The Coalition of Finance Ministers for Climate Action

GMMET: Global Macroeconomic Model for the Energy Transition

International Monetary Fund (IMF) Research Department

A contribution to the 'Compendium of Practice from a Global Community of Ministries of Finance and Leading Organizations: Economic analysis and modeling tools to assist Ministries of Finance in driving green and resilient transitions'

Topic: Modeling tools relevant to Ministries of Finance

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Access the full Compendium at www.greenandresilienteconomics.org

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Overview

The Global Macroeconomic Model for the Energy Transition (GMMET) is a multi-sector, multi-region dynamic macroeconomic model aimed at mapping mitigation policies to emissions reduction and macroeconomic and sectoral variables covering the four sectors of the economy: real (including consumption, investment, GDP, employment), external (trade, exchange rate), fiscal (Government revenue and expenditures, deficit, debt), and monetary (inflation, interest rate).

Strengths and limitations

GMMET balances the sectoral granularity (electricity, transportation, energy-intensive manufacturing, etc.) used to discuss various sector-specific policies (carbon tax, subsidies, regulations) with a macroeconomic framework used to discuss the role of structural, fiscal, and monetary policies. The main model results (the impact of mitigation policies on growth, inflation, fiscal balance) depend on key elasticities, for which the range of estimates is large, e.g., the substitutability between energy and capital, and between technologies or energies at the sectoral level. Redistributive implications (inequalities) and details of labor market analysis are not covered specifically. Climate damage and resilience policies are beyond the scope of the model.

Relevance to Ministries of Finance

GMMET has a two-country version (one country and the rest of the World) that can be calibrated on various cases using either country data or the inter-country input-output table GLORIA. This version is particularly suitable to assess the macroeconomic impact of different domestic decarbonization strategies for either forecasting (growth, inflation, trade balance) or public finance management (Government revenue, deficit, and debt dynamics).

Key policy/analytical questions addressed

A large set of policy questions could be addressed with GMMET. For instance, the model can inform the trade-off between growth-friendly mitigation policies (with a large part of subsidies) and debt sustainability (with a large part of greenhouse gas tax), can investigate the impact on the external sector (trade balance, financing needs, etc.) resulting from decarbonization (trade in green goods, fossil fuel, domestic investment needs), depending on the country-specific international specialization, or can assess the inflation dynamics and monetary policy response in different regimes (inflation targeting, fixed nominal exchange rate, or hybrid). It may also put mitigation policies in perspective in comparison with other structural policies (labor policies, tax reform).

Use in practice

The production and use of a version of GMMET for a specific country requires very specialized staff. Applications for Ministries of Finance are typically provided by the IMF as part of an Article IV or a staff report. The documentation of the model is publicly available. The GMMET team is working on sharing procedures with central banks and MoFs.

Future work

The model is under continuous development. In the latest iterations, key sectors have been identified and singled-out (i.e., energy-intensive sectors, construction, and buildings) to address specific questions such as investment needs in energy-efficient capital stock, the impact of border adjustment tax, or the cost passthrough along the value chain. The modeling team is also exploring the international specialization of transition commodities, such as metals, and goods such as electric vehicles and solar panels. Additionally, the team is working on two aspects of the modeling infrastructure: (i) streamlining and simplifying the model's calibration to enhance usability, and (ii) improving the reporting of model results.

Analysis in action

GMMET has been utilized for both global scenarios and country-specific analyses. For example, the model has assessed the impact of the U.S. Inflation Reduction Act on domestic and global greenhouse gas emissions, as well as its effects on inflation, growth, public revenues, and expenditures (Voigts and Paret, 2024). Another application, for the Dominican Republic, focuses on a reform of the energy sector and its implications for the economy (real, external, and fiscal). Although the reform does not primarily aim to reduce emissions, it modifies the energy mix, resulting in a change in emissions.

Reference

Voigts, S., and Paret, A.-C. (2024) *Emissions Reduction, Fiscal Costs, and Macro Effects: A Model-based Assessment of IRA Climate Measures and Complementary Policies*. Working Paper 2024/024, International Monetary Fund.