

ORIGINAL RESEARCH ARTICLE

Public health expenditure, fiscal space, and
economic growth: A cross-country panel
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Abstract

The relationship between public health expenditure and economic growth remains contested, particularly in the post-pandemic context of mounting fiscal pressures. While the human-capital framework predicts positive growth benefits from health investment, recent evidence points to heterogeneous, conditional effects. This study examines whether the growth impact of domestic general government health expenditure is moderated by fiscal space—proxied by public debt and the primary balance—across income levels. Using a strongly balanced cross-country panel drawn from the World Health Organization Global Health Expenditure Database, fiscal space database, and the World Bank World Development Indicators, the analysis combines within-country fixed effects, Driscoll–Kraay standard errors, and two-step System Generalized Method of Moments. A higher share of public health expenditure is, on average, associated with lower gross domestic product growth, but this association is strongly conditioned by fiscal space: higher public debt deepens the negative relationship, whereas a stronger primary balance attenuates it. The effect is concentrated in high- and upper-middle-income economies and is statistically negligible in lower-middle- and low-income countries. System Generalized Method of Moments diagnostics support instrument validity. Overall, the findings indicate that the growth impact of public health spending depends jointly on a country's level of development and fiscal space, underscoring the need for expenditure-efficiency and fiscal-management reforms rather than higher spending alone.

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1. Introduction

The relationship between public health expenditure and economic growth has emerged as a central question at the intersection of health economics, public finance, and development policy. Health spending now accounts for approximately 10% of global gross domestic product (GDP), and the World Health Organization (WHO) projects continued real growth in health budgets through 2030, particularly in low- and middle-income economies (Jakovljevic, 2015; Jakovljevic & Getzen, 2016), where the determinants of health spending differ markedly from those in advanced economies (Zhou *et al.*, 2020). However, the empirical literature has not converged on whether

higher public health spending consistently promotes economic growth, attenuates it, or generates effects that vary systematically across countries and macroeconomic contexts (Bloom *et al.*, 2018; Hu & Wang, 2024).

The theoretical case for a positive growth effect is well established. In the Grossman framework (Grossman, 1972a, 1972b), health is treated as a durable form of human capital that augments productive time and labor productivity. Building on this microfoundation, Barro (1996) identifies two distinct channels through which improved population health stimulates aggregate output: direct gains in labor productivity and indirect gains through higher survival probabilities that lengthen the effective planning horizon for human-capital investment. Subsequent contributions by Bloom *et al.* (2004) and Bhargava *et al.* (2001) provide cross-country evidence consistent with these predictions.

Against this benchmark, however, a growing body of evidence documents nonlinear, threshold, or even negative associations between public health spending and economic growth. Wang *et al.* (2022) and Hu and Wang (2024) find that the relationship between government health expenditure and growth in the Organization for Economic Co-operation and Development (OECD) economies is highly nonlinear, with the marginal contribution diminishing—and turning negative—above certain levels of consumption and capital investment thresholds. Gaies (2022) reassesses this nexus in the context of the global health crisis and reports heterogeneous effects across developing countries. These findings echo a much older debate on the composition of public expenditure originating in Aschauer (1989), Barro (1990), and Devarajan *et al.* (1996), which emphasizes that current expenditures—of which health spending is a substantial component—may exhibit non-monotonic or crowding-out effects on growth depending on initial conditions and the productivity of complementary inputs.

A second strand of literature has focused on the macro-fiscal environment within which health spending decisions are made. The concept of fiscal space—formally introduced by Heller (2005) and extended to the health sector in Heller (2006)—captures the capacity of governments to finance desired expenditures without compromising fiscal sustainability. Tandon and Cashin (2010) and Barroy and Gupta (2021) refine this framework, emphasizing that fiscal space for health depends on overall fiscal capacity, prioritization, and public financial management. Kose *et al.* (2022) operationalize fiscal space through a multi-dimensional cross-country database covering debt sustainability, balance-sheet vulnerability, and market access indicators.

Despite the theoretical importance of fiscal space, empirical work that explicitly tests whether it conditions

the growth impact of public health expenditure remains limited. Existing studies typically examine either the unconditional growth effect of health spending (Beylik *et al.*, 2022; Kofi Boachie *et al.*, 2018) or, separately, the unconditional effect of fiscal indicators such as public debt on growth (Eberhardt & Presbitero, 2015; Égert, 2015; Reinhart & Rogoff, 2010). The interaction between the two—whether the growth returns to health spending depend on the country's debt position, primary balance, or income level—has received comparatively little attention in a unified cross-country panel framework.

