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Fiscal sustainability, public expenditure and economic growth

Botero et al. (2020)

Economics and Business Studies Group (GEE)

Agenda

- Motivation.
- Description of the model.
- Model Calibration.
- Structure of the simulated infrastructure program.
- Simulation results.
- Final considerations.

There are many investment opportunities in a society that are not being made because their benefits cannot be appropriated by the private sector. Nevertheless, these investments could generate positive externalities of undoubted benefit to society. Therefore, it is a matter of creating public-private schemes that guarantee the appropriateness of these externalities by private agents, and which therefore trigger virtuous circles of economic growth that are beneficial to society.

In this sense, this work evaluates an infrastructure construction program through public-private partnerships, using a Recursive Computable General Equilibrium Dynamic Model, which explains in detail the functioning of the Colombian economy. The model considers formal and informal markets, monopolistic competition, and includes heterogeneous companies, using a Melitz approach.

The model focuses on the three aspects that describe the trilemma of public finances:

1) Short-term effects, assessed through an "investment-led" macroeconomic closing, which allows to capture the impact of investment in roads above the level of economic activity.
2) The inclusion of externalities in production functions, to capture supply and productivity effects.
3) The careful and detailed modeling of public debt, including endogenous revenues that reflect productive activity, the financial costs of borrowing, which are sensitive to the government´s indebtedness, and the payment of investment through "future funds" provisions..

There are two positions beetwen analyst:

- Those who emphasize the sustainability risks that would arise from not addressing binding restrictions, and therefore recommend fiscal austerity policies,
- Those who insist on the need to find space for public spending, in order to face not only the problems of growth dynamics, but also the distributive problems, which have gained prominence in recent years.

Both sides are right, but their considerations are incomplete:

- The costs associated with the excess spending would outweigh the benefits.
- But this, of course, should not make us forget the urgent need for public policies that encourage growth, improve the reallocation of resources, boost innovation and productivity, and confront the problems of legitimacy that derive from the generalized perceptions about the distributive issues that affect the world today.

So, we need carefully designed public policies that, while maintaining strict compliance with budget restrictions, make room for spending tools with a long-term impact on economic activity.

- There is a wide field for these policies in the productive relationship of governments with private capital.
- There are many investment opportunities in a society, which are not exploited because its benefits are not privately appropriable, but which generate positive externalities of undoubted benefit to society.
- It is then a matter of creating public-private schemes that convert externalities into positive benefits to society, guarantee their appropriability by private agents, at least to the point where they justify the investment, and thus unleash virtuous cycles of economic growth which benefit society.

A typical example is the Colombian transportation infrastructure investment program, through Public-Private Partnerships (PPP), which is generally known as the 4G (fourth generation) highways program. The program involves the construction of nearly 8,000 km of roads, through concession programs.

This type of programs solves what we could call the fundamental trilemma of public finances:

- mobilize public resources efficiently,
- without sacrificing the financial sustainability of public entities,
- and generating welfare benefits for the entire society.

