Government Expenditure and Sustainable Development Prioritization: Lessons from the Policy Priority Inference Research Programme

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Artificial intelligence and computational models can support efforts to accelerate the implementation of the 2030 Agenda for Sustainable Development. This contribution examines the lessons learned from quantitatively analysing the linkage between government expenditure and development outcomes from a multidimensional perspective. It builds on the Policy Priority Inference (PPI) research programme,[2] which uses computational methods to analyse how budgetary priorities impact the performance of various development indicators representing interdependent policy dimensions. The computational approach developed in PPI enables multidimensional impact evaluation in the context of the Sustainable Development Goals (SDGs). It allows exploiting new open-spending data sets to understand how policy priorities shape the dynamics of the SDG indicators. This piece summarizes and reflects on insights obtained from various academic and policy studies, particularly regarding their policy implications. It looks at studies that focus on a single country (Mexico) and then at analyses comparing several countries.[3]

Data challenges: government spending, indicators, and computational models

The amount and quality of government spending data have increased in the past decade thanks to the efforts of public administrations and international organizations in setting standards for the publication of data sets.[4] The main objectives of these initiatives are to support the good-governance agenda and to empower citizens and non-governmental organizations by enabling the monitoring of public funds via fiscal transparency. While these efforts are commendable, using open-spending data for the sole purpose of promoting transparency is limiting. Given the ongoing multiple crises, it is important to move beyond monitoring concerns and take on impact-evaluation challenges. This type of analysis is indispensable when policymakers need to align government budgets to the SDGs.

Several barriers prevent using detailed expenditure data in impact evaluation across multiple interrelated development dimensions, such as those reflected in the SDGs. First, spending categories are usually mismatched with the policy issues covered by development indicators. This drawback means that the mapping of expenditure programmes to the outcome variables is far from perfect.[5] Second, since open-spending data sets are relatively new, they often come with few observations across time (the same happens for many development indicators). Such "small" data do not meet the technical requirements of methods stemming from econometrics and machine learning to produce impact evaluations.[6] Third, even when data on spending and indicators are "big", aligning budgets to the SDGs means that one needs to account for the interdependencies between SDG indicators, which is not an easily scalable task when employing expert analysis or traditional quantitative tools. Fourth, the efficacy of government expenditure varies depending on the institutional context of each country; thus, it is necessary to account for governance and political economy features such as technical inefficiencies and corruption.

Computational frameworks can help overcome these challenges by accommodating the intricacies of multilevel causal chains between government expenditure and development indicators. These analytical tools allow a detailed description (informed by theory and expert knowledge) of the process through which government programmes influence the dynamics of the outcome variables. This level of theoretical content is necessary to fill gaps related to the lack of data. In contrast to structural interventions such as building physical infrastructure or creating anti-poverty programmes, financial interventions mainly focus on the short term because they tend to operate with already existing policies. Thus, computational tools designed to analyse short-term interventions are important to properly understand the scope and reach of policy prioritization via budgets. One example is the PPI research programme, which builds on a type of artificial intelligence known as agent-based modelling or agent computing.

The Policy Priority Inference research programme

The PPI computational model simulates a central Government facing the problem of allocating resources to a set of agencies that must implement the existing programmes. The model considers that the implementation of such programmes may not be efficient since public officials have conflicting incentives (including competing goals). In addition, the effectiveness of these programmes may be limited by long-term structural factors such as poor infrastructure and lack of capacity. Initially, PPI started with a model specifying how Governments formulate policy priorities–in terms of budgets[7] –in a setting with uncertainty and interdependencies. Then, through collaboration with the United Nations Development Programme (UNDP), the framework was improved to make it usable with open-spending data of various levels of granularity in the context of the SDGs.

PPI accounts for the interdependencies between indicators and institutional factors that shape a country's quality of governance. Because it is a simulation tool, it enables counterfactual analyses to assess the impact of government expenditure at a high level of disaggregation. This capability is essential for producing multidimensional impact evaluations and quantifying concepts used in discussions on SDG implementation (such as accelerators and bottlenecks). Finally, the algorithmic nature of PPI allows the inclusion of expert knowledge regarding the distinction between policy issues that can be affected by government programmes (instrumental) and those where the Government has limited or no influence (collateral).

