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Macroeconomic Effects of Healthcare Financing in Colombia

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Abstract

Real healthcare expenditure in Colombia is expected to increase by 49% over the next eight years, due to population aging, rising costs, and domestic policies. These trends add significant pressure to public finances, in a context of high levels of informality. Using a dynamic general equilibrium model with heterogeneous households, we analyze the macroeconomic impact of financing higher public healthcare expenditure through different taxes. Funding sources play a significant role in shaping the aggregate dynamics and income inequality. While consumption taxes are the best option in terms of output, financing with taxes on high-skilled labor improves income distribution with similar effects on production. Population aging puts additional pressure on aggregate dynamics by reducing labor supply, savings and capital accumulation.

JEL Classification: E10, E62, E26, F41

Keywords: *General Equilibrium; Heterogeneous Agents; Taxes; Government Expenditure.*

1 Introduction

Public healthcare expenditure in Colombia is expected to increase by approximately 49%, about two percentage points of GDP, over the next eight years, L. Arango et al. (2023). This increase is primarily driven by higher demand for quality services, rising costs of specialized procedures, technological advancements, and an aging population—factors that, according to Lorenzoni et al. (2019), contribute to the rising trend in healthcare spending in OECD countries. In addition to these factors, certain characteristics of Colombia's healthcare system and economy further intensify the pressure on public finances. Specifically, the process of equalizing per capita healthcare expenditure between the two regimes of the system, high levels of informality among both firms and workers, which reduce direct contributions, and low out-of-pocket spending. All these factors contribute to a challenging outlook for the financial sustainability of Colombia's healthcare system.

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In this paper, we analyze the macroeconomic effects of funding the additional expenditure through increases in taxes on consumption or production factors (capital and labor). Additionally, we examine how our results change under alternative scenarios, which explore the positive spillover of healthcare on labor productivity, population aging, the use of foreign public debt as a financing source, and migration. To conduct the analysis, we develop a dynamic general equilibrium model for a small open economy with heterogeneous households, a fragmented labor market with formal and informal labor, and various fiscal policy instruments. We then simulate the response of macroeconomic variables to different financing schemes of the increase in healthcare expenditure.

Colombia's healthcare system consists of two regimes: contributory and subsidized. In the contributory regime, formal firms and workers pay payroll taxes that directly fund the system. In the subsidized regime, the government allocates resources from the national budget to subsidize the rest of the population, including informal workers, migrants, and the unemployed. By 2024, approximately 50% of the population belonged to the subsidized regime, underscoring the critical link between labor informality, healthcare, and public finances. These characteristics of the Colombian labor market and healthcare system motivate the development of a model with fragmented labor markets.

Our study contributes to the literature on the macroeconomic effects of healthcare financing by providing a flexible quantitative tool that considers different financing schemes and can easily be adapted to any small open economy with fragmented labor markets. Our results highlight the importance of 1) understanding the impact of alternative financing sources on various macroeconomic outcomes under a fragmented labor market framework, 2) including externalities in the analysis of healthcare expenditure, and 3) quantifying the impact of population aging and migration.

Our results suggest that all financing sources negatively impact aggregate output, with varying magnitudes and effects on welfare and the income distribution. Funding health care through consumption taxes generates fewer distortions and requires a smaller tax rate increase, leading to a less severe reduction in output. In contrast, taxing low-skilled formal labor is the least desirable option, as it adversely affects output, income inequality, and welfare. Financing with taxes to high-skilled labor improves the income distribution. Notably, if healthcare expenditure has positive spillover effects on labor productivity, we observe a reduction in the negative effects of higher taxation.

Additionally, we find that increasing the population of high-skilled households positively affects the economy. In this scenario, financing the additional expenditure does not require a tax increase. In contrast, when the low-skilled population increases, we observe a reduction in per capita output, and the economy requires higher taxes to finance the additional expenditure. Finally, population aging places an additional burden on public finances due to a reduction in the working-age population and an increase in healthcare expenditure.

In general, the overall impact of a higher healthcare expenditure on the economy is ambiguous. On one hand, it may improve health outcomes, reduce treatment costs, and increase productivity.[1] On the other hand, higher expenditure may divert resources from

[1] The literature has found positive effects of higher expenditure on life expectancy, birth, and mortality rates (Berger and Messer 2002; Nixon and Ulmann 2006; Blazquez-Fernández, Cantarero-Prieto, and Pascual-Saez 2017; Christopoulos and Eleftheriou 2020).

alternative use. This paper shows that for the Colombian economy, the positive effects of higher healthcare expenditure are outweighed by the costs of higher taxes, unless labor productivity increases, or informality drops. Our study adds to the literature by demonstrating that understanding the impact of healthcare financing on macroeconomic aggregates is crucial for designing effective policies (Gechert, Paetz, and Villanueva 2021). There is mixed evidence of the impact of healthcare spending on economic growth. Some studies find that tax hikes have contractionary effects on the economy, and lower contributions stimulate economic growth through positive supply side effects (C. Romer and D. Romer 2016; Cloyne 2013), while others suggest that higher healthcare expenditure leads to better economic performance, especially if it is below the optimal level (Alper, Demiral, et al. 2016; Wang 2015) Other studies find a positive correlation between healthcare expenditure and economic outcomes such as income, GDP, and labor productivity, particularly in the United States (V. Raghupathi and W. Raghupathi 2020).

The remainder of this paper is structured as follows. Section 2 presents the general equilibrium model to study the effects of different healthcare financing policies in a small open economy with heterogeneous households and fragmented labor markets. Section 3 describes relevant aspects of the Colombian health system and presents a quantification of the expected increase in costs in the coming years. Section 4 describes the strategy for calibrating the model for the Colombian context. Section 5 presents the results and analysis of the effects of four alternative tax schemes to finance additional healthcare expenditure, as well as some extensions to the benchmark model. Section 6 concludes.

2 Model

This section presents the dynamic general equilibrium model used for our quantitative analysis. Building on the framework of Ávila-Montealegre et al. (2023) and L. E. Arango et al. (2022), our model extends the benchmark small open economy (SOE) model to include heterogeneous households with differentiated labor and alternative tax mechanisms for financing public expenditure. Specifically, the model features two types of households that differ in labor productivity, access to financial markets, and distribution of subsidies (healthcare and lump-sum transfers).

On the production side, we consider two layers. First, a representative monopolistic competitor uses capital and labor to produce heterogeneous intermediate goods. Second, a competitive producer aggregates these goods into a single homogeneous product, which is used for consumption, investment, and net exports. Formal low-skilled workers earn a fixed minimum wage. The government finances public spending through taxes on consumption, capital, and labor while maintaining a balanced budget. Public expenditure is distributed as lump-sum transfers to households. The following sections detail the optimization problems of households and firms, as well as the government's budget constraints, and the exogenous minimum wage for formal low-skilled workers.

2.1 Households

A mass one of households is divided into high-skilled N^H and low-skilled N^L. On the one hand, high-skilled households offer highly productive labor, have access to foreign financial markets, own physical capital and firms, and make consumption and investment decisions. The representative high-skilled consumer maximizes the present value of her utility, choosing consumption (c_t^H), hours supplied (h_t^H), foreign assets (a_t^f), capital (k_t), and investment (i_t). They also pay taxes on consumption (τ_t^c) and labor income (τ_t^H) and obtain a healthcare subsidy from the government (g_t^H). Their income sources are wages (w_t^H), rent on capital (R_t), foreign asset returns ($\Phi_t R_t^f$), and any firm's profit (Π_t). To properly account for non-health public expenditure, we include an additional term in the utility function and the budget constraint, c^{pub}. This component enters in the utility function linearly, therefore it does not affect optimality conditions, and is completely funded by a lump-sum tax, τ^{pub}. The optimization problem of a representative high-skilled household is given by

$$\max_{c_t^H, h_t^H, i_t, k_{t+1}, a_{t+1}^f} E_0 \sum_{t=0}^{\infty} \beta^t \left(\frac{(c_t^H)^{1-\sigma}}{1-\sigma} - \psi_H \frac{\nu_H}{1+\nu_H} (h_t^H)^{\frac{1+\nu_H}{\nu_H}} + c^{pub} \right)$$

subject to the budget constraint, capital's law of motion with investment adjustment costs, and debt-elastic interest rate, Equations 1 to 3:

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

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

$$\Phi_t = \Phi_{ss} exp \left(-\phi_a \left(A_t^f / Y_t - \overline{A}^f / \overline{Y} \right) \right) \tag{3}$$

Following Schmitt-Grohé and Uribe (2003), we consider that the risk premium depends on the deviations of aggregate foreign debt, $A_t^f = N_t^H a_t^f$ as a percentage of GDP from its steady-state value, Equation 3. Higher values of debt imply a higher risk premium and reduce incentives to permanently increase consumption.

