# Macroeconomic and Fiscal Effects of Increased Efficiency in Medicine Procurement: A General Equilibrium Analysis of the Colombian Health System

**Authors:** Oscar Ávila-Montealegre, Sebastian Bauhoff, Jesús Alonso Botero-García, Laura Giles Álvarez, Santiago León-Moncada, Cristhian Larrahondo, Luis Ignacio Lozano-Espitia, Ligia Alba Melo-Becerra, José Luis Ortiz-Hoyos y Jesús Rodríguez-Ávila

December, 2024

UNIVERSIDAD EAFIT

# Macroeconomic and Fiscal Effects of Increased Efficiency in Medicine Procurement: A General Equilibrium Analysis of the Colombian Health System

**Authors:** Oscar Ávila-Montealegre, Sebastian Bauhoff, Jesús Alonso Botero-García, Laura Giles Álvarez, Santiago León-Moncada, Cristhian Larrahondo, Luis Ignacio Lozano-Espitia, Ligia Alba Melo-Becerra, José Luis Ortiz-Hoyos y Jesús Rodríguez-Ávila

## Executive Summary

This study analyzes the macroeconomic and fiscal effects of greater efficiency in medicines procurement in Colombia, using both static (computable) and dynamic general equilibrium models. The findings indicate that implementing an efficient drug procurement policy could reduce the total health system spending, with potential savings of up to 8.4% in the short term and up to 10.8% in the long term. These savings could be reinvested within the health system, allocated to other sectors, or used to reduce tax burden on capital, consumption, or social contributions. The latter option would increase production by up to 1.1%, investment by 1.7% and consumption by 0.8%. Potential measures to achieve such efficiency gains include promoting and purchasing generic drugs, conducting joint procurement, and implementing price regulation.

**JEL codes:** C68, D58, E62, H21, H51, I11, I18.

**Keywords:** Medications, health expenditure, health system, Colombia, taxes, general equilibrium models, pharmaceutical policy.

## Acknowledgments

This technical note is part of a study on the macroeconomic and fiscal effects of greater efficiency in the purchase of medicines in the Colombian health system, conducted jointly with the Inter-American Development Bank, Banco de la República and Universidad EAFIT. The authors thank Osmel Manzano, Leandro Andrian, Pamela Góngora, Claudia Vaca and Tatiana Andia for their comments, revisions and suggestions. They also thank Juan José Ospina and Juan Esteban Carranza for their management and coordination of this study.

**Cataloging-in-Publication data provided**
**by the Inter-American Development Bank**
**Felipe Herrera Library**

Macroeconomic and Fiscal Effects of Increased Efficiency in Medicine Procurement: A General Equilibrium Analysis of the Colombian Health System/ Oscar Ávila-Montealegre, Sebastian Bauhoff, Jesús Alonso Botero-García, Laura Giles Álvarez, Santiago León-Moncada, Cristhian Larrahondo, Luis Ignacio Lozano Espitia, Ligia Alba Melo-Becerra, José Luis Ortiz-Hoyos, Jesús Rodríguez-Ávila.

p. cm. — (IDB Monograph ; 1250)

Includes bibliographic references.

1. Drugs-Prices-Colombia. 2. Generic drugs-Economic aspects-Colombia. 3. Drugs-Colombia-Generic substitution. 4. Medical care, Cost of -Colombia. I. Ávila-Montealegre, Oscar. II. Bauhoff, Sebastian. III. Botero García, Jesús. IV. Giles Álvarez, Laura. V. León, Santiago. VI. Larrahondo, Cristhian. VII. Lozano Espitia, Luis. VIII. Melo-Becerra, Ligia. IX. Ortiz, José Luis. X. Rodríguez-Ávila, Jesús. XI. Inter-American Development Bank. Andean Group Countries Department. XII. Serie.

IDB-MG-1250

**Keywords: Medications, health expenditure, health system, Colombia, taxes, general equilibrium models, pharmaceutical policy.**
**JEL codes: C68, D58, E62, H21, H51, I11, I18.**

Copyright © 2024 Inter-American Development Bank ("IDB"). This work is subject to a Creative Commons license CC BY 3.0 IGO (https://creativecommons.org/licenses/by/3.0/igo/legalcode). The terms and conditions indicated in the URL link must be met and the respective recognition must be granted to the IDB.

Further to section 8 of the above license, any mediation relating to disputes arising under such license shall be conducted in accordance with the WIPO Mediation Rules. Any dispute related to the use of the works of the IDB that cannot be settled amicably shall be submitted to arbitration pursuant to the United Nations Commission on International Trade Law (UNCITRAL) rules. The use of the IDB's name for any purpose other than for attribution, and the use of IDB's logo shall be subject to a separate written license agreement between the IDB and the user and is not authorized as part of this license.

Note that the URL link includes terms and conditions that are an integral part of this license.

The opinions expressed in this work are those of the authors and do not necessarily reflect the views of the Inter-American Development Bank, its Board of Director s, or the countries they represent.

# Table of contents

1
Introduction ....... 7

2
Literature review ....... 8

3
The health sector in Colombia ....... 9

4
Methodology ....... 12

5
Results ....... 15

6
Policy Options ....... 21

References ....... 23

Annexes ....... 26

# Acronyms

| | |
|---|---|
| **ADRES** | Administrator of Social Security Resources in Health |
| **CGEM** | Computable General Equilibrium Model |
| **COP** | Colombian Pesos |
| **DANE** | National Administrative Department of Statistics |
| **DGEM** | Dynamic General Equilibrium Model |
| **DSGE** | Stochastic Dynamic General Equilibrium Models |
| **EPS** | Health Promoting Entities |
| **GDP** | Gross Domestic Product |
| **GG** | General Government |
| **IPS** | Health Service Provider Institutions |
| **PBS** | Health Benefits Plan |
| **SGSSS** | General System of Social Security in Health |

# 1 Introduction

Access to health care services in Latin America and the Caribbean has improved over the last decade, as shown by the Universal Health Coverage Index, which increased from 58 to 76 between 2000 and 2021 (CEPAL, 2023). However, health spending has also risen, from 6.6% to 7.9% of GDP in the last two decades (Gutiérrez, Palacio, Giedion, & Distrutti, 2023). Total health spending is expected to continue increasing, driven by demographic changes, technology, and the expansion of health coverage (Rao et al., 2022). This has raised growing concerns about financial sustainability.

In Colombia, this challenge is particularly relevant, as the country's per capita health expenditure significantly higher than the regional average: USD $943 per capita between 2015 and 2019, compared to USD $667 on average in Latin America and the Caribbean (Goyeneche and Bauhoff, 2023). A key component of health spending in Colombia is spending on medicines, which reached COP 11 trillion in 2020, representing 19% of total health spending and 1.1% of GDP (Gutiérrez et al., 2023). This percentage is notably higher than the Latin American and Caribbean average, where spending on medicines represents around 16% of health expenditure (Vargas, Rama, & Singh 2022).

Given this context, optimizing medicines procurement without compromising coverage or quality has become increasingly relevant for the Colombian health system (Garber & Sculpher 2011). Savedoff et al. (2023), for example, propose strategies such as fostering competition, regulating prices in non-competitive markets, promoting the use of bioequivalents or generics to reduce costs, and linking payments to the efficiency and quality of health services. However, little is known about the macroeconomic and fiscal effects of drug price regulation of in the country.

This study examines the macroeconomic and fiscal effects of increasing efficiency in drug procurement within the Colombian health system. A general equilibrium approach is applied using two models: a Computable General Equilibrium Model (CGEM) and a Dynamic General Equilibrium Model (DGEM). The CGEM evaluates the impacts of improved efficiency in drug procurement on public health spending, the fiscal deficit and economic growth, providing insights into the financial sustainability of more efficient drug purchasing policies. The DGEM, on the other hand, analyzes the effects of different efficiency scenarios on production, consumption, and investment, offering insights into their long-term implications.

Section 2 reviews relevant literature on efficiency in health systems and specific strategies to enhance it in medicines procurement and use. Section 3 describes the Colombian health system. Section 4 outlines the methodology used to assess the fiscal and macroeconomic effects of different efficiency scenarios. The results are presented in Section 5. Finally, Section 6 explores policy options to improve efficiency in drug procurement.

# 2

# Literature review

A substantial body of international literature examines health expenditure efficiency using a range of methodologies. Among parametric techniques, Stochastic Frontier models have been widely applied (Grigoli & Capsules, 2018;Novignon & Lawanson, 2014;Varabyova & Schreyögg, 2013).Data Envelopment Analysis has been the dominant non-parametric technique (Gayneche & Bauhoff, 2023;Bajaro et al., 2023;García-Escribano et al., 2022;Herrera & Ouedraogo, 2018;Sun et al., 2017;Monterubbianesi et al., 2017;Steel et al., 2017; Hsu, 2013). These approaches compare health system inputs with outcomes, often revealing large variations in efficiency across and within countries. General findings from this literature emphasize the need for improved resource management and allocation of to achieve better cost-benefit outcomes and enhanced health results.

In Colombia, analyses of health spending efficiency have gained prominence. Data Envelopment Analysis (DEA) has been used to assess the technical efficiency of Colombian hospitals and other health service providers (Botello Peñaloza, 2014;Ruiz-Rodríguez et al., 2016;Maza Ávila et al., 2012;Murillo et al., 2018;España et al., 2011). These studies highlight regional and institutional variations in efficiency and identify opportunities to enhance health sector performance. Using Stochastic Frontier Techniques, Melo-Becerra et al. (2023) also found efficiency disparities among health service providers, many of which faced financial difficulties. Additionally, allocation issues have been analyzed in other studies using inequality indices and panel models (Espinosa et al., 2022;Slavic-Schmalbach et al., 2008).

Health spending efficiency significantly impacts the macroeconomy and public finances (Darvas et al., 2018). Several studies have employed stochastic dynamic general equilibrium (DSGE) models to examine the economic impacts of the health sector through various approaches. Keshavarzi & Horry (2023);Ani et al. (2020) andMcKibbin & Fernando (2021)analyze the effects of health shocks, such as disasters and pandemics. Atolia et al. (2021) and Ehrlich & Yin (2013) examine government policies and spending limits, while Jung & Tran, (2008) as well as Radhika & Elizabeth, (2008) explore the interplay between public and private healthcare. Finally, Melo-Becerra et al. (2023) apply computable general equilibrium and stochastic dynamic models to evaluate risks such as demographic changes and the evolving patterns of chronic non-communicable diseases.

The pharmaceutical sector plays a pivotal role in health spending efficiency and has gained increasing global importance (José et al., 2020; Kumari, 2024). This has prompted greater demand for strategies to improve efficiency in drug spending. Norway implemented a price regulation system for generic drugs (Dalen et al., 2006), while Germany adjusted drug prices based on clinical effectiveness (Lauenroth et al., 2020). Denmark reformed its reference price calculation (Kaiser et al., 2010) and countries like Chile (Raventós and Zolezzi,

2015) and Jordan have used joint procurement to reduce drug prices (Al-Abbadi et al., 2009). Additionally, the introduction of bioequivalents (Allende et al., 2024), and Health Technology Assessment-based negotiations in Ireland (McCullagh et al., 2014) have also demonstrated significant benefits.

In Colombia, the inclusion of medicines in the benefits plan has reduced prices and boosted sales but has also led to higher prices and volumes for drugs with limited competition (Romero, 2017 and Arias et al., 2023). Price regulation had mixed effects, reducing prices in some cases while increasing them in others (Bardey et al., 2021). Although price inflation has slowed, real pharmaceutical spending has doubled due to the "portfolio effect", which has also raised prices for unregulated products (Prada et al., 2018 and Andia, 2018). Finally, spending on high-cost medicines remains substantial, suggesting the need for more efficient alternatives to ensure the sustainability of the health system (Gutiérrez et al. 2023).

