Different Paths, Different Outcomes: Comparing EU ETS Revenue Recycling Scenarios in a Hybrid CGE Model

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This paper assesses the macroeconomic, environmental, and distributional impacts of alternative strategies for recycling EU ETS and ETS2 revenues in the Czech Republic, using the MERCI-CZ model â€” a recursive-dynamic hybrid Computable General Equilibrium (CGE) model for the Czech Republic implemented in GAMS and solved as a Mixed Complementarity Problem. The model extends standard CGE approaches through three innovations: a disaggregated bottom-up electricity sector with technology-specific zero-profit conditions and capacity constraints across eight generation technologies; a discrete choice module for private vehicle purchases based on mixed logit estimation of Czech consumer survey data, capturing heterogeneous preferences over conventional vehicles, plug-in hybrids, and battery electric vehicles, coupled with a vehicle stock-and-flow accounting model; and an endogenous energy efficiency mechanism linking cumulative ETS-revenue-financed expenditures to input-specific productivity improvements in the nested production structure. Calibrated to Czech national accounts and sectoral data for 2018, with electricity capacities aligned to TIMES-CZ results from the National Energy and Climate Plan (NECP, 2024) and emission allowance prices following the European Commission's Harmonized Cost Trajectories, the model simulates five revenue recycling configurations through 2050 against a baseline without the Fit for 55 package. The scenarios vary along two dimensions â€” the type of expenditure (social transfers, green technology subsidies, energy efficiency investments, debt reduction) and the institutional setup (presence or absence of ETS2 and the Social Climate Fund) â€” enabling isolation of each instrument's marginal contribution. Results show that all scenarios entail significant macroeconomic adjustment, with GDP falling 4.5â€“6% below baseline by 2050. However, balanced strategies combining household support with targeted green investments (WAM NECP, WAM SCF) mitigate early GDP losses and even generate modest short-term gains, while scenarios excluding social transfers (WAM NoSocial, WAM Debt) dampen consumption and deepen mid-transition output losses. From an environmental perspective, all scenarios with ETS2 achieve sustained emission reductions, with the NoSocial scenario performing best due to the highest investment in energy efficiency, though at the cost of weaker short-term economic performance and absent household support. To address epistemological uncertainty, the paper additionally contrasts the neoclassical CGE results with those from the Post-Keynesian demand-led E3ME model applied to identical scenarios, revealing that theoretical assumptions about supply- versus demand-driven adjustment fundamentally shape the magnitude and even the sign of projected GDP and employment impacts. This dual-model comparison â€” rarely undertaken in applied climate policy analysis â€” demonstrates that E3ME produces consistently more optimistic GDP and employment outcomes, as its demand-led structure allows green investment to activate spare capacity rather than crowd out other uses. The analysis contributes to the literature by providing one of the first institutionally grounded, multi-scenario assessments of ETS revenue recycling for a Central European EU member state, embedded within a hybrid model architecture that combines macroeconomic general equilibrium with engineering detail, behavioral realism, and endogenous technological change. The findings confirm that no single recycling strategy dominates across all dimensions and that the optimal approach must balance support to households with targeted investments in low-carbon technologies to maintain economic viability, social equity, and environmental ambition simultaneously