PPI has been used in collaboration with local and national governments (including Colombia and Mexico), specialized agencies (such as Public Health Wales and the Office for National Statistics in the United Kingdom of Great Britain and Northern Ireland), and international organizations (including UNDP). In some cases, it has been adopted as part of planning processes and assessment exercises. The rest of this contribution elaborates on how PPI has been used to draw new insights related to policy prioritization in various countries in the context of the 2030 Agenda.

Country-level experience: the case of Mexico

The development of PPI has benefited from country-specific studies. Several of them have focused on Mexico (between 2008 and 2021) as its Government holds one of the best expenditure data sets available in terms of both disaggregation and time coverage. For instance, one of these studies quantifies the concept of accelerators–a policy issue that, if well-funded, can catalyse development in other dimensions through indirect effects. Surprisingly, in Mexico, there are more SDG accelerators than bottlenecks (33 SDG targets out of 75 are identified as accelerators). Among these catalysers, targets 3.7 (ensure universal access to sexual and reproductive health-care services) and 16.5 (substantially reduce corruption and bribery in all their forms) stand out as the two most influential targets. The policy implications are self-evident: when considering development dimensions with similar development levels, policymakers should secure funding for the associated targets identified as accelerators to produce systemic impacts.

PPI has also been applied to investigate how socioeconomic deprivation[8] has evolved in Mexico due to the financing of government programmes, remittances, and the domestic income of households. The results show the importance of household remittances in alleviating poverty, not only due to their monetary importance but also because they reach their targets through channels other than those used for public spending. Furthermore, these results indicate that income shocks can severely harm social progress, so Governments would have to implement compensatory measures through focalized public spending.

Finally, PPI was used to analyse SDG implementation at the subnational level, considering the large fiscal imbalances across the 32 Mexican states. The analysis focused on how federal transfers to the states could be reconfigured to reach the aspirations captured by one specific SDG or all of them simultaneously.[9] These transfers, traditionally justified in terms of compensation for historical inequalities related to poverty rates (SDG 1), are allocated annually through the Fiscal Coordination Act via a mathematical formula. PPI was used to evaluate whether the formula employed by the Fiscal Coordination Act provides the best possible allocation when the government prioritizes SDG 1. The results indicate a high sensitivity of the optimal allocations to the Government's development goals and that federal transfers could be better allocated according to the SDGs that the Government seeks to prioritize.

