



Asymmetric Sovereign Risk: Implications for Climate Change Preparation

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Inter-American Development Bank.

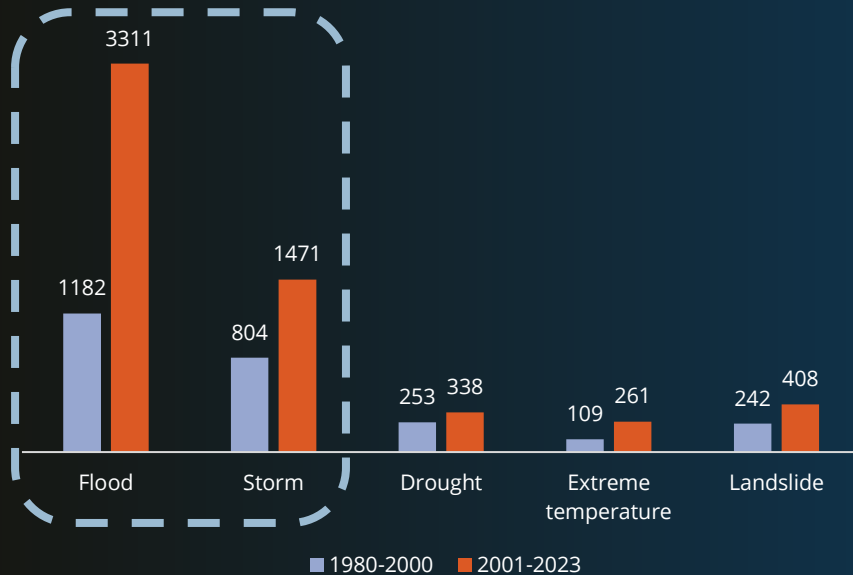
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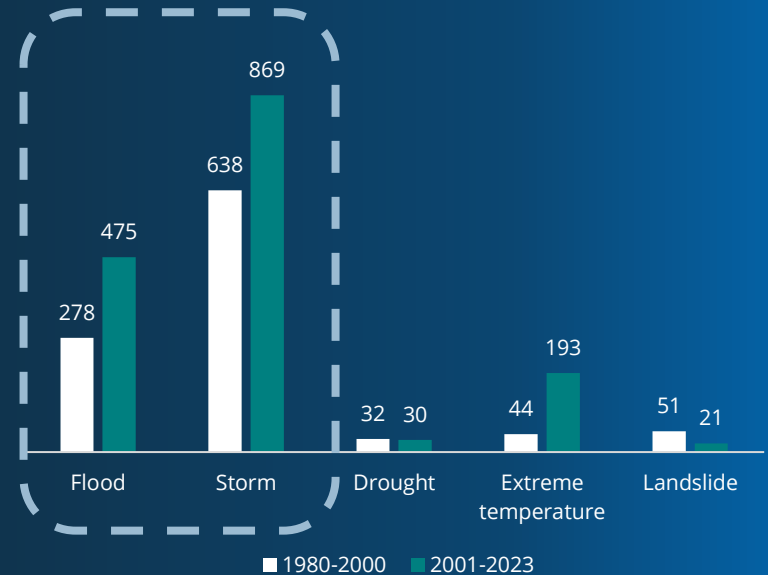
Natural disasters have doubled in the last 20 years, leading to significant macro-fiscal costs

