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Sovereigns on Thinning Ice

Navigating Debt Sustainability Under Climate Change

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Executive Summary

Climate change presents a critical challenge to sovereign debt sustainability, particularly for countries vulnerable to extreme weather events and rising adaptation costs. The study *"Sovereigns on Thinning Ice: Debt Sustainability, Climate Impacts, and Adaptation"* highlights the interplay between fiscal risks, climate shocks, and debt dynamics. The study emphasises that climate risks—if unaddressed—can exacerbate fiscal vulnerabilities, pushing debt-to-GDP ratios to unsustainable levels in climate-exposed economies.
The study employs a novel methodology integrating Debt Sustainability Analysis (DSA) with Integrated Assessment Models (IAMs), specifically the RICE50+ model. The latter incorporates regional socio-economic pathways (SSPs) and climate scenarios (RCPs) to predict growth and fiscal effects.

Key findings suggest that:

- Under **moderate climate scenarios (SSP2-RCP4.5)**, fiscal efforts required for stabilisation remain manageable, demanding an additional fiscal adjustment of approximately **0.2% of GDP annually**.
- **Severe scenarios (SSP3-RCP7.0)** necessitate significant adjustments, with some countries like Italy requiring up to **1% of GDP annually** for debt stabilisation.

Adaptation measures are considered essential, but they require significant public financing. The analysis shows that although contributions from the private sector can help reduce some adaptation costs, public sector investments are crucial to facing environmental impacts. Policymakers must carefully balance the need to maintain debt sustainability with the necessity of public spending to address climate risks effectively.

Context and Importance of the Issue

Climate risks are now increasingly acknowledged as crucial in determining debt sustainability. Natural disasters like hurricanes, floods, and droughts result in direct infrastructure damage, reduced economic output, and higher government spending on recovery. Over time, these effects amplify debt vulnerabilities, particularly in low- and middle-income countries with constrained fiscal space. The study *Sovereigns on Thinning Ice: Debt Sustainability, Climate Impacts, and Adaptation* highlights that:

- **Immediate Impacts**: Climate events reduce GDP growth by an average of 0.5% annually in highly exposed countries, with debt-to-GDP ratios increasing by 10 percentage points over 20 years under severe scenarios.
- **Long-Term Risks**: Without adaptation measures, the cumulative costs of climate change could lead to a doubling of fiscal pressures in vulnerable economies by 2050 .

Empirical literature corroborates these findings. Batten (2018) emphasises that climate risks undermine macroeconomic stability and investor confidence, leading to higher borrowing costs. Bolton *et al.* (2022) highlight that countries with higher exposure to climate risks face worsened debt conditions, leading to greater reliance on concessional financing and debt restructuring.

To assess the fiscal implications of climate change, this study employs the RICE50+ model, a next-generation Integrated Assessment Model (IAM) developed by Gazzotti *et al.* (2021), which builds upon the DICE framework Introduced by Nobel Prize-winning economist William Nordhaus. (Nordhaus, 1993). The Zenios and Consiglio DSA model (Zenios *et al.*, 2021) extend the traditional assessment of sovereign debt sustainability by integrating the regional economic pathways and climate risk projections generated by RICE50+. This advanced framework allows for a more exhaustive evaluation of sovereign debt by explicitly capturing the non-linear effects of climate-related damages on GDP, sovereign borrowing costs, and primary balance.

Table 1 summarises the paper's main findings and provides significant alerts to policymakers.

In particular, under the moderate climate scenario (SSP2-RCP4.5), advanced economies like Italy require fiscal adjustments of 0.2% of GDP annually to maintain debt sustainability. In comparison, emerging markets need at least 0.5%, and highly vulnerable economies require 1%. Under severe climate impact (SSP3-RCP7.0), the situation deteriorates dramatically. Italy and other advanced economies would need annual fiscal adjustments of up to 1% of GDP. In comparison, emerging economies would need to adjust by 1.5%, and highly vulnerable nations could face an unsustainable burden of 2.6% of GDP annually.