From the first order conditions (F.O.Cs), we find the marginal rate of substitution between consumption and labor:

$$P_t(1+\tau_t^c) \psi_H (h_t^H)^{1/\nu_H} = (c_t^H)^{-\sigma} w_t^H (1-\tau_t^H) \tag{4}$$

and the Euler equations for investment, capital, and foreign bonds are:

$$\frac{(c_t^H)^{-\sigma}}{(1+\tau_t^c)} = \mu_t \left(1 - \phi \left(\frac{i_t}{i_{t-1}} - 1 \right) \frac{1}{i_{t-1}} \right) + \beta E_t \left[\mu_{t+1} \phi \left(\frac{i_{t+1}}{i_t} - 1 \right) \frac{i_{t+1}}{i_t^2} \right] \tag{5}$$

$$\mu_t = \beta E_t \left[\mu_{t+1}(1-\delta) + \frac{(c_{t+1}^H)^{-\sigma}}{P_{t+1}(1+\tau_{t+1}^c)} R_{t+1} \right] \tag{6}$$

$$\frac{(c_t^H)^{-\sigma}}{P_t(1+\tau_t^c)} = \beta E_t \left[\frac{(c_{t+1}^H)^{-\sigma}}{P_{t+1}(1+\tau_{t+1}^c)} \Phi_t R_t^f \right] \tag{7}$$

Low-skilled households are hand-to-mouth workers, meaning that their consumption (c_t^L) equals their income. They offer two types of low-productivity labor, formal (h_t^F) and informal (h_t^I), and receive healthcare subsidies (g_t^H). Low-skilled households also pay consumption taxes and potentially on formal labor income (τ_t^L). Informal labor does not pay taxes and is less productive than formal labor. The income sources of low-skilled households include wages from formal and informal labor, w_t^F and w_t^I. The representative low-skilled consumer maximizes the value of her utility subject to the budget constraint.

$$\max_{c_t^L, h_t^F, h_t^I} E_0 \sum_{t=0}^{\infty} \beta^t \left[\frac{(c_t^L)^{1-\sigma}}{1-\sigma} - \psi_F \frac{\nu_F}{1+\nu_F} (h_t^F)^{\frac{1+\nu_F}{\nu_F}} - \psi_I \frac{\nu_I}{1+\nu_I} (h_t^I)^{\frac{1+\nu_I}{\nu_I}} \right]$$

subject to

$$P_t c_t^L (1+\tau_t^c) \leq w_t^F h_t^F (1-\tau_t^L) + w_t^I h_t^I + P_t g_t^L \tag{8}$$

This group of households cannot distribute resources over time, which implies that their optimization problem is static. From the F.O.Cs, we obtain the marginal rates of substitution between consumption and formal and informal labor.

$$P_t(1+\tau_t^c)\psi_F (h_t^F)^{1/\nu_F} = (c_t^L)^{-\sigma} w_t^F (1-\tau_t^L) \tag{9}$$

$$P_t(1+\tau_t^c)\psi_I (h_t^I)^{1/\nu_I} = (c_t^L)^{-\sigma} w_t^I \tag{10}$$

These two equations determine the supply of formal and informal low-skilled labor. However, equation 9 is irrelevant due to the presence of a binding minimum wage for formal low-skilled workers.

2.2 Production

We divide the production process into two stages. At the top stage, a competitive firm combines a continuum of heterogeneous domestic inputs to produce a homogeneous final good. This firm maximizes its profits according to

$$\max_{Y_t(j)} P_t Y_t - \int_0^1 P_t(j) Y_t(j) dj$$

$$s.t. \quad Y_t = \left(\int_0^1 Y_t(j)^{\frac{\xi-1}{\xi}} dj \right)^{\frac{\xi}{\xi-1}} \tag{11}$$

where Y_t is domestic production, and $Y_t(j)$ is the input produced by the heterogeneous firm (j). In equilibrium, domestic production is allocated to consumption among households, investment, and net exports. From the F.O.C. we find that the demand for input (j) depends on its relative price and the aggregate demand for domestic goods:

$$Y_t(j) = \left(\frac{P_t(j)}{P_t} \right)^{-\xi} Y_t \tag{12}$$

Our small open economy setup follows the emerging market business cycle literature (Garcia-Cicco, Pancrazi, and Uribe 2010; Schmitt-Grohé and Uribe 2003), assuming that the domestic final good is substitutable for the good produced by the rest of the world. This property, along with the exogenous foreign interest rate, allows the model to be closed with net exports, eliminating the need for explicit modeling of exports and imports. This also implies that the real exchange rate is equal to one in the long run.

At the inner level, a representative monopolistic competitor (j) minimizes production costs, including wages of the three types of labor w^H, w^F, w^I, the rent of capital R, the firm's contribution to the social security of formal workers, high-skilled and low-skilled, τ^{FH}, τ^{LH} and a tax on the use of capital τ^K.[2] Thus, firm (j) chooses its optimal demand for capital and the three types of labor, subject to technological constraints and demand for its heterogeneous input. We subtract the time index to simplify the notation. The optimization problem is:

$$\begin{aligned} \max_{P(j),K(j),L^H(j),L^F(j),L^I(j)} \quad & P(j)Y(j)- \\ (1+\tau^{FH})w^H L^H(j) + (1+\tau^{FL})w^F L^F(j) + w^I L^I(j) + (1+\tau^k)RK(j) \end{aligned} \tag{13}$$

subject to technological constraint and the product, demand Equation 12:

$$Y(j) = AK(j)^{\alpha} L(j)^{1-\alpha} \tag{14}$$

$$L(j) = \quad \theta(L^L(j))^{\frac{\eta-1}{\eta}} + (1-\theta)(L^H(j))^{\frac{\eta-1}{\eta}} \quad {}^{\frac{\eta}{\eta-1}} \tag{15}$$

$$L^L(j) = \quad \theta_L(L^I(j))^{\frac{\eta_L-1}{\eta_L}} + (1-\theta_L)(L^F(j))^{\frac{\eta_L-1}{\eta_L}} \quad {}^{\frac{\eta_L}{\eta_L-1}} \tag{16}$$

The aggregation of production factors is highly flexible, allowing for different degrees of substitutability among the three types of labor. Taking advantage of the CES structure, we construct an aggregate labor input, assuming that formal and informal low-skilled labor are more substitutes, whereas high-skilled and low-skilled labor are more complements. In the first step, Equation 16 combines formal and informal low-skilled labor into a factor L^L. This combination is governed by the elasticity of substitution η_L and relative productivity θ_L. Similarly, Equation 15 shows how total labor L is a combination of low- and high-skilled workers regulated by parameters η and θ. Finally, we aggregate labor factor L with capital K using a standard Cobb-Douglas production function. Although the model considers that the share of total labor compensation is fixed, $1-\alpha$, it allows for changes within the types of labor.[3] From the first-order conditions of this optimization problem, we find the relative demand for factors as functions of their relative prices, marginal cost as a function of productivity and factor prices, and the optimal price.

$$\alpha\frac{Y(j)}{K(j)} = \frac{(1+\tau^k)R}{P(j)} \tag{17}$$

$$(1-\alpha)\frac{Y(j)}{L(j)}(1-\theta)\left(\frac{L(j)}{L^H(j)}\right)^{1/\eta} = (1+\tau^{FH})\frac{w^H}{P(j)} \tag{18}$$

$$(1-\alpha)\frac{Y(j)}{L(j)}\theta\left(\frac{L(j)}{L^L(j)}\right)^{1/\eta}(1-\theta_L)\left(\frac{L^L(j)}{L^F(j)}\right)^{1/\eta_L} = (1+\tau^{FL})\frac{w^F}{P(j)} \tag{19}$$

$$P(j) = \frac{\xi}{\xi-1}MC \tag{20}$$

[2]In this framework the assumption of monopolistically competitive firms is not necessary for our main results. This structure was necessary in a previous version in which we consider also taxes to benefits (dividends) to finance healthcare. Those results are available upon request.