However, three gaps remain. First, the unconditional spending-growth literature rarely models fiscal space as a moderator rather than a control. Second, studies linking fiscal indicators (e.g., debt, primary balance) to growth seldom interact them with public expenditure composition. Third, income-group heterogeneity in the growth-enhancing effects of health spending has not been tested jointly with fiscal-space moderation in a long, cross-country panel. This study addresses all three within a single interaction-based specification covering 161 countries over 2000–2023.

Using a strongly balanced panel of 161 countries over 2000–2023, we estimate the relationship between domestic general government health expenditure (DGGHE) and GDP growth, allowing the slope to vary with two fiscal space indicators—government debt and the primary balance—and with the country's income classification. We exploit complementary estimation approaches: within-country fixed effects with cluster-robust standard errors, Driscoll–Kraay (Driscoll & Kraay, 1998) standard errors to accommodate cross-sectional dependence, and two-step System Generalized Method of Moments (GMM) (Blundell & Bond, 1998) with orthogonal deviations and Windmeijer-corrected standard errors to address the potential endogeneity of health spending.

Our analysis yields four main findings. First, a 1% increase in DGGHE/GDP is associated with a 0.47% decline in annual GDP growth in the baseline specification, a magnitude robust to alternative estimators. Second, the DGGHE–debt/GDP interaction is negative and statistically significant once human capital is controlled for, while the DGGHE–primary balance/GDP interaction is positive and significant, indicating that fiscal space materially conditions the growth–health relationship. Third, the negative association is concentrated in high- and upper-middle-income economies, while it is statistically indistinguishable from zero for lower-middle-income countries—consistent with the stronger marginal productivity of health investment at intermediate development levels. Fourth, System GMM diagnostics (AR[2] $p = 0.253$; Hansen J

$p = 0.721$) support the substantive interpretation under plausible identification assumptions.

The contribution of this study is three-fold. Methodologically, we provide what is, to our knowledge, one of the first systematic empirical examinations of the interaction between public health expenditure and fiscal space in a long-horizon, cross-country panel, leveraging novel data on fiscal space (Kose *et al.*, 2022) and modern panel estimators robust to cross-sectional dependence and endogeneity. Substantively, we reconcile apparently divergent findings in the recent literature—positive effects in OECD samples (Beylik *et al.*, 2022), threshold effects in narrower panels (Hu & Wang, 2024), and conditional effects in developing-country contexts (Gaies, 2022; Gerald Iheoma, 2024)—by showing that the growth impact of public health spending depends jointly on the level of development and the macro-fiscal environment. From a policy perspective, our findings imply that scaling up public health spending without complementary attention to fiscal space and expenditure efficiency may not deliver the growth benefits predicted by the canonical framework, with direct implications for universal health coverage strategies in fiscally constrained settings (Barroy & Gupta, 2021; Kurowski *et al.*, 2021).

The remainder of the study is organized as follows. Section 2 reviews the theoretical framework and develops testable hypotheses. Section 3 describes the data and empirical strategy. Section 4 presents the main results, marginal effects, income-group heterogeneity, and robustness checks. Section 5 discusses the findings in relation to the literature and outlines limitations. Section 6 concludes with policy implications.

2. Literature review and theoretical framework

2.1. Health, human capital, and economic growth

The canonical theoretical lens through which health investment is linked to growth is the human-capital framework articulated by Grossman (1972a, 1972b). In this framework, health is conceptualized as a durable capital stock that depreciates with age and can be augmented through investment in medical care, time, and complementary inputs. Health enters individual utility both as a consumption good and as a productive input, generating healthy time available for market work and home production. The aggregation of these microeconomic mechanisms underpins the prediction that improvements in population health raise labor productivity, improve labor-market participation and productivity, and stimulate human-capital accumulation more broadly.