# 3

# The health sector in Colombia

The Constitution established that the Colombian state must guarantee universal access to health promotion, protection, and recovery services. The General System of Social Security in Health (SGSSS for its Spanish acronym) was created by Law 100 of 1993 to provide this access and. Under this system, health insurance is mandatory and managed by Health Promoting Entities (EPS, by its Spanish acronym) through two regimes: subsidized and contributory[1]. These entities are responsible for managing health insurance and ensuring the provision of services, technologies, and medicines to the population. They do so by contracting with Health Service Provider Institutions (IPS) in exchange for an annual amount paid to the EPS for each affiliate, known as the Capitation Payment Unit (UPC, by its Spanish acronym) (Melo-Becerra et al., 2023).

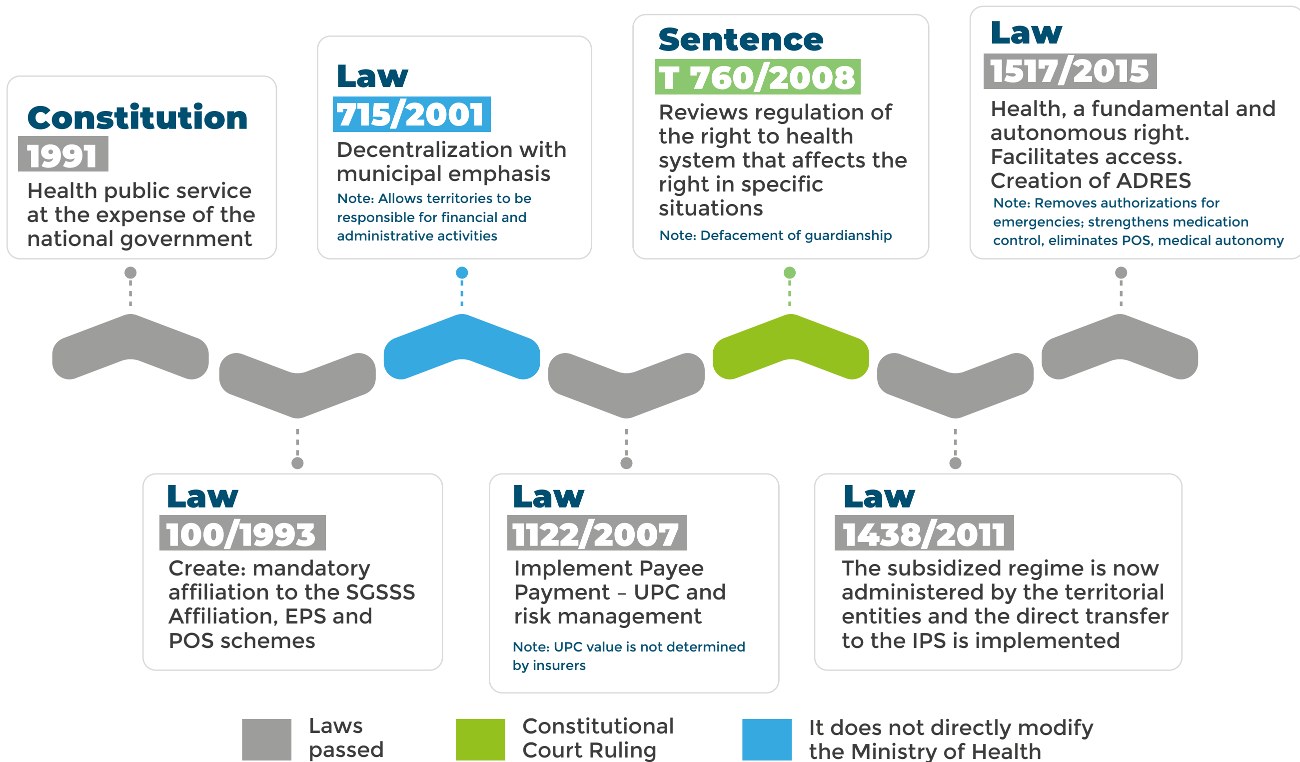
The UPC value is calculated annually using actuarial methodologies based on the benefits covered by the health system and their costs from the previous year. It is adjusted according to criteria such as age, sex, geographical location, and population projections. Thus, the UPC represents the expected cost of the health benefits to be financed and is determined as a fixed amount per affiliate. It covers the obligations of the Health System while allowing a margin of profitability for insurers (Ministry of Health and Social Protection, 2023). According to Resolution 2366 of 2023, the UPC currently covers 96.76% of all authorized medicines in the country.

Since the creation of the SGSSS, various laws and constitutional rulings have introduced significant changes to the health system, focusing on institutional adaptation, sustainability, and financing improvements. Notably, Law 1438 of 2011 established the updating and unification of the benefits plan between the two regimes, laid the groundwork for a pharmaceutical policy, and allowed

[1] The contributory regime covers formal and independent workers who can pay, along with their families; affiliates contribute a percentage of their monthly income. The subsidized regime provides health services to vulnerable populations that cannot afford to contribute to the health system and is primarily financed by the government. Additionally, there is an exception regime that offers coverage to specific groups, such as the Armed Forces, Police, and teachers, through special schemes that operate independently of the general SGSSS.

direct payments to IPS. Additionally, Statutory Law 1517 of 2015 brought major changes, by transitioning the health benefits plan from an explicit list of services and technologies to an exclusion-based plan. This shift enhanced access guarantees, defined a comprehensive pharmaceutical policy, and implemented drug price regulation.

**Figure 1. Structural reforms to the SGSSS**



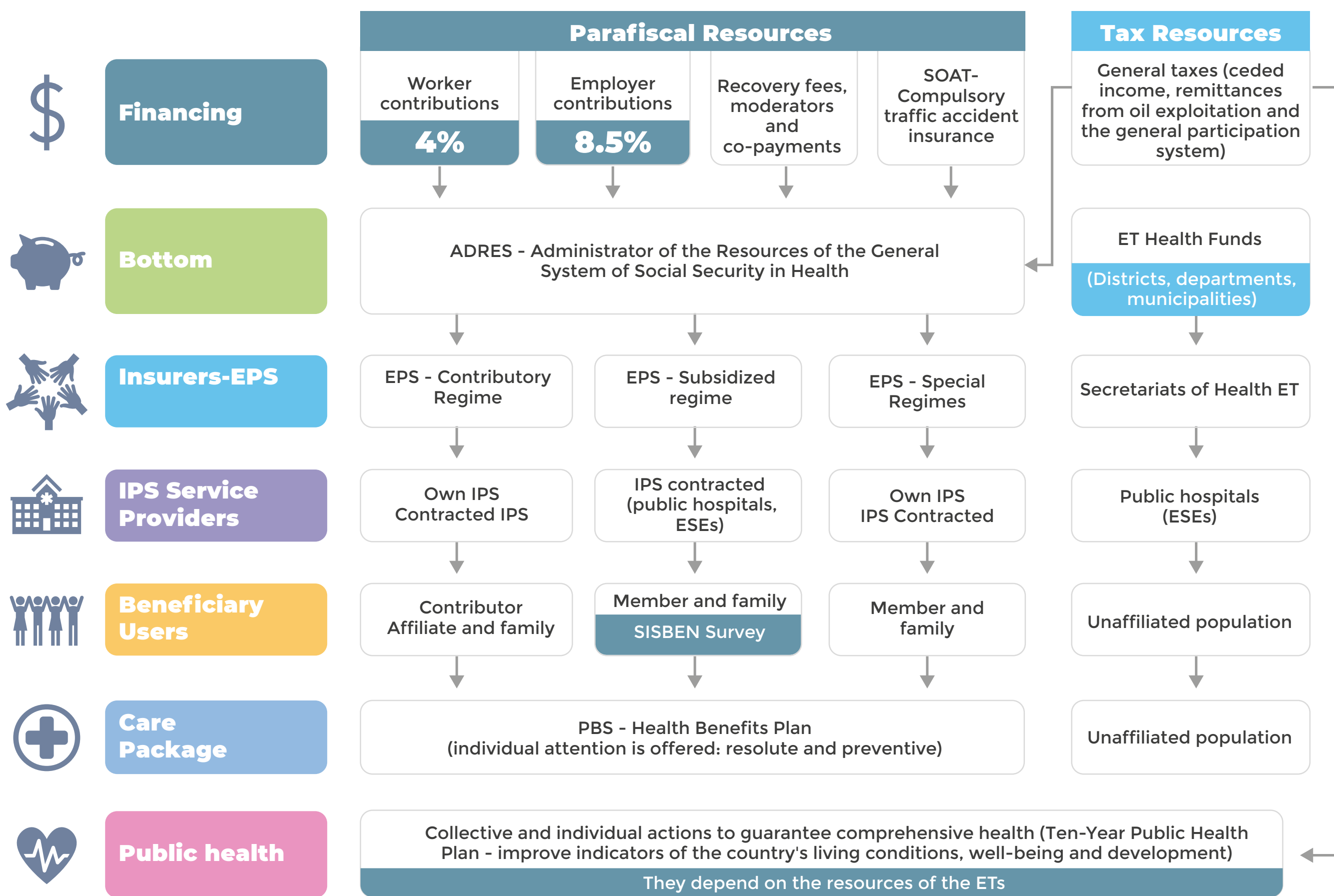

Source: Authors' elaboration.

The health system includes several key stakeholders. The Ministry of Health and Social Protection acts as the regulatory and governing body of the system. Entities such as the National Superintendence of Health and the National Institute of Drug and Food Surveillance are responsible for the inspection, surveillance and control of the EPS and IPS, as well as establishments involved in the production and marketing of health products (Observatorio Fiscal Universidad Javeriana, 2022). The Administrator of Social Security Resources in Health (ADRES, by its Spanish acronym) centralizes and manages the system's funds for both regimes, transferring resources from the UPC to the EPS and making direct payments to some IPS[2] and territorial entities for promotion and prevention programs (Granger et al., 2023).

[2] The EPS are primarily responsible for paying the IPS according to their contractual agreements. ADRES directly pays the IPS in specific cases, such as for high-cost services or treatments included in the Health Benefits Plan (PBS) that are not covered by the UPC.

Beneficiaries in the contributory regime contribute to the health system in proportion to their income level, while companies also cover a part of this insurance[3]. These resources are used to partially finance the coverage of beneficiaries in the subsidized regime. Fiscal resources, including national revenues, taxes on cigarettes and alcohol, the General System of Participations[4] (SGP, by its Spanish acronym), and resources from territorial entities, further complement health system financing (Granger et al., 2023). The 2023 health system budget was COP 82 trillion, with 90% allocated to UPC payments(ADRES, 2023).

**Figure 2. General Operating Structure of the SGSSS**




Source: (Chávez et al., 2021)

[3] Companies are exempt from contributing 8.5 points for workers with incomes of up to ten times the legal minimum wage.

[4] The System of General Participation refers to the resources that are transferred from the nation to the territorial entities to finance basic needs for health, education, drinking water and sanitation.

All SGSSS affiliates are entitled to the same Health Benefits Plan (PBS),[5] managed by the EPS. In 2024, the PBS included 1,146 drugs and active ingredients, approximately 2,500 procedures and 1,271 laboratory tests, all funded through UPC resources. The Ministry of Health updates the PBS annually and adjusts the UPC value based on variables such as age, sex, and geographic location(Arias et al., 2023).

Approximately 98.9% of the Colombian population has health coverage, primarily through the subsidized regime[6]. Other significant health milestones include improvements in indicators such as infant mortality, which declined from 25 to 11 per 1,000 live births between 1995 and 2021 (Banco Mundial, 2021) and pentavalent vaccination coverage for children, which reached 94% in 2019 (MSPS, 2020).