Number of Disasters by Type

Emerging Markets

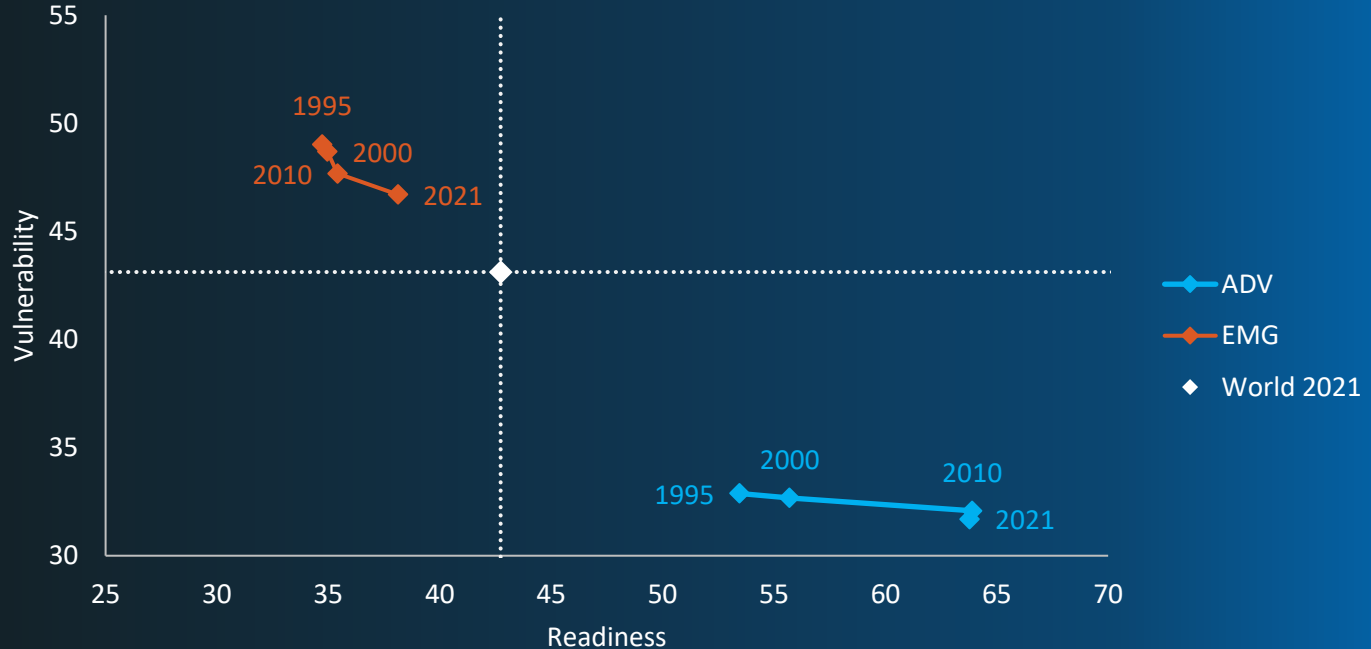


Advanced Economies



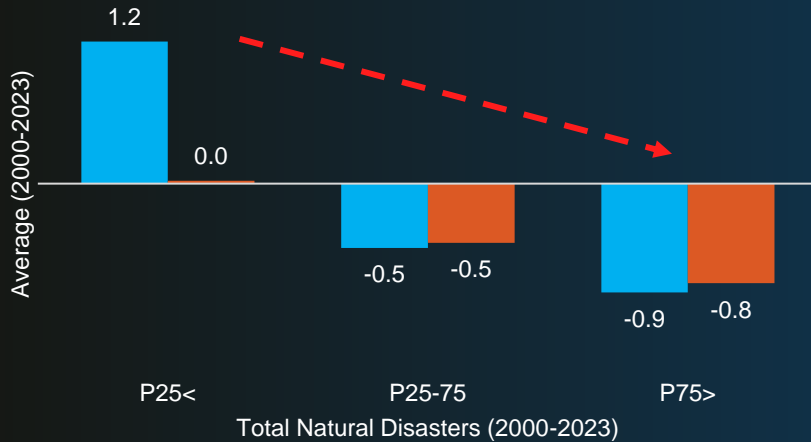
Emerging economies faces the challenge of improving disaster readiness and reduce vulnerability

ND-Gain Evolution

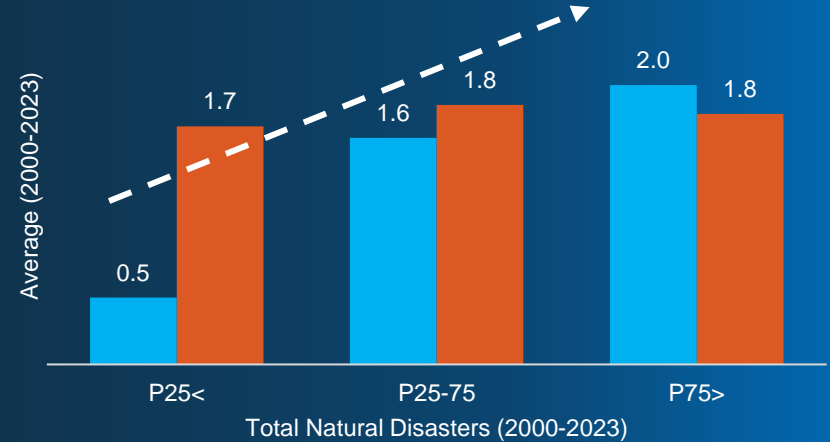


Natural disasters happens with considerable fiscal constraints

Primary Balance
General Government (% GDP)



Interest Payment
General Government (% GDP)



■ Advanced countries ■ Emerging countries

What We Do?



- » We examine how sovereign spreads respond to vulnerability and preparedness to climate change, while recognizing **the different dynamics expected alongside the sovereign risk distribution.**
- » We expand previous literature that analyzes the effects of **macro, financial and fiscal variables**, and show that changed effects across the risk distribution also change in this case.
- » We avoid making arbitrary distinctions between countries (e.g., "advanced," "emerging," or "low income") for estimation purposes, while fully recognizing **the different dynamics expected from different risk levels.**
- » We also take into consideration the measurement of the occurrence of **natural disasters** (measured in different scales, e.g. GDP loss, and the number of people affected).



Key Findings Summary



Climate change vulnerability increases significantly for shorter maturities.



This impact is particularly pronounced for countries with a high-risk profile (elevated borrowing costs).



Certain determinants of spreads hold more relevance for different segments of the spread distribution. Others are virtually unimportant at specific quantiles.



Including variables accounting for natural disasters enhances the overall model fit (but effects are small).



Empirical Strategy

Our methodology consists of two parts:

1 Random Forest (RF)

- RF is used to analyze of missing values in the yield spreads data.
- It uses a large dataset, theoretically expected to be associated with sovereign yield spreads:
 - Macroeconomic.
 - Institutional.
 - Debt-related variables.

2 Panel Quantile Factor Model (PQFM)

- It fits the whole conditional distribution of the spread.

$$Q_{it} = x'_{it}\beta_p + f_t^{int}\beta_{fp} + z'_{it}b_i$$

- x'_{it} : vector of variables
 - Rule of law.
 - Terms of trade change in %.
 - Real GDP growth.
 - Inflation rate.
 - Gross debt as % GDP.
 - Readiness Indicator.
 - Vulnerability indicator.
 - Economic complexity indicator.