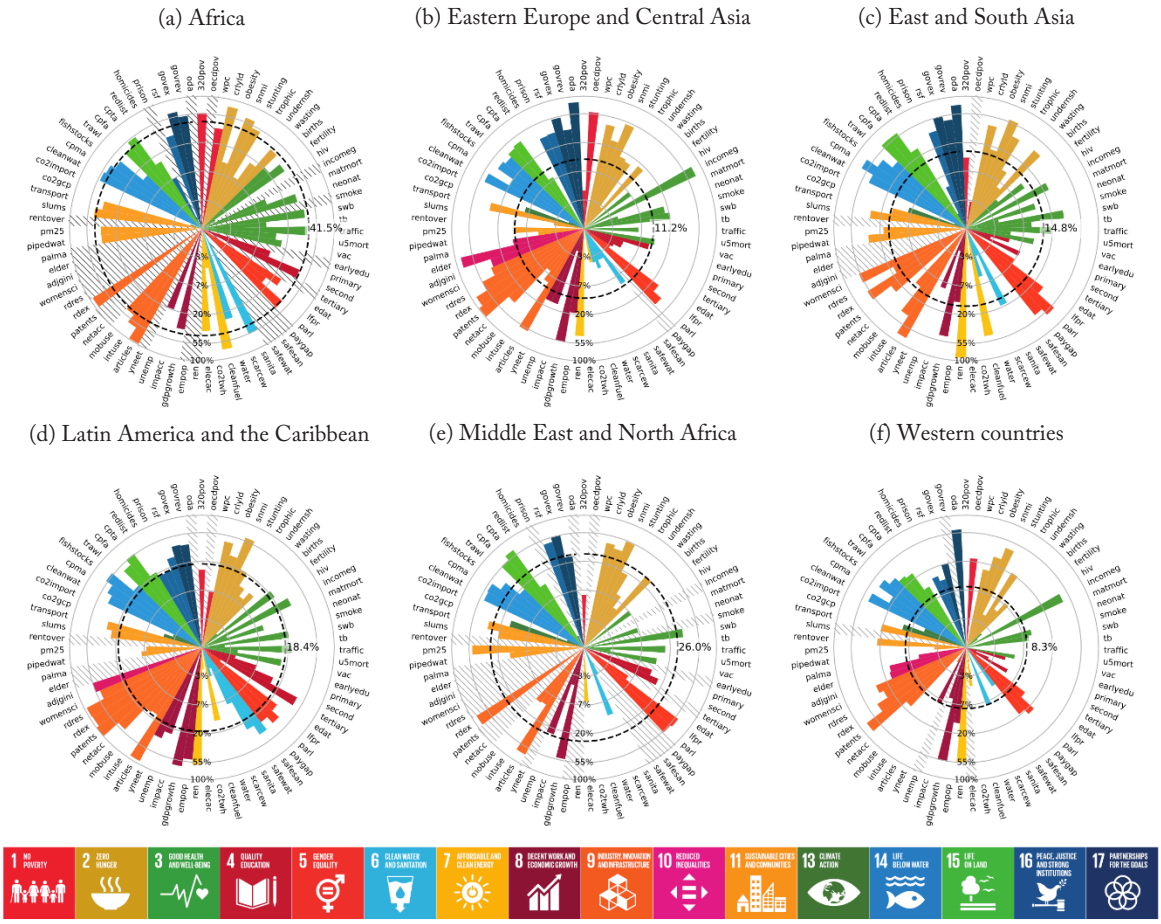
Why has public spending shown modest impact on the SDGs?

Moving to multi-country studies, the first lesson derived from PPI is not surprising: the 2030 Agenda is overambitious. Even without considering the COVID-19 pandemic, numerous development gaps will remain by 2030 (and even by 2040),[10] with the findings suggesting wide disparities across indicators and countries. As illustrated in figure 1, Western countries are expected to experience an 8.3 per cent average SDG gap, Eastern Europe and Central Asia an 11.2 per cent gap, Eastern and Southern Asia a 14.8 per cent gap, Latin America and the Caribbean an 18.4 per cent gap, the Middle East and North Africa region a 26.0 per cent gap, and Africa a 41.5 per cent gap.

The response of development indicators to budgetary changes varies considerably across SDGs, countries and regions. One way to measure the potential impact is through the number of years saved (or lost) to close the gaps through increments (or reductions) in the budget. For instance, in an average country in Latin America and the Caribbean, the largest impact of budgetary increments corresponds to SDG 13, while the smallest one corresponds to SDG 8. In contrast, for the average country in the West, an augmented budget produces the largest impact on SDG 5 and the smallest one on SDG 1. This type of analysis has implications for Governments in terms of identifying policy issues that respond well to additional public expenditure and could boost SDG implementation.

While there are indicators that respond well to financial interventions, government spending on others is ineffective as a result of long-term structural factors such as poor infrastructure, lack of capacity, or ill-designed government programmes. These constraints create idiosyncratic bottlenecks, which are specific to individual policy issues and vary across country contexts.