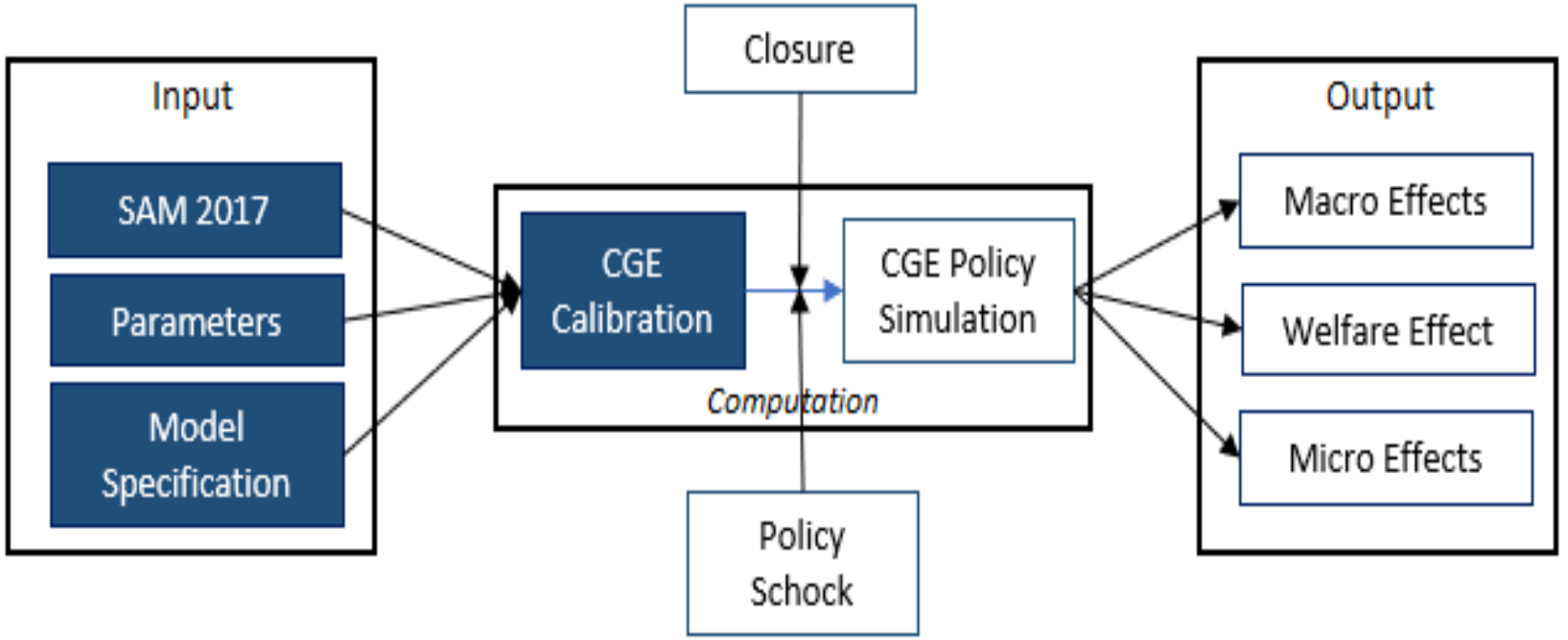
The program invites the private sector to make investments in infrastructure, guaranteeing an adequate financial return, through “future budgetary commitments", and therefore has three types of effects:

- Keynesian effects, due to the role that public investment has in the short-term dynamics of the economy (demand effects).
- Positive externalities on production and competitiveness, allowing the country’s producers to connect with international markets (supply effects).
- Positive effects on public finances because, when the programs are well structured, they generate public revenues in advance, which are then used to pay the disbursements contemplated in the “future budgetary commitments " (sustainability effect).

The program illustrates what should be the priority of public policies at the present time:

- Expansionary demand policies,
- Which generate productivity effects in the medium and long term,
- Without sacrificing the sustainability of public finances.