Barro (1996) and Barro and Sala-i-Martin (1995) formalize this insight in cross-country growth regressions, identifying two distinct channels. The first is a direct productivity effect: healthier workers are more productive and supply more effective labor hours. The second is an indirect effect through demographic and behavioral channels—higher life expectancy raises returns to schooling and induces greater savings and physical capital accumulation. Bloom *et al.* (2004) augmented the standard Solow-type production function with a measure of population health and found that health stock makes an independent, statistically significant contribution to per-capita output. Bhargava *et al.* (2001) employed adult survival rates and reported that the elasticity of growth with respect to health is heterogeneous across income levels, with stronger effects in low- and middle-income economies where health stocks are further from the production frontier. Relatedly, Halıcı-Tülüce *et al.* (2016) show that income level is itself a key determinant of the health expenditure–growth nexus, with the relationship differing systematically between higher- and lower-income countries.

More recent contributions have refined the framework along three dimensions. Bloom *et al.* (2018) explored the theoretical and empirical literature and emphasized multiple transmission channels, including productivity, education, savings, demographic dividends, and inequality. Sharma (2018), using dynamic panel data spanning 143 years, found that the long-run health–growth relationship is robust to a wide range of specifications but exhibits substantial heterogeneity over time and across regions. For OECD countries specifically, Hartwig (2010) reported panel Granger-causality evidence, suggesting that health capital formation contributes to long-term growth, though the magnitude is smaller than in earlier studies—consistent with diminishing marginal returns at high health-stock levels.

2.2. Public health expenditure, productivity, and crowding-out

The transition from population health improvements to growth effects of public health expenditure is not automatic. While health spending is an essential input into health capital, the marginal contribution of increases in public health spending to economic growth depends on multiple intervening factors: the efficiency of health systems, the composition of spending, and the opportunity cost of public funds (Grigoli & Kapsoli, 2018). A classical strand of public-finance literature, beginning with Aschauer (1989) and Barro (1990), distinguishes between productive and unproductive components of public expenditure, with the former entering the aggregate production function directly,

whereas the financing of the latter through distortionary taxation may crowd out private investment.

Devarajan *et al.* (1996) provided an influential empirical test of these ideas in a panel of 43 developing countries, showing that an excessive share of current expenditure—of which health is a major component—can be associated with lower growth, particularly when complementary investments in physical infrastructure are constrained. Baldacci *et al.* (2008) extended this framework to a panel of 118 developing countries from 1971 to 2000 and found that both education and health spending have positive associations with human capital and growth, but that the magnitude of these effects depends critically on governance quality, inflation control, and the size of fiscal deficits. Their central insight—that higher spending alone is insufficient and must be complemented by efficiency-enhancing reforms—is echoed in more recent contributions.

Empirical evidence specifically on public health expenditure and growth has produced mixed results. Beylik *et al.* (2022) examined 21 OECD countries using Driscoll–Kraay standard errors and found a positive association between health expenditure indicators and economic growth. At the single-country level, Atilgan *et al.* (2017) tested the health-led growth hypothesis for Turkey and reported a long-run relationship between health expenditure and economic growth. Wang *et al.* (2022) employed a nonparametric additive model on Chinese provincial data and documented a nonlinear relationship with significant regional heterogeneity. Hu and Wang (2024) applied a dynamic panel threshold model to 33 OECD countries from 2001 to 2017 and found that the growth effect of public health expenditure is positive below certain thresholds of consumption, wages, and capital but turns negative above them. Dritsaki and Dritsaki (2023) examined the G7 in a heterogeneous panel data framework and reported long-run positive effects of health expenditure on per-capita output.

In developing-country contexts, the evidence is more nuanced. Kofi Boachie *et al.* (2018) reported positive associations between health expenditure and outcomes in Ghana, while Faruk *et al.* (2022) found that the health expenditure–growth nexus in Middle Eastern and North African countries is moderated by institutional quality. Ikpe *et al.* (2024) reported that the effect of health expenditure on growth in Sub-Saharan Africa depends materially on governance quality, providing further evidence of conditionality. Gaies (2022) explicitly reassessed these relationships in light of the post-2020 health crisis and found that the relationship between health expenditure and growth has changed substantially in many developing economies, reflecting both fiscal strain and pandemic-related economic disruptions.

A parallel literature situates health spending within the income–expenditure nexus and the demographic transition. Baltagi *et al.* (2017), using a global sample and spatial-econometric methods, demonstrated that health-care expenditure is income-elastic but that the elasticity declined below unity once cross-country dependence was accounted for, implying that health care behaved more like a necessity than a luxury at the global level. Complementing this, Lopreite *et al.* (2023) applied word-embedding and bibliometric techniques to map the thematic evolution of the aging–health expenditure literature, identifying e-health and the fiscal sustainability of health systems under population aging as emergent policy priorities. These contributions motivate the present study: because the level of health spending is tightly bound to income and demographic structure, isolating the conditional growth effect of public health expenditure while accounting for fiscal capacity.

