Finanziato dall'Unione europea NextGenerationEU
Ministero dell'Università e della Ricerca
Italiadomani
Università Ca'Foscari Venezia

Finanziato nell'ambito del Piano Nazionale di Ripresa e Resilienza PNRR. Missione 4, Componente 2, Investimento 1.3 Creazione di "Partenariati estesi alle università, ai centri di ricerca, alle aziende per il finanziamento di progetti di ricerca di base"

GRINS FOUNDATION

GRINS – Growing Resilient, INclusive and Sustainable

"9. Economic and financial sustainability of systems and territories"

Codice Identificativo: **PE00000018**

Finanziato nell'ambito del Piano Nazionale di Ripresa e Resilienza PNRR Missione 4 – Componente 2

SPOKE 4

D4.3.2 - Policy briefs on climate-related uncertainty measures and policy implications

March 2025

Scenario analysis under uncertainty and controllability:

Andrea Mazzocchetti
Università Ca' Foscari Venezia

Executive Summary

Climate change poses significant challenges to Italy, as the country is exposed and vulnerable to natural disasters (such as floods, droughts, and heatwaves), has high public debt, and is still lacking targeted adaptation measures.
By developing an online tool and employing the EIRIN stock-flow consistency model tailored to Italy's economic context, the study "Scenario Analysis under Uncertainty and Controllability: An Online Tool" explores the effects of climate transition and physical risk scenarios on the Italian economy and financial system, both in terms of their intrinsic uncertainty and potential possibility to be controlled.
The online tool consists of a complete set of detailed economic and financial trajectories conditioned to climate scenarios and parameters. It allows users to obtain aggregate and sector-level outcomes that can be visualized and exported, supporting a comprehensive analysis of the evolution of the Italian economy.

Key findings reveal that:

- **An orderly transition can lead to co-benefits in Italy** (in terms of GDP and GHG emissions) **in the mid-term**. In contrast, a disorderly transition worsens the economic performance and financial stability.
- **Severe impact on capital stock potentially caused by climate tail risks can lead to sustained economic setbacks** in the absence of adequate adaptation and financial strategies.

The results contribute to the understanding on how climate transition policies can shape the trajectory of the low-carbon transition, also providing insight into the key role of public green subsidies in counteracting the economic impacts of carbon taxation. Furthermore, the outcomes highlight that the role of financial and prudential policies in times of crisis is crucial to provide support to economies reeling from natural disasters.
This underscores the importance of developing adaptation strategies and forward-looking financial policies that not only address immediate recovery needs, but also build resilience against future risks.

Context and Importance of the Issue

As part of the EU, Italy committed to reduce its net greenhouse gas emissions by at least 55% by 2030, compared to 1990 levels. This will require the uptake of renewable energies and an unprecedented pace in the electrification of final energy uses (e.g. in buildings and transport).
In this context, it is crucial to understand the extent to which climate transition and physical risks may impact the economy and financial system. To this end, this study investigates the macroeconomic and financial effects of climate transition scenarios and physical risk in Italy, by tailoring and extending the Stock-Flow Consistent (SFC) macrofinancial model EIRIN (Monasterolo and Raberto, 2018; Dunz et al., 2023; Mazzocchetti et al. 2024).

The model has been used to analyse:

(i) **the macrofinancial impacts of climate transition scenarios**, aligned with the framework developed by The Network of Central Banks and Supervisors for Greening the Financial System (NGFS).

(ii) **under which conditions climate tail risk scenarios could lead to a persistent shock on macroeconomic and financial outcomes**, and the transmission channels through which the shocks propagate.

The results reveal that the Net Zero 2050 (NZ) scenario, which assumes a gradual and coordinated introduction of climate policies, leads to a significant reduction in Greenhouse Gas (GHG) emissions and only a slight decrease in GDP compared to the Current Policies (CP) scenario. This reflects an initial drop in private investments due to the rise in carbon prices, which is compensated in the medium term (Figure 1). Conversely, the Delayed Transition (DT) scenario can lead to higher transition risk and worsen economic outcomes (see also Gourdel et al. 2024). In the context of the analysed scenarios, the role of the government green subsidies can be relevant in reducing the costs of transition, leading to higher GDP and lower emissions (Figure 1).