Description of the model

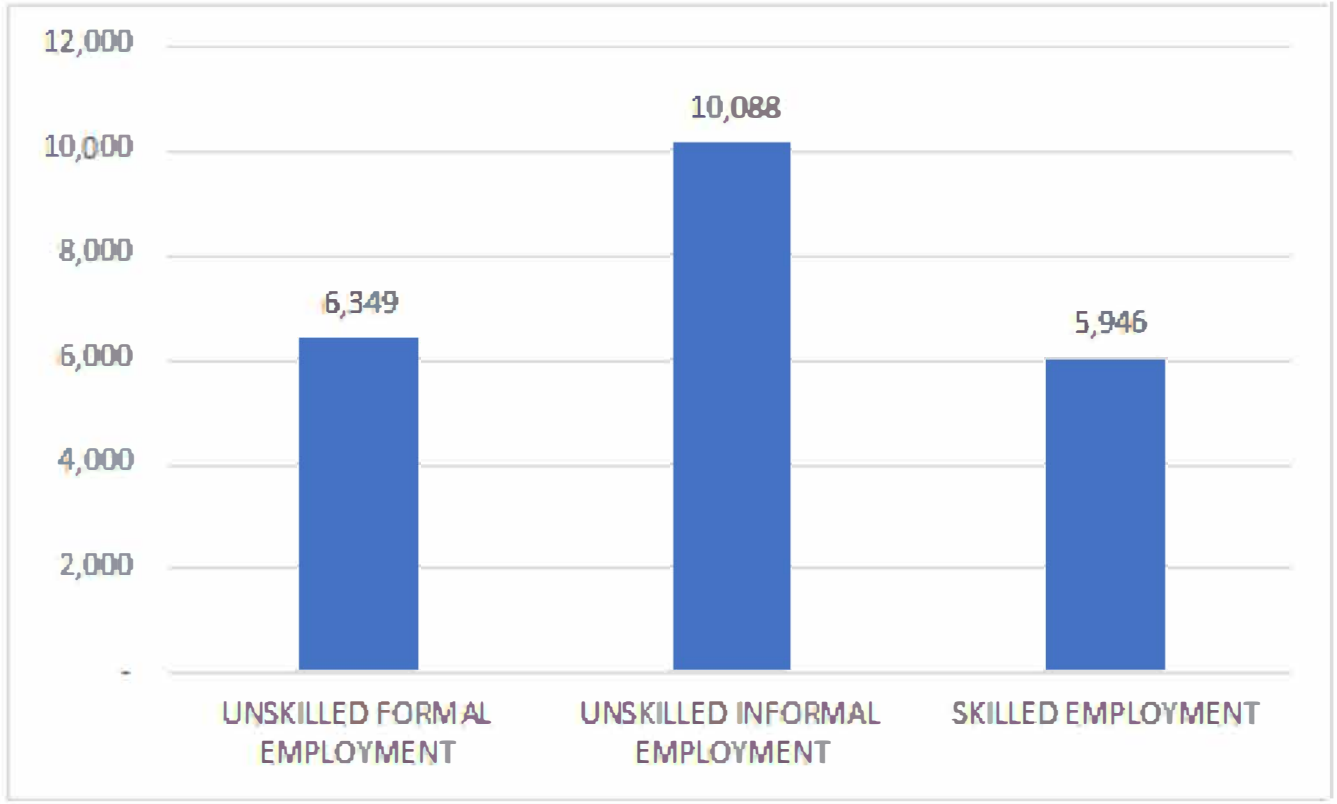


A Recursive Computable General Equilibrium Dynamic model

- 12 productive branches,
- 16 basic types of products,
- 16 trade partners in the world
- Three types of productive resources: skilled labor, unskilled labor and capital.

SECTORS	PRODUCTS
Agricultural activities	Agricultural activities
Mining	Oil
	Other mining products
Manufacturing	Food
	Other consumption products
	Intermediate inputs
	Capital goods
Electricity and gas	Electricity and gas
Construction	Housing and infrastructure
Commerce	Wholesale, Retail and hotels
	Transportation
ICT	Information and telecommunication
Financial sector	Financial activities and insurance
Real estate	Real estate activities
Profesional services	Profesional services
Public administration	Public administration, Health and education services
Other services	Other services activities

The model considers formal and informal markets, capturing a fundamental characteristic of the Colombian economy (its degree of informality, close to 50% measured through informal work), incorporates monopolistic competition, and includes heterogeneous companies, using the Melitz approach, which tries to account for the way the country is inserted in international markets.



Total Employment in Colombia 2017 (thousands)

- Formal technologies use capital, skilled labor, and unskilled labor, and their value added is modeled using a CES production function at two levels: in the first, skilled and unskilled labor are added, while in the second, aggregated work and capital are added. Entrepreneurs minimize costs, given the capital stock they have, and demand both types of work, equating wages with the value of their marginal product.
- For the formal technologies, we assume monopolistic competition in all sectors but agriculture, which operates under perfect competition.

- Informal technology is a fixed coefficient technology, in which the added value depends only on the amount of work done.
- Informal technology operates under perfect competition, because there is no differentiation in its services and products, and there is no market power either.
- Both technologies use intermediate inputs in fixed proportions to produce the final goods or services, but there are indirect taxes only on formal technologies.