Despite these advances, Colombia faces considerable challenges, particularly in health financing, which threaten the system's sustainability and the preservation of recent achievements. One key factor driving financial pressure is the adoption of advanced health technologies, including new medicines and procedures, which generally drive up costs. Gutiérrez and Gómez (2018) estimate that technological changes accounted for 45% to 67% of the increase in per capita health spending in Colombia between 1996 and 2014. Additional challenges include misallocation of sector spending (Botello Peñaloza, 2014) and inefficiencies in management and governance(Espinosa et al., 2023).

To address these issues and manage fiscal constraints, Colombia has implemented several measures to control health spending, particularly on medicines, technologies, and procedures. Key initiatives include the Maximum Value of Recoveries and the Maximum Budgets, which set spending caps for non-PBS health technologies based on retrospective and prospective calculations (Arias et al., 2023). Additionally, following the National Pharmaceutical Policy guidelines in CONPES 155 of 2012[7], the country began implementing medicine price controls by comparing international reference prices (see Circular 18 of 2024 for further details). Additionally, Law 1753 has facilitated the determination of new medicine prices based on therapeutic value, though this has yet to be fully implemented (Castillo, 2021).

4

# Methodology

This study evaluates the macro-fiscal effects of implementing measures to enhance efficiency in medicine procurement in Colombia. It first estimates potential cost savings in medicine expenditures, followed by an analysis of macro-fiscal effects on both the health sector and the overall Colombian economy using two general equilibrium models[8].

[5] Under the jurisprudence stemming from the 2015 Statutory Health Law, Colombia has a comprehensive PBS that excludes only technologies intended for aesthetic or cosmetic purposes, those not approved in the country, and those lacking sufficient clinical evidence. Additionally, since the enactment of Law 100, individuals have used legal mechanisms, such as tutela actions, to obtain access to procedures and medications not covered in the Benefits Plan.

[6] According to data from the Ministry of Health, at the end of 2023, 49.9% of the insured population was in the subsidized regime, 44.7% in the contributory regime, and 4.2% in the exception regime.

[7] It aims to promote policies that improve access, timely dispensing, quality, and appropriate drug use based on population needs, regardless of individuals' ability to pay.

[8] The CGEM and DGEM models were initially used to calculate the effects on health system spending and various macroeconomic variables associated with risks facing the system, including demographic and morbidity pattern changes and rising service demand (Melo et. al., 2023).

The initial analysis uses a Computable General Equilibrium Model (CGEM) to evaluate impacts on public health spending, the fiscal deficit, and economic growth. This is supplemented by a Dynamic General Equilibrium Model (DGEM) which analyzes financing alternatives and their effects on production, consumption, investment, and the labor market over various time horizons.

Data from the Drug Price Information System, the Ministry of Health and Social Protection, and the Administrator of Resources of the General System of Social Security in Health (ADRES) are used to examine the macroeconomic and fiscal effects of efficiency measures in drug procurement and their implications for the sustainability of the health system.

### 4.1 Calculation of Drug Demand and Potential Savings Scenarios

The demand for medicines in 2023 is calculated using data on institutional transactions, sales, and repayment/payment operations (see Annex 1 for further details). Medicines are categorized based on their inclusion in the PBS and whether they are subject to price regulation. As stipulated in Circular 06 of 2018, entities must report the minimum and maximum unit prices for medicine procurement monthly. Here, an "efficient procurement" is defined as a transaction conducted at the minimum unit price—the lowest cost obtained by an entity when procuring the same drug at varying prices in a single month. Based on this approach, three efficiency scenarios are proposed:

**(1)** All purchases are efficient.

**(2)** Only purchases of regulated drugs are efficient.

**(3)** Only purchases of unregulated drugs are efficient[9].

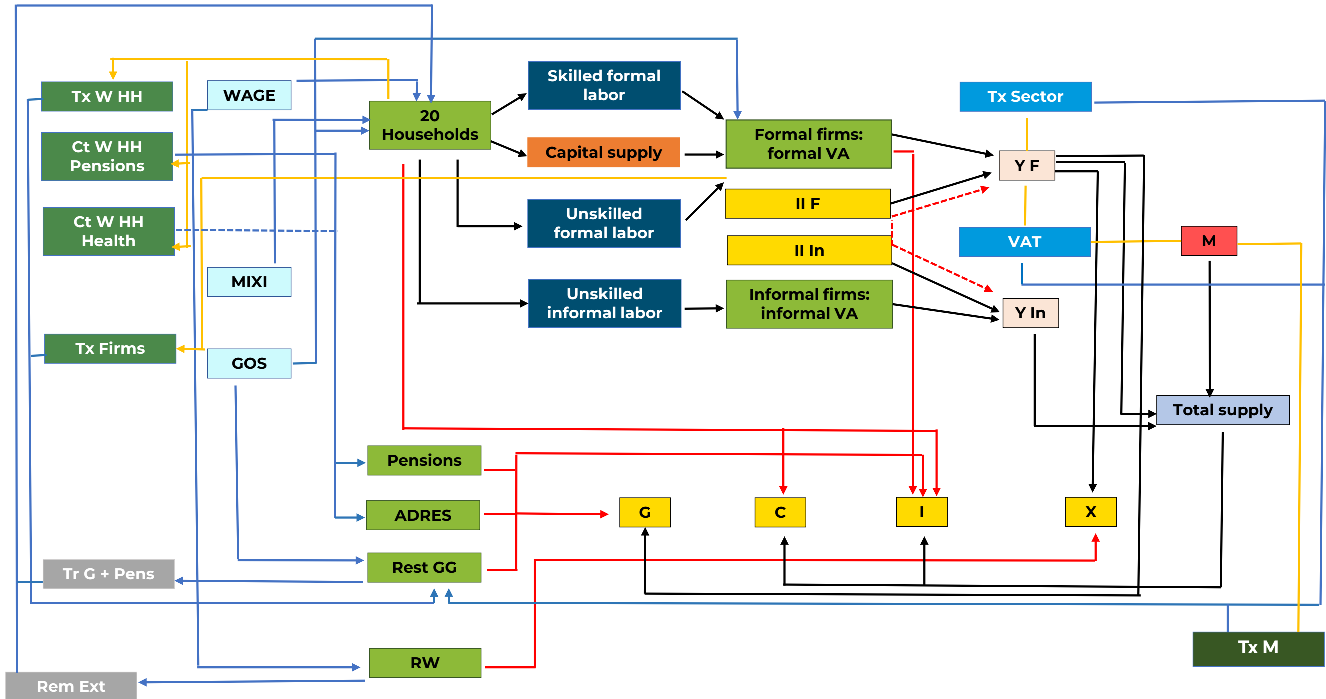
### 4.2 Computable General Equilibrium Model (CGEM)

The CGEM simulates interactions among various economic agents within markets for goods, services, and factors. Households allocate a fixed portion of their income to savings, while government agencies—including ADRES, the National Central Government and local administrations—manage income and expenses, generating residual savings. Additionally, the economy receives foreign funds to finance the current account in the balance of payments, contributing to gross capital formation. Savings availability serves as a binding constraint on economic growth.

Figure 3 illustrates the interactions among economic agents: households, firms, the government, and the external sector. Black arrows represent the supply of goods and services, red arrows indicate demand from various agents, yellow arrows reflect tax payments, and blue arrows show income received from taxes or factor income. Price changes affect the value of the UPC (the annual insurance premium paid per member).

[9] Potential savings in each scenario were calculated by comparing the total invoiced value in 2023 with the hypothetical value that would have been invoiced if purchases had been made efficiently according to each scenario

**Figure 3. CGEM Outline**




Source: Melo et al. (2023)

The model's simulations project the trajectory of public health spending, the fiscal deficit, and economic growth over a 17-year period (2023-2040). Different scenarios are considered, incorporating changes in demographic patterns based on National Administrative Department of Statistics projections, increases in service demand due to new medical procedures, and the raising costs associated with Chronic Non-Communicable Diseases[10]. Starting in 2024, the UPC is adjusted to account for expected inflation and health system usage growth factors.

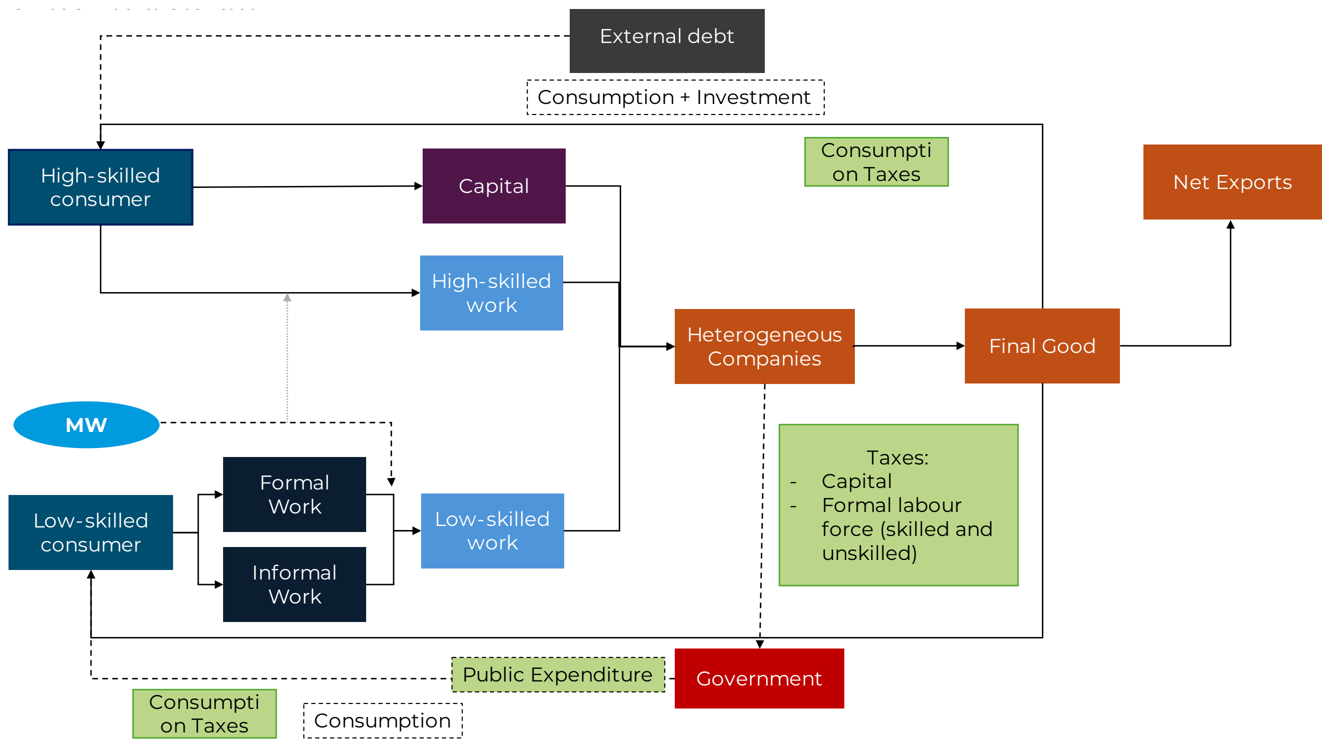
## 4.3 Dynamic General Equilibrium Model (DGEM)

The DGEM models an economy with two types of households: high-skilled, who maximize utility and have access to financial markets, and low-skilled, who consume their daily labor income and receive subsidies. Government transfers, based on various financing schemes, close the model. Aggregate demand comprises consumption, investment, and net exports, while government spending is funded by consumption, capital, and labor taxes, while maintaining a balanced budget.