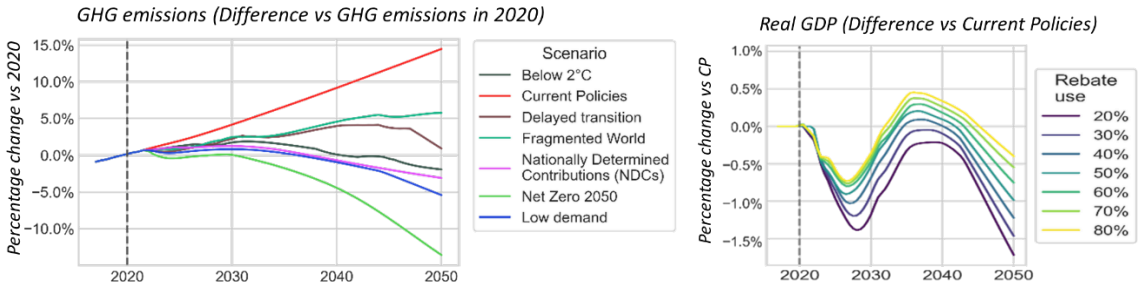

Figure 1. Greenhouse gas emissions and real GDP. The left figure shows the change in greenhouse gas emissions relative to 2020 for each of the NGFS – Phase IV scenarios (NGFS, 2023) up to 2050. The right figure shows real GDP as a percentage change in GDP in the Net Zero 2050 scenario compared to the Current Policies scenario up to 2050, considering different shares of revenues from the carbon tax allocated to green subsidies.

The study also analyses extreme climate physical risk scenarios to identify the magnitude of shocks necessary to make the impacts on the economy persistent, with significant repercussions for fiscal and financial stability. For this purpose, the simulated scenarios include: i) increasing impacts in the form of destruction of firms' productive capital up to a maximum of 15% in four quarters. This impact is directly reflected in production and indirectly on other economic and financial variables, such as employment and firms' Probability of Default (PD); ii) potential amplification effects of the shock, such as credit restrictions by banks on investments for reconstruction following the extreme climate event.

The results show that extreme climate events (e.g. floods) can cause a significant and persistent decrease in GDP and an increase in the debt-to-GDP ratio, and that the economic consequences can worsen nonlinearly when the destruction of capital is coupled by credit restrictions (Figure 2).

The destruction of firms' capital reduces their production capacity, leading to a decrease in demand, which in turn causes firms to revise downward their demand and investment expectations, potentially leading to an economic breaking point characterized by a permanently depressed GDP and unsustainable public debt in the medium term, in absence of adaptation and financial policies. Thus, the development of adaptation measures and financial policies can play a crucial role in enhancing Italy's economic resilience and promoting sustainable growth.

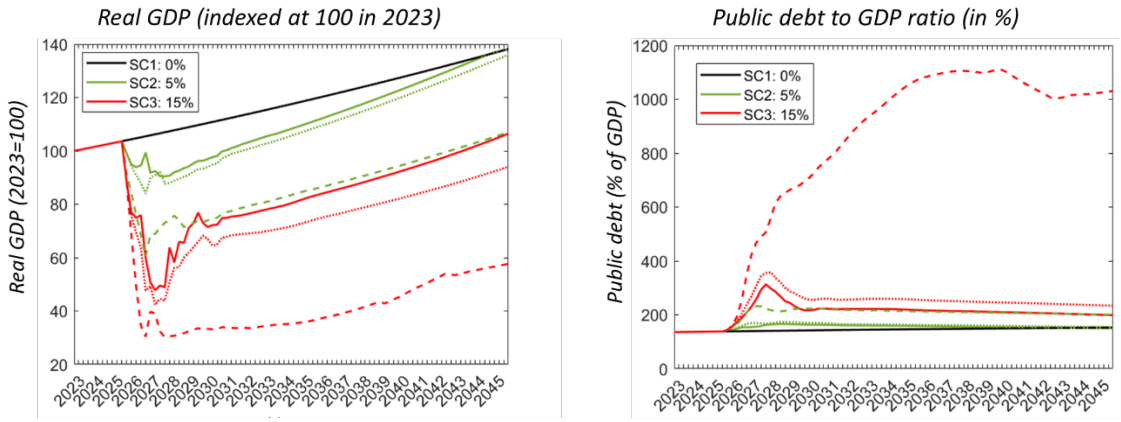

Figure 2. Real GDP and debt-to-GDP ratio. The left figure shows real GDP (left chart) and the debt-to-GDP ratio (right chart) from 2023 to 2045, considering both the destruction of productive capital and credit restrictions. The solid lines illustrate the scenario without credit restrictions. The dotted lines show scenarios where banks provide 50% of the requested credit in 2025, while the dashed lines indicate scenarios where banks provide 0% of the requested credit in 2025.