- The aggregation of formal and informal products and services is modelled using a CES function, in such a way that it is assumed that the productions of both technologies are imperfect substitutes.
- And the total production resulting from this aggregation is distributed among the types of products through a production matrix, which details the composition of the sector's production.

- The types of products obtained serve as basic inputs to value-generating entrepreneurs, who satisfy the demands of domestic and external consumers, and who are heterogeneous in terms of their productivity and differentiated in their ability to satisfy consumer needs with its generated economic value.
- The narrative underlying this modeling scheme is as follows: there are productive, formal and informal entrepreneurs, who generate goods and services, which are used by value entrepreneurs to satisfy the demand of different types of consumers.

- The underlying logic for productive entrepreneurs is to manufacture objects or to produce services efficiently, that is, at the least cost possible, and the concept of productivity as efficiency operates for them.
- The underlying logic of value entrepreneurs, on the other hand, is to convert those objects and services into well-being for consumers, and the concept of productivity that apply to them is improvement through innovation.

- The value-added entrepreneurs are, by definition, heterogeneous, so their behaviour is modeled as Melitz (2003).
- The distribution function is assumed to be a Pareto distribution.
- They face “iceberg cost” in each market they serve, and their possibility to serve that markets depends on their productivy.
- Free entry to the market is assumed.

- External demand is modeled using the function of compound good (the traditional Armington function of the general equilibrium literature), while in the domestic markets, there are trade entrepreneurs, who buy domestic goods and imported goods to minimize the cost to consumers of the purchases made.
- This is also expressed in the well-known CES function system, in the Armington way.
- So, the model is an Armigton-Melitz model, to capture the differentiation in inputs, and the heterogeneity in products.

- The model considers five agents: households, companies, central government, decentralized government and the rest of the world.
- It generates the corresponding factor incomes, and includes inter-institutional transactions, in four main categories:
  - Payment of taxes.
  - Social security contributions and benefits.
  - Property income represented in dividends, interest, royalties or other payments.
  - Transfers.

- The resulting disposable income is dedicated to savings or consumption.
- Government demand is distributed among product types, using fixed coefficients.
- Household demand is modeled on two levels: at the first level, the representative household chooses a given category of goods: agricultural, industrial, or services, which is modeled using the Almost Ideal Demand System, which allows to discriminate price and income elasticities between the categories considered.
- At the second level, consumption is distributed among the types of goods,in fixed proportions.

- The external market is adjusted by exchange rate, given an exogenously determined capital flows. And household savings are adjusted to balance the model, given an exogenously determined investment, which includes investment in infrastructure.
- It is therefore an “investment-driven“ model.

Model calibration

		Expenses					
		Productive sectors (12)	**Products (16)**	**Production factors (3)**	**Institutions (5)**	**Transactions**	**Savings-Investment**
Income	**Productive sectors (12)**		Production matrix				
	Products (16)	Input - Output			Consumption expenditure - Exports		GFCF - Inventories
	Production factors (3)	Added value	Taxes - Tariffs				
	Institutions (5)		Imports	Payment factors assignment - Indirect taxes		Tax income received	
	Transactions				Transfers		
	Savings-Investment				Savings - Debts		

Parameter	Sector	Value
Aggregation elasticity of unskilled work	All	0.9
Aggregation elasticity of skilled and unskilled work	All	0.9
Elasticity of the frontier of production possibilities CET	All	-1.5
Export demand elasticity	All	1.5
Composite good elasticity	Goods	1.48
Elasticity of the product to public capital	Central National Government	0.06
Added value elasticity	All	0.9