[10] El aumento de los costos debido a cambios en las Enfermedades Crónicas No Transmisibles considera los escenarios presentados en Melo et al., 2023.

Production is divided between heterogeneous firms in monopolistic competition and a competitive firm that produces homogeneous goods. Heterogeneous firms use capital and labor to create intermediate goods, which are aggregated to create the final good. Government transfers to households vary by group, according to health spending data for Colombia. Employment and wages for high-skilled workers adjust according to supply and demand, while low-skilled labor earns an exogenous minimum wage, with equilibrium determined by firm demand. Figure 4 illustrates the DGEM.

**Figure 4. DGEM Outline**




Source: Authors' elaboration.

5

# Results

## .5.1 Demand for medicines

In 2023, 24.3% of total health spending[11], equivalent to COP 20 trillion, was allocated to medicines. Of this amount, 87.8% (COP 17.6 trillion) was spent on products included in the PBS, while 9.2% (COP 1.8 trillion) went toward medicines outside the PBS. Additionally, non-regulated medicines accounted for 29.6% of total medicine spending (COP 14.1 trillion), with regulated medicines comprising the remaining 70.4% (COP 5.9 trillion).

Table 1 summarizes drug spending for the baseline scenario and the three efficiency scenarios outlined in section 4.1. Under the first scenario, where all medicines are purchased

[11] In 2023, total public health spending according to ADRES amounted COP 82.3 trillion.

efficiently, the estimated savings amount to 34.5% (COP 6.9 trillion) of total medicine spending. In scenario 2, where efficient procurement is applied only to regulated medicines), potential savings would reach 23% (COP 4.6 trillion). Under scenario 3, focusing on non-regulated medicines, savings would reach 11.5% (COP 2.3 trillion).

**Table 1. Drug spending by type and regulation (2023, COP trillion)**

| | Base | Efficient Procurement 1 | Efficient Procurement 2 | Efficient Procurement 3 |
|---|---|---|---|---|
| | | All medicines | Regulated | Non-regulated |
| **Total Spending** | **20** | **13.1** | **15.4** | **17.7** |
| *Regulated* | 14.1 | 9.5 | 9.5 | 14.1 |
| *Non-regulated* | 5.9 | 3.6 | 5.9 | 3.6 |
| **PBS** | **17.6** | **12.0** | **13.8** | **15.8** |
| *Regulated* | 12.9 | 9.0 | 9.1 | 12.9 |
| *Non-regulated* | 4.7 | 3.0 | 4.7 | 2.9 |
| **No PBS** | **1.8** | **0.5** | **1.0** | **1.3** |
| *Regulated* | 1.2 | 0.4 | 0.4 | 1.2 |
| *Non-regulated* | 0.6 | 0.1 | 0.6 | 0.1 |
| **Unclassified** | **0.6** | **0.6** | **0.6** | **0.6** |
| *Regulated* | 0.0 | 0.0 | 0.0 | 0.0 |
| *Non-regulated* | 0.6 | 0.5 | 0.6 | 0.5 |
| **Savings (%)[12]** | **NA** | **34.5%** | **23.0%** | **11.5%** |

Source: Authors' calculations based on information from the Commission for the Regulation of Drug Prices
Note: COP 0.6 trillion is not classified due to insufficient information.

In 2023, health spending reached 82.3 trillion, representing 4.4% of GDP. Implementing an efficient procurement policy for all medicines could reduce total health spending to COP 75.4 trillion (4.1% of GDP), yielding potential short-term savings of 8.4%[13].

### 5.2 CGEM

This study uses the CGEM to assess the effects of an efficient drug procurement policy on public health spending and the fiscal deficit. Table 2 summarizes the simulation results for the baseline and the three efficient procurement scenarios, detailing the evolution of contribution income, health service spending, and the deficit to be covered by the general government[14]. Panel A presents the baseline scenario, while Panels B, C and D show results for scenarios for efficient procurement applied to all, regulated medicines, and non-regulated medicines, respectively. Table 3 outlines the variations in the General Government (GG) deficit under each scenario for 2024, 2030 and 2040.

[12] The savings are calculated by taking the difference between the Total Expenditure of medicines in 2023 and the value that would have been invoiced under each of the efficient procurement scenarios.

[13] The reduction from 4.4% of GDP to 4.1% of GDP represents a decrease of 8.4%.

[14] The deficit is determined as the difference between resources from contributions and other system revenues and the expenses required for health service provision. This deficit must be covered by the General Budget of the Nation and the resources of territorial entities.

**Table 2. Revenues, Expenditures and Deficits of the Health System: Results of Simulations**

| | Panel A. Baseline Scenario | | | | | | Panel B. Efficient Procurement: All Medications | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2024 | | 2030 | | 2040 | | 2024 | | 2030 | | 2040 | |
| | $MM | %PIB | $MM | %PIB | $MM | %PIB | $MM | %PIB | $MM | %PIB | $MM | %PIB |
| **Contributions and other rev.** | 39,356 | 2.1% | 60,809 | 2.0% | 129,677 | 2.0% | 39,409 | 2.1% | 61,539 | 2.0% | 133,587 | 2.0% |
| **Health benefits expenses** | 92,857 | 5.0% | 196,090 | 6.6% | 476,052 | 7.4% | 85,269 | 4.6% | 180,082 | 6.0% | 437,222 | 6.6% |
| **Deficit covered by the GG** | 53,502 | 2.9% | 135,281 | 4.5% | 346,375 | 5.4% | 45,860 | 2.5% | 118,542 | 3.9% | 303,635 | 4.6% |

| | Panel C. Efficient Procurement: Regulated | | | | | | Panel D. Efficient Procurement: Non-regulated | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2024 | | 2030 | | 2040 | | 2024 | | 2030 | | 2040 | |
| | $MM | %PIB | $MM | %PIB | $MM | %PIB | $MM | %PIB | $MM | %PIB | $MM | %PIB |
| **Contributions and other rev.** | 39,392 | 2.1% | 61,311 | 2.0% | 132,374 | 2.0% | 39,373 | 2.1% | 61,040 | 2.0% | 130,924 | 2.0% |
| **Health benefits expenses** | 87,656 | 4.8% | 185,117 | 6.2% | 449,438 | 6.9% | 90,470 | 4.9% | 191,055 | 6.4% | 463,840 | 7.2% |
| **Deficit covered by the GG** | 48,264 | 2.6% | 123,807 | 4.1% | 317,064 | 4.9% | 51,098 | 2.8% | 130,015 | 4.3% | 332,916 | 5.2% |

Source: Authors' elaboration.
$MM: COP billions.

In the baseline scenario, health service spending is projected to rise from 5.0% of GDP in 2024 to 6.6% in 2030 and 7.4% in 2040. This GG deficit increases from 2.9% of GDP in 2024 to 4.5% in 2030 and 5.4% of GDP in 2024 (Table 2)[15]. The system's financing needs exceed the increase in spending, partly due to population aging, which elevates health service demand while also reducing employment and, consequently, system contributions. Additionally, the increase in government spending impacts economic growth, which in turn influences employment.

Results suggest that health system spending could decrease from 6.6% of GDP in 2030 in the baseline scenario, to 6.4%, 6.2%, and 6.0% of GDP with efficient procurement of non-regulated, regulated, or all medicines, respectively. By 2040, spending on service provision could decline from 7.5% in the baseline scenario to 7.2%, 6.9%, and 6.7% of GDP under these scenarios (Table 2). These reductions correspond to lower financing needs of 0.2%, 0.4% and 0.6% of GDP in 2030, depending on efficient drug procurement, and would alleviate pressure on the GG to cover the

[15] It is important to note that according to recent data on birth rates, population aging in the country may accelerate, impacting system expenditures. Using the latest revision from the United Nations Population Prospects, health sector spending is projected to rise to 6.8% of GDP by 2030 and 8.1% by 2040. Consequently, the health system deficit to be covered by the government would increase to 4.9% of GDP by 2030 and 6.5% by 2040.

health system deficit by 0.3%, 0.6%, and 0.8% of GDP in 2040 (Table 3).

The decline in financing needs stems from reduced health services spending due to lower drug costs, alongside the positive effect of decreased public spending on economic growth. In fact, the GDP growth rate would increase, on average, from 3.1% to 3.2% over 2023-2040 when transitioning from the baseline scenario to the scenario where all medicines are procured efficiently.

**Table 3. Reduction of the Deficit to be Covered by the General Government with respect to the Deficit in the Reference Scenario and the Efficient Drug Procurement Scenarios (% of GDP)**

| | 2024 | 2030 | 2040 |
|---|---|---|---|
| **Efficient procurement of all medicines** | 0.4% | 0.6% | 0.8% |
| **Efficient procurement of regulated drugs** | 0.3% | 0.4% | 0.6% |
| **Efficient procurement of non-regulated drugs** | 0.1% | 0.2% | 0.3% |

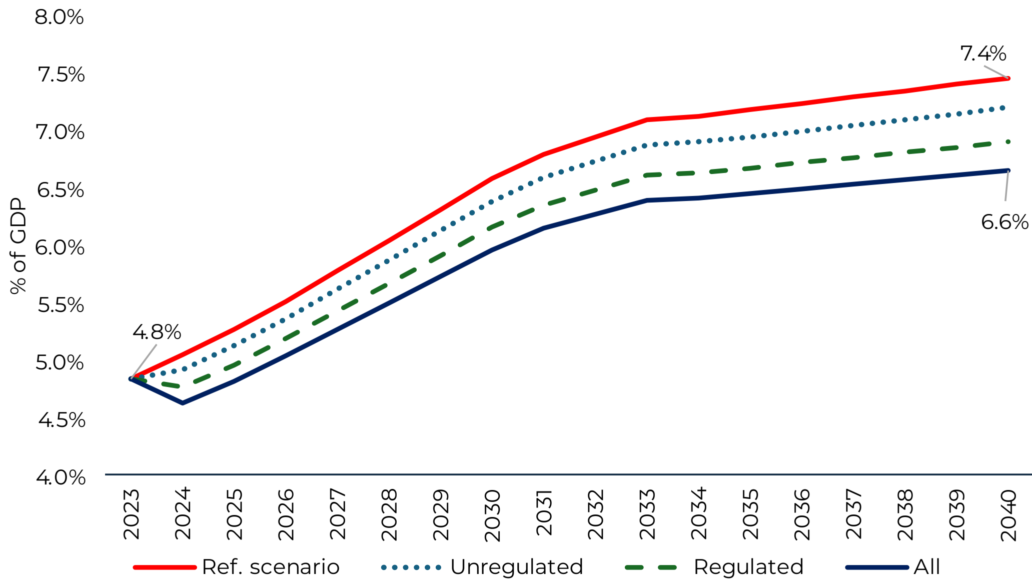
Source: Authors' elaboration.

Based on the calculations carried out, the fiscal deficit of the health sector has an average elasticity of 0.4 with respect to a reduction in spending on medicines. A 34.5% reduction in the cost medicines due to a more efficient management reduces the deficit of the health sector by 12.4% (from 4.5% to 3.9% of GDP in the projection for 2023). This shows the importance that an efficient drug purchasing policy can have on the costs of the Colombian health system. This is particularly urgent given the rising pressure on costs relating to population aging, new service demands and the need to continue improving improve access to the system for the entire population.

Figures 5 and 6 depict the projected trajectories of health system spending and the required GG transfers to cover the financing deficit across the scenarios analyzed. Figure 5 indicates that, in the long term, health spending could decline by up to 10.8%[16], assuming savings are reinvested in the system. The projections show a reduced demand for resources as efficiency in medicine procurement improves.