[3]One possible extension is to consider a CES aggregation at the top level.

where $MC = \frac{1}{A}\left(\frac{(1+\tau^k)R}{\alpha}\right)^{\alpha} \quad \frac{w}{1-\alpha} \quad ^{1-\alpha}$, $w = \quad \theta^{\eta}(w^L)^{1-\eta} + (1-\theta)^{\eta}((1+\tau^{FH})w^H)^{1-\eta} \quad ^{1/(1-\eta)}$, and $w^L = \quad \theta_L^{\eta_L}(w^I)^{1-\eta_L} + (1-\theta_L)^{\eta_L}((1+\tau^{FL})w^F)^{1-\eta_L} \quad ^{1/(1-\eta_L)}$.

To close the model, we assume that P_t is the numeraire; therefore, $P_t = 1$. Aggregate consumption is the sum of individual consumption multiplied by the number of households of each type, $C_t = N_t^H c_t^H + N_t^L c_t^L$. Similarly, aggregate investment, capital, high-skilled labor, and foreign assets are given by $X_t = N_t^H x_t$. Where $X_t \in \{I_t, K_t, L_t^H, A_t\}$ and $x_t \in \{i_t, k_t, h_t^H, a_t\}$. The total low-skilled formal and informal labor are defined as $L_t^F = N_t^L h_t^{F,d}$ and $L_t^I = N_t^L h_t^I$. Note that formal low-skilled labor is cleared with $h_t^{F,d}$ which represents a firm's demand for this type of worker. This condition arises from the existence of a binding minimum wage, as explained below. Finally, aggregate demand is the sum of consumption, investment, and net exports $Y_t = C_t + I_t + NX_t$.

2.3 Labor Market and the Minimum Wage

As previously described, our economy has three types of labor: high-skilled, formal, and informal low-skilled. The interaction between demand and supply determines employment and wages for informal low-skilled and high-skilled labor, given the optimal decisions of firms and households. However, in the case of low-skilled formal labor, the level of employment is not determined competitively. We assume that there is an exogenous minimum wage above the competitive equilibrium, therefore firms will hire less labor than they would in competitive framework. Although households prefer to supply more formal labor at the minimum wage, they are constrained by the level of labor demanded by firms. The demand side then determines the employment level. In particular we consider:

$$w_t^F = w^{min,F} \tag{21}$$

where $w^{min,F}$ is exogenously given, and it is calibrated such that the initial unemployment rate is 10%, which is the average unemployment rate of Colombia. We define unemployment as the difference between the supply and demand of formal low-skilled labor. In our model, there is an interdependence between the two types of low-skilled labor, which reflects the mobility between formal and informal workers, capturing the central elements of the models used to analyze minimum wage policies (Gramlich 1976; Mincer 1976).

2.4 Government

In this model, the government provides healthcare expenditure in the form of lump-sum transfers to high-skilled and low-skilled households, g_t^H and g_t^L. These transfers are financed by taxes and may differ between each household type, which is consistent with data on public healthcare expenditure in Colombia. For modeling purposes, we assume that these expenditures can be affected by transitory or permanent shocks ϵ_t^x.

$$g_t^x = g_{ss}^x + \epsilon_t^x, x \in \{H, L\} \tag{22}$$

Accordingly, public healthcare expenditure G_t is given by the sum of transfers to each type of household and can change either because of public policy or because the mass of households is changing.[4]

$$G_t = g_t^H N_t^H + g_t^L N_t^L \tag{23}$$

[4]While in our baseline model we keep the mass of households constant. We explore the effect of changing the size of population in the alternative scenarios.

On the income side, to finance public health, the government receives revenue from taxes on formal labor (firms and households), firms' use of capital, and consumption. Thus, total income is given by:

$$T_t = (\tau_t^H + \tau_t^{FH})w_t^H L_t^H + (\tau_t^L + \tau_t^{FL})w_t^F L_t^F + \tau_t^k R_t K_t + \tau_t^c(C_t^H + C_t^L) \qquad (24)$$

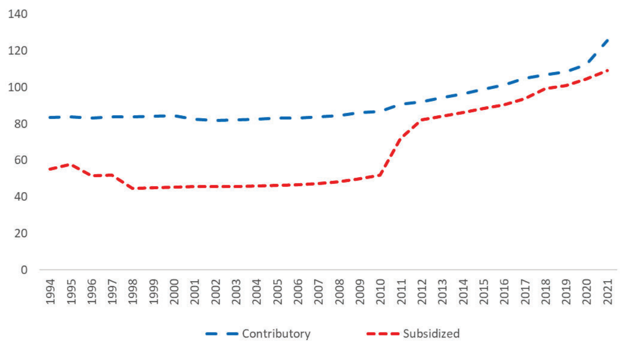
Assuming a balanced budget, we have $G_t = T_t$. Finally, we introduce an additional transfer to high-skilled households, denoted by c^{pub}, which captures public non-health expenditure. This transfer is fully financed by a lump-sum tax to the same group of households, τ^{pub}. This transfer is useful for accounting purposes, helping to map public and private consumption from the data, as well as mapping funding sources. This non-health public consumption will be constant across the different scenarios.

3 Healthcare system in Colombia

Law 100 of 1993 established Colombia's healthcare system, which operates under a dual-affiliation regime based on employment status. Formal workers and their dependents are covered by the contributory regime, funded by payroll taxes from workers and firms. The subsidized regime, which serves informal and unemployed workers, is financed by government transfers funded by taxes and public debt. In 2019, direct contributions accounted for 48.2% of the total healthcare funding, highlighting the importance of government support for system's sustainability.

A key feature of the system is the annual per capita budget, g_t^x in our model.[5] This budget covers the insurance risk premium, administrative costs, and ensures providers' profitability. Its value varies based on age, location, sex, and the regime to which the individuals belong, with higher allocations for the contributory regime. As shown in Figure 1, per capita healthcare costs have been consistently lower in the subsidized regime since 1995, often about half the cost in the contributory regime until 2010. In 2011, a reform of the healthcare system increased expenditure on the subsidized system. Since then, equalizing per capita expenditures among regimes is a central issue.

Figure 1: Evolution of real health expenditure per person.



Note: Index of g in the contributory regime 1994 = 100.

Colombia's healthcare system faces financial stability challenges in the coming years due to global trends like aging populations and rising healthcare costs. Domestic pressures, such

[5] This is known as UPC (Unidad de Pago por Capitación) in Spanish.

as equalizing per capita expenditures across regimes and expanding covered medicines and treatments, add further strain. To estimate the real per capita expenditure growth over the next eight years, we extrapolated the 3.1% annual growth rate observed in the contributory regime from 2010 to 2020. The projected increase is driven by factors such as population aging, expenditure equalization across regimes, advancements in medical technology, and other influences.

The effect of these factors is inspected in different scenarios in Table 1, where the columns refer to the contributory, subsidized, or average population. In the first row, population aging accounts for a 7.1% increase in the contributory regime and 7.3% in the subsidized regime, based on DANE projections and current expenditure distribution by age, gender, and regime. The second row adds the effect of expenditure equalization across regimes. As expected, this does not change costs in the contributory regime but increases subsidized regime expenditure by 28.6%. The third row incorporates rising treatment and medicine costs, reflecting trends in the consumer price index over the past decade. Combined, these three factors explain the 25% increase in average per capita expenditure, with 14.2% for the contributory regime and 37% for the subsidized regime. However, the projected 27% increase in the contributory regime suggests additional drivers, such as expanded coverage of medicines and treatments. The total expected increase is presented in the fourth row.

Table 1: Percentage Growth of g 2022 - 2030

Scenario	Contributory	Subsidized	Average
Aging	7.1%	7.3%	7.3%
Aging + Equalization	7.1%	28.6%	17.3%
Aging + Equalization +Higher costs	14.2%	37.0%	25.0%
Aging+ Equalization + Higher costs + Other	27.7%	53.2%	41.2%

* Own calculations based on Ministry of health and DANE.

4 Model Calibration and Parameter Selection

We calibrate the model to the Colombian economy using an annual frequency. We set the parameter values using a combination of data, literature for Colombia (González et al. 2011; Ávila-Montealegre et al. 2023), international evidence (Whalen and Reichling 2017; Krusell et al. 2000), and targeting some steady state ratios to time-series averages. The values from the literature and data are reported in Table 2, and the targeted values with their corresponding targets are displayed in Panel A of Table 3.

