Feeling the Heat: Climate Risks and the Cost of Sovereign Borrowing

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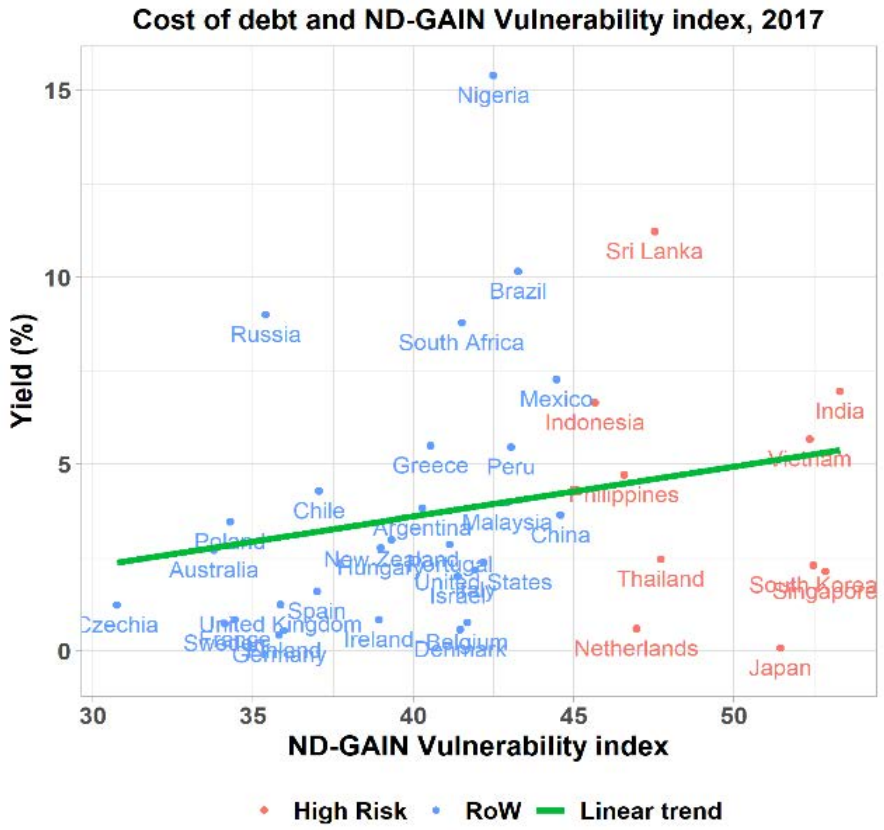
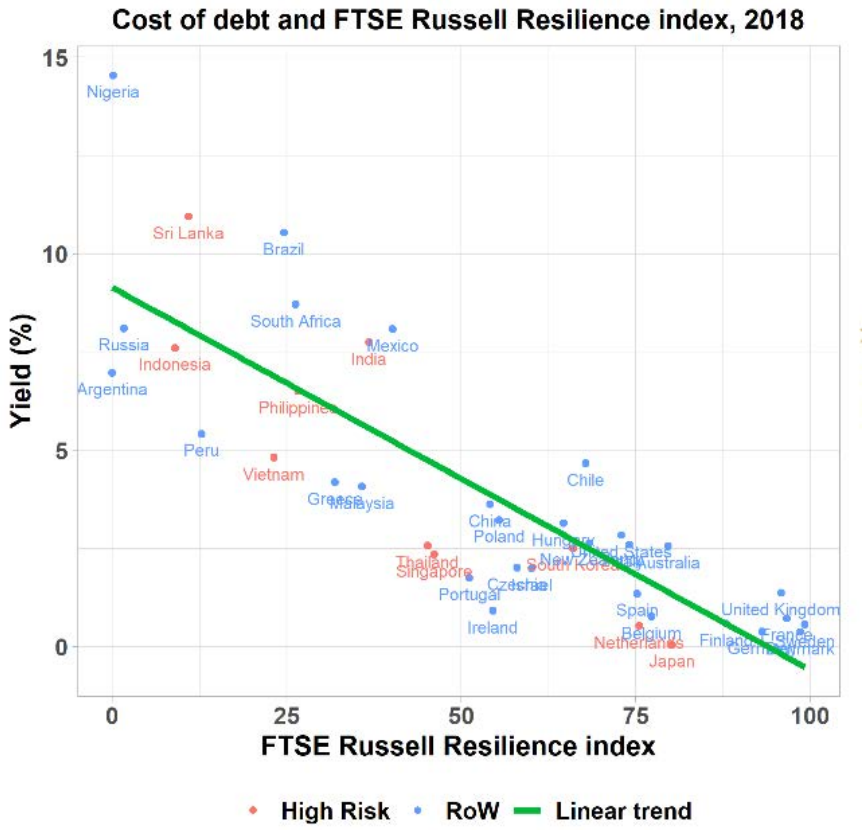
Background