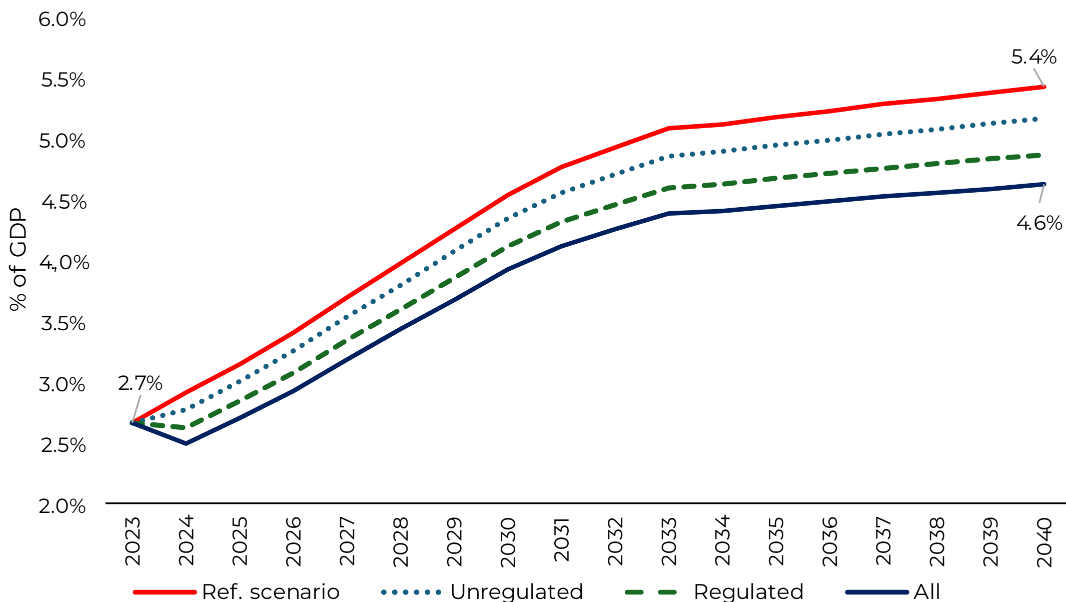
[16] The reduction from 7.4% of GDP to 6.6% of GDP represents a decrease of 10.8%.

**Figure 5. Health System Spending (% of GDP)**




Source: Authors' elaboration.

**Figure 6. GG Transfers to the Health Sector (% of GDP)**




Source: Authors' elaboration.

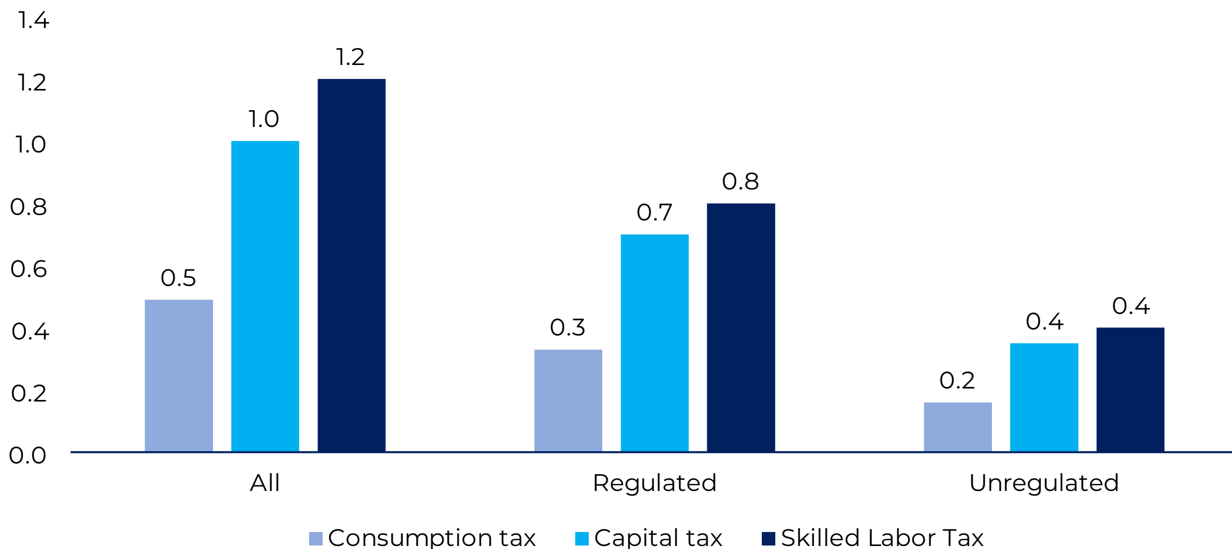
A significant portion of the increase in expenditures is attributable to demographic changes. The value of the UPC rises with age due to the higher demand for health services among older populations. In the reference scenario, this demographic shift places pressure on GG's public finances, contributing to an estimated deficit increase from 2.9% in 2024 to 5.4% in 2040, or 2.5% of GDP (Table 2). The analysis suggests that part of this additional deficit could be mitigated through improved efficiency in drug procurement. Specifically, while the reference scenario reflects the financial impact of an aging population and estimates the government deficit to rise by 2.5% of GDP, efficient medicine procurement could reduce this deficit by 0.8%, absorbing roughly a third of the projected increase (Table 3).

### 5.3 DGEM

The cost savings from more efficient drug procurement can be reinvested in the health system, as highlighted in section 5.2 of the CGEM model. These savings may also help reduce the tax burden on the population. The DGEM evaluates the impact of an efficient drug procurement policy on various financing alternatives and their effects on production, consumption, and investment.

To examine the tax and macroeconomic effects of this policy, three scenarios are explored. Each assumes that lower drug spending leads to a reduction in a specific type of tax: consumption, capital use, or skilled labor employment (Figure 7). Across all scenarios, enhanced efficiency in drug procurement boosts production levels in the short, medium, and long term, though the magnitude of the effect varies by scenario.

**Figure 7. Tax Reduction (in p.p) from Savings in Efficient Drug Procurement**




Source: Authors' elaboration.

Closing the DGEM with capital taxes yields the largest production gains (1.1%), primarily due to a greater effect on investment (1.7%) and consumption (0.8%) over the long term (Table 4). Under this scenario, reducing capital taxes from 1% to 0% lowers capital usage costs and encourages investment. Qualified households, responsible for investment decisions, allocate a significant share of their resources to build capital, thus limiting their short-term consumption growth. However, in the long run, they benefit from higher returns on capital and increase in labor income. The complementarity between capital and various types of labor drives demand for both high- and low-skilled labor, resulting in higher employment for these groups and increased income and consumption. Unqualified households experience these benefits only in the long term.

Fiscal closures involving other tax types yield similar macroeconomic effects, though of smaller magnitude and different transmission mechanisms. For example, closing with consumption taxes reduces the rate from 1.9% to 1.5%, stimulating household demand for final goods and boosting consumption in the short, medium and long term. To meet this rising demand, firms expand hiring of skilled and unskilled labor, along with capital usage. Meanwhile, closing with taxes on formal labor hiring primarily benefits formally hired workers, rising their wages and widening the consumption gap between high- and low-skilled households.

Table 4 presents the long-term results for GDP, consumption, and investment across the three alternative efficient drug procurement scenarios: all medicines, regulated medicines, and non-regulated medicines. While the qualitative effects are similar, the impact diminishes when the policy covers a narrower group of drugs.

**Table 4. Macroeconomic Outcomes: Scenarios of Efficient Drug Procurement**

| Financing Scheme (Lower taxes on:) | Change in GDP (%) | | |
|---|---|---|---|
| | All | Regulated | Non-regulated |
| Consumption | 0.3% | 0.2% | 0.1% |
| Capital | 1.1% | 0.7% | 0.4% |
| Skilled Labor | 0.5% | 0.3% | 0.2% |
| | Change in Consumption (%) | | |
| | All | Regulated | Non-regulated |
| Consumption | 0.2% | 0.2% | 0.1% |
| Capital | 0.8% | 0.5% | 0.3% |
| Skilled Labor | 0.5% | 0.3% | 0.2% |
| | Change in Consumption (%) | | |
| | All | Regulated | Non-regulated |
| Consumption | 0.3% | 0.2% | 0.1% |
| Capital | 1.7% | 1.4% | 0.7% |
| Skilled Labor | 0.4% | 0.3% | 0.1% |

Source: Authors' elaboration.

# 6 Policy Options

This study has analyzed the macroeconomic and fiscal effects of improving efficiency in drug procurement in Colombia. The findings indicate that adopting an efficient drug procurement policy could result in health expenditure savings of up to 8.4% in the short term and 10.8% in the long term. Efficient medicine procurement could help finance the health system deficit, reducing it between 10.4% and 31.9%. Reinvesting savings into the health system, allocating them to other sectors, or using them to mitigate the tax burden on

capital, consumption, or social contributions can further amplify these benefits. Among these options, reducing capital taxes offers the greatest potential, increasing production by up to 1.1%, investment by 1.7%, and consumption by 0.8%.

Drug prices are influenced by various factors, including supply (e.g., intellectual property, costs, market structure), demand (e.g., drug awareness, price sensitivity), and national context (e.g., trade policies, legal considerations, etc.). Additionally, multiple policy tools can help reduce drug prices, generate savings and improve efficiency in the sector (albeit results may be less pronounced than those modeled in this study). Some of these mechanisms include promoting and procuring generic drugs, conducting joint drug purchases, and regulating prices (Savedoff et al., 2023).

Generic drug procurement involves replacing original or patented medicines with those containing the same active ingredients and therapeutic value and similar risk profiles (Savedoff et al., 2023). In the Dominican Republic, for example, switching to unbranded generics generated annual public system savings of up to US$315 million. However, successful implementation requires robust policies to facilitate market entry and sales of generics, ensure market transparency and promote substitution of branded medicines (Atal et al., 2023).

Joint drug purchasing, where batches of drugs are bundled for lower unit price negotiations, can be implemented by the public sector, the private sector, or even by groups of countries. In Chile, the digital platform Chilecompra helped the government save over 8% on drug expenditures (Raventós & Zolezzi, 2015). In Jordan, joint procurement introduced in 2006 led to savings of 2.4% and 8.9% on total drug expenditures (Al-Abbadi et al., 2009).

In recent years, Colombia has implemented different measures to increase health sector efficiency and reduce drug spending. Notably, price regulation based on international benchmarks has had mixed effects: while prices decreased for three of eighteen drug groups, prices for non-regulated drugs rose (Prada et al., 2018; Andia, 2018).

It is also worth noting that Colombia has the necessary legal framework to implement price regulation based on the therapeutic value of new medicines. Other tools impacting drug prices include entry agreements with pharmaceutical companies, procurement strategies, co-payment structure design, and prescription regulations of (IDB, Red Criteria, n.d.)

In conclusion, there are opportunities to mitigate the pressure of rising drug costs both in the short and long term. While this study's scenarios demonstrate the potential for substantial savings, gradual implementation of these measures could deliver similar benefits over time. The policies discussed here represent only a few options available in the region, yet there is scope to study and develop new measures to enhance efficiency in drug procurement, with positive fiscal and macroeconomic outcomes in the long run.