2.3. Fiscal space and its measurement

The concept of fiscal space was formalized by Heller (2005) as “the availability of budgetary room that allows a government to provide resources for a desired purpose without any prejudice to the sustainability of a government’s financial position.” The notion gained prominence in the context of scaling up public expenditure to meet the Millennium Development Goals, particularly in low-income countries facing tight budget constraints. Heller (2006) subsequently extended the framework to the health sector, identifying five potential sources of expansion: raising domestic revenue, reprioritizing existing expenditure, borrowing, seigniorage, and external grants.

Roy *et al.* (2007) offered an alternative formulation that emphasized concrete policy actions for domestic resource mobilization, while Tandon and Cashin (2010) developed the most influential operational framework, identifying five pillars of fiscal space for health: (i) economic growth, (ii) budget reprioritization, (iii) earmarked revenues, (iv) efficiency gains, and (v) external resources. Barroy and Gupta (2021) revisited Heller’s framework after 15 years and argued for a broader concept of “budgetary space for health” that integrates public financial management considerations. The International Monetary Fund’s subsequent reassessment (International Monetary Fund, 2018) further refined the operational definition by combining indicators of debt sustainability, balance-sheet risk, and market access.

Kose *et al.* (2022) provided a comprehensive cross-country database of fiscal space indicators, covering 202 countries over 1990–2022 with 28–30 indicators grouped into four categories: (i) government debt sustainability,

(ii) balance-sheet composition, (iii) external and private-sector debt, and (iv) market perception. Their analysis documented a weakening of fiscal space across emerging and developing economies since the global financial crisis—a trend exacerbated by the COVID-19 pandemic, as confirmed by Kurowski *et al.* (2021). The fiscal-space indicators used in the present study are drawn from the 2026 update of this dataset.

2.4 Public debt, primary balance, and growth

A separate but related literature examines the impact of fiscal indicators—particularly public debt and the primary balance—on economic growth. The seminal contribution of Reinhart and Rogoff (2010) suggested a threshold relationship in which debt-to-GDP ratios exceeding 90% are associated with materially lower growth, though their findings have been the subject of intense methodological debate. Eberhardt and Presbitero (2015) re-examined the debt–growth nexus in a large panel of countries using novel methods that allow for cross-country heterogeneity and found support for a negative average relationship without evidence of a common threshold. Égert (2015) provided a critical reassessment of nonlinear effects, while Chudik *et al.* (2017) employed methods robust to cross-sectional dependence and reported evidence of a debt threshold effect on output growth around 30% of GDP, lower than the Reinhart and Rogoff (2010) benchmark.

More recent contributions have refined this debate. Asteriou *et al.* (2021) reported nonlinear effects in Asian panel data, while Law *et al.* (2021) provided threshold analysis for developing countries. The primary balance has received comparatively less attention as an indicator of fiscal conditions, despite its importance as an indicator of near-term fiscal flexibility. A positive primary balance—indicating that current revenues exceed non-interest expenditure—is widely regarded as a key indicator of fiscal sustainability and policy flexibility (International Monetary Fund, 2018; Kose *et al.*, 2022).

2.5. Hypotheses development

Building on the preceding review, we develop four testable hypotheses on the relationship between public health expenditure, fiscal space, and economic growth in a cross-country panel:

- (i) H1: The unconditional association between DGGHE/GDP and economic growth across the global sample is economically meaningful and may not be positive, reflecting the joint operation of human-capital channels and crowding-out effects identified in Aschauer (1989), Barro (1990), and Devarajan *et al.* (1996).

- (ii) H2: The growth impact of DGGHE is moderated by public debt. Countries with higher debt-to-GDP ratios face tighter fiscal constraints and higher interest burdens, which can reduce the productivity of public expenditure on health and amplify crowding-out effects.
- (iii) H3: The growth impact of DGGHE is moderated by the primary balance. Stronger primary fiscal positions—indicating greater fiscal capacity—strengthen the growth-enhancing effects of public health spending by signaling sustainability and reducing risk premia on public borrowing.
- (iv) H4: The growth impact of DGGHE varies systematically across income groups. Following the human-capital framework (Barro, 1996; Bhargava *et al.*, 2001), the marginal productivity of health investment is expected to be greater in lower-middle-income economies where health stocks are below the production frontier and smaller in high-income economies operating near the frontier.