- **Climate risks** can have material impact on **the sustainability of public finances**.
  - In climate-vulnerable countries, **fiscal health is under threat** by potential output losses related to climate hazards and disaster recovery costs, as well as transition risks that may hit specific sectors or the economy at large.
- While a growing body of research has studied the macroeconomic impacts of climate change, **relatively little research** has been conducted on the nexus between climate risk and sovereign risk.
- This paper empirically examines the link between the cost of sovereign borrowing and climate risk for 40 advanced and emerging economies.
  - **panel analysis** + impulse response functions generated from a **panel structural vector autoregression**
  - ADBI Working Paper 1160: “Feeling the Heat: Climate Risks and the Cost of Sovereign Borrowing” by J. Beirne, N. Renzhi and U. Volz, June 2020

Relationship between climate risk and sovereign bond yields

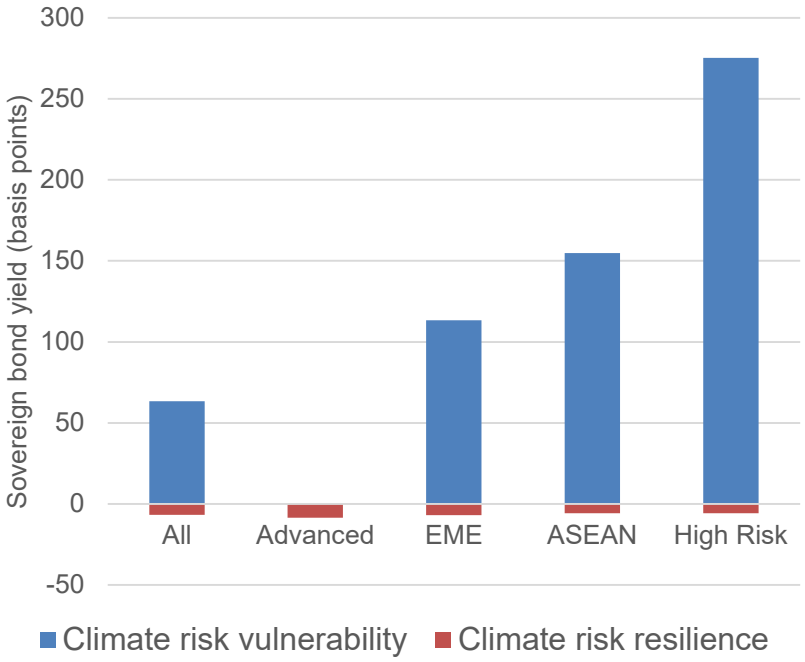




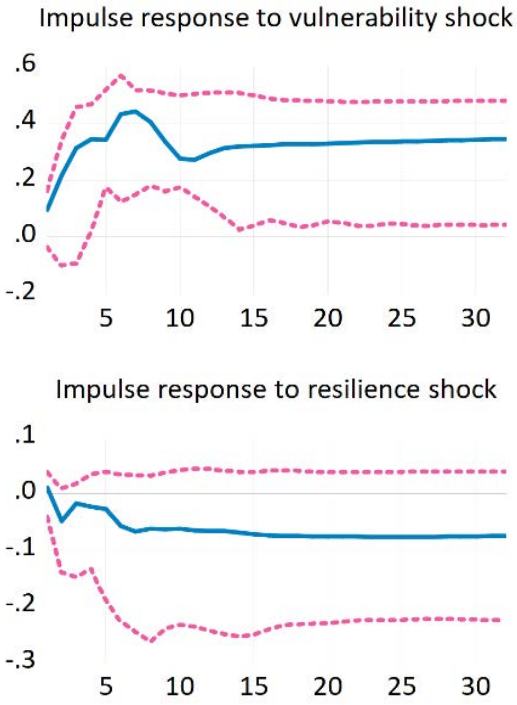
Source: Authors' calculations from ND-Gain, Kling et al (2020), Bloomberg