Data and Imputation

➤ **Maturities of 1, 2, 5, and 10 years.**

➤ **68 countries from 2000 to 19:**

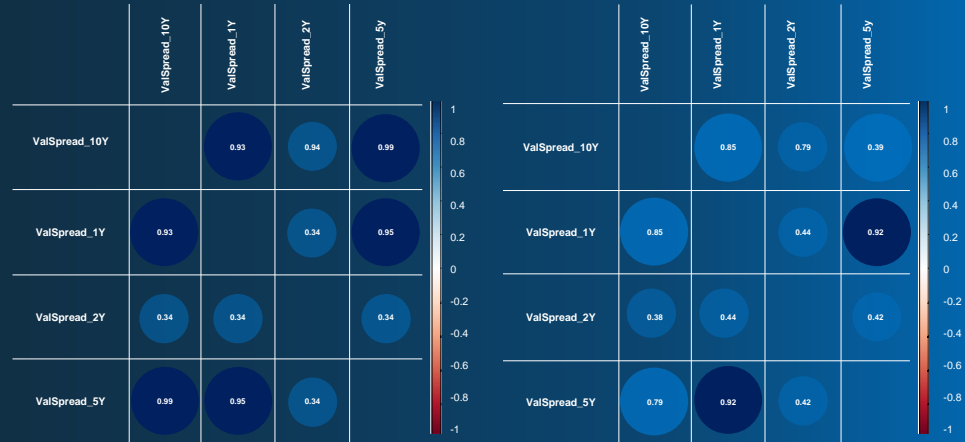
- 30 advanced economies.
- 38 low-income emerging markets.

➤ **To fill missing values, mostly concentrated in emerging markets, following imputation is addressed:**

$$\phi(X_{i,t}) = \sum_{k=1}^K f_k(X_{i,t})$$

➤ **Gains in sample size:**

- 70% more countries compared to Beirne et al. (2021).
- 1.4 times larger than the dataset used by Du et al. (2012, 2018).

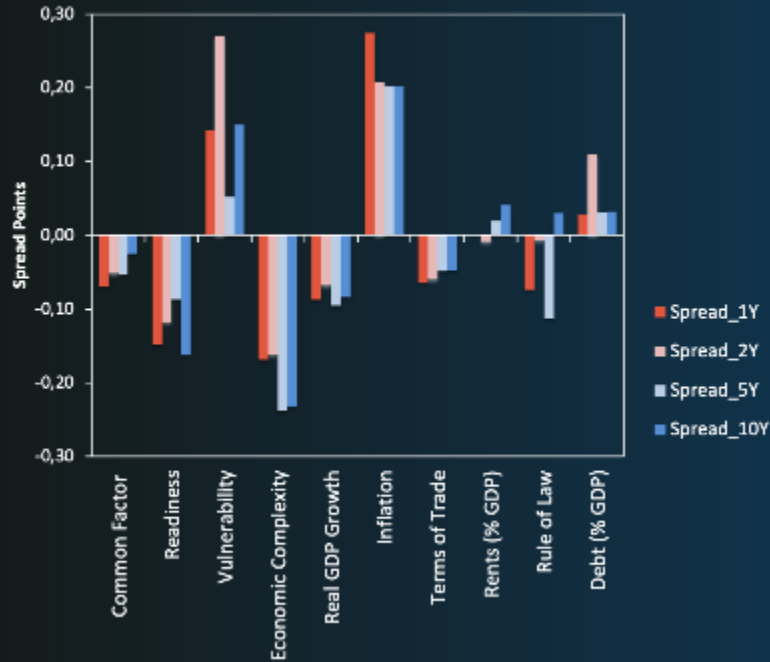


Note: The figure shows the correlation among sovereign spreads with respect to the United States for 1 year, 2 years, 5 years and 10 years maturities, from 2000 to 2019, for a sample of 68 countries, before and after imputation of missing observations by random forest.

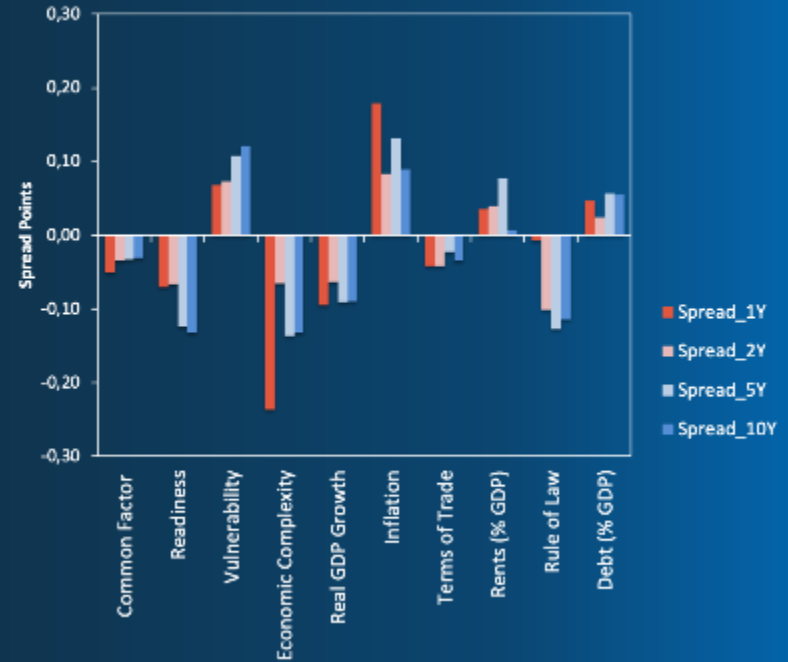


Main Results

High Spreads (Q-90th)