Policy Options and Analysis

Option 1: Fostering an orderly transition and green subsidies schemes

- Analysis: Early actions delivering an orderly transition to achieve global net-zero emissions by 2050 represent the optimal pathway to minimise climate-related risks and losses. In this context, using revenues from carbon taxes to fund green subsidies can stimulate positive growth and reduce emissions.
- Policy Implications: Introduce climate mitigation policies in a coordinated manner and early, with a gradual and predictable carbon price increase, and supplementary government measures such as green subsidies.

Option 2: Increase investments in adaptation measures:

- Analysis: Investments in adaptation measures and the introduction of accessible and comprehensive insurance schemes against climate-related disasters are crucial in the reduction of costs associated with the impacts of climate-related natural hazards.
- Policy Implications: Long-term investments in disaster risk reduction, adaptation infrastructure, and the introduction of accessible and comprehensive insurance schemes against climate-related disasters can help to build resilience against acute and chronic physical risks.

Recommendations

1. **Promoting early and credible climate policies:**
    - Commit to a credible and predictable climate policies, allowing firms and banks to plan investments in low-carbon technologies, and aligning investors' expectations with climate policy objectives.
    - Strengthen international policy coordination to support a just and orderly transition.

2. **Increase funding for investments in adaptation:**
    - Development of financial instruments (e.g. European Climate Bonds, Monasterolo et al. 2024) to provide funding for climate policies.
    - Integrating adaptation into macro-fiscal policy

3. **Strengthen climate risk modelling:**
    - Macroeconomic models used to produce climate scenarios should be capable to capture the complexity of climate risk and account for the interplay between the economy and the financial sector, including the expectations and reactions of the main actors to climate policies.

Implementation Considerations

I. **Policy Coordination:** Ensure Italy's national climate strategies are aligned with international commitments (e.g. Paris Agreement), enhancing the effectiveness of domestic policies by integrating them with established global frameworks.

II. **Public and Stakeholder Engagement:** Engage with the public, businesses, and non-governmental organizations in the policy development process to gain broader support and cooperation. This includes transparent communication about the goals and expected outcomes of the policies.

III. **Debt sustainability:** Include climate risks in Debt Sustainability Analysis (DSA), enabling the assessment of the feedback loops between climate risks and sovereign debt sustainability.

Conclusion

This study highlights the critical importance of early and coordinated climate policies for Italy's economic resilience and environmental sustainability. An orderly transition, supported by green subsidies funded from carbon taxes, can optimize growth and reduce emissions, while minimizing the risks and losses associated with the low-carbon transition. Investments in adaptation measures and comprehensive insurance schemes are crucial in managing the impacts of severe climate events and building long-term resilience. The findings stress the need for enhanced climate risk modelling and policy coordination to support effective policy-making.

References

Dunz, N., Hrast Essenfelder, A., Mazzocchetti, A., Monasterolo, I. and Raberto, M. (2023). Compounding COVID-19 and climate risks: The interplay of banks' lending and government's policy in the shock recovery. *Journal of Banking & Finance*, p.106306. DOI link: https://doi.org/10.1016/j.jbankfin.2021.106306.

Gourdel, R., Monasterolo, I., Dunz, N., Mazzocchetti, A., Parisi, L. (2024). The Double Materiality of Climate Physical and Transition Risks in the Euro Area. *Journal of Financial Stability*, 71, p. 101233. DOI link: https://doi.org/10.1016/j.jfs.2024.101233.

Mazzocchetti, A., Monasterolo, I., Dunz N., Essenfelder, A.H (2025). Breaking the economy: how climate tail risk and financial conditions can shape loss persistence and economic recovery. Submitted to *Ecological Economics*, under review.

Monasterolo, I., Pacelli, A., Pagano, M., Russo, C. (2024). A European Climate Bond. *Economic Policy*, eiae065. DOI link: https://doi.org/10.1093/epolic/eiae065.

Monasterolo, I. and Raberto, M. (2018). The EIRIN Flow-of-funds Behavioural Model of Green Fiscal Policies and Green Sovereign Bonds. *Ecological Economics*, 144, pp. 228–243. DOI link: https://doi.org/10.1016/j.ecolecon.2017.07.029.