Empirical findings on impact of climate risk on sovereign bond yields

Climate risk coefficients from panel regression



Impulse responses for high risk economies



Source: Beirne et al. (2020)

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Thank you very much !!!

Background slides

List of Countries

Advanced	Emerging	ASEAN	High Risk
Australia	Argentina	Indonesia	Indonesia
Belgium	Brazil	Malaysia	India
Denmark	Chile	Philippines	Japan
Finland	Columbia	Singapore	Netherlands
France	Czech Republic	Thailand	Philippines
Germany	Hungary	Viet Nam	Republic of Korea
Greece	India		Singapore
Ireland	Israel		Sri Lanka
Italy	Mexico		Thailand
Japan	Nigeria		Viet Nam
Netherlands	People's Republic of China		
New Zealand	Peru		
Portugal	Poland		
Spain	Republic of Korea		
Sweden	Russian Federation		
United Kingdom	South Africa		
United States	Sri Lanka		

Data

- Using a quarterly data frequency and a fixed effects panel model over the period from 2001Q1 to 2018Q4 across 40 countries.
  - includes **advanced economies**, **emerging economies (EMEs),** and **ASEAN** countries.
    - We also examine a sub-panel based on economies characterized as having **high climate-related risks**, defined as being in the top quartile for risk exposure.
  - The **macroeconomic data** were attained from Bloomberg, IMF IFS, OECD, and CEIC.
  - Data for **vulnerability to climate risk** are taken from a refined version of the ND-GAIN vulnerability index developed by Kling et al. (2020)
    - comprises all the components from the ND-GAIN vulnerability index that are not highly related to economic variables.
  - Data for **climate resilience** are from FTSE Russell
    - refers to the extent to which an economy has measures in place to address exposure to climate risks

Overview of Variables Used in the Empirical Analysis

Variable	Data Source	Definition
Sovereign bond yield	Bloomberg	10-year government bond yield.
Vulnerability	ND-GAIN and Kling et al. (2020)	The refined vulnerability measure by Kling et al. (2020) comprises all of the components from the ND-GAIN vulnerability index that are not highly related to economic variables.
Resilience	FTSE Russell	Resilience refers to a country's preparedness and actions to cope with climate change.
Current account/GDP	OECD and CEIC	The current account balance to GDP ratio.
GDP per capita	The World Bank	Real GDP per capita at constant 2010 US$.
Public debt/GDP	IMF International Financial Statistics	The public debt as a share of GDP, defined as general government gross debt to GDP ratio.
Fiscal balance/GDP	IMF International Financial Statistics	The fiscal balance as a share of GDP, defined as cyclically adjusted primary balance to GDP ratio.
GDP growth	OECD and CEIC	The real GDP growth rate.
Crisis	Laeven and Valencia (2018)	The Laeven and Valencia (2018) indicator for the incidence of a crisis event for each country in the sample.
US bond yield	Bloomberg	US 10-year government bond yield.
VIX	Bloomberg	VIX stands for the Chicago Board Options Exchange (CBOE) Volatility Index, a measure of global risk aversion.
Transition risk	FTSE Russell	Transition risk from mitigation encompassed by GHG emission requirements.
Physical risk	FTSE Russell	Fundamental climate-related risk to the country and its economy