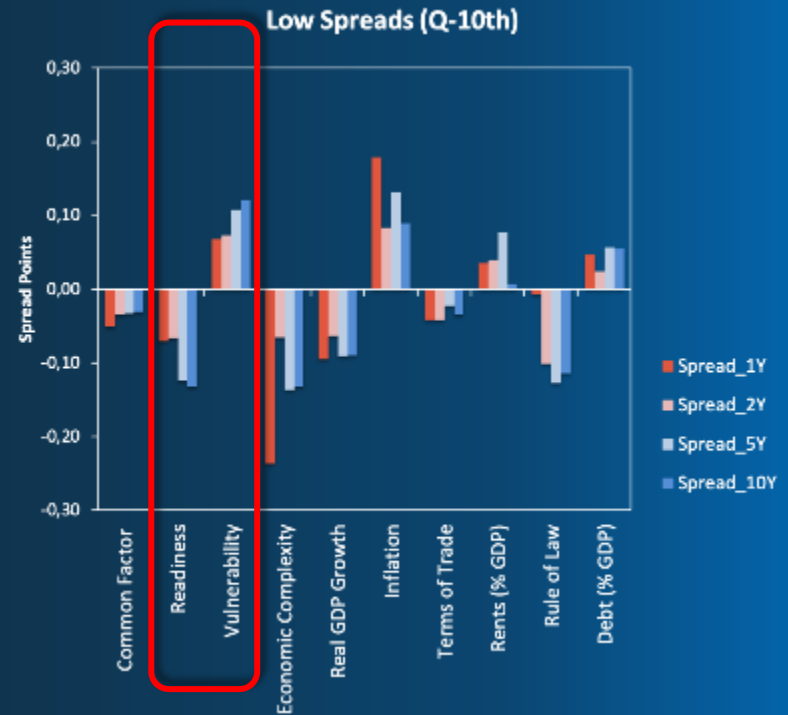
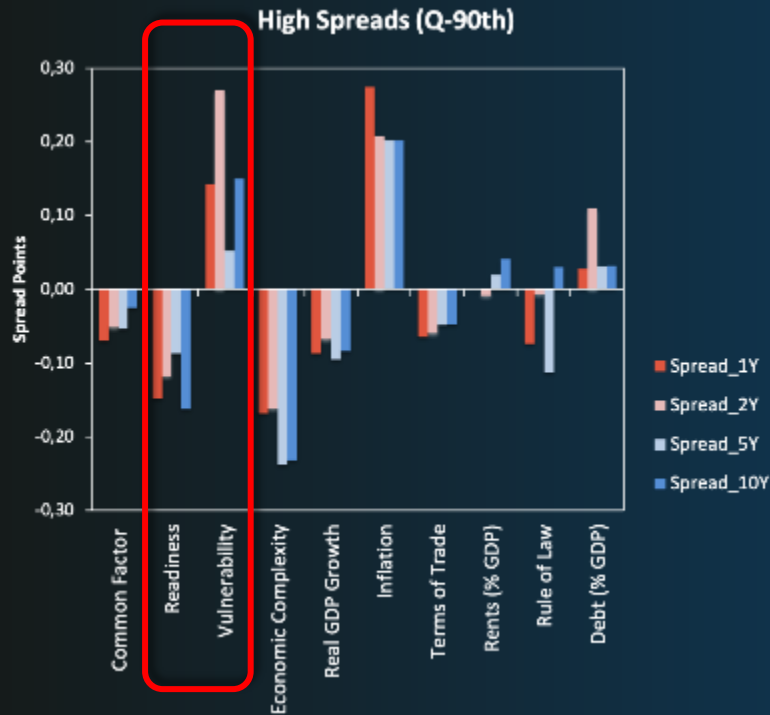


Low Spreads (Q-10th)