Investment projection, activation of works and future values. Millions of pesos 2019				
Year	Investment	Activation of works	Future budgetary commitments	Contingent Liability Balance with agents
2020	8,168			8,168
2021	8,168			16,867
2022	8,168			26,131
2023	8,168	32,671		35,997
2024	8,168			46,505
2025	8,168			57,696
2026	8,168			69,614
2027	8,168			82,307
2028	8,168	40,840		95,825
2029			14,396	87,657
2030			14,396	78,958
2031			14,396	69,694
2032			14,396	59,827
2033			14,396	49,320
2034			14,396	38,129
2035			14,396	26,211
2036			14,396	13,518
2037			14,396	-
TOTAL	**73,511**	**73,511**	**129,568**	

Structure of the simulated infrastructure program. Source: Own calculations

Results of simulation

The effect of the infrastructure investment is threefold: first, it generates an important source of demand growth, associated with the investment made; second, it generates productive externalities, which improve the overall productivity of the economy as a whole; and third, the fiscal effort is spread over the investment period, generating additional payment sources, associated with the incremental tax collections that are generated.

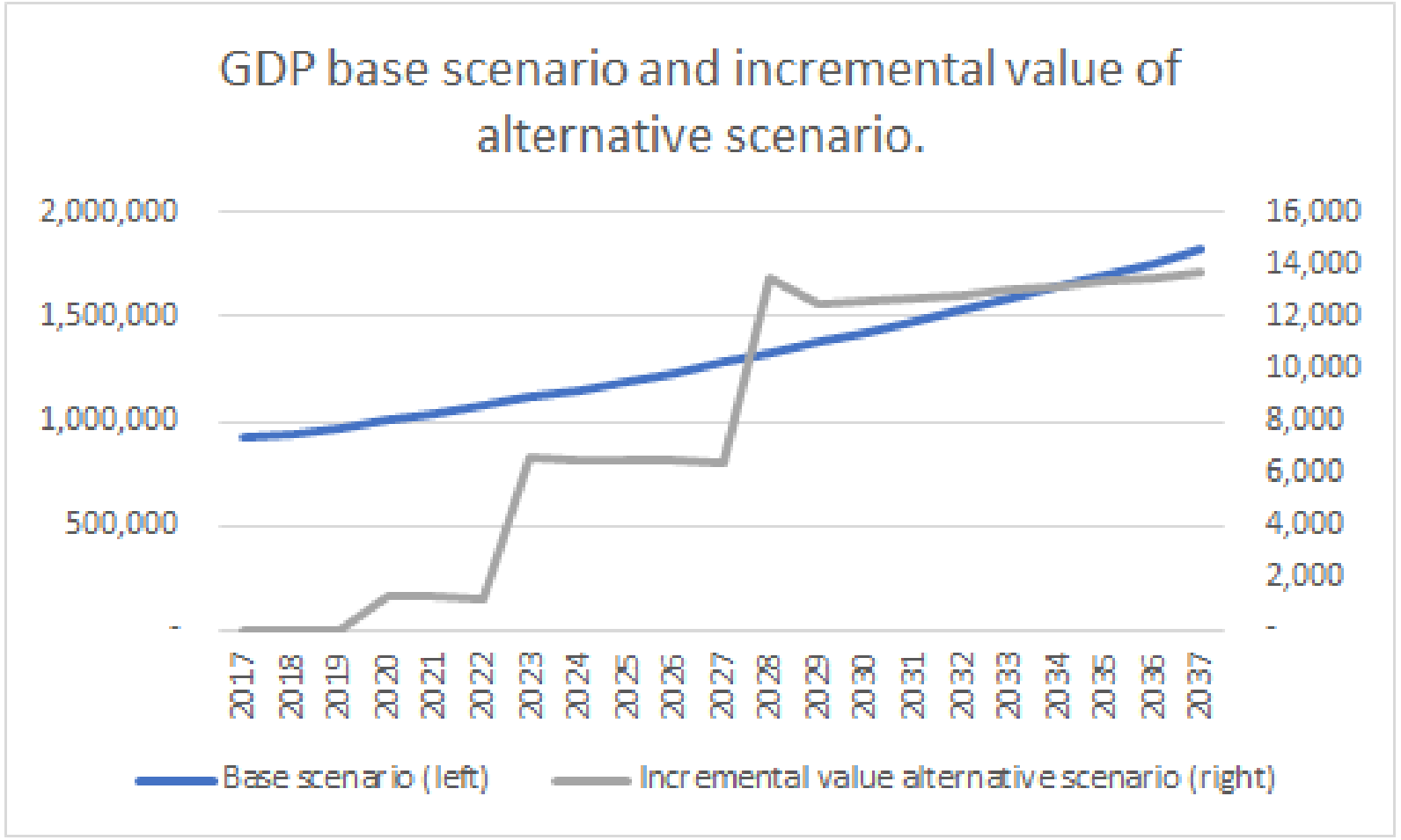
Results of simulation

Simulation results. Alternative scenario final values			
Variable	**Initial year. Billions of pesos**	**Final year. Base scenario. Billions of pesos of 2017**	**Final year. Alternative scenario. Billions of pesos of 2018**
GDP	920,195	1,818,606	1,832,352
Unemployment rate	9.37%	8.40%	8.30%
Public surplus or deficit	-3.7%	-2.7%	-2.7%

Source: Model CGE

The table may prove misleading, because final GDP shows relatively little difference with base scenario, but it highlights three things: first, it is a public effort carried out through public-private partnerships that permanently raises GDP; second, improves the overall employment in the economy; and third, does it without adversely affecting public finances.

