green-ness/ESG score or encouraging banks to pledge more climate-aligned assets via moral suasion
 - Targeted credit operations or differentiated interest rate for lending conditional on borrowers’ Greenness, commitment to decarbonising, etc
 - Green asset purchase programmes (i.e. Green QE)
- ✓ Concerns:
 - Violation of market neutrality principle – Privileging green corporate bonds over others will interfere with the free-market asset market dynamics and compromise the principle of market neutrality
 - Has central bank funding been biased to date towards Brown industries?

4. Greening of Monetary Policy: Debate Unsettled (3)

- ✓ Debate on role of central banks use if Monetary Policy in Greening economy remains unsettled:

“Today, climate change is not something that we directly consider in setting monetary policy...We’re quite actively exploring exactly what climate implications are for our supervisory, regulatory and financial stability responsibilities...At the Fed, we see our role as an important one that is tied tightly to our existing mandate...Our mandate hasn’t changed. We haven’t been assigned a role in setting overall policy. We don’t have a secondary mandate to support the economic policies of the government.”



- Jerome Powell, Chairman of the US Federal Reserve, June 2021



“Both climate change and the transition to a carbon neutral economy pose substantial challenges for the economy and the financial system, with the potential to affect growth and inflation in the short term, but also over much longer horizons...In short, climate change has consequences for us as a central bank pursuing our primary mandate of price stability...”

- Christine Lagarde, President of the ECB, July 2021

5. Green Prudential Policies

- ✓ Broadly the aim of green prudential policies is to ensure that the financial system is able to proactively manage and pre-emptively mitigate climate change related financial risks
- ✓ **Green micro-prudential policies** – Focused on individual financial institutions to ensure that their environmental and social risk (E&S) assessment frameworks, risk disclosures, and lending and operational guidelines also incorporate the impact of physical and transition risks arising from extreme-weather events and climate change
- ✓ **Green macroprudential policies** – Focused on mitigating the systemic impacts of climate change (including extreme-weather events and the risks posed in the transition to a low-carbon economy) on the stability of the entire financial system

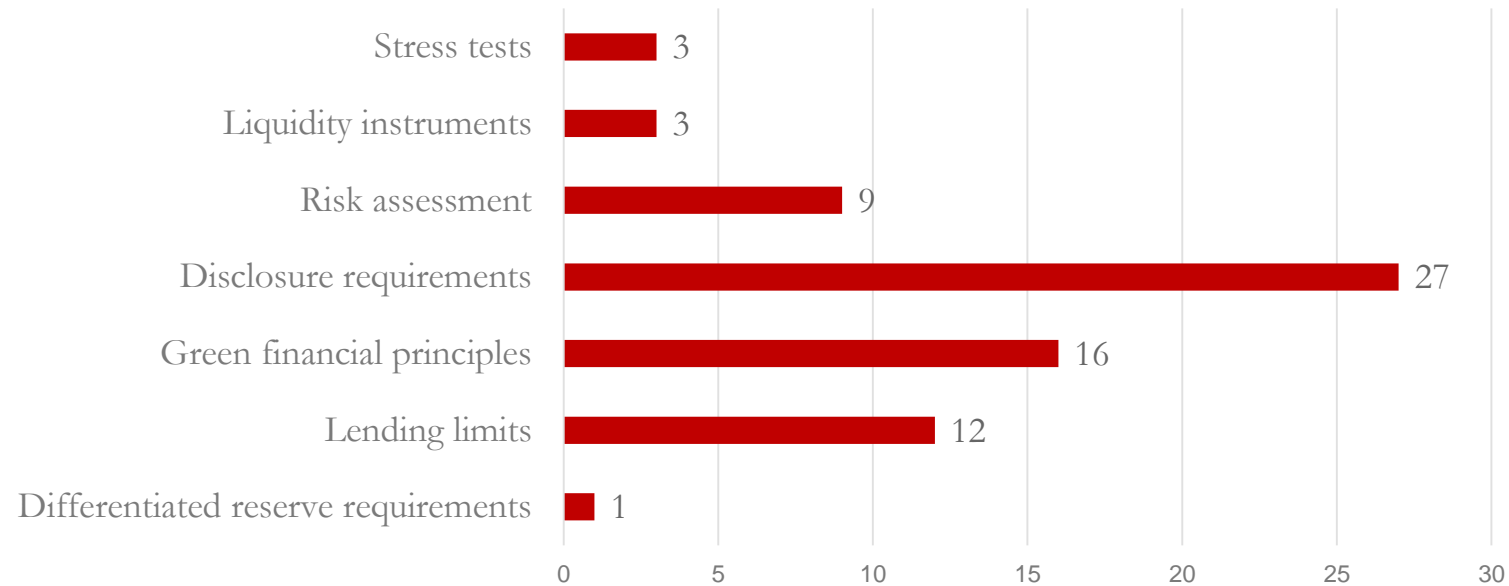
5.1 Types of Green Prudential Policies (1)