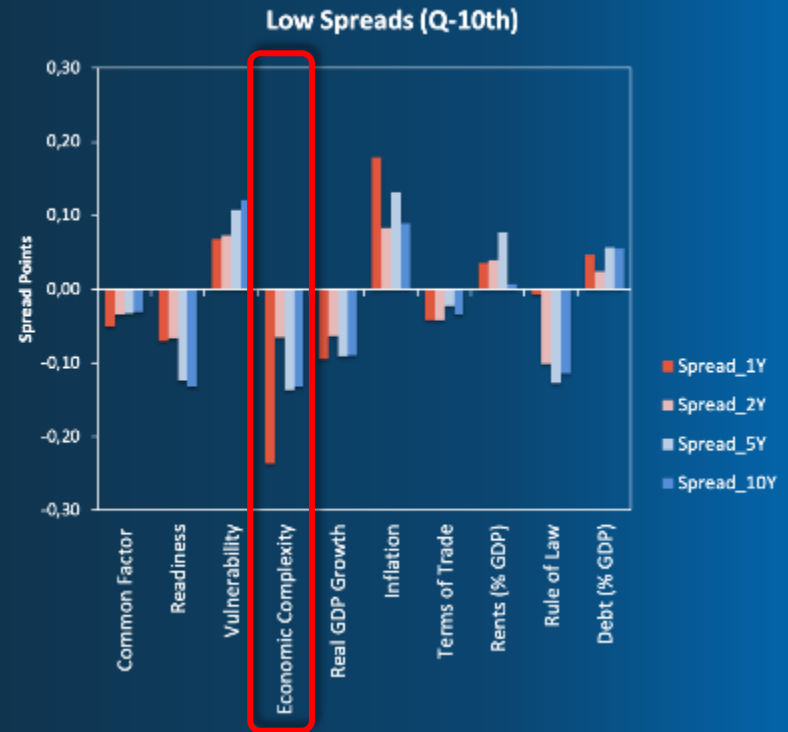
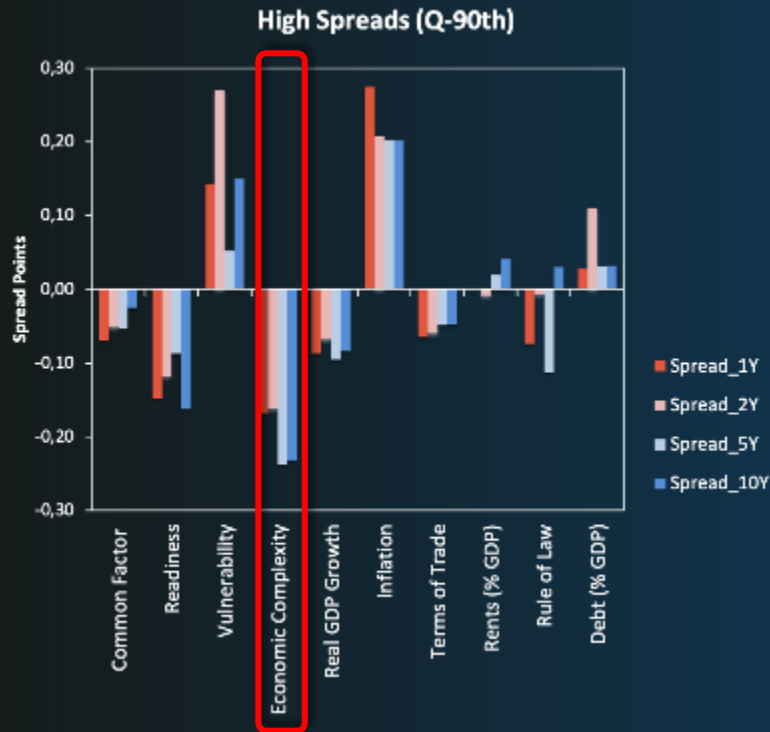


Rises in vulnerability increase sovereign risk, while more preparation reduces it:



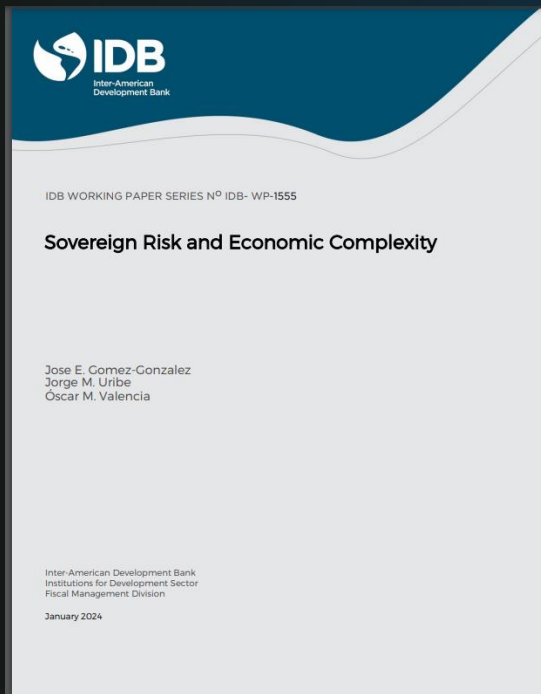


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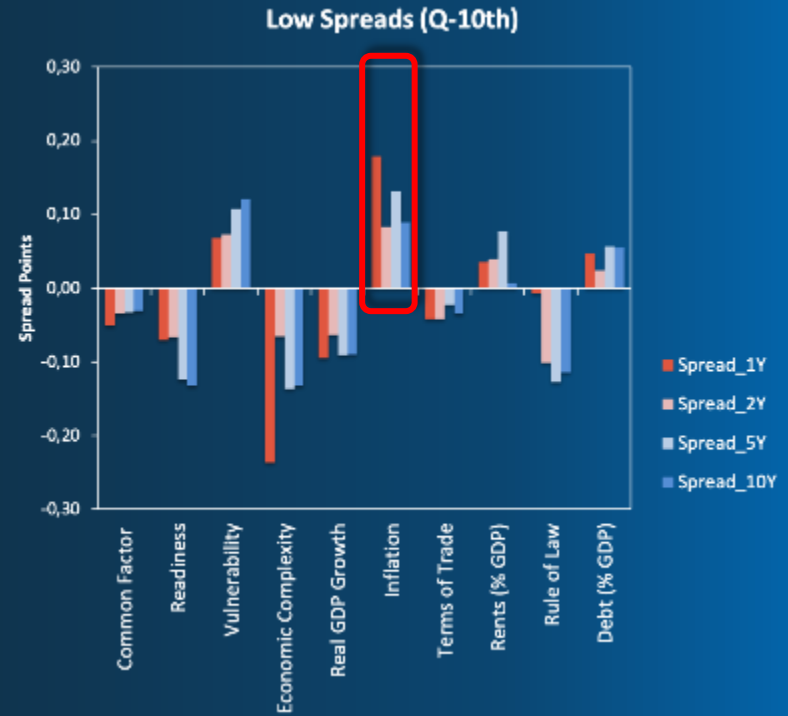
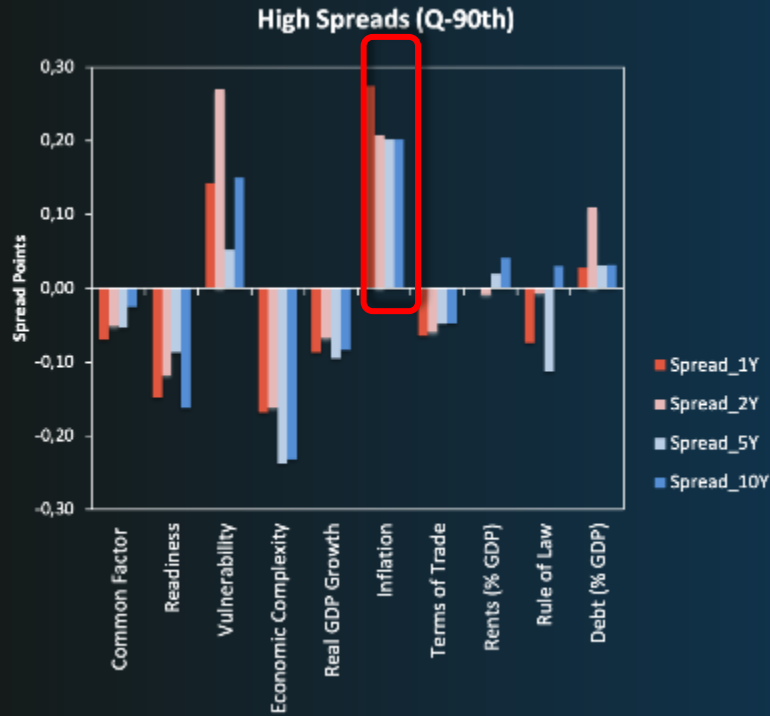
Economic Complexity new evidence for sovereign risk



- A one-unit increase in the Economic Complexity Index (ECI) correlates with a reduction of approximately 87 basis points in the 10-year yield spread.
- Impacts on indicating its influence on both **the level** of sovereign yield spreads and the **slope of the yield curve**.
- Economic complexity is a top-three predictor of sovereign risk, alongside inflation and institutional factors like the rule of law.
- Economic complexity lowers sovereign risk and plays a key role in long-term productivity, output, income stability, and fiscal crisis prevention.

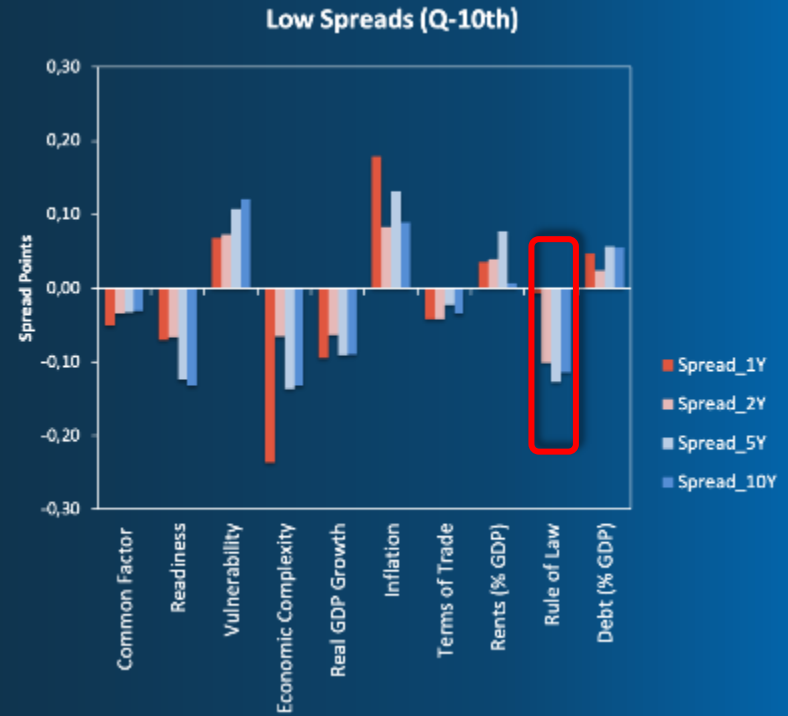
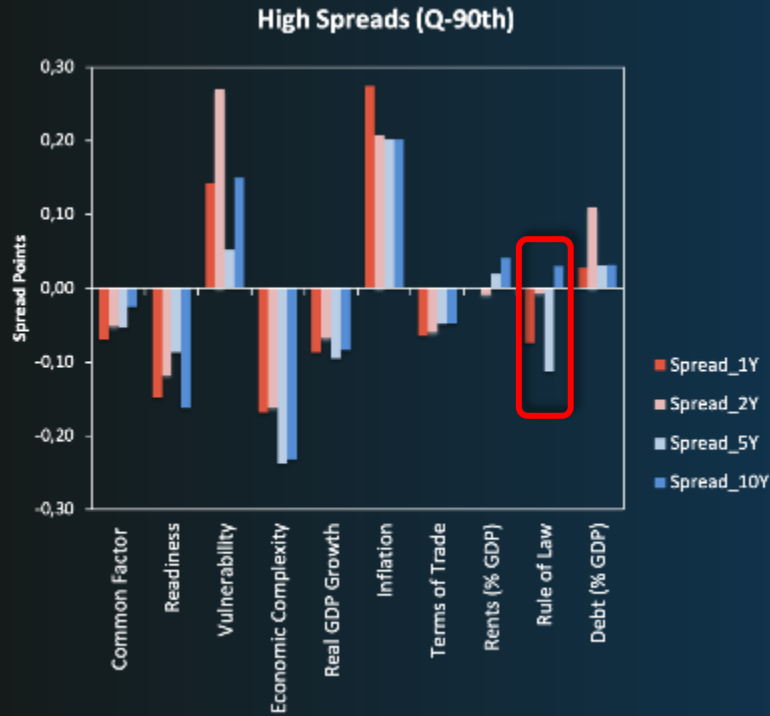