	GDP ($MM 2017)		UNEMPLOYMENT RATE		DEFICIT CENTRAL GOVERMENT (% GDP)	
	BASE	PPP	BASE	PPP	BASE	PPP
2017	920,195	920,195	9.4%	9.4%	-3.7%	-3.7%
2018	942,913	942,913	9.3%	9.3%	-3.6%	-3.6%
2019	971,708	971,708	9.6%	9.6%	-3.6%	-3.6%
2020	1,004,654	1,005,951	9.3%	9.2%	-3.7%	-3.7%
2021	1,037,780	1,039,057	9.1%	8.9%	-3.6%	-3.6%
2022	1,074,935	1,076,192	8.8%	8.6%	-3.5%	-3.5%
2023	1,112,103	1,118,697	8.6%	8.3%	-3.4%	-3.4%
2024	1,151,366	1,157,926	8.3%	8.1%	-3.3%	-3.2%
2025	1,192,570	1,199,089	8.2%	8.0%	-3.3%	-3.1%
2026	1,235,514	1,241,999	8.1%	7.9%	-3.2%	-3.0%
2027	1,279,958	1,286,415	8.0%	7.8%	-3.1%	-2.9%
2028	1,326,340	1,339,770	8.0%	7.7%	-3.0%	-2.8%
2029	1,374,592	1,387,088	7.9%	7.8%	-3.0%	-2.9%
2030	1,424,641	1,437,247	7.9%	7.8%	-2.9%	-2.9%
2031	1,476,412	1,489,137	7.9%	7.8%	-2.9%	-2.8%
2032	1,529,827	1,542,686	7.9%	7.8%	-2.8%	-2.8%
2033	1,584,804	1,597,811	8.0%	7.9%	-2.8%	-2.7%
2034	1,641,258	1,654,429	8.0%	7.9%	-2.7%	-2.7%
2035	1,699,104	1,712,451	8.1%	8.0%	-2.7%	-2.7%
2036	1,758,251	1,771,788	8.3%	8.2%	-2.7%	-2.7%
2037	1,818,606	1,832,352	8.4%	8.3%	-2.7%	-2.7%



Source: Model CGE

The increase in GDP begins in 2020, because of the Keynesian effect of demand, associated with the investment. In the years between 2023 and 2037, in which the investment is made, the supply effect occurs: program is completed, having a positive impact on factorial productivity and the output.

The final difference is a permanent level change, which must of course have additional effects, but even, without considering these permanent effects, the net present value of the difference between the GDP in the alternative scenario and the base scenario is 105 trillion pesos or 1.44 times the investment made. An outcome that is achieved without increasing the taxes that society must pay!