We categorize Colombian workers according to their labor income relative to the minimum wage, using data from the Colombian Household Survey (GEIH) from 2010 to 2019.[6] In particular, we define high-skilled formal workers as those with earnings exceeding 1.1 times the minimum hourly wage, low-skilled formal workers as those with earnings between 0.9 and 1.1 times the minimum hourly wage, and, the remaining individuals are categorized as low-skilled informal workers.[7] Given these thresholds, we calibrate the

[6]The National Administrative Department of Statistics (DANE) conducts the GEIH, a continuous household survey that investigates employment, income, hours, and other labor market-related variables.

[7]Workers surveyed in the GEIH do not always report the wage stated in their contract, but the actual wage they receive. This discrepancy can arise because of factors such as social security discounts and subsidies. By using a range to define minimum wage earners, we can account for these variations.

relative productivity between low- and high-skilled workers (θ) to obtain a wage ratio of 2.7, and the relative productivity between formal and informal low-skilled workers (θ_L) to yield a wage ratio of 2.3. We define the mass of high-skilled households N^H as 52%, which is consistent with the data, and set the disutility of low-skilled labor (ψ_I) to match an informal employment share of 40%. Similarly, we obtain the disutility of high-skilled labor to match the wage share of 64% for this type of worker. To define the initial level of the minimum wage (w_{min}) we target a level of low-skilled formal employment 10% below than in a competitive market.

The remaining parameters in the production function are the capital share (α), depreciation rate (δ), and total factor productivity (A_{ss}). These values are chosen to match a consumption over GDP of 84.0%, capital over GDP of 3.0, and normalized GDP of one in the steady state. These values also imply that investment over GDP is 13.5%. The calibration of these economic variables is made between 2010 and 2019 with the National account information from DANE, in order to mitigate the influence of short-term economic fluctuations and better reflect the steady-state conditions. To ensure proper accounting we divide total consumption into private and public, the second one is a pure transfer to close the model and it is independent of public expenditure on health.

Table 2: Definition of Parameters and Values from Literature and Data

Param.	Definition	Value	Param.	Definition	Value
		Panel A. Literature**			
β	discount factor	0.95	ν_I	frisch elast. IL	1.5
σ	intertemporal elast.	1.0	η	elast. subs. H and L	1.01
ν_H	Frisch elast. H	1.0	η_L	elast. subs. F and I	1.50
ν_F	Frisch elast. FL	1.5	ξ	elast. of subs. interm.	10
		Panel B. Data			
N_H	share of H Hhs	0.52	τ^{FL}	tax FL labor (firms)	0.00
g_{ss}	health govern. expenditure	0.043	τ^H	tax H labor (Hh)	0.04
g_{ss}^L	transfers to L	0.04	τ^L	tax FL labor (Hh)	0.04
τ^{FH}	tax H labor (firms)	0.02	τ^k	tax capital	0.01

* Param. stands for Parameter, elast. for elasticity of substitution, Hh for households, govern for government, and interm. for intermediates.
** González et al. (2011), Whalen and Reichling (2017), and Krusell et al. (2000).

It is important to highlight that our calibration algorithm perfectly matches all the long-run ratios. For the long-run equilibrium, we assume that net foreign debt is 50% of GDP ($A_{ss}^f = 50\%$), implying a trade surplus of 2.6%, the risk premium is one ($\Phi_{ss} = 1.0$), and government expenditure is ($G/Y = 4.3\%$). This implies a transfer of 0.043 for high-skilled households and 0.0407 for low-skilled households, which is consistent with the health expenditure per person in Colombia for the two regimes. Total government expenditure on healthcare, represented by g_{ss}, involves the computation of its proportion relative to GDP between 2019 and 2022. This computation exclusively considers the direct costs associated with a Unified Healthcare Provision for both healthcare regimes. To perform this analysis, we use data from the Social Security Resource Administration Office. In our calibration we focus on recent years of information to consider the current status and the effect of the reforms in the system.

As mentioned in Section 3 Colombia's healthcare system is financed through direct contributions from firms and workers, and by indirect resources through government transfers. Workers contribute 4% of their wages, while firms contribute 8.5%, provided that the wage exceeds ten minimum wages.[8] Using these payroll taxes and the proportion of formal high- and low-skilled workers from the GEIH, we compute the average tax rates for formal jobs in our model. According to this calibration, 66% of the expenditure is financed with direct contributions, in particular, 54% from taxes to high-skilled labor and the remaining 12% to formal low-skilled labor.[9]

The tax on capital is defined according to administrative data. To guarantee a balanced budget for the government and close the model in the initial steady state, we allow the tax on consumption to freely adjust, $\tau^c = 1.5\%$. Regarding taxes on consumption and capital, they finance 26% and 7% of the expenditure. Finally, as Figure 1 shows, the annual healthcare expenditure per individual in the subsidized regime, g^L, is approximately 90% of the expenditure in the contributory regime, g^H.

In order to check how the model adjusts the data, Panel B of Table 3 compares some non-targeted moments with the official data from the labor market. As we can see, the model closely replicates employment and wage shares.

Table 3: Targeted, Non-Targeted Moments and Parameters

Panel A. Targeted Moments

Target	Value	Parameter	Description	Value
Y	1.0	A_{ss}	total factor Prod.	1.285
K/Y	3.0	α	capital share	0.30
C/Y	0.84	δ	depreciation of K	0.045
A^f_{ss}/Y	-0.50	A^f_{ss}	foreign assets	-0.50
G/Y	0.043	g^H_{ss}	transfers to H	0.045
g^L_{ss}	$0.9g^H_{ss}$	g^L_{ss}	transfers to L	0.041
w^H/w^F	2.7	θ	relative prod. H and L	0.437
w^F/w^I	2.3	θ_L	relative prod. F and I	0.349
employment share I	0.4	ψ_I	dis-utility labor IL	0.431
wage share H	0.64	ψ_H	dis-utility labor H	1.795

Panel B. Non-Targeted Moments

Moment	Model	Data
employment share H	0.307	0.303
employment share FL	0.293	0.308
wage share IL	0.134	0.18
wage share FL	0.226	0.201

Prod. stands for productivity, H for High-skilled, IL for informal low-skilled, and FL for formal low-skilled workers. Employment share $x \in \{I, FL, H\}$ is defined as $(L^x)/(L^H + L^I + L^F)$. The wage share for $x \in \{I, FL, H\}$ is defined as $(w^x L^x)/(w^H L^H + w^{IL} L^I + w^{FL} L^F)$.

[8] Since Law 1607/2012, the contributions of formal workers who earn less than 10 minimum wages are covered by the government budget.

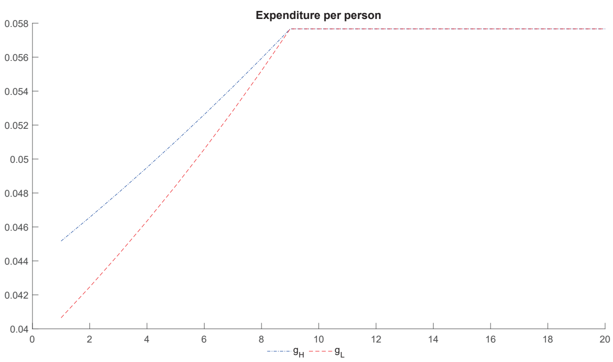
[9] The share of direct contributions is a bit higher than in the data, but this is a non-targeted moment and results from using the official tax rates.

5 Macroeconomic Effects of Healthcare Funding

This section investigates how financing a gradual and permanent increase in real per capita healthcare expenditure in Colombia affects the macroeconomy under various funding scenarios. Our benchmark scenario assumes that healthcare expenditure has no direct impact on labor productivity. However, section 5.2 extends the benchmark simulation to explore alternative scenarios. These scenarios consider positive externalities on labor productivity, financing through foreign debt, the impact of an aging population, and a migration shock.

Based on the projections in Section 3, we assume an annual growth rate of 3.1% in real per capita expenditure for the contributory regime and 5.4% in the subsidized regime. This growth equalizes expenditures in both regimes by the eighth year, as shown in Figure 2. Subsequently, per capita expenditure remains constant for both regimes. In the initial equilibrium, healthcare expenditures differ across households, with values of 0.045 and 0.041 in our calibration.

