Policy design framework for balancing economic and environmental SDGs: Application to the Egyptian economy

Mohammed Basheer [1], Victor Nechifor [2], Alvaro Calzadilla [3], Julien Harou [1,4]

[1] Department of Mechanical, Aerospace and Civil Engineering, The University of Manchester, Manchester, UK.

[2] Joint Research Centre, European Commission.

[3] Institute for Sustainable Resources, University College London, London, UK.

[4] Department of Civil, Environmental and Geomatic Engineering, University College London, London, UK.

Abstract

In 2015, the 193 member states of the United Nations agreed on a plan to achieve 17 sustainable development goals by 2030. This paper introduces a framework for identifying economy-wide interventions to progress towards economy-related sustainable development goals. The framework is based on dynamic economy-wide simulation using computable general equilibrium, and artificial intelligence search. We demonstrate the framework for Egypt, a middle-income African country. The case study results reveal that hybrid economy-wide intervention policies into government poverty reduction programs, producer taxes/subsidies, and income taxes can reduce income inequalities and greenhouse gas emissions while maintaining at least the baseline growth in Gross Domestic Product.

Keywords: Computable general equilibrium; multi-objective search; Africa; IFPRI standard CGE model

1. Introduction

The world is facing several pressures that could intensify if business as usual economic, social, and environmental practices continue. Under a medium-variant projection, the global population is expected to reach around 9.7 billion in 2050 compared to 7.7 billion in 2019, with sub-Saharan Africa expected to contribute around half of this growth [1]. This rapid increase in population, along with economic development, urbanization, and changes in lifestyles, will increase demands for services, increase anthropogenic impacts, and push the planet rapidly towards planetary boundaries [2,3]. In 2019, around 23% of the world population lived in multidimensional poverty and under high inequalities within societies, with 57.5% of the sub-Saharan African population in multidimensional poverty [4]. The unfolding climate change is another threat to natural and social systems [5–10]. Tackling these

challenges and other social, economic, and environmental pressures has prompted global initiatives such as the Sustainable Development Goals (SDGs) [11].

At the 2015 United Nations Sustainable Development Summit, the 193 United Nations member states formally adopted the SDGs to be achieved by 2030 [12]. The 2030 agenda for sustainable development includes 17 goals and 169 targets that cut across social, economic, and environmental sustainability dimensions [12]. The SDGs have five focus areas: people, planet, prosperity, peace, and partnership, or the "five Ps," aiming at eradicating poverty, hunger, and inequalities, providing sustainable services (e.g., health, education, water, energy, and sanitation), promoting peace and justice, limiting environment damage, and combating climate change.

The uniqueness of countries and regions should be recognized and considered when designing national policies for sustainable development [13,14]. Often it falls on governments to devise and coordinate a national response to progress towards sustainable development, but what processes can be used to strategically select structural changes that would impact most economic sectors? Ideally, policy-makers and stakeholders would craft combinations of policies that aim for synergies and manage trade-offs between different goals [15,16]. For instance, climate mitigation and adaptation actions could have short-term trade-offs with other SDGs, such as poverty reduction and economic growth, although tackling climate change would have a long-term positive impact on 16 of the SDGs [17]. The actions needed to achieve the SDGs are further complicated by the multiple disciplines, sectors, actors, and levels that need to be involved in sustainability decision-making. Fragmented decisions on policy interventions would likely result in frictions and trade-offs between the SDGs. Such trade-offs and conflicts can be minimized or even avoided through comprehensive, inclusive dialogue considering various policy instruments that can be used to progress toward the SDGs. Interdependencies highlight the need for a coordinated and strategic multi-dimensional analysis and design of national policies.

2. Study contribution

This study introduces a new framework for designing national policies to progress toward the SDGs. The framework combines computer-based national-scale economy-wide sustainability performance simulation with Artificial Intelligence (AI) to search for efficient national economic policy portfolios that maximize synergies and minimize trade-offs between sustainable development goals and targets. Two AI algorithm types are used: a multi-objective evolutionary algorithm (to search for efficient policy portfolios) and a machine learning algorithm (to understand the effectiveness of different policy levers in achieving the SDGs). We demonstrate the framework on Egypt, a middle-income country with the second-highest CO_2 emissions in Africa, by unraveling the

trade-offs and synergies resulting from government economic interventions aimed at advancing some SDGs. In this application of the framework, we use a dynamic Computable General Equilibrium (CGE) model of Egypt's economy to simulate the country's performance in achieving targets related to SDG1 (no poverty), SDG8 (decent work and economic growth), SDG10 (reduced inequalities), and SDG13 (climate action). We then link the CGE model to AI algorithms to search for efficient national policy portfolios.

Based on 1.8 million 15-year dynamic simulations, five policy portfolios were selected to highlight the tradeoffs and synergies in achieving the SDGs considered. The selected policy portfolios show that aiming to achieve the highest GDP growth results in only a slight improvement in income inequalities, whereas targeting low inequality results in an accumulated GDP value close to the baseline. Achieving the highest GDP growth involves a 50% reduction in the total amount of government transfers to households, over 100% increases in income taxes on households, and around 50% reduction in subsidies on petroleum commodities. Results also show a tradeoff between rural and urban income. Reducing income inequalities requires increasing government transfers to households by 440%, channeling most government transfers to poor urban households, and increasing income taxes on rich households. Sustainability performance under a low emission portfolio shows a reduction in overall and urban inequalities, a reduction in rural income, an increase in urban income, and a slight improvement in GDP performance compared to the baseline. The low emission portfolio involves an increase in government transfers to poor urban households, thanks to resources available to the government as a result of cutting down energy subsides. Targeting a low emission portfolio involves reducing subsidies on petroleum commodities by around 90%. Results reveal that policy portfolios based on a combination of government poverty reduction programs, producer taxes/subsidies, sales taxes, and income taxes can reduce income inequalities and greenhouse gas emissions while maintaining at least the baseline growth in GDP.

3. References

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