3. Methodology

3.1. Data sources and sample

The empirical analysis combined three internationally comparable data sources. Public health expenditure data were obtained from the 2024 WHO Global Health Expenditure Database, which provides internally consistent expenditure aggregates for 195 countries beginning in 2000 (World Health Organization, 2024). The key variable of interest, domestic general government health expenditure as a share of GDP (DGGHE/GDP), captures the resources channeled through public budgets into health-sector spending, excluding out-of-pocket payments and external grants. This measure is the most policy-relevant indicator for analyses of fiscal space and public expenditure efficiency.

Fiscal-space indicators—general government gross debt as a share of GDP, the primary balance as a share of GDP, and sovereign credit ratings—were obtained from the Cross-Country Database of Fiscal Space constructed by Kose *et al.* (2022), using its Spring 2026 update. This database covers up to 202 countries from 1990 to 2022 and includes 28–30 indicators of fiscal space grouped into four categories. In this study, the analysis focused on government debt and the primary balance as the two principal moderating variables, given their central role in the conceptual framework articulated by Heller (2005) and the International Monetary Fund (2018).

The 2000–2023 window is dictated by data availability rather than by design: the WHO Global Health Expenditure

Database provides internationally consistent public-health-expenditure aggregates only from 2000 onward, and the Kose *et al.* (2022) fiscal-space indicators are most complete over this period. The resulting time dimension ($T = 24$) is consistent with the requirements of the estimators employed in this study: Driscoll–Kraay standard errors require a relatively large T for their asymptotic properties (Hoechle, 2007), and System GMM is designed for panels with large N and moderate T to avoid instrument proliferation (Roodman, 2009).

Macroeconomic and demographic controls were obtained from the World Bank World Development Indicators (World Bank, 2024) and include gross fixed capital formation as a share of GDP, the share of the population aged 65 and over, trade openness (the sum of exports and imports as a share of GDP), and the annual inflation rate measured by the consumer price index. School life expectancy, used in robustness checks as a proxy for educational human capital, is also obtained from the World Development Indicators. Income-group classifications follow the World Bank's official classification for fiscal year 2024.

The final analytical sample forms a strongly balanced panel covering 161 countries over 2000–2023 ($T = 24$, $N = 161$), yielding 3,469 country–year observations in the baseline specification after accounting for missing values in the main regressors. The sample includes 39 high-income, 47 upper-middle-income, 48 lower-middle-income, and 27 low-income economies, providing the variation in income levels needed to test the heterogeneity hypothesis (H4).

3.2. Empirical strategy

Our empirical strategy is structured into four complementary stages designed to address key econometric challenges in cross-country growth regressions, including omitted-variable bias, cross-sectional dependence, endogeneity of public health spending, and parameter heterogeneity across income groups.

3.2.1. Stage 1: Within-country fixed effects

The baseline specification is a two-way fixed-effects model with country-clustered standard errors:

$$\text{growth}_{it} = \alpha + \beta_1 \cdot \text{DGGHE}_{it} + \beta_2 \cdot (\text{DGGHE}_{it} \times \text{FS}_{it}) + \gamma' X_{it} + \mu_i + \lambda_t + \varepsilon_{it} \quad (1)$$

where:

- (i) growth_{it} denotes annual GDP growth in country i at time t .
- (ii) DGGHE_{it} is domestic government health expenditure as a share of GDP.

- (iii) FS_{it} is a fiscal-space indicator (debt-to-GDP or primary balance).
- (iv) X_{it} is a vector of controls including gross capital formation, the share of the population aged 65 years and above, trade openness, and inflation.
- (v) μ_i represents country fixed effects capturing time-invariant heterogeneity.
- (vi) λ_t represents year fixed effects capturing global shocks.
- (vii) ε_{it} is an idiosyncratic error term.
- (viii) The coefficient of interest is β_2 , which captures the conditional moderating role of fiscal space.