Inflation Amplifies Risk, Especially Amid Persistent Supply Shocks

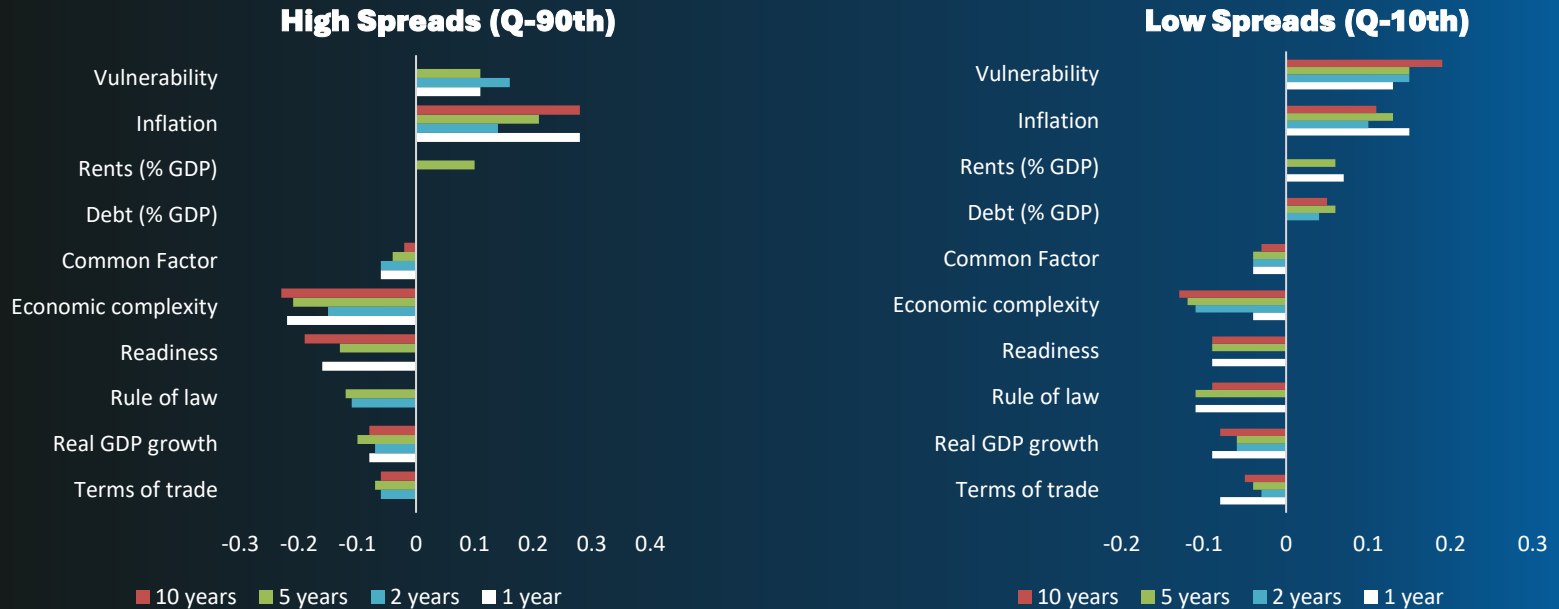




Rule of Law Helps Mitigate Impact with an Asymmetric Response



With natural disasters, as an idiosyncratic country-specific component, increments the model's overall fit, especially at longer maturities:



Note: Only significant coefficients are shown.

RESULTS: INCLUSION OF NATURAL DISASTERS- IDIOSYNCRATIC COMPONENT

Negative (economic) and positive (persons exposed) effects on the level of the model 'fixed effects' ...