Scenario	Advanced Economies (Italy, EU)	Emerging Markets (Brazil, India)	Highly Vulnerable Economies
SSP2-RCP4.5 (Moderate Climate Impact)	0.2% of GDP annually	0.5% of GDP annually	1.0% of GDP annually
SSP3-RCP7.0 (Severe Climate Impact)	1% of GDP annually	1.5% of GDP annually	2.6% of GDP annually

Table 1. Lore ipxe

Adaptation investments can help mitigate the negative fiscal impacts of climate change, especially under severe scenarios. However, the effectiveness of these measures depends on their financing sources and the extent of climate damage.

The study analyses three financing strategies: (1) full private-sector funding, which yields the best debt outcomes but is mainly unrealistic, as currently, private sector contributions account for less than 2% of global adaptation investments (Tall *et al.*, 2021); (2) a mixed approach with governments only funding reactive adaptation (like disaster relief); and (3) full government financing, which can worsen debt sustainability due to increased sovereign borrowing.

Figure 1 illustrates the impact of climate adaptation on debt ratios by the end of the century under scenarios of high climate damages. The results show a U-shaped relationship across various policies: fully private adaptation consistently reduces debt burdens, although its effects may be limited in some countries. Public spending on reactive adaptation can enhance debt sustainability, but fully government-funded adaptation is expensive and may exceed its benefits.

Despite some reductions in debt, no adaptation strategy completely mitigates the fiscal risks associated with climate change, as evidenced by the upward arrows indicating unsustainable debt trajectories.

The mixed strategy—where the public sector manages reactive measures while the private sector funds proactive ones—appears to be the most viable option. This approach has the potential to prevent further deterioration of debt levels. Policymakers should aim to balance adaptation spending with long-term debt sustainability to prevent imposing excessive financial burdens.

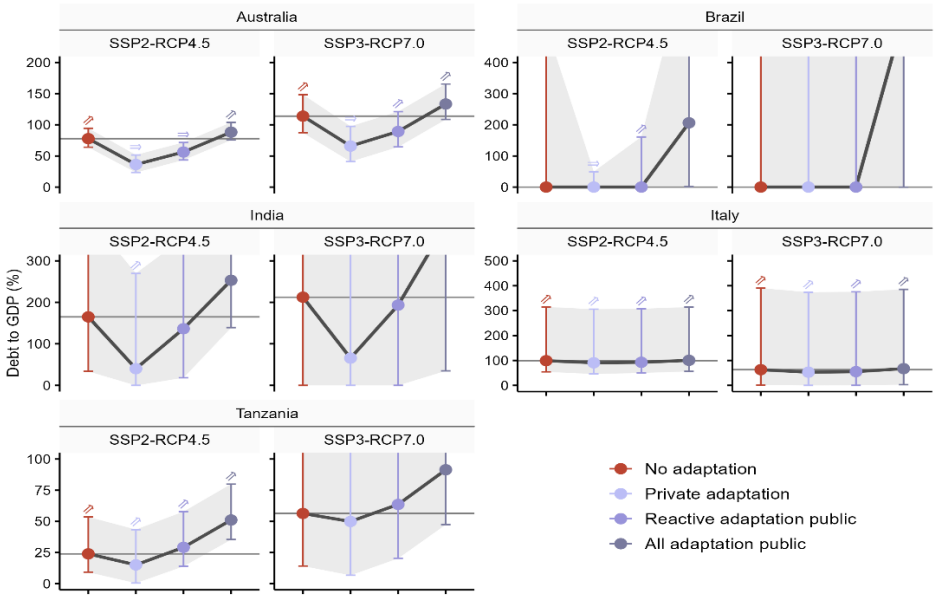

Figure 1. Effect of climate change adaptation on end-of-century debt ratios under high climate damages. The figure illustrates median values and the inter-quartile range for different adaptation policies. The double arrow above each whisker indicates debt trajectory stability: horizontal arrows signify stable debt dynamics while upward-pointing arrows indicate unsustainable debt increases.

Policy Options and Analysis

Option 1: Integrate Climate Risk into Debt Sustainability Frameworks

- Analysis: Traditional debt sustainability analyses (DSA) often neglect climate risks, underestimating vulnerabilities. The study shows that incorporating climate scenarios into DSA improves the accuracy of fiscal assessments, enabling governments to anticipate and address risks proactively.
- Policy Implications:
    - Develop DSA models that account for both immediate and long-term climate impacts.
    - Use scenario analysis to identify critical tipping points where fiscal stability becomes unsustainable under different climate pathways.