# References

**ADRES. (2023).** Gestión Presupuestal, Unidad de Recursos Administrados (URA). *Informe Acumulado Trimestral Diciembre de 2023.*

**Al-Abbadi, I., Qawwas, A., Jaafreh, M., Abosamen, T., & Saket, M. (2009).** One-Year assessment of joint procurement of pharmaceuticals in the public health sector in Jordan. *Clinical Therapeutics, 31*(6), 1335–1344. https://doi.org/10.1016/j.clinthera.2009.05.021

**Allende, C., Atal, J. P., Carril, R., Cuesta, J. I., & González-Lira, A. (2024).** Drivers of public procurement prices: Evidence from pharmaceutical markets. *International Journal of Industrial Organization*, 103086. https://doi.org/10.1016/j.ijindorg.2024.103086

**Andia, T. (2018).** *El "efecto portafolio" de la regulación de precios de medicamentos: La respuesta de la industria farmacéutica a la regulación de precios de medicamentos en Colombia*. https://doi.org/10.18235/0001305

**Ani, A., Davtyan, V., Igityan, H., Kartashyan, H., & Manukyan, H. (2020).** Modelling the Effects of a Health Shock on the Armenian Economy. *Russian Journal of Money and Finance*, 79(4), 18–44. https://doi.org/10.31477/rjmf.202004.18

**Arias, C., Bardey, D., Chávez, M., Cardona, J., Martínez-Rodríguez, L. J., & Ortiz, J. L. (2023a).** *¿Cómo afectan los esquemas de pago el acceso y el gasto en salud?: evidencia del sistema de salud colombiano*. https://doi.org/10.18235/0005142

**Arias, C., Bardey, D., Chávez, M., Cardona, J., Martínez-Rodríguez, L. J., & Ortiz, J. L. (2023b).** *¿Cómo afectan los esquemas de pago el acceso y el gasto en salud?: evidencia del sistema de salud colombiano*. https://doi.org/10.18235/0005142

**Atal, J. P., Giedion, U., Gutiérrez, C., & Jorgensen, N. (2023).** *¿Cuál es el costo de oportunidad de financiar medicamentos de marca? El caso de República Dominicana.* http://www.iadb.org

**Atolia, M., Papageorgiou, C., & Turnovsky, S. J. (2021).** TAXATION AND PUBLIC HEALTH INVESTMENT: POLICY CHOICES AND TRADEOFFS. *Macroeconomic Dynamics, 25*(2), 426–461. https://doi.org/10.1017/S1365100519000245

**Bajaro, D. F., Jinjarak, Y., Myoda, Y., Park, D., & Quising, P. (2023).** *Health Spending Efficiency in Developing Asia.* https://doi.org/10.22617/WPS230471-2

**Banco Mundial. (2021).** *Mortalidad infantil, tasa (por cada 1,000 nacidos vivos).* https://data.worldbank.org/indicator/SP.DYN.IMRT.IN?end=2021&loca-=null&locations=CO&start=1995

**Bardey, D., Harker, A., & Zuluaga, D. (2021).** *Price cap regulation in the Colombian pharmaceutical market: An impact evaluation*. http://economia.uniandes.edu.co

**BID - Red Criteria. (n.d.).** *Curso: ¿Qué priorizar en salud y a qué precio?* Retrieved October 17, 2024, from https://criteria.iadb.org/es/mooc

**Botello Peñaloza, H. A. (2014).** Eficiencia en la cobertura del régimen subsidiado de salud: una perspectiva departamental en Colombia. *Sociedad y Economía, 26*, 121–135. https://doi.org/10.25100/sye.v0i26.3954

**Çelik, Y., Khan, M., & Hikmet, N. (2017).** Achieving value for money in health: a comparative analysis of OECD countries and regional countries. *The International Journal of Health Planning and Management, 32*(4). https://doi.org/10.1002/hpm.2375

**Chávez M., Cardona J., & Savedoff B. (2021).** *Contexto de la Telesalud y Telemedicina en Colombia.* Banco Inter-Americano de Desarrollo.

**Comisión Económica para América Latina y el Caribe (CEPAL). (2023).** SDG Gateway: Database on Sustainable Development Goals. https://statistics.cepal.org/portal/databank/index.html?lang=es&indicator_id=3773&context=sdg

**Dalen, D. M., Strøm, S., & Haabeth, T. (2006).** Price regulation and generic competition in the pharmaceutical market. *The European Journal of Health Economics, 7*(3), 204–211. https://doi.org/10.1007/s10198-006-0357-y

**Darvas, Z., Moës, N., Myachenkova, Y., & Pichler, D. (2018).** Executive summary The macroeconomic implications of healthcare. *Policy Contributions.* http://iri.jrc.ec.europa.eu/scoreboard16.html.

**Ehrlich, I., & Yin, Y. (2013).** Equilibrium Health Spending and Population Aging in a Model of Endogenous Growth: Will the GDP Share of Health Spending Keep Rising? *Journal of Human Capital, 7*(4), 411–447. https://doi.org/10.1086/675640

**Eslava-Schmalbach, J., Barón, G., Gaitán-Duarte, H., Alfonso, H., Agudelo, C., & Sánchez, C. (2008).** Evaluación del Impacto en Costo-equidad del Sistema de Salud en Colombia 1998-2005. *Revista de Salud Pública, 10*(1), 3–17. https://doi.org/10.1590/S0124-00642008000100002

**España, J. L. N., Francisco Javier, M. Á., & Rafael Antonio, V. B. (2011).** La eficiencia de los Hospitales Colombianos en el contexto Latinoamericano. Una aplicación de Análisis Envolvente de Datos (DEA) en un grupo de hospitales de alta complejidad, 2009. *Ecos de Economia, 15,* 71–93.

**Espinosa, O., Rodríguez, J., Ávila, D., Rodríguez-Lesmes, P., Basto, S., Romano, G., Mesa, L., & Enríquez, H. (2023).** *The impact of updating health benefits plans on health technologies usage and expenditures: the case of Colombia.*

**Espinosa, O., Rodríguez-Lesmes, P., Orozco, L., Ávila, D., Enríquez, H., Romano, G., & Ceballos, M. (2022).** Estimating cost-effectiveness thresholds under a managed healthcare system: experiences from Colombia. *Health Policy and Planning, 37*(3), 359–368. https://doi.org/10.1093/heapol/czab146

**Garber, A. M., & Sculpher, M. J. (2011).** *Cost Effectiveness and Payment Policy* (pp. 471–497). https://doi.org/10.1016/B978-0-444-53592-4.00008-6

**Garcia-Escribano, M., Mogues, T., & Juarros, P. (2022).** Patterns and Drivers of Health Spending Efficiency. *IMF Working Papers, 2022(*048), 1. https://doi.org/10.5089/9798400204388.001

**Goyeneche, L., & Bauhoff, S. (2023).** *Efficiency of Health Systems in Middle-Income Countries and Determinants of Efficiency in Latin American and the Caribbean*. http://www.iadb.org

**Granger, C., Ramos-Forero, J. E., Melo-Becerra, L. A., & Silva-Samudio, G. T. (2023).** *Financiamiento del Sistema de Salud en Colombia: Fuentes y usos.* https://doi.org/10.32468/be.1233

**Grigoli, F., & Kapsoli, J. (2018).** Waste not, want not: The efficiency of health expenditure in emerging and developing economies. *Review of Development Economics, 22*(1), 384–403. https://doi.org/10.1111/rode.12346

**Gutiérrez, C., & Gómez, N. (2018).** *El sistema de salud colombiano en las próximas décadas: cómo avanzar hacia la sostenibilidad y la calidad en la atención.* (60; Cuadernos de Fedesarrollo).

**Gutiérrez, C., Palacio, S., Giedion, Ú., & Distrutti, M. (2023).** *¿En que gastan los países sus recursos en salud?: el caso de Colombia*. https://doi.org/10.18235/0005157

**Gutiérrez, C., Palacio, S., Giedion, U., & Ollendorf, D. (2023).** *¿Cuál es el costo de oportunidad de financiar medicamentos de alto costo? El caso de Colombia.* http://www.iadb.org

**Herrera, S., & Ouedraogo, A. (2018).** Efficiency of Public Spending in Education, Health, and Infrastructure: An International Benchmarking Exercise. World Bank, Washington, DC. https://doi.org/10.1596/1813-9450-8586

**Hsu, Y.-C. (2013).** The efficiency of government spending on health: Evidence from Europe and Central Asia. *The Social Science Journal, 50*(4), 665–673. https://doi.org/10.1016/j.soscij.2013.09.005

**José, J., Piedrahita, E., Humberto, J., Zea, R., Alberto, D., Gaviria, G., Tecnologico, I., & Research, M. (2020).** *Determinants of increased health care spending: Colombia in the international context.* https://doi.org/10.21203/rs.3.rs-47868/v1

**Jung, J., & Tran, C. (2008).** The Macroeconomics of Health Savings Accounts. *SSRN Electronic Journal.* https://doi.org/10.2139/ssrn.1024556

**Kaiser, U., Mendez, S. J., & Rønde, T. (2010).** Regulation of Pharmaceutical Prices: Evidence from a Reference Price Reform in Denmark. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.1685213

**Keshavarzi, A., & Horry, H. R. (2023).** Bayesian estimation of a dynamic stochastic general equilibrium model with health disaster risk. *Stochastic Environmental Research and Risk Assessment, 37(4), 1199–1211.* https://doi.org/10.1007/s00477-022-02357-1

**KUMARI, S. (2024).** PHARMACEUTICAL INDUSTRY ANALYSIS: A COMPREHENSIVE REVIEW OF MARKET TRENDS, COMPETITIVE LANDSCAPE, AND FUTURE OUTLOOK. *INTERANTIONAL JOURNAL OF SCIENTIFIC RESEARCH IN ENGINEERING AND MANAGEMENT, 08*(04), 1–5. https://doi.org/10.55041/IJSREM32665

**Lauenroth, V. D., Kesselheim, A. S., Sarpatwari, A., & Stern, A. D. (2020).** Lessons From The Impact Of Price Regulation On The Pricing Of Anticancer Drugs In Germany. *Health Affairs, 39*(7), 1185–1193. https://doi.org/10.1377/hlthaff.2019.01122

**Maza Ávila, F. J., Vergara Schmalbach, J. C., & Navarro España, J. L. (2012).** EFICIENCIA DE LA INVERSIÓN EN EL RÉGIMEN SUBSIDIADO EN SALUD EN BOLÍVAR - COLOMBIA. *INVESTIGACIONES ANDINA. No, 12*(24), 386–400.

**McCullagh, L. M., Tilson, L., Adams, R., & Barry, M. (2014)**. HTA Informed Price Negotiations: Cost Savings To The Health Payer in Ireland. *Value in Health, 17*(7), A420. https://doi.org/10.1016/j.jval.2014.08.1030

**McKibbin, W., & Fernando, R. (2021).** The Global Macroeconomic Impacts of COVID-19: Seven Scenarios. *Asian Economic Papers, 20*(2), 1–30. https://doi.org/10.1162/asep_a_00796

**Melo-Becerra, L. A., Arango-Thomas, L. E., Ávila-Montealegre, Ó., Ayala-García, J., Bonilla-Mejía, L., Botero-García, J. A., Cardona-Badillo, M., Crispin-Fory, C., Gallo-Montaño, D. del P., Granger-Castaño, C. J., Guzmán-Finol, K., Iregui-Bohórquez, A. M., Ospina-Tejeiro, J. J., Pinilla-Alarcón, D., Posso-Suárez, C., Ramírez-Giraldo, M. T., Ramos-Forero, J. E., Ramos-Veloza, M., Restrepo-Tobón, D. A., ... Vásquez-Escobar, D. M. (2023)**. Aspectos financieros y fiscales del sistema de salud en Colombia. Ensayos Sobre *Politica Economica, 2023*(106), 6–73. https://doi.org/10.32468/espe106

**Ministerio de Salud y Protección Social. (2023).** *Estudio de suficiencia y de los mecanismos de ajuste de riesgo para el cálculo de la Unidad de Pago por Capitación 2023: Recursos para garantizar la financiación de tecnologías y servicios de salud en los regímenes Contributivo y Subsidiado.* Dirección de Regulación de Beneficios, Costos y Tarifas del Aseguramiento en Salud. https://www.minsalud.gov.co/salud/POS/paginas/unidad-de-pago-por-capitacion-upc.aspx