Policy Area (Examples)	Type of Instrument	Concept
Microprudential	<ol style="list-style-type: none"> 1. Disclosure requirements 2. E&S risk management 3. Reserve requirements 	<ol style="list-style-type: none"> 1. Require greater transparency and information disclosure of climate-related financial risks by banks 2. Require banks to develop environment and social risk management framework and standards and implement 3. Lower reserve requirements for bank's green portfolio to encourage green investments
Macroprudential	<ol style="list-style-type: none"> 1. Stress testing 2. Differentiated capital requirements 3. Loan-to-value and loan-to-income caps 4. Loan exposure restrictions 5. Sectoral leverage ratio 6. Liquidity restrictions 	<ol style="list-style-type: none"> 1. Assess the impact of climate risks on the financial system 2. Assign higher risk weights to carbon-intensive assets when evaluating the capital to risk assets ratio of banks 3. Limit the flow of resources to sectors or companies that exceed specified carbon-emission targets 4. Limit the credit exposure by banks to carbon-intensive borrowers 5. Limit an overleveraged position to carbon-intensive assets 6. Introduce an incentive mechanism for the Liquidity Coverage Ratio (LCR) and the Net Stable Funding Ratio (NSFR) requirements to link the climate targets and the liquidity/maturity mismatch requirements

Source: Park and Kim (2020)