3.2.2. Stage 2: Driscoll–Kraay standard errors

In a cross-country panel of this scale, errors are likely correlated across countries due to common global shocks (e.g., oil price changes, financial crises, pandemics) and spillovers via trade and financial linkages. Standard cluster-robust standard errors may be inadequate in the presence of substantial cross-sectional dependence. The baseline model was therefore re-estimated using the nonparametric standard errors proposed by Driscoll and Kraay (1998), which are robust to general forms of cross-sectional and temporal dependence as the time dimension grows. Following Hoechle (2007), we implemented the Driscoll–Kraay procedure with a Bartlett kernel and a two-lag truncation. As a preliminary diagnostic, the Pesaran (2021) cross-sectional dependence test rejects the null of cross-sectional independence in our panel, thereby supporting the use of Driscoll–Kraay corrections.

3.2.3. Stage 3: Two-step System GMM

Public health expenditure is likely endogenous to growth through three principal channels: (i) reverse causality, since higher GDP growth raises tax revenues and fiscal space for health spending; (ii) simultaneity, since contemporaneous shocks to productivity (e.g., pandemics) jointly affect growth and health spending; and (iii) measurement error in GDP that feeds into both the dependent variable and the spending ratio. To address these concerns, the model was estimated using the two-step System GMM (Blundell & Bond, 1998) with orthogonal deviations (Arellano & Bover, 1995) and Windmeijer-corrected standard errors (Windmeijer, 2005):

$$\text{growth}_{it} = \alpha + \rho \cdot \text{growth}_{i,t-1} + \beta_1 \cdot \text{DGGHE}_{it} + \beta_2 \cdot (\text{DGGHE}_{it} \times \text{FS}_{it}) + \gamma' X_{it} + \mu_i + \lambda_t + \varepsilon_{it} \quad (2)$$

Following best practice (Roodman, 2009), the number of instruments was limited to avoid the well-known instrument proliferation and overidentification

problems associated with System GMM. DGGHE and its interactions were treated as endogenous and instrumented using lagged levels dated two periods and earlier for the levels equation, together with lagged differences for the differenced equation. Year fixed effects were treated as strictly exogenous. Identification rests on the assumption that the instruments are uncorrelated with the structural error after controlling for fixed effects. Instrument validity was assessed using the Hansen J test of over-identifying restrictions and the Arellano–Bond AR(2) test (Arellano & Bond, 1991) for second-order autocorrelation in the differenced residuals.

3.2.4. Stage 4: Income-group heterogeneity

To test H4, the baseline was augmented with interactions between DGGHE/GDP and World Bank income-group dummies (e.g., low-income, lower-middle-income, upper-middle-income, with high-income as the reference category):

$$\begin{aligned} growth_{it} = & \alpha + \beta_1 \cdot DGGHE_{it} + \sum g \delta_g \cdot (DGGHE_{it} \times Group_g) \\ & + \gamma' X_{it} + \mu_i + \lambda_t + \varepsilon_{it} \end{aligned} \quad (3)$$

The net effect of DGGHE on growth for income group g is $\beta_1 + \delta_g$, with statistical significance assessed via joint Wald tests.

3.3. Identification, robustness, and diagnostics

The identification strategy is based on three complementary approaches: (i) within-country variation controls for time-invariant heterogeneity; (ii) lagged instruments in System GMM help mitigate potential endogeneity arising from reverse causality and simultaneity; and (iii) Driscoll–Kraay corrections protect inference against cross-sectional dependence. These approaches are complemented by a battery of robustness checks reported in Section 4.4: (i) inclusion of school life expectancy as an additional human-capital control; (ii) replacement of the debt-based interaction with a primary-balance-based interaction; and (iii) estimation of the model with log GDP per capita (at constant 2021 international dollars) as the dependent variable to assess long-run level effects.

Although not reported explicitly in the main results tables for parsimony, diagnostic tests confirm that the panel exhibits cross-sectional dependence—the Pesaran (2021) cross-sectional dependence test rejects the null—and that the principal regressors are stationary in levels based on the Im *et al.* (2003) and cross-sectionally augmented Pesaran (2007) panel unit-root tests. These diagnostics support the preferred specification of growth (a first-difference transformation of GDP) on contemporaneous and lagged

regressors and support the use of Driscoll–Kraay rather than conventional cluster-robust standard errors as the primary inference method.

4. Empirical results

4.1. Descriptive statistics

Table 1 presents the summary statistics for the variables used in the empirical analysis. Three patterns emerge from the descriptive statistics. First, the panel exhibits substantial dispersion in DGGHE/GDP, ranging from 1.223% at the lower end to 27.090% at the upper end, with a mean of 6.232%. This dispersion reflects both income-level differences in fiscal capacity and divergent policy choices regarding health prioritization (Jakovljevic *et al.*, 2024).