Spread 1 Year												
	Quantile=0.9				Quantile=0.5				Quantile=0.1			
	Estimate	Std.Error	z.value	P(> z)	Estimate	Std.Error	z.value	P(> z)	Estimate	Std.Error	z.value	P(> z)
Component 1	0.01	0.02	0.61	0.53	-0.38	0.04	-8.39	0.00	-0.72	0.05	-15.37	0.00
Component 2	0.33	0.05	6.13	0.00	-0.04	0.03	-1.25	0.21	-0.38	0.02	-18.18	0.00
Component 3	1.06	0.18	6.02	0.00	0.33	0.06	5.14	0.00	0.10	0.05	2.19	0.03
Natural D. 1.1	-0.01	0.01	-0.85	0.39	-0.04	0.02	-1.46	0.14	-0.10	0.03	-2.81	0.00
Natural D. 1.2	-0.04	0.06	-0.71	0.47	-0.01	0.02	-0.54	0.57	-0.01	0.03	-0.31	0.74
Natural D. 1.3	-0.15	0.06	-2.32	0.02	-0.02	0.04	-0.53	0.58	-0.03	0.03	-1.14	0.25
Natural D. 2.1	-0.01	0.01	-0.79	0.42	-0.04	0.02	-1.98	0.05	0.02	0.01	1.74	0.08
Natural D. 2.2	-0.02	0.03	-0.53	0.59	-0.02	0.02	-1.35	0.17	0.00	0.01	0.30	0.75
Natural D. 2.3	-0.02	0.08	-0.22	0.81	-0.04	0.03	-1.45	0.14	-0.01	0.02	-0.65	0.50
Natural D. 3.1	0.00	0.01	0.14	0.87	0.00	0.01	0.10	0.90	0.00	0.02	0.15	0.86
Natural D. 3.2	0.01	0.03	0.24	0.79	0.01	0.01	0.85	0.39	0.03	0.01	3.06	0.00
Natural D. 3.3	-0.08	0.05	-1.66	0.09	0.00	0.02	0.24	0.79	0.03	0.01	2.46	0.01
Spread 2 Years												
	Quantile=0.9				Quantile=0.5				Quantile=0.1			
	Estimate	Std.Error	z.value	P(> z)	Estimate	Std.Error	z.value	P(> z)	Estimate	Std.Error	z.value	P(> z)
Component 1	-0.05	0.02	-2.61	0.01	-0.26	0.03	-10.26	0.00	-0.52	0.02	-26.81	0.00
Component 2	0.26	0.04	5.98	0.00	-0.04	0.04	-1.19	0.23	-0.28	0.01	-19.55	0.00
Component 3	1.09	0.64	1.69	0.09	0.20	0.10	2.03	0.04	-0.17	0.06	-3.10	0.00
Natural D. 1.1	-0.01	0.02	-0.66	0.50	-0.05	0.02	-2.64	0.01	-0.05	0.02	-2.98	0.00
Natural D. 1.2	0.02	0.02	0.89	0.37	-0.06	0.03	-1.79	0.07	0.02	0.02	0.98	0.32
Natural D. 1.3	0.16	0.40	0.39	0.68	0.03	0.05	0.50	0.60	0.03	0.04	0.73	0.45
Natural D. 2.1	0.00	0.01	0.04	0.95	0.00	0.02	-0.16	0.85	0.01	0.01	0.57	0.55
Natural D. 2.2	-0.01	0.02	-0.73	0.45	-0.03	0.02	-1.39	0.16	-0.01	0.02	-0.76	0.44
Natural D. 2.3	1.35	0.70	1.93	0.05	0.01	0.02	0.27	0.77	0.01	0.03	0.43	0.65
Natural D. 3.1	0.02	0.02	0.88	0.37	0.02	0.01	1.95	0.05	0.01	0.01	0.70	0.47
Natural D. 3.2	-0.01	0.01	-0.79	0.42	0.01	0.01	1.45	0.14	0.02	0.01	3.44	0.00
Natural D. 3.3	-0.84	0.42	-2.01	0.04	0.00	0.01	-0.01	0.97	0.00	0.01	0.37	0.70

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Natural D. 2.3	-0.02	0.08	-0.22	0.81	-0.04	0.03	-1.45	0.14	-0.01	0.02	-0.65	0.50
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Natural D. 3.3	-0.84	0.42	-2.01	0.04	0.00	0.01	-0.01	0.97	0.00	0.01	0.37	0.70



Conclusions

High (0.9 quantile) and low (0.1 quantile) spreads respond differently to their determinants (e.g., preparation and vulnerability to climate change). Therefore, **there is an asymmetric risk for emerging and low-income versus developed countries:**

Vulnerability affects more the high quantiles of the spread distribution (i.e., countries facing significant credit restrictions in periods of scarce credit supply).

Moreover, we found asymmetric responses beyond those associated with climate change (e.g., inflation, terms of trade, the debt-to-GDP ratio, economic complexity, natural resource rents, and institutional quality).

Higher responses at shorter maturities are also common. In fact, the most pronounced effects of explanatory variables (including vulnerability and preparedness) occur in short-term maturities.



Conclusions

Spreads predominantly react to vulnerability and readiness for climate change, rather than the actual occurrence of natural disasters.

The inclusion of natural disasters enhances the overall model fit, particularly for 5-10 maturities.

When significant, the effects of natural disasters vary depending on how they are measured: economic losses (greater effect) vs. people exposed (lower effect).

CAUTION: The effect of natural disasters is almost insignificant when we control for traditional determinants of sovereign risk, including macroeconomic, institutional, and fiscal variables. Our model does address indirect effects (e.g., Klusak et al., 2023).



Implications

Efforts on the 'readiness' are most effective (in relative terms) for reducing sovereign risk at long-term maturities. However, the impact diminishes notably at shorter maturities.

Particularly, an increase in readiness can potentially offset heightened vulnerability to climate change, mostly at the lower quantiles of the spread distribution.

This is good news for developed countries that are preparing for climate change, as they experience lower debt spreads and primarily finance through long-term debt.



Implications

By contrast, countries with high spreads, relying on short-term debt, face a distressing situation:

- Increments in readiness tend to be smaller than the effects of vulnerability. Although preparation has positive effects, it is insufficient to counterbalance the impact of vulnerability.

- Additional measures like enhancing their productive structure to improve the quality of exports, may be essential to concurrently manage sovereign risk.



Thank you!