**Monterubbianesi, P. D., Geri, M., Lago, F., & Moscoso, N. S. (2017).** Eficiencia del Gasto Total en Salud: Análisis no paramétrico en una muestra amplia de países. *Revista de Salud Pública, 19*(1), 79–85. https://doi.org/10.15446/rsap.v19n1.44546

**MSPS. (2020)**. Información vacunas y programas de vacunación. In *Gov.co.* https://www.minsalud.gov.co/salud/publica/Vacunacion/Paginas/pai.aspx

**Murillo, K. P., Miguel Rocha, E. A., & García González, C. A. (2018).** Análisis de eficiencia multidireccional en hospitales públicos del Valle del Cauca. *Gerencia y Políticas de Salud, 17(*34). https://doi.org/10.11144/Javeriana.rgps17-34.aemh

**Novignon, J., & Lawanson, A. (2014).** *Munich Personal RePEc Archive Efficiency of health systems in sub-Sahara Africa: a comparative analysis of time varying stochastic frontier models.*

**Observatorio de Salud Pública & Epidemiologia. (2024).** *BOLETIN OBSERVATORIO DE VACUNACION.* https://confianzaenlasvacunasla.org/escenario-

**Prada, S. I., Soto, V. E., Andia, T. S., Vaca, C. P., Morales, Á. A., Márquez, S. R., & Gaviria, A. (2018).** Higher pharmaceutical public expenditure after direct price control: *improved access or induced demand? The Colombian case. Cost Effectiveness and Resource Allocation, 16*(1), 8. https://doi.org/10.1186/s12962-018-0092-0

**Radhika, L., & Elizabeth, R. (2008).** Public and Private Expenditures on Health in the Presence of Inequality and Endogenous Mortality: A Political Economy Perspective. *Research Papers in Economics.*

**Rao, K. D., Vecino Ortiz, A. I., Roberton, T., Lopez Hernandez, A., & Noonan, C. (2022).** *Future Health Spending in Latin America and the Caribbean: Health Expenditure Projections & Scenario Analysis*. https://doi.org/10.18235/0004185

**Raventós, P., & Zolezzi, S. (2015).** Electronic tendering of pharmaceuticals and medical devices in Chile. *Journal of Business Research, 68*(12), 2569–2578. https://doi.org/10.1016/j.jbusres.2015.06.024

**Romero, M. (n.d.).** *Benefit plans, insurer competition, and pharmaceutical prices: Evidence from Colombia.*

**Ruiz-Rodriguez, M., Rodriguez-Villamizar, L. A., & Heredia-Pi, I. (2016).** Technical efficiency of women's health prevention programs in Bucaramanga, Colombia: a four-stage analysis. *BMC Health Services Research, 16*(1), 576. https://doi.org/10.1186/s12913-016-1837-0

**Sun, D., Ahn, H., Lievens, T., & Zeng, W. (2017).** Evaluation of the performance of national health systems in 2004-2011: An analysis of 173 countries. *PLOS ONE, 12*(3), e0173346. https://doi.org/10.1371/journal.pone.0173346

**Varabyova, Y., & Schreyögg, J. (2013).** International comparisons of the technical efficiency of the hospital sector: Panel data analysis of OECD countries using parametric and non-parametric approaches. *Health Policy, 112*(1–2), 70–79. https://doi.org/10.1016/j.healthpol.2013.03.003

**Vargas, V., Rama, M., & Singh, R. (2022).** *Pharmaceuticals in Latin America and the Caribbean: Players, Access, and Innovation Across Diverse Models*. https://doi.org/10.13140/RG.2.2.15374.02888

# Annexes

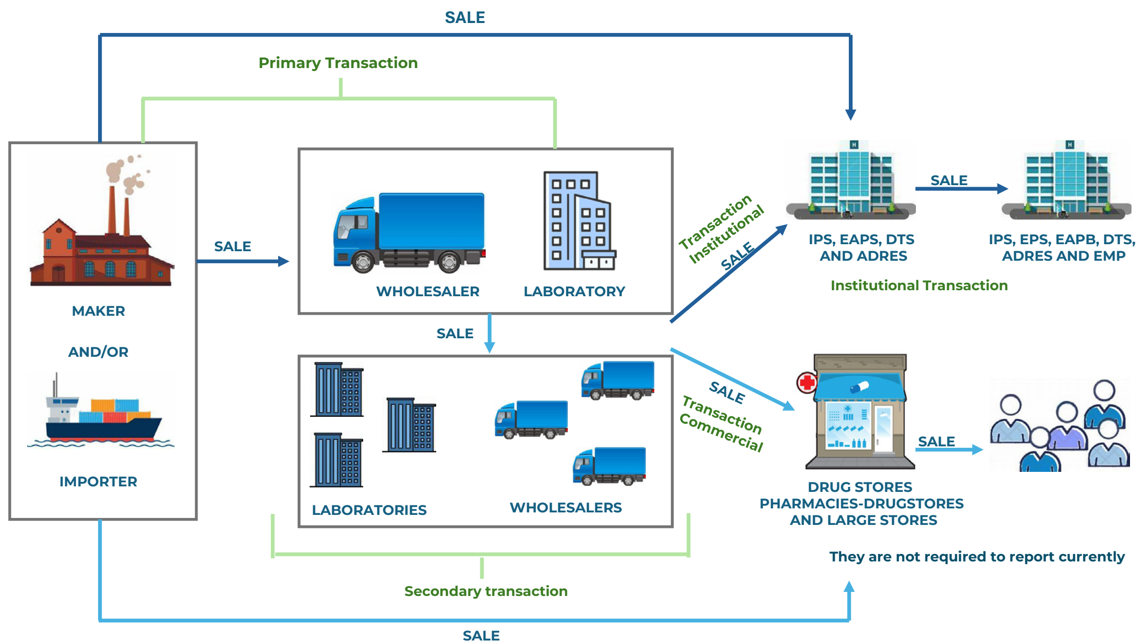
## **Annex 1:** Specification of Drug Demand Calculation and Potential Savings Scenarios

The calculation of savings in medicines is based on the Drug Price Information System (SISMED, by its Spanish acronym), which provides the necessary data for regulating the national drug market. SISMED records three types of transactions: primary (from manufacturers or importers, such as laboratories), secondary (involving distributors or logistics operators), and final (pertaining to the payment or dispensation of medication by the EPS, IPS or DTS). These transactions are financed through two channels: institutional and commercial.

The institutional channel uses public resources, while the commercial channel involves out-of-pocket expenses. Additionally, SISMED monitors three types of operations that must be reported during each transaction: procurement, sale, and payment/repayment. Figure 7 summarizes how these transactions operate.

This study focuses on the final institutional transaction and the associated types of sales and payment/repayment stages. The aim is to gather information on dispensed medicines financed with public resources, as reported by the EPS and IPS to SISMED, which are subsequently billed to ADRES.

**Figure 8. Transaction Types**




Source: Taken from the Ministry of Health.

The SISMED database, containing the characteristics of public drug demand for 2023, was supplemented with additional data sources, including information on PBS and non-PBS coverage, as well as drug regulation, both provided by the Ministry of Health and Social Protection. These databases were integrated using the Unique Drug Code (CUM, by its Spanish acronym), resulting in a consolidated database, as shown in Table 5 below.

**Table 5. Demand for medicines**

| CUM | Medicine | Units Purchased | Minimum Unit Value | Maximum Unit Value | Total Invoiced Value | PBS Coverage | Regulation | Efficient |
|---|---|---|---|---|---|---|---|---|
| 19994642-1 | BETAMETHASE DIPROPIONATE | 10 | 3,000 | 17,230 | 44,230 | YES | NR | 30,000 |
| 20001852-27 | DOLEX® AVANZADO | 2,700 | 699 | 1,562 | 2,442,200 | YES | NR | 1,887,300 |
| 20066115-17 | OMEPRAZOL 20 MG | 3,424 | 150 | 600 | 582,200 | NO | R | 513,600 |

Source: Authors' calculation.

The calculations for the reference scenario are conducted as follows: using the consolidated database, the total invoiced value of all medicines is summed to determine medicines public expenditure. This classification provides the amounts for regulated, non-regulated, PBS-funded, and non-PBS-funded drugs, as shown in Table 1 of Section 5.1.

Subsequently, three efficient procurement scenarios are proposed, where "efficient procurement" refers to the minimum invoiced price. When demand planning for a drug is inadequate, multiple transactions for the same product may occur, resulting in price variations. This happens because larger purchases tend to reduce prices. The proposed efficient procurement scenarios are: (1) all purchases are efficient; (2) only regulated drug purchases are efficient; and (3) only non-regulated drug purchases are efficient.

By comparing current spending to the minimum price scenario in each case, potential savings can be estimated. However, some medicines lacked a reported minimum price, so the total invoiced value for these cases was maintained, potentially leading to an underestimation of actual savings. Additionally, each transaction record reported by each entity was respected, as price differences may be attributable to transaction costs, such as the superior negotiation capabilities of the EPS or IPS, or higher transportation costs for accessing remote areas.

## **Annex 2:** Technical Model Specification (CGEM)

Households' utility function is determined using Lluch's (1973) linear system of extended expenditure, which builds upon the Stone-Geary98 demand system. According to this model, utility is derived from the consumption of each product (i), above the subsistence consumption level, along with the leisure of both skilled and unskilled households:

$$U = \sum_{ii=1}^{n} m_i \ln\left(c_i - \bar{c}_i\right) + \gamma_1 \ln(PETC - PEAC) + \gamma_2 \ln(PETNC - PEANC)$$

The production function of formal firms consists of three levels. At the third level, skilled and formal unskilled labor are combined for each branch i using a CES function, with an expansion path: $(TC_i)$ $(TNCF_i)$

$$\frac{TNCF_i}{TC_i} = \left(KTT_i \ \frac{\delta}{1-\delta} \frac{WC_i}{WNCF_i}\right)^{\sigma}$$

At the second level, formal labor (TT) and capital (K) are combined for each branch $i$ using a CES function, following this expansion path:

$$\frac{TT_i}{K_i} = KCT_i\left(\frac{\delta_V}{1-\delta_V} \frac{r_i}{w_i}\right)^{\sigma_V}$$

Finally, at the first level, a fixed-coefficients function combines formal value added ($VA$) and formal intermediate purchases (io). As noted, the formal firm will pay taxes to the branch ($ivar$)

$$P_{y,i}Y_i = \left(p_{va,i}VA_i + \sum_{i=1}^{n} p_{y,i}(iof_i)y_i\right)(1 + ivar_i)$$

For informal enterprises, the production function consists of a single level, where informal intermediate purchases ($VAI_i$) are combined with informal value added ($ioii$), which is composed entirely of informal unskilled work:

$$P_{yi,i}Y_i = p_{vai,i}VAI_i + \sum_{i=1}^{n} p_{yi,i}(ioi_i)yi_i$$

**Annex 3:** Especificación técnica del modelo (MEGD)

There are two types of households described as follows:

**1.** High-skilled households with access to financial markets and ownership of capital.

$$\max_{c_t^H,\ h_t^H,\, a_{t+1}^f, i_t, k_{t+1}} E_o \sum_{t=0}^{\infty} \beta^t \left(\frac{(c_t^H)^{1-\sigma}-1}{1-\sigma} - \psi_H \frac{\nu_H}{1+\nu_H}(h_t^H)^{\frac{1+\nu_H}{\nu_H}}\right)$$