Second, the fiscal-space indicators reveal considerable cross-country and time-series heterogeneity. The debt-to-GDP ratio ranges from near-zero to over 600% (a few extreme observations in highly indebted small economies), with a mean of 54.987% and a standard deviation of 44.691%. The primary balance shows a mean of −0.432% of GDP with a standard deviation of 6.257%, with values ranging from −55.749% to 126.464%—a distribution consistent with the post-financial-crisis and post-pandemic patterns documented in Kose *et al.* (2022).

Third, GDP growth shows a mean of 3.336% per year over the sample period, with substantial cross-sectional dispersion (standard deviation of 6.025%). The presence of extreme observations—including economies experiencing severe contractions in 2009 and 2020—motivates the use of winsorization at the 1st and 99th percentiles for continuous fiscal variables and inflation, to limit the influence of outliers without materially altering the underlying distribution of variables.

In economic terms, the dispersion across countries and over time is substantial. DGGHE/GDP ranges from 1.223% to 27.09% (mean = 6.2%), indicating that the highest-spending governments allocate more than four times the sample-average share of economic output to public health. Government debt averages 54.987% of GDP but ranges from near-zero levels to more than 600%, reflecting heterogeneity across highly indebted small economies and relatively debt-free resource-exporting countries. GDP growth averages 3.336% annually, with a standard deviation of 6.025%. Thus, a one-standard-deviation (SD) movement in growth (approximately 6 percentage points) is considerably larger than the estimated marginal effect associated with DGGHE/GDP (−0.47%), suggesting that public health expenditure represents one of several moderate contributors to growth dynamics rather than a dominant determinant.

Table 1 presents the descriptive statistics for all variables. The substantial variation across countries and time periods, together with the broad panel coverage (161 countries over 24 years), provides sufficient variation to estimate the conditional relationship between public health expenditure, fiscal space, and economic growth.

However, the decomposition of variation indicates that the sources of identifying variation differ substantially across regressors. For DGGHE/GDP, cross-country (between) variation (SD = 2.606, interquartile range [IQR] = 3.524) is approximately twice the within-country dispersion (SD = 1.221, IQR = 1.146), suggesting that differences in public health spending are largely structural and persistent rather than driven by short-term fluctuations. Since the fixed-effects and System GMM estimators rely primarily on within-country variation, the estimated DGGHE coefficient is identified from a relatively limited range of temporal changes, with a within-country IQR of approximately 1.1 percentage points of GDP.

In contrast, government debt, the primary balance, GDP growth, and inflation exhibit considerably greater within-country variation (within SDs of 29.559, 5.464, 5.672, and 17.495, respectively), allowing the fiscal-space moderators and macroeconomic controls to be more precisely identified over time. Population aging is predominantly a between-country characteristic (between-country SD = 5.728; within-country SD = 1.482), consistent with the gradual evolution of demographic structures.

Table 2 presents the pairwise correlation matrix. Two observations are particularly relevant. First, DGGHE/GDP is negatively correlated with GDP growth ($\rho = -0.229$), suggesting a negative association that is examined further in the regression analysis. Second, DGGHE/GDP is strongly positively correlated with the share of population aged 65 years and older ($\rho = 0.619$), reflecting both the higher health-care needs of aging populations and the greater fiscal capacity of high-income, demographically aged economies. This correlation motivates careful inclusion of demographic controls in all specifications.

Figure 1 presents a graphical visualization of the bivariate relationships among the key variables. The heatmap highlights two notable patterns. First, DGGHE/GDP exhibits a strong positive correlation with the share of the population aged 65 years and above ($\rho = 0.62$), consistent with the association between demographic aging and greater demand for health-care resources. Second, trade openness, inflation, and the main fiscal variables display consistently weak correlations, providing no indication of severe multicollinearity within the empirical specification.

Figure 2 provides a graphical preview of the central empirical relationship examined in the regression analysis. The binned scatter plot presents 20 equal-sized bins of DGGHE/GDP against residual GDP growth after removing the effects of gross capital formation, the share of the population aged 65 years and above, trade openness, inflation, and country fixed effects. The clear

Table 1. Descriptive statistics

Variable	No. of observations	Mean	Minimum	Maximum	Overall		Between-country