

A Channel-Based Framework for Endogenizing Climate–Inequality Dynamics in Macroeconomic models

Topic: Sustainable Inclusive Wellbeing (Beyond GDP) in Input-Output Analysis

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Climate change and inequality form a reinforcing feedback, but much of the macroeconomic–climate modelling literature still relies on aggregate damage representations and treats distribution as exogenous. This paper develops a transparent, top-down ecological macroeconomic framework that endogenizes climate–inequality dynamics within a demand-led multi-regional input–output (MRIO) accounting core. As a high level of disaggregation of economic activity is necessary, input-output data-based models with detailed inter-industry linkages representation are the most appropriate underlying macroeconomic models. The MRIO core captures cross-sectoral and cross-region propagation, enabling structurally explicit incidence analysis along global value chains. We conceptualize loop closure in evolutionary terms, as a set of cumulative causation mechanisms operating through sectoral propagation, group heterogeneity, and institutional feasibility. Three distributional channels link climate hazards to income and wealth: 1) agriculture and food prices, 2) differential exposure, losses, and adaptive capacity, and 3) wellbeing changes that may cumulate into persistent distributional divergence through health pathways. We then specify the reverse causality: how inequality amplifies emissions and weakens mitigation and adaptation through consumption heterogeneity, asset ownership, and wealth changes, thereby increasing future hazards and compounding distributional losses. We outline the minimal data required for implementation and identify binding gaps, particularly asset-type ownership matrices by household group and harmonized exposure/loss accounts. The framework is modular, allowing tiered empirical applications while making remaining reduced form assumptions explicit. These components support transparent calibration and sensitivity analysis.

Research questions

RQ1: What is the minimal set of explicit, tractable mechanisms required to close the feedback loop between climate change and inequality in a MRIO model while preserving transparency and accounting consistency?

RQ2: How does inequality feedback to climate outcomes through heterogeneous consumption footprints, asset ownership, and wealth dynamics, and what simplified representations are defensible in a top-down modelling setting?

The core is a demand-led MRIO model that solves output as a function of final demand through Leontief propagation, complemented by a price block to transmit sectoral shocks into product prices. Household heterogeneity is introduced by mapping distributional income and consumption information (e.g., deciles/quintiles and consumption baskets) into the MRIO product space via explicit concordance matrices and micro–macro reconciliation to national-accounts household final consumption totals. The macroeconomic core is treated deliberately in a general form–sufficient to ensure economy-wide accounting consistency and to host distributional and physical satellite accounts–while the main contribution is the explicit formalization of climate–inequality feedback loops.

The paper is conceptual and does not estimate the system empirically, but it specifies the data requirements necessary for operationalization. The macroeconomic core can be implemented using MRIO/IO tables (e.g., FIGARO) with standard final demand categories and value-added components. Environmental integration relies on environmental satellite accounts consistent with physical supply–use tables. Distributional integration requires household microdata and

distributional national accounts capable of allocating wages, profits, transfers, taxes, consumption baskets, and asset ownership across household groups (e.g., income deciles). Hazard and exposure components draw on climate and disaster datasets that support region-level hazard indices and event-based losses, while the wellbeing block requires social indicator datasets ideally disaggregated by income group. We highlight two particularly binding gaps for closing the loop: 1) harmonized asset-ownership matrices by household group and asset class that connect disaster-related capital losses to household wealth; and 2) consistent group-level exposure and vulnerability metrics that can be mapped to hazard indices.

The paper's novelty lies in explicitly closing the climate–inequality feedback loop within a transparent, top-down ecological macroeconomic framework, rather than treating inequality as ex-post indicator. We aim to extend the IO modelling tradition by embedding distributional heterogeneity directly into the final-demand block, enabling group-specific price exposure, income effects, and consumption-based footprints to be computed in an accounting-consistent way. Our framework also provides a systematic method to integrate stock–flow and balance-sheet dynamics, opening a route for IO analysis of climate-induced wealth redistribution. By specifying mechanisms and data needs clearly, the paper also