**Subject to a budget constraint**

$$P_t(1+\tau_t^c)c_t^H + P_t i_t + a_{t+1}^f \leq \Phi_{t-1}R_{t-1}^f\, a_t^f + w_t^H(1-\tau_t^H)h_t^H + R_t k_t + \frac{\Pi_t}{N_t^H} + P_t g_t^H$$

$$i_t = k_{t+1} - (1-\delta)k_t + \frac{\phi}{2}\left(\frac{i_t}{i_{t-1}} - 1\right)^2$$

**2.** Non-skilled households ($NL$) without savings or borrowing options, offering formal and informal labor.

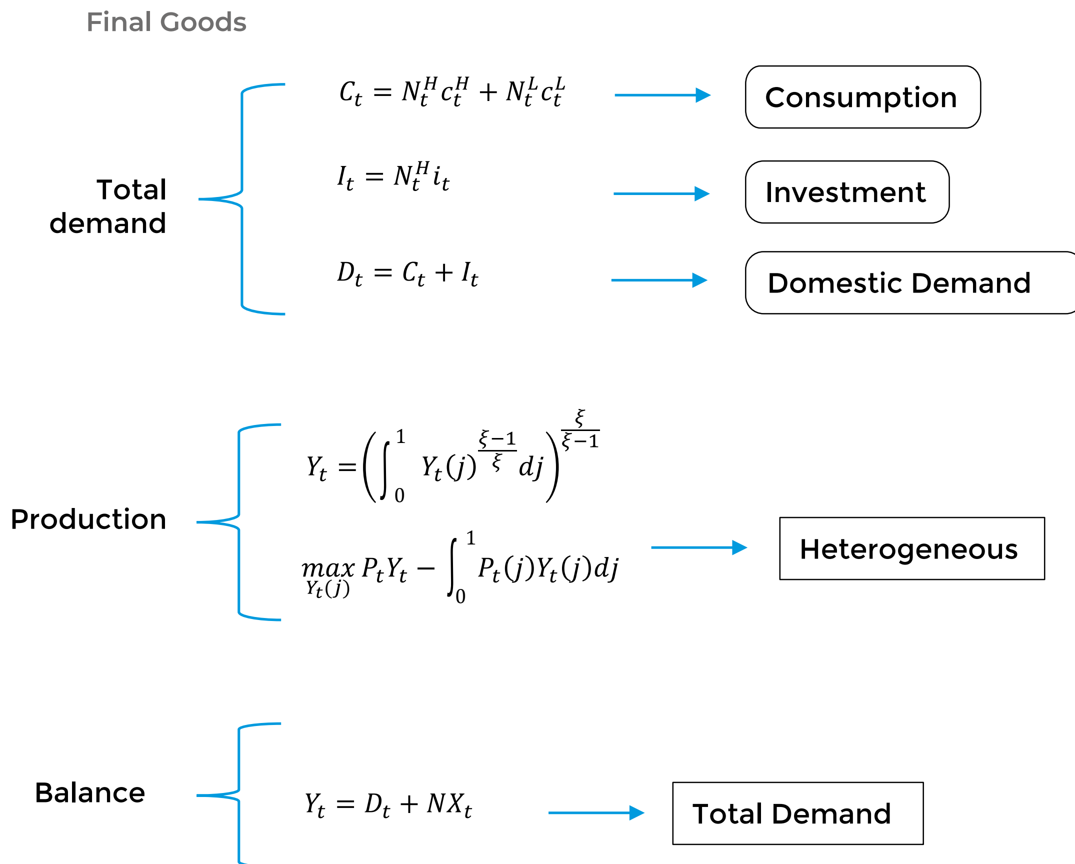
$$\max_{c_t^L, h_t^{FL}, h_t^{IL}} \left( \frac{(c_t^L)^{1-\sigma}}{1-\sigma} - \psi_{FL} \frac{\nu_{FL}}{1+\nu_{FL}} (h_t^{FL})^{\frac{1+\nu_{FL}}{\nu_{FL}}} - \psi_{IL} \frac{\nu_{IL}}{1+\nu_{IL}} (h_t^{IL})^{\frac{1+\nu_{IL}}{\nu_{IL}}} \right)$$

**Subject to a budget constraint**

$$P_t(1+\tau_t^c)c_t^L \leq w_t^{FL}(1-\tau_t^L)h_t^{FL} + w_t^{IL}h_t^{IL} + P_t g_t^L$$

The production equations for final and intermediate goods are divided as follows:

- Heterogeneous firms, operating in monopolistic competition, use capital and labor to produce differentiated goods. They pay taxes on the hiring of formal labor and the use of capital.
- Heterogeneous goods are aggregated into a homogeneous good, which is allocated for consumption, investment, and net exports.



### Intermediate goods

$$\max_{K_{it},L_{it}^{H},L_{it}^{I},L_{it}^{F}} \left(P_{it}Y_{it} - \left((1+\tau_t^{FH})w_t^{H}L_{it}^{H} + (1+\tau_t^{FL})w_t^{F}L_{it}^{F} + w_t^{I}L_{it}^{I} + (1+\tau_t^{K})R_tK_{it}\right)\right)$$

$$Y_{it} = A_t(K_{it})^{\alpha}(L_{it})^{(1-\alpha)}$$

$$L_{it} = \left[\theta(L_t^{L})^{\frac{\eta-1}{\eta}} + (1-\theta)(L_t^{H})^{\frac{\eta-1}{\eta}}\right]^{\frac{\eta}{\eta-1}}$$

$$L_{it}^{L} = \left[\theta_L(L_t^{I})^{\frac{\eta_L-1}{\eta_L}} + (1-\theta_L)(L_{it}^{F})^{\frac{\eta_L-1}{\eta_L}}\right]^{\frac{\eta_L}{\eta_L-1}}$$

$$Y_{it} = \left(\frac{P_{it}}{P_t}\right)^{-\xi} Y_t$$

Government:

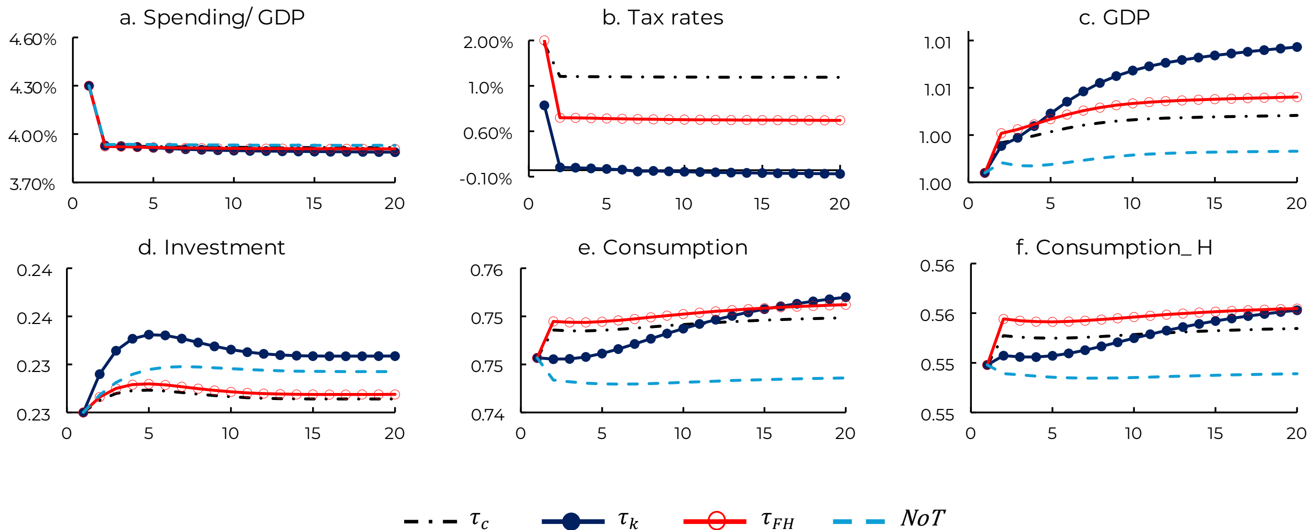
- Government spending on social security (differentiated by household), financed by taxes on formal labor, consumption, and the use of capital.
- Minimum wage for formal unskilled (rigid) labor.

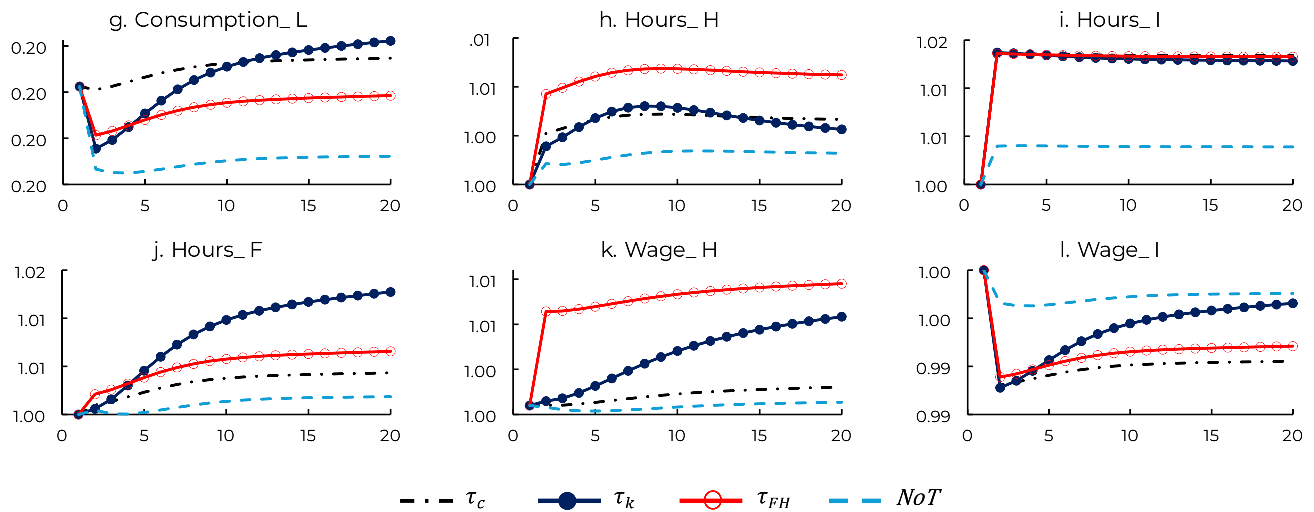
$$T_t = (\tau_t^{FL} + \tau_t^{L})w_t^{FL}L_t^{F} + (\tau_t^{FH} + \tau_t^{H})w_t^{H}L_t^{H} + \tau_t^{K}R_tK_t + \tau_t^{c}(C_t^{H} + C_t^{L})$$

$$G_t = g_t^{H}N_t^{H} + g_t^{L}N_t^{L}$$

## **Annex 4:** Results (DGEM)

**Figure 9. Tax and Macroeconomic Effects**






Note: Each line corresponds to a different fiscal closure. In this sense, $\tau_c$,$\tau_k$,$\tau_{FH}$ refer to fiscal closures with taxes on consumption, capital, and skilled labor, respectively, while NoT represents a closure that keeps constant taxes. The initial values for tax rates, GDP, investment and consumption correspond to their initial equilibrium, while hours and wages are normalized to 1.

**Macroeconomic and Fiscal Effects of Increased Efficiency in Medicine Procurement: A General Equilibrium Analysis of the Colombian Health System**

**Authors:**
Oscar Iván Ávila Montealegre
Sebastian Bauhoff
Jesús Alonso Botero García
Laura Giles Álvarez
Santiago León Moncada
Cristhian Larrahondo
Luis Ignacio Lozano Espitia
Ligia Alba Melo Becerra
José Luis Ortiz Hoyos
Jesús Rodríguez Ávila

**Desing:**
Shanny Siomara Hernández

**December, 2024**

BID
BANCO DE LA REPÚBLICA COLOMBIA
UNIVERSIDAD EAFIT