Figure 2: Per capita Healthcare expenditure



Note: g_H and g_L stand for individual transfers to high-skilled and low-skilled households, respectively.

For our simulations, we assume an exogenous increase in per capita healthcare expenditure for each regime, with the closing tax rate determined endogenously. This means the model calculates the tax rate needed to maintain a balanced fiscal budget in each period. We analyze four financing options, each involving a single tax: consumption (τ^c), capital use (τ^k), hiring high-skilled labor (τ^{FH}), and hiring low-skilled labor (τ^{FL}). Except for the consumption tax, the other taxes directly affect the relative demand for production factors, which significantly impacts the results. The economy begins in a steady state, and agents are informed of the increase in per capita healthcare expenditure and the corresponding tax adjustments for the next eight years. The economy then transitions to a new long-run equilibrium with higher taxes and transfers.[10]

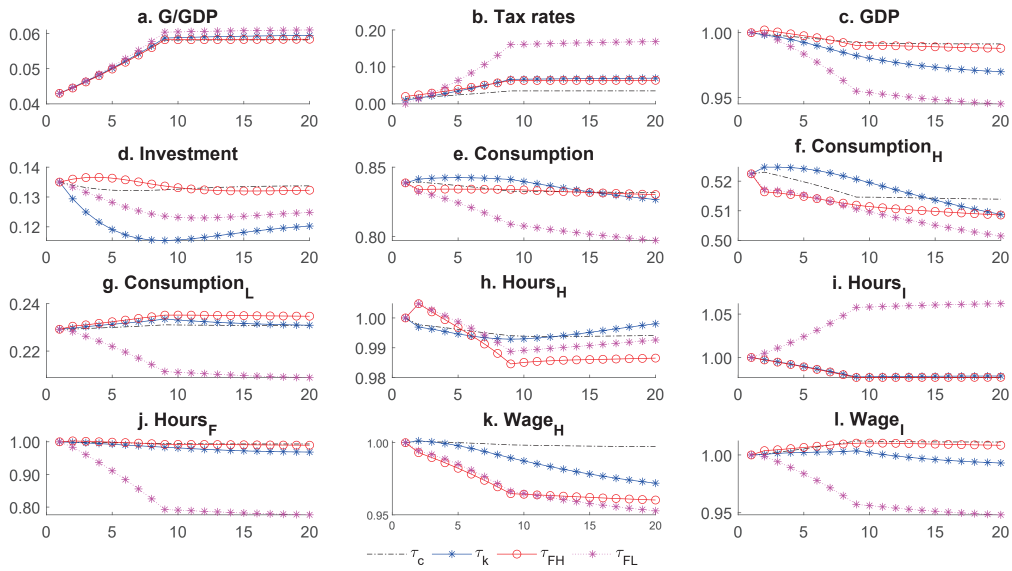
5.1 Benchmark results

The dynamics of key macroeconomic variables following the increase in healthcare expenditure under the four financing schemes are shown in Figure 3. Panel A displays the

[10]For this equilibrium transition, we use the perfect foresight option in Dynare (see Adjemian et al. (2021)).

increase in total healthcare expenditure as a share of output, varying by the type of tax used. Panel B shows that higher expenditure raises all tax rates, creating distortions that negatively impact GDP, investment, and consumption (Panels C, D, and E). Although all funding options have negative effects, their magnitudes differ. Raising consumption taxes causes the least distortion (in terms of aggregate production), followed closely by taxes on high-skilled labor, whereas taxes on low-skilled formal labor are the most distorting.

Figure 3: Macroeconomic response to an increase in public expenditure.



Note: Initial values for G/Y, τ, GDP, I, C, C_H, and C_L correspond to the steady state before the shock. Labor market variables, h_H, h_I, h_F, w_H, w_I, are expressed relative to the initial steady state. Consumption includes private and public expenditure.

When healthcare is financed through consumption taxes (τ^c), the negative effects on the economy are smaller for two main reasons. First, the required increase in the consumption tax rate is relatively modest—only two percentage points (pp)—compared to the 4.4 pp increase needed for the formal high-skilled labor tax, which is the next smallest tax hike. Since private consumption represents approximately 75% of the total output, even a small tax increase generates sufficient revenue for healthcare spending. Second, as a general tax, it does not directly interfere with firms' decisions to use capital or hire labor. This neutrality is evident from the uniform decline in the use of all production factors, without favoring or penalizing specific inputs, Panels D, H, I, and J. As a result, raising the consumption tax rate leads to a relatively small long-term GDP decline of 0.86%, compared to the larger drops of 1.2% to 5.5% observed under other financing schemes.

For low-skilled households, the negative impact of higher taxes on consumption is offset by increased government transfer. Consequently, the income effect of increased transfers allows them to maintain a relatively stable consumption. Despite the reduction in formal employment, it is not necessary to compensate for this with an increase in the informal labor supply; instead, we observe a decrease in informal employment and an increase in informal wages, Panels I and L. Thus, transfers boost consumption, Panel G. Similar patterns are observed with tax schemes that do not target hiring formal low-skilled workers. However, lower demand reduces formal employment for both high- and low-skilled workers, resulting in lower wages and employment levels, Panels H, J, and K. In contrast, the alternative tax schemes increase the relative cost of labor or capital, altering firms' input demand and causing larger declines in production.

The most significant reduction in GDP occurs when additional healthcare spending is financed by taxing formal low-skilled labor (τ^{FL}). To balance the budget, the tax rate increases sharply by 17 percentage points (pp), as shown in Panel B. Formal low-skilled labor represents 10% of employment, 23% of total wages, and 12% of GDP, requiring this large tax hike. The higher hiring costs discourage firms from employing formal low-skilled workers. Due to the rigid minimum wage, firms cannot cut wages and instead reduce demand, resulting in a 22% decline in formal low-skilled employment in the long run (Panel J). This significantly impacts low-income households, as government transfers fail to fully offset the loss of labor income. Consequently, these households cut consumption and increase informal labor supply, raising informality and reducing informal wages (Panels I and L). Taxing formal low-skilled labor proves to be the least favorable option, causing the largest decline in output and the greatest increase in inequality.

The remaining financing options involve taxing capital, τ^k, and taxing high-skilled labor, τ^H. Both taxes directly reduce the demand for the respective factors. Specifically, increasing τ^k cuts investment by 11%, while raising τ^H reduces high-skilled employment by 1.4 percentage points (pp). In both schemes, the increase in the tax rate is similar, between 4 and 6 pp, and passes on higher production costs that affect the demand for complementary factors of production, such as low-skilled labor. From a macroeconomic perspective, taxing high-skilled labor is preferable to taxing capital. This results in a smaller drop in output and reduces consumption inequality.

While aggregate and high-skilled consumption decline under all four financing schemes, the impact on low-skilled consumption varies by tax. Notably, low-skilled consumption decreases only when additional healthcare spending is funded by taxes on formal low-skilled labor. In this case, the increase in healthcare transfers fails to compensate for the loss of income from formal employment, leading hand-to-mouth households to reduce their consumption.

These findings are significant for policymakers aiming to reduce income and consumption inequality through transfers and taxes. The observed variations in the effects of tax schemes on output, consumption inequality, and employment (both formal and informal) highlight the importance of designing healthcare financing policies carefully. Policymakers should consider the potential trade-offs between fiscal sustainability and economic performance when selecting tax schemes. To complement our analysis, in the following section we report the welfare changes induced by each funding option.