Option 2: Increase Funding for Adaptation Efforts

- Analysis: Adaptation measures, such as resilient infrastructure and climate-smart agriculture, reduce the fiscal impacts of natural disasters. However, financing adaptation requires significant upfront costs, which may weaken already limited budgetary resources.
- Policy Implications:
    - Promote innovative financing mechanisms, such as green bonds and climate resilience bonds, to mobilize private capital for adaptation projects.
    - Increase international support through concessional financing, such as access to World Bank IDA loans for low-cost, long-term funding or IMF's Resilience and Sustainability Trust (RST) to strengthen fiscal stability.

Option 3: Foster International Cooperation

- Analysis: Climate risks transcend borders, necessitating coordinated international efforts to address their fiscal implications. Collective action can enhance resource mobilization, share best practices, and provide technical assistance.
- Policy Implications:
    - Establish global frameworks to integrate climate risks into sovereign debt relief programs.
    - Strengthen regional cooperation to pool resources for adaptation and risk-sharing mechanisms.

Recommendations

1. **Incorporate Climate Risks into Debt Assessments:**
   - Develop advanced DSA tools that include climate risk factors and scenario-based modelling.
   - Train fiscal authorities to utilize these tools effectively in policy planning.
2. **Increase Funding for Climate Adaptation:**
   - Mobilize private capital through green bonds and climate-focused financial instruments.
   - Strengthen international support by expanding concessional loans and grants for adaptation projects in climate-vulnerable countries.
3. **Promote International Collaboration:**
   - Foster partnerships between multilateral organizations and national governments to integrate climate risks into debt relief programs.
   - Establish regional climate risk-sharing mechanisms to support countries in managing fiscal shocks from natural disasters.

Implementation Considerations

I. **Institutional Strengthening:** Build capacity within debt management offices to integrate climate risk into fiscal planning and DSA tools.

II. **Data and Metrics:** Invest in high-quality climate and fiscal data collection to ensure robust risk assessments.

III. **Stakeholder Engagement:** Engage with private investors, multilateral institutions, and civil society to align adaptation financing with fiscal needs.

IV. **Policy Coordination:** Align national strategies with global initiatives, such as the Paris Agreement and Sustainable Development Goals, to leverage existing frameworks for climate resilience.

Conclusion

Climate change is pushing many economies toward an unsustainable debt future. To stay ahead, policymakers must **integrate climate risks into financial planning, secure more funding for adaptation, and strengthen global collaboration**. Smart

investments and innovative financing—such as concessional loans and green bonds—can ease the burden. Without bold action, climate shocks will drive debt higher, threatening economic stability for years to come. The time to act is now.

References

1. Batten, S. (2018) *Climate Change and the Macro-Economy: A Critical Review*. Staff Working Paper 706. London: Bank of England. Available at: https://www.ssrn.com/abstract=3104554 (Accessed: 29 January 2025).

2. Bolton, P. *et al.* (2022) *Climate and Debt*. Geneva: ICMB International Center for Monetary and Banking Studies (Geneva reports on the world economy, 25).

3. Gazzotti, P. *et al.* (2021) 'Persistent inequality in economically optimal climate policies', *Nature Communications*, 12(1), p. 3421. Available at: https://doi.org/10.1038/s41467-021-23613-y.

4. Nordhaus, W.D. (1993) 'Rolling the "DICE": an optimal transition path for controlling greenhouse gases', *Resource and Energy Economics*, 15(1), pp. 27–50. Available at: https://doi.org/10.1016/0928-7655(93)90017-O.

5. Tall, A. *et al.* (2021) 'Enabling Private Investment in Climate Adaptation and Resilience', *World Bank Publications - Reports* [Preprint]. Available at: https://hdl.handle.net/10986/35203.

6. Zenios, S.A. *et al.* (2021) 'Risk Management for Sustainable Sovereign Debt Financing', *Operations Research*, 69(3), pp. 755–773. Available at: https://doi.org/10.1287/opre.2020.2055.