Final considerations

This article argues the following: there are investment opportunities in a country that are not adequately exploited, because they produce external effects that cannot be captured by investors. These opportunities correspond to investments that increase total productivity, allowing for higher levels of production without necessarily increasing the productive resources used.

Final considerations

If there are no adequate institutional conditions, such investments will not be made. The role of the government should be to design markets suitable for these externalities, making investment possible. In carefully chosen investments, which have a clear social and productive benefit, projects can generate the future income that pays for them, thus producing a positive welfare effect on society.

Final considerations

Of course, this makes the "expansive policies-sustainability" dilemma perhaps a poorly posed dilemma, because there is a wide range of opportunities in which it would not operate. It is up to the government to identify "worthwhile investment opportunities" that increase overall well-being, without overwhelming impact on the balance of public finances. With a suitable mix of market design and financial engineering, it is possible to realize these opportunities.

But identifying those opportunities, designing markets and the mechanisms to implement them, becomes perhaps one of the most important functions of the state.

Thanks

References

Ahmed, V., Abbas, A., & Ahmed, S. (2013). Public Infrastructure and Economic Growth in Pakistan: A Dynamic CGE-Microsimulation Analysis (pp. 117-143). https://doi.org/10.1007/978-3-319-03137-8_5

Ashimov, A. A., Borovskiy, Y. V., Novikov, D. A., Sultanov, B. T., & Onalbekov, M. A. (2020). Macroeconomic Analysis and Parametric Control Based on Global Multi-country Dynamic Computable General Equilibrium Model (Model 1). In Macroeconomic Analysis and Parametric Control of a Regional Economic Union (pp. 73-201). Springer, Cham.

Asturias, J., García-Santana, M., & Ramos, R. (2019). Competition and the welfare gains from transportation infrastructure: Evidence from the Golden Quadrilateral of India. Journal of the European Economic Association, 17(6), 1881-1940.

Balistreri, E. J., & Rutherford, T. F. (2013). Computing general equilibrium theories of monopolistic competition and heterogeneous firms. In Handbook of computable general equilibrium modeling (Vol. 1, pp. 1513-1570). Elsevier.

Baker, N. B., Khater, M., & Haddad, C. (2019). Political Stability and the Contribution of Private Investment Commitments in Infrastructure to GDP: An Institutional Perspective. Public Performance and Management Review, 42(4), 808-835. https://doi.org/10.1080/15309576.2018.1523064

Botero, J. (2011). Desempleo e informalidad en Colombia: Un análisis de equilibrio general computable.

Botero, J. (2011). Effect of Taxes on Capital and Labor in Colombia: A Computable General Equilibrium Analysis. Ecos de Economía VO - 15, (33), 49. Retrieved from http://search.ebscohost.com/login.aspx?direct=true&db=edssci&AN=edssci.S1657.42062011000200003&lang=es&site=eds-live

Bovaird, T. (2004). Public-private partnerships: From contested concepts to prevalent practice. International Review of Administrative Sciences, 70(2), 199-215. https://doi.org/10.1177/0020852304044250

Chen, Z., Daito, N., & Gifford, J. L. (2017). Socioeconomic impacts of transportation public-private partnerships: A dynamic CGE assessment. Transport Policy, 58, 80-87.

Chen, Z., & Haynes, K. E. (2015). Spatial impact of transportation infrastructure: a spatial econometric CGE approach. In Regional science matters (pp. 163-186). Springer, Cham.

Chen, Z., & Haynes, K. E. (2017). Measuring the Impact of Infrastructure Systems Using Computable General Equilibrium Models. In Regional Research Frontiers-Vol. 2 (pp. 79-103). Springer, Cham.

Chisari, O., Maquieyra, J. A., & Miller, S. J. (2012). Manual sobre Modelos de Equilibrio General Computado para Economías de LAC con Énfasis en el Análisis Económico del Cambio Climático. Bid, 261. Retrieved from https://goo.gl/1NDx5A

Chong, E., Huet, F., Saussier, S., & Steiner, F. (2006). Public-private partnerships and prices: Evidence from water distribution in France. Review of Industrial Organization, 29(1-2), 149-169.