5.1.1 Welfare Analysis

The financing schemes presented in the previous section have different effects on households' decisions: consumption and labor. To evaluate how the well-being of each household changes under alternative financing schemes, we explore the change in welfare in this section. For this purpose, we calculate the present discounted value of the utility under each tax scheme and compare it with the value of utility associated with staying in the initial steady state. For instance, the percentage welfare variation for household H, $\Delta\%W^H$, is:

$$\Delta\%W_j^H = \frac{PV_j^H - PV_{ss}^H}{|PV_{H,ss}|} * 100 \tag{25}$$

where

$$PV_j^H = \sum_{t=0}^{\infty} \beta^t \left(\frac{(c_t^H)^{1-\sigma}}{1-\sigma} - \psi_H \frac{\nu_H}{1+\nu_H} (h_t^H)^{\frac{1+\nu_H}{\nu_H}} + c^{pub} \right);$$

$$PV_{ss}^H = \frac{1}{1-\beta} \left(\frac{(c_{ss,0}^H)^{1-\sigma}}{1-\sigma} - \psi_H \frac{\nu_H}{1+\nu_H} (h_{ss,0}^H)^{\frac{1+\nu_H}{\nu_H}} + c^{pub} \right)$$

j corresponds to each funding option and the subscript $ss, 0$ indicates the initial steady-state values.[11] A similar expression can be used for welfare variation of low-skilled households. We extend this methodology and compute the percentage changes in welfare and consumption between the initial and final steady states. To avoid social welfare considerations, we present the changes in welfare for each household. Table 4 reports the percentage changes in welfare in columns 1 and 2. The percentage change between the two steady states in welfare, columns 3 and 4, and consumption, columns 5 and 6.

The following four key results were obtained. Firstly, high-skilled households consistently experience welfare losses relative to the initial equilibrium; however, financing the increase in healthcare expenditure through consumption taxes mitigates these losses. Secondly, low-skilled households experience welfare gains when additional taxation does not directly affect the hiring of formal low-skilled labor. This result contrast with the literature where the increase in consumption taxes is regressive, see for instance Warren (2008). In our framework, the increase in healthcare transfers offset the negative effect of taxation and allow low-skilled households to keep the consumption level. Thirdly, financing through taxes on hiring formal low-skilled labor is the least desirable option, as it significantly magnifies welfare losses for both high-skilled and low-skilled households. Additionally, it generates the largest decline in consumption in the long run. Fourthly, the reduction in consumption plays a crucial role in determining the overall welfare changes across all taxing schemes. This is also, evidenced by the impulse response functions, where consumption reacts more strongly than labor supply.

Finally steady state comparisons magnify the negative effects of the policy. In all cases, welfare losses are larger than those in the dynamic calculation. Two facts explain this difference. On the one hand, the static comparison does not consider the timing of the policy, which takes several years to be fully implemented. On the other hand, the economy takes time to fully adjust to the shock due to capital adjustment costs, and substitution forces across the different factors of production.

Given the results in this section, we have different metrics to evaluate the effects of higher taxation on financing additional healthcare expenditure. If we focus only on economic activity, consumption tax is the least distorting option. Alternatively, if we are concerned about inequality or increasing welfare for low-skilled households, taxes on hiring high-skilled labor become a good alternative.

[11] In our calculations is not necessary to include c_t^{pub} as it is exogenous and do not vary across steady states.

Table 4: Welfare and Consumption change under alternative funding options.

Tax	$\Delta\%W^H$	$\Delta\%W^L$	$\Delta\%W^H_{ss}$	$\Delta\%W^L_{ss}$	$\Delta\%C^H_{ss}$	$\Delta\%C^L_{ss}$
τ^c	-1.50	0.68	-2.17	0.84	-1.71	0.69
τ^k	-2.34	1.14	-6.60	1.10	-4.40	0.23
τ^{FH}	-2.69	1.68	-4.01	2.00	-3.20	2.24
τ^{FL}	-4.27	-1.90	-7.88	-2.88	-5.49	-9.55

5.2 Complementary scenarios and further analysis

This section explores four complementary scenarios to investigate dimensions that may significantly influence the effects of increased healthcare expenditure and its financing, but are not fully captured by our benchmark model. The first scenario examines the extent to which a positive externality of healthcare expenditure on labor productivity affects the benchmark results. The second introduces a third agent into the model, who is a retiree, providing a more detailed representation of the change in the composition of the population as people live longer, and old agents gain importance in the economy. This refinement aims to better capture the impact of an aging population, characterized by a larger share of older individuals reliant on healthcare and a smaller share of younger individuals who work, save, and pay taxes. The third scenario considers the possibility that the government can partially rely on foreign debt as an alternative source to finance the additional healthcare expenditure in the short run. Finally, the fourth scenario evaluates the impact of changing the population size of high- and low-skilled workers, without affecting the expenditure per individual in each household. This scenario helps us understand the effects of migration shocks that have been relevant to Colombia during the last decade. For clarity and ease of analysis, each scenario is treated independently.

5.2.1 Positive externality on labor productivity

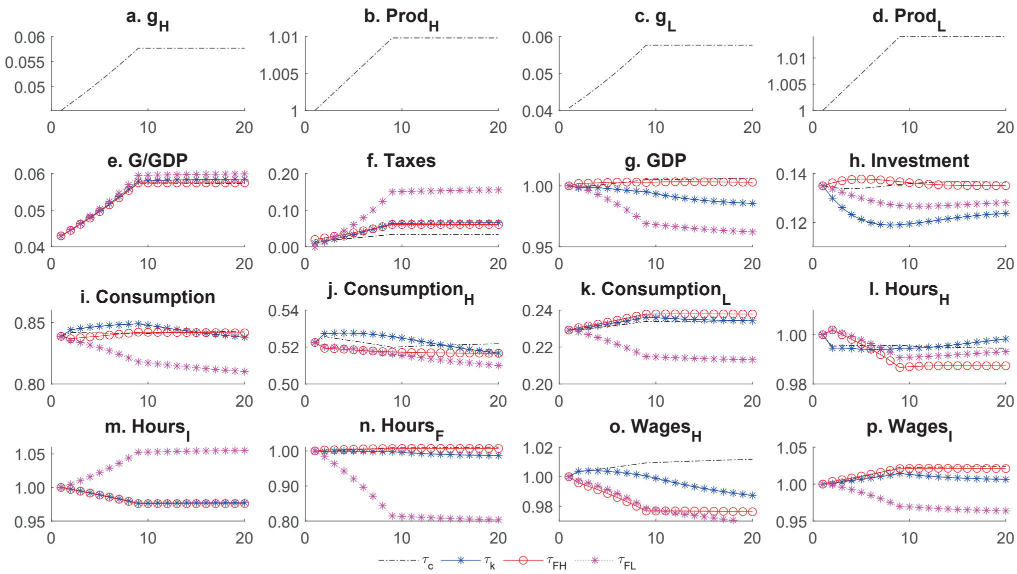
So far, we have assumed that healthcare expenditure is a transfer that does not affect labor productivity. However, numerous studies have shown that investing in healthcare positively influences labor productivity and per capita income (Mankiw, D. Romer, and Weil 1992; Gyimah-Brempong and Wilson 2004; Howitt 2005; Bloom and Canning 2009; Bloom, Canning, et al. 2019). Motivated by this research, we extend our analysis to include a positive externality of health expenditure on labor productivity. Specifically, we modify the production function from Equation 15 to reflect that any increase in per capita health expenditure above the initial steady-state levels, $(g_{L,0}, g_{H,0})$ increases labor productivity. For illustrative purposes, we assume that healthcare expenditure has an immediate effect on productivity. However, we recognize that this process may take several years; thus, we should interpret the short-term effects with caution.[12] This equation ensures that models with and without productivity externalities start at the same equilibrium.

$$L_{it} = \left[\left(\frac{g_{L,t}}{g_{L,0}} \right)^{\gamma_L \frac{\eta}{\eta-1}} \theta (L^L_{it})^{\frac{\eta-1}{\eta}} + \left(\frac{g_{H,t}}{g_{H,0}} \right)^{\gamma_H \frac{\eta}{\eta-1}} (1-\theta)(L^H_{it})^{\frac{\eta-1}{\eta}} \right]^{\frac{\eta}{\eta-1}} \tag{26}$$

[12] We develop an alternative scenario to examine how the positive spillover on labor productivity may take years to materialize. The results show that the negative impacts of tax increases persist in the short run until the positive effect on productivity appears. Results are available upon request.

The parameters γ_L and γ_H determine the magnitude of the externality of healthcare on labor productivity. We set them to 4% based on evidence from Weil (2014) and the findings of Barro et al. (1996), which indicate that a 40% increase in life expectancy results in a 1.4% increase in per capita income. With this setup, we analyze the dynamics of macroeconomic variables following an increase in healthcare expenditure. As shown in Panels A and C of Figure 4, increasing per capita health expenditure in the contributory system by 27.7% yields a 1.0% gain in high-skilled labor productivity. Similarly, raising the individual transfer for low-skilled households by 53.2% boosts labor productivity by 1.4%, (Panels B and D). In this alternative setup, the adverse effects of increasing taxes

Figure 4: Macroeconomic response to an increase in public expenditure. Model with externalities.