Methodology: First Stage

- The first stage examines **the drivers of sovereign bond yields**, based on a large set of macroeconomic data and two climate-related indicators :
  - **climate risk vulnerability** and **climate risk resilience**

$$y_{i,t} = \beta x_{i,t-1} + \gamma Z_{i,t-1} + \chi VIX_{t-1} + \tau USY_{t-1} + CRISIS_{i,t-1} + \delta_i + \varepsilon_{i,t}\ i=1,\ldots,N,\ t=1,\ldots,T$$

- $y_{i,t}$ represents the government bond yield
- $x_{i,t}$ represents a set of domestic fundamentals and other controls
- $Z_{i,t}$ denotes our climate vulnerability and resilience indicators
- VIX_t stands for the Chicago Board Options Exchange (CBOE) Volatility Index
- USY_t are US long-term government bond yields
- $CRISIS$ represents the Laeven and Valencia (2018) indicator for the incidence of a crisis event for each country in the sample
- $\delta_{i,t}$ are country fixed effects
- $\varepsilon_{i,t}$ is the error term
- The variables are lagged by one period to mitigate against endogeneity concerns.

Methodology: Second Stage

- Second, a structural panel is used to examine **the response of sovereign bond yields to shocks to climate vulnerability and resilience.**
  - Those shocks control for a range of macroeconomic fundamentals and global factors.
  - The panel SVAR is implemented across the same 40 countries as in stage one, but over the period from 2007Q1 to 2017Q4 in a balanced set-up.

$$A(L)Y_{i,t} = \mu_{i,t}$$

  - $A(L)$ is the matrix of the lag polynomial
  - $Y_{i,t}$ refers to the demeaned value of endogenous variables of country i to accommodate country-specific fixed effects
  - $\mu_{i,t}$ is a vector of structural disturbances
  - Our identification strategy is based on a block recursive restriction (Christiano, Eichenbaum, and Evans 1999) :
    - the variables at the top (global factors) will not be affected by contemporaneous shocks to the lower variables (domestic fundamentals and climate-related indicators)

The Determinants of Sovereign Bond Yields

	(1) All	(2) ADV	(3) EME	(4) ASEAN	(5) HRSK
			Climate risk vulnerability and resilience		
Vulnerability	**0.634*** **	**-0.001**	**1.134*** **	**1.549*** **	**2.753*** **
	(0.150)	(0.164)	(0.434)	(0.328)	(0.388)
Resilience	**-0.067*** **	**-0.084*** **	**-0.070*** **	**-0.057*** **	**-0.057*** **
	(0.009)	(0.013)	(0.016)	(0.015)	(0.016)
			Domestic factors		
Current account/GDP	-0.051***	-0.019	-0.127***	-0.0650***	-0.106***
	(0.011)	(0.015)	(0.029)	(0.013)	(0.015)
GDP per capita	-0.748*	-9.181***	-0.265	-4.587***	1.049
	(0.385)	(0.992)	(0.571)	(0.868)	(0.666)
Public debt/GDP	0.016***	0.013***	-0.0133*	0.0294***	0.00991***
	(0.001)	(0.002)	(0.008)	(0.005)	(0.003)
Fiscal balance/GDP	0.008	-0.014	0.172***	-0.015	-0.023
	(0.008)	(0.008)	(0.035)	(0.022)	(0.020)
GDP growth	-0.180***	-0.142***	-0.242***	-0.042	-0.042*
	(0.014)	(0.019)	(0.027)	(0.027)	(0.023)
Crisis	0.673***	1.325***	-0.129	n/a	0.605
	(0.203)	(0.226)	(0.377)		(0.743)
			Global factors		
US bond yield	0.803***	0.832***	0.587***	0.282**	0.861***
	(0.052)	(0.072)	(0.092)	(0.129)	(0.101)
VIX	0.049***	0.035***	0.059***	0.006	0.038***
	(0.005)	(0.007)	(0.009)	(0.010)	(0.009)
Constant	-14.94**	102.3***	-36.96**	-30.90*	-142.3***
	(7.242)	(13.16)	(17.67)	(17.54)	(20.95)
Observations	2,399	1,088	949	362	600
R-squared	0.296	0.430	0.236	0.573	0.411
Number of countries	40	17	17	6	10
Country fixed effects	Yes	Yes	Yes	Yes	Yes

Note: Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

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