5.1 Types of Green Prudential Policies

(2) Popularity of Green Prudential Regulations

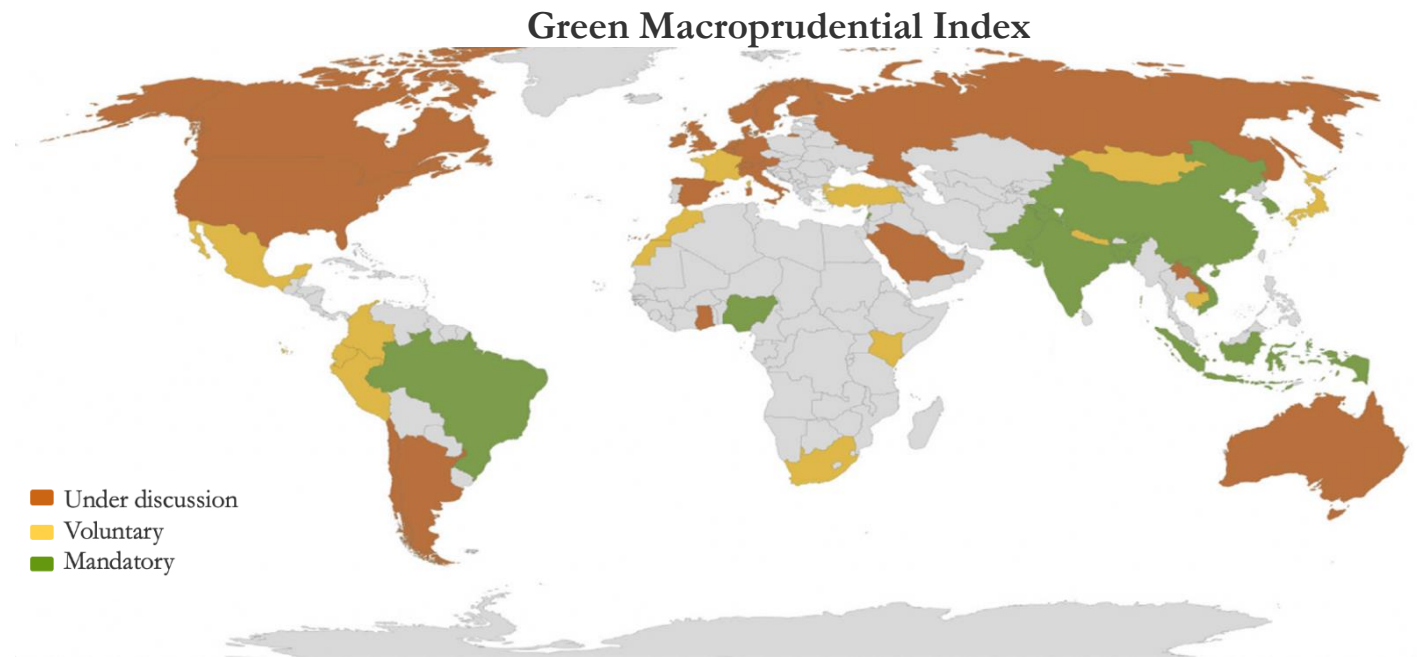


Notes: Green Financial Principles include aligning prudential and environmental objectives, incorporating sustainability principles in finance, undertaking risk analysis of climate change impact on the financial system, and so on. All instruments presented here include those at the discussion stage, or which have been implemented (voluntarily or mandatorily).

Source: Based on D'Orazio and Popoyan (2019)

5.2 Diffusion of Green Prudential Policies

- ✓ Countries have begun implementing green prudential policies either mandatorily or voluntarily, although diffusion uneven across regions
 - Highest adoption seen in developing countries in South Asia and Latin America



Source: D'Orazio and Popoyan (2019)

6. Empirical Model (1)

- ✓ Empirically examine the determinants of imposition of green macroprudential policies (GMP) in various countries
- ✓ Conjecture that the widespread recognition of climate change-related risks drives the decision for central banks to incorporate a low-carbon objective in their mandate and implement GMP.
- ✓ Start by only including the climate risk-related indicators in the baseline using a probit model.

$$GMI_i = f(CRI_i)$$

GMI_i is a dummy variable Green Macroprudential Index (GMI) indicating whether GMP is adopted in country i

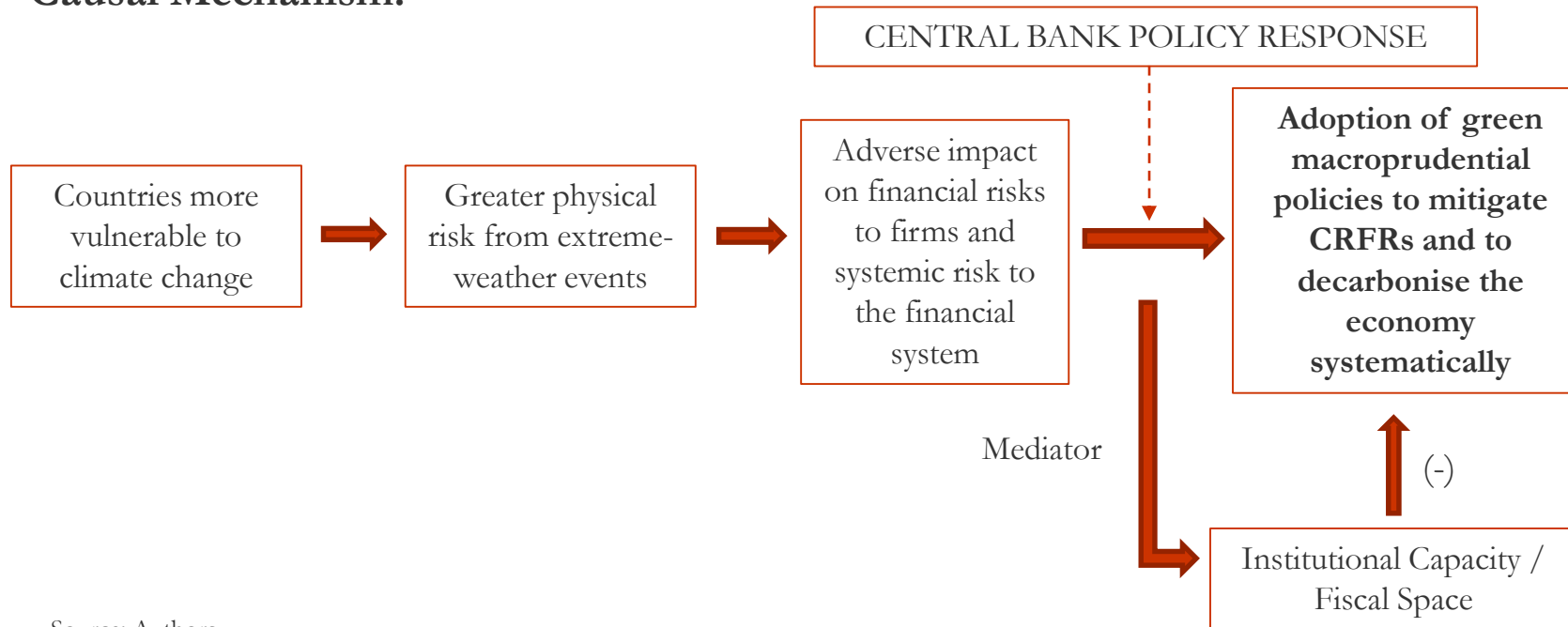
CRI_i is a proxy for climate risk

6. Empirical Model (2)

- ✓ Other determinants of GMP – a country that previously imposed macroprudential policy instruments in general is more likely to adopt green macroprudential practices
 - Also accounts for more general determinants of adoption of macroprudential policies
- ✓ Introduce a proxy for institutional capacity using the indicator “potential to respond to climate risks”
 - Hypothesis: Better institutional capacity and greater fiscal resources of an economy reduces the responsiveness of green macroprudential measures to climate risk

6. Empirical Model (3)

Causal Mechanism:



Source: Authors

6. Empirical Model (4)

- ✓ Final cross-sectional sample of 41 countries with data availability across the independent variable, the outcome variable and the two controls in 2018 used for empirical analysis
- ✓ Green Macroprudential Index – 2018
- ✓ HSBC Climate Vulnerability Index – Covers climate-related events till 2016
 - 1) the sensitivity score (impacts of extreme weather events felt by society); and
 - 2) the physical impact of weather-related events on the economy and people
- ✓ Control: Macroprudential Index (MPI) compiled by Cerutti et al. -- 2017

Economies included in the

Argentina	Lebanon
Australia	Mexico
Austria	Morocco
Bangladesh	Netherlands
Belgium	Nigeria
Brazil	Norway
Canada	Pakistan
Chile	Peru
China	Russia
Colombia	Saudi Arabia
Czech Republic	Singapore
Denmark	South Africa
Finland	South Korea
France	Spain
Germany	Sweden
India	Switzerland
Indonesia	Turkey
Ireland	United Kingdom
Italy	United States
Japan	Vietnam
Kenya	

7. Results (1)

- ✓ Sensitivity score, physical impacts as well as aggregate indicators are all significant determinants.
- ✓ Results stay robust to the inclusion of MPI as a control and the magnitude of coefficients on all measures of climate risks remain largely similar.
- ✓ The MPI index itself enters with an expected positive sign though it is not significant.

Dependent variable:	(1)	(2)	(3)	(4)	(5)	(6)
GMI Dummy						
<u>Sensrisk_rev</u>	0.327*** (0.0959)	0.327*** (0.101)				
<u>Phyrisk_rev</u>			0.417*** (0.156)	0.495*** (0.184)		
<u>Aggrisk_rev</u>					0.788*** (0.192)	0.803*** (0.200)
mpi_2017		0.00285 (0.138)		0.202 (0.128)		0.103 (0.135)
Constant	-1.838*** (0.546)	-1.849*** (0.680)	-2.076*** (0.748)	-3.425*** (1.262)	-4.080*** (0.989)	-4.652*** (1.275)
Observations	41	41	41	41	41	41

Note: Probit coefficients are reported. Robust standard errors are adopted.

*** Significantly different from 0 at the 1% significance level.

** At 5% significance level.

* At 10% significance level.

7. Results (2)

- ✓ Next, include interaction terms between the three climate risk indices and the potential to respond to climate risks
- ✓ Sensitivity score, physical impacts as well as aggregate indicators remain robust determinants
- ✓ Interaction terms between climate risk-related indicators and overall institutional capacity are all statistically significant and negative
 - Greater institutional capacity/fiscal capacity reduces likelihood of GMP implementation given a climate sensitivity score or a physical impact score

Dependent variable: GMI Dummy	(1)	(2)	(3)
<u>Sensirisk_rev</u>	0.746** (0.337)		
Sensitivity score*Overall Capacity	-0.117** (0.0538)		
<u>Phyrisk_rev</u>		1.318** (0.562)	
Physical impacts*Overall Capacity		-0.176** (0.0858)	
<u>Aggrisk_rev</u>			2.587*** (0.804)
Aggregate*Overall Capacity			-0.355*** (0.110)
Overall Capacity	-0.0110 (0.311)	0.219 (0.397)	1.200** (0.552)
mpi_2017	0.0816 (0.141)	0.227 (0.165)	0.167 (0.194)
Constant	-1.531 (1.987)	-4.441 (3.192)	-11.17** (4.491)
Observations	41	41	41

Note: Probit coefficients are reported. Robust standard errors are adopted.

*** Significantly different from 0 at the 1% significance level.

** At 5% significance level.

* At 10% significance level.

9. Conclusion (1)

- ✓ *“Climate-related risks may be highly non-linear, and their effects on the financial system subject to substantial uncertainty and tail-risk. But it is foreseeable that some combination of physical and transition effects will occur.” (p.1)*



FSB Roadmap for Addressing Climate-Related Financial Risks



7 July 2021

Conclusion (2)

- ✓ Given lack of harmonized set of disclosures by private entities and absence of sector-specific carbon/climate policies, firms are not incorporating climatic risks into their balance sheets and projections and risks are consequently underpriced
- ✓ Some suggest central bank intervention should be limited to market-correcting strategies including taxonomies, requiring better climate related disclosures so as to reduce information asymmetries
- ✓ Even with more complete disclosures risks are especially hard to model and therefore difficult to price in, i.e. 'efficient' price discovery may not be possible hence requiring more active central bank intervention
- ✓ Prudential policy tools have emerged as an important response to mitigate the financial risks arising from climate change and extreme weather-related events and enhance the financial sector's role in allocating capital in support of a low-carbon transition

9. Conclusion (3)

- ✓ Greater vulnerability to climatic risks is a significant predictor of the adoption of green prudential policies by countries conditioned on institutional capacity:
 - A country with institutional capacity to manage climate-related risks in other ways may, other things equal, choose not to implement or delay implementing green macroprudential measures
 - Could explain why developing economies have emerged as frontrunners in implementing green prudential policies
 - It is also likely that for many advanced economies focus is more on developing a stable, clear and standardised taxonomy
- ✓ Caveats: Sample size. (extend data on green prudential policies cross-country and over time); Alternative measures of Climate risks (Germanwatch CRI; ND-Gain Country Index; SwissRe Climate index etc)

Thank You!