Note: Initial values for G/Y, τ, GDP, I, C, C_H, and C_L correspond to the steady state before the shock. Labor market variables, h_H, h_I, h_F, w_H, w_I, are expressed relative to the initial steady state. g_H and g_L stand for transfers to high-skilled and low-skilled households. Consumption includes private and public expenditure.

to finance additional healthcare expenditures are mitigated by higher labor productivity among both high-skilled and low-skilled workers. Specifically, for each funding option, we observe smaller declines in output, consumption, and investment, as shown in Panels G to I of Figure 4. Notably, when financed through consumption taxes or taxes on high-skilled workers, GDP experiences modest long-term expansions, ranging from 0.3% to 0.6%.

Higher labor productivity offsets the negative tax distortions by lowering firms' marginal labor costs, thereby boosting employment and increasing workers' incomes. A comparison between Figures 3 and 4 reveals that, under all alternative funding options, wages for high-skilled and informal workers decrease less when productivity externalities are considered. Furthermore, Panel F highlights that the tax increase required to fund additional expenditures is smaller across the board, further explaining the reduced negative effects on output.

In summary, healthcare expenditures that enhance labor productivity can help offset the negative effects of higher tax rates. However, even when healthcare spending boosts productivity, the associated gains only partially counterbalance the negative impacts of tax-based financing. This mitigation is most effective when funding comes from taxing consumption or high-skilled workers.

5.2.2 Population aging

To capture the effects of population aging we follow Yoshino and Miyamoto (2017) and introduce a retiree as an additional agent into the model. This agent neither works nor possesses capital, and exclusively consumes transfers from the government, which are fully financed by taxes.

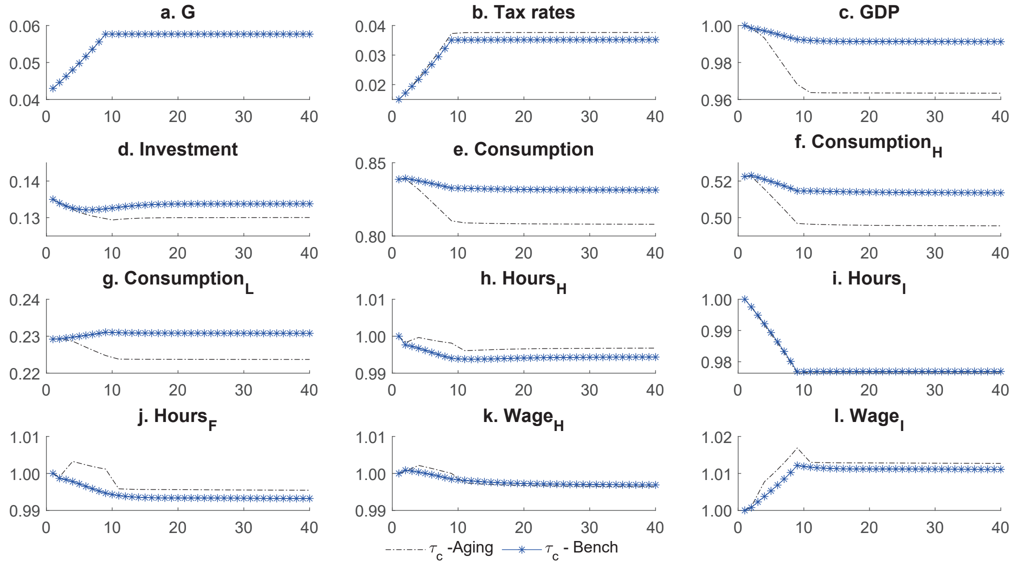
$$C_t^{ret} = T_t^{ret} \tag{27}$$

Given the limitations of Colombian data on consumption, we approximate the effects of population aging, using the observed patterns for the United States gathered by the Consumer Expenditure Survey. Data from the U.S. serve as a proxy for the demographic transition that other countries will face. According to this survey, the share of consumption by individuals aged 65 years and older increased from 18.7% in 2014 to 21.5% in 2023. To incorporate these trends into the model, we assume that the retiree population share gradually increases from 0% to 2.5%, with the combined share of high- and low-skilled households shrinking to 97.5%. Regarding health expenditure, we assume that transfers to retirees are equivalent to those for households in the contributory regime. Intuitively, this demographic shift increases the proportion of hand-to-mouth agents who do not participate in the labor force and reduce the share of agents who save and invest.

Under this scenario, the economy experiences an additional shock due to a decline in the population share of both high-skilled and low-skilled households. These shrinking populations result in a gradual reduction in consumption, investment, and output, as fewer people consume, save, and work. For simplicity, we assume that the additional funding comes entirely from a consumption tax, as illustrated in Figure 5. In this scenario, GDP contracts by approximately 3.5% (vs 1% in the benchmark), primarily driven by the decline in consumption, Panels C to G. To finance higher healthcare expenditures a larger increase in consumption tax is needed, amplifying economic distortions in a low consumption environment. By construction the increase in total government expenditure is the same as in the benchmark scenario.

It is important to highlight that, in this scenario, the dynamics are influenced by three key forces: higher expenditure, higher taxes, and changes in population shares. For example, examining the dynamics of low-skilled household consumption reveals a total decline of 1.7%. This drop can be decomposed into two components: a reduction in population (-2.5%) and an increase in consumption per person (0.9%). These results suggest that, while aggregate consumption decreases, consumption per household member actually rises for low-skilled households. However, this pattern does not apply to high-skilled households, where both total and per-member consumption decrease. At the aggregate level, the additional consumption generated by the growing retired population does not offset the decline in consumption from high-skilled and low-skilled households. The dynamics of investment can be explained by the same decomposition for high-skilled workers. The

Figure 5: Macroeconomic response to an increase in public expenditure. Model with population aging



Note: Initial values for G, Taxes, GDP, I, C, C_H, and C_L correspond to the steady state before the shock. Labor market variables, h_H, h_I, h_F, w_H, w_I, are expressed relative to the initial steady state. Consumption includes private and public expenditure.

total reduction of 3.5% is explained by a 2.5% contraction of population, and a 1.0% decrease in per-member investment.

According to these results, a demographic transition that reduces the share of relatively young and productive agents, and increases the share of retirees magnifies the effects of financing additional healthcare expenditure.

5.2.3 Public Debt

In this section, we consider that the government can use foreign debt in the short run as an alternative option to fund the increase in healthcare expenditure. It is important to note that we do not consider the possibility of higher healthcare expenditure being financed by permanently higher debt levels. This is because Colombian public debt is already at a level close to the sustainable debt limits (by different standard measures), and public finances are projected to remain under pressure. In particular, we modify Equations 23 and 24 which define government expenditure and income, by including public foreign debt $A_t^{f,G}$ as a mechanism to finance public expenditure but also as a factor that puts additional pressure on financing the government budget and the risk premium.

$$G_t = g_t^H N_t^H + g_t^L N_t^L + A_{t-1}^{f,G}(R_t^f - 1)\Phi_t \tag{28}$$

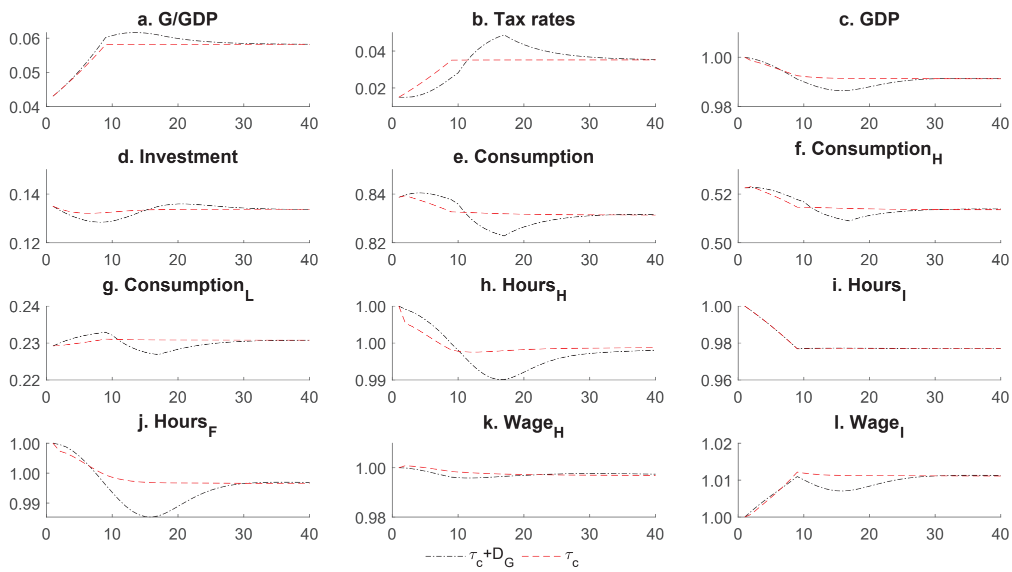
$$T_t = (\tau_t^H + \tau_t^{FH}) w_t^H L_t^H + (\tau_t^L + \tau_t^{FL}) w_t^F L_t^F + \tau_t^k R_t K_t + \tau_t^c (C_t^H + C_t^L) + A_t^{f,G} - A_{t-1}^{f,G} \tag{29}$$