Expected development gaps in 2030



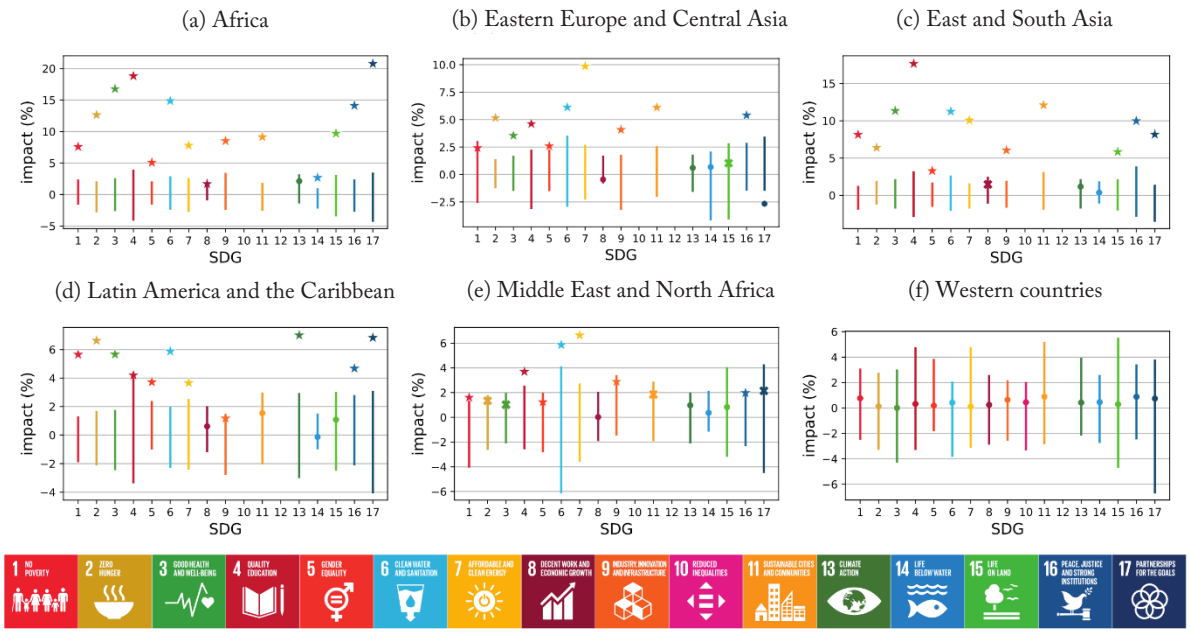
Source: Omar A. Guerrero and Gonzalo Castañeda, *Complexity Economics and Sustainable Development: A Computational Framework for Policy Priority Inference* (Cambridge, United Kingdom, Cambridge University Press, 2023).

Notes: Each bar indicates the expected gap in a specific indicator in 2030, averaged across the countries in the same group. The striped areas indicate that such an indicator was not available for any country in the group. The dashed ring denotes the average expected gap, and its value appears on the right. The concentric circles and the bars are presented in logarithmic scale, so differences are larger in the outer circles. These estimates use indicator data from the *Sustainable Development Report 2021*; SDG 12 lacks observations in this data set.

When the estimates from all countries are pooled together, SDG 9 stands out as the most prominent host of potential bottlenecks. On the contrary, there are no bottlenecks related to SDG 8 in any of the six groups of countries. When analysing country groups, Eastern and Southern Asia is particularly salient as the region that exhibits the most indicators subjected to idiosyncratic bottlenecks. Interestingly, countries in Latin America and the Caribbean do not present bottlenecks in programmes associated with poverty reduction (although this is a prevalent issue in the region). Consequently, their poor performance might be related to limited funding. This type of result is crucial to support Governments when determining whether a short-term financial intervention would have a significant impact or if a revamp of government programmes is necessary.

Another relevant finding relates to SDG 16 and the impact of the quality of governance on corruption. Less developed countries face greater challenges in finding the right mix between prioritizing improvements in governance versus other policy dimensions in terms of budget allocations. Additional public expenditure in governance may contribute to higher corruption levels as the underdevelopment of other SDGs may reinforce a corruption-focused strategy of public servants (for example, extracting bribes in service delivery). Finding this balance is more difficult because the interdependencies between SDGs, social norms of corruption, and higher institutional uncertainty create a more volatile environment in terms of how corruption responds to government expenditure. This result is aligned with country-level data showing that corruption has not decreased in the global South despite substantial investments in improving governance (a well-known paradox in the corruption literature).

SDG-level impact of international aid by country grouping



Source: Omar A. Guerrero and Gonzalo Castañeda, *Complexity Economics and Sustainable Development: A Computational Framework for Policy Priority Inference* (Cambridge, United Kingdom, Cambridge University Press, 2023).

Notes: The markers (dot, cross and star) indicate the statistical significance level of the impact metric: star = significant at 99 per cent; cross = significant at 95 per cent; and dot = not significant. The vertical line represents the distribution range for the impact metric. The impact metric measures the percentage of development that is attributed to the relevant aid funds; see Omar A. Guerrero, Daniele Guariso and Gonzalo Castañeda, "Aid effectiveness in sustainable development: a multidimensional approach", *World Development*, vol. 168 (August 2023), 106256, available at https://doi.org/10.1016/j.worlddev.2023.106256. The sample period in this study corresponds to 2000-2013. The data set contains only aid recipient countries. The indicators data were obtained from the *Sustainable Development Report 2021* (SDG 12 lacks observations), the aid flows data from AidData, and total government expenditure from the World Bank.

The contribution of international aid to multidimensional development

PPI has also been used to estimate the SDG impact of international aid. The results show that aid exerts positive impacts across SDG indicators for several country groups, though not for emerging economies within the Organisation for Economic Co-operation and Development. When looking at the average impacts on SDG indicators across countries, 52 (out of 74) indicators experience a statistically significant impact. Aid is effective in contributing to progress on several indicators across SDGs 2, 3, 4, 6, 7, 11 and 17. In contrast, aid weakly influences progress on indicators related to SDGs 8, 9, 10, 14 and 15.

A call for better data and computational modelling in evidence-based policymaking

Computational frameworks such as PPI have great potential to help Governments address SDG implementation challenges. To harness this potential, it is important that Governments commit to the systematic generation of high-quality data in terms of both indicators and government expenditure. Furthermore, Governments should seek to advance efforts to tag expenditure data to development categories such as the SDGs, which would allow linking expenditure programmes to development indicators. New artificial intelligence methods could support these efforts to scale up budget tagging.[11]

At present, technical barriers remain for the wider adoption of computational models to inform SDG implementation and sustainable development policies more generally. There are challenges in terms of computational literacy and the understanding of complex systems among both technical teams in Governments and social science scholars. Thus, Governments and research and educational institutions should further invest in the emerging field of computational social science to endow the new generations of decision makers and social scientists with a mix of skills and interdisciplinarity that would allow them to advance holistic and innovative policies to respond to the global sustainable development challenges of the twenty-first century.

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Endnotes

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2 Information on the Policy Priority Inference research programme is available at www.policypriority.org.

3 The lessons reviewed in this contribution come from various published academic studies as well as policy reports prepared in collaboration with local governments and international organizations; source details are provided in the Works Cited section of this contribution. Many of the analyses and their technical details have been synthesized in a new book produced by the present authors.

4 Two examples are the work of the Global Initiative for Fiscal Transparency and the integrated national financing framework developed by the United Nations Development Programme (UNDP, SDG *Alignment and Budget Tagging: Towards an SDG Taxonomy--Analysis for Colombia* [UNDP Colombia, 2022], p. 60, available at https://www.undp.org/sites/g/files/zskgke326/files/migration/co/UNDP_Co_POB_Publicacion_SDG_Aligment_and_Budget_Tagging_Methodology_May23_2022.pdf).

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7 Gonzalo Castañeda, Florian Chávez-Juárez and Omar Guerrero, "How do Governments determine policy priorities? Studying development strategies through networked spillovers", *Journal of Economic Behavior and Organization*, vol. 154 (2018), pp. 335-361.

8 Socioeconomic deprivation is a recent framework for conceptualizing poverty, inspired by the ideas of Amartya Sen regarding the provision of capabilities and liberties. It considers poverty a problem relating not only to income but also to education, health, housing, nutrition, economic well-being, and social security. The lack of access to one or more of these rights implies socioeconomic deprivation.

9 In Mexico, most taxes are collected by the federal Government and then redistributed to the states through federal transfers. The study addressing fiscal imbalances analyses a specific type of transfer called *contribution* as it accounts for nearly 50 per cent of the states' budgets.

10 A development gap is measured as the distance between the level of an indicator and the value that the Government aspires to reach. The values for both existing indicators and aspirations are provided by the *Sustainable Development Report 2021* data set.

11 Daniele Guariso, Omar A. Guerrero and Gonzalo Castañeda, "Automatic SDG budget tagging: building public financial management capacity through natural language processing".