In the short run, government expenditure can increase because of the emission of foreign debt. However, this implies higher taxes in the future due to debt payments and a higher risk premium. For this scenario, we consider that the increase of healthcare during the first eight years is financed through foreign debt. After that, the government finances the new level of expenditure and starts repaying its debt to converge to its initial level in the long run.

Figure 6 compares the macroeconomic responses to funding through the consumption tax with and without foreign debt. As we can see in Panel A, public expenditure as a percentage of GDP is higher after period eight and during some periods due to debt repayment (including interest). In the short run, as the government uses debt to finance the increase in healthcare expenditure, the tax rate on consumption is lower; however, as debt payment starts, the tax rate increases considerably over the value in our benchmark scenario, Panel B.

In the short run, investment declines compared to the benchmark due to a higher risk premium, Panel D. In contrast, consumption increases for both household types, driven by the lower tax rate and higher investment costs, Panels E to H. This rise in consumption temporarily boosts GDP, as shown in Panel C. However, once debt repayment and healthcare expenditures intensify, the substantial tax rate increase reduces consumption, with a more pronounced impact on high-skilled households. During the transition, GDP falls below the benchmark scenario, leading to a sharper decline in formal employment for both high- and low-skilled workers. In the long run, once the foreign debt is fully repaid, the macroeconomic responses converge with those of the benchmark scenario.

Figure 6: Macroeconomic response to an increase in public expenditure. Model with public debt



Note: Initial values for G/Y, τ, GDP, I, C, C_H, and C_L correspond to the steady state before the shock. Labor market variables, h_H, h_I, h_F, w_H, w_I, are expressed relative to the initial steady state. g_H and g_L stand for transfers to high-skilled and low-skilled households.

5.2.4 Migration of Low or High skilled workers

In recent years, Colombia has experienced a large influx of people from Venezuela. Healthcare laws were reformed, and migrants were covered by the subsidized healthcare system, given that inmigrants are mainly low-skilled workers and do not find jobs in formal companies. This increase in the population places higher stress on financing the healthcare system. In this section, we analyze the effects of the migration of low- and high-skilled workers. The main purpose of these simulations is to understand how the relative shares of high- and low-skilled households affect the funding sources of healthcare expenditure.

For this purpose, we considered two alternative scenarios. First, we increase the mass of high-skilled households by 5%, N^H, which increases the total population (N) by 2.6%, and increases the participation of low-skilled households in the economy from 0.52 0.532. In the second case, we increase the number of low-skilled households by 5%, N^L, which increases the total population by 2.4%, N. The importance of this type of households changes from 0.48 to 0.492. Thus, we consider that the total expenditure increases only by changing the mass of each type of households in Equation 23, while we keep per capita health expenditure constant. On the tax revenue side, Equation 24 implies that it is endogenous because it depends on wages, employment, consumption, the interest rate, and capital. Due to this endogeneity and the fact that the labor force is increasing in both cases, *ex-ante*, we do not know if the economy requires higher or lower taxes to fully finance the additional expenditure. As in our benchmark scenario, we consider the same four alternative taxes to maintain a balanced budget.

Table 5: Change in population shares

Scenario		$\Delta\%N_H$			$\Delta\%N_L$		
Tax	τ_{ini}	$\Delta\tau$	$\Delta\%Y$	$\Delta\%(Y/N)$	$\Delta\tau$	$\Delta\%Y$	$\Delta\%(Y/N)$
τ^c	1.5	-0.07	3.73	1.1	0.08	0.93	-1.44
τ^k	1.00	-0.18	3.82	1.19	0.22	0.82	-1.54
τ^{FH}	2.00	-0.14	3.75	1.12	0.19	0.98	-1.39
τ^{FL}	0.00	-0.42	3.88	1.25	0.52	0.75	-1.61

Note: τ_{ini} stands for initial tax rate. τ_{ini} and $\Delta\tau$ are multiplied by 100.

Table 5 reports the simulation results for the migration of high-skilled, columns 2 to 4, and low-skilled workers, columns 5 to 7. To simplify the analysis, we focus on long-run changes in three variables: taxes, GDP, and GDP per capita. The first column presents the initial tax rate for each tax scheme τ_{ini}. Regardless of the financing scheme and the type of migration, low or high-skilled workers, increasing the size of the population, has a positive effect on total output. The GDP has a larger increase when the migration is from high-skilled households of approximately 3.8 % versus 0.8 % when the migration is from low-skilled workers.

With respect to per capita GDP, there is a clear difference in its response depending on the type of migration. The migration of high-skilled workers increases per capita income because these migrants are more productive and can also consume and invest, which leads to higher consumption, capital accumulation, and output. However, if low-skilled workers migrate, as they have low productivity and do not save or invest, there is an increase in consumption and aggregate GDP. In this scenario, the increase in GDP by

0.8% is lower than the increase in the total population of 2.6%. Therefore, per capita GDP decreases. This result is consistent with the findings of Hamann et al. (2021) and highlights the asymmetry of labor productivity in the production process. With regard to fiscal considerations, tax rates, and revenues. If the economy experiences migration of high-skilled workers, it increases government revenue more than expenditure. As high-skilled workers are formal, migration increases the direct contributions to the healthcare via payroll taxes. This allows a potential reduction in tax rates to maintain a balanced budget. By contrast, the migration of the low-skilled population increases the financial needs of the healthcare system, as they are primarily enrolled in the subsidized regime and do not make significant direct contributions. Thus, an increase in tax rates is necessary to guarantee healthcare provision.

6 Conclusion

Over the next eight years, the Colombian health system will require an increase in public expenditure equivalent to approximately two percentage points of GDP. To ensure the system's sustainability, this increase in expenditure requires a permanent increase in funding sources, primarily through higher taxes. This study investigates the macroeconomic implications of alternative financing schemes by using a dynamic general equilibrium model tailored to a small open economy with fragmented labor markets. The model is calibrated to the Colombian economy and evaluates the macroeconomic effects of financing additional health expenditures through four alternative options: taxes on consumption and on the use of production factors, such as capital and labor.

Our results indicate that funding options influence aggregate dynamics and consumption inequality. We find that the most desirable option in terms of output is financing with taxes on consumption. This result can be explained by two key mechanisms. First, to finance the additional expenditure, the tax rate needs to increase by around 2 pp, which is smaller than the other options (between 4.4 and 17 pp). Second, unlike taxes on the use of capital and labor in production, consumption taxes are general taxes and do not directly distort a firm's optimality conditions, such as investment and employment decisions. In contrast, funding with taxes on hiring formal low-skilled labor is the least desirable option. Due to the small share of this type of labor, the economy requires a large increase in the tax rate. In addition, firms' decisions are distorted, and informality is encouraged. Regarding inequality, healthcare transfers can serve as tools to enhance the income distribution.

If this is an objective of the policy, a potential approach would involve financing additional expenditures through taxes on hiring high-skilled labor. In this scenario, low-skilled households could benefit from increased transfers, whereas the tax burden would fall on high-income households. Finally, our findings underscore the importance of labor productivity and population aging in shaping the effects of healthcare expenditure. In the case of the former, when additional spending positively impacts productivity, it mitigates the adverse effects of higher taxation and, in certain situations, it may foster long-term improvements in economic activity. In the latter case, an increasingly aging population, with a declining share of young and productive agents, can exacerbate the negative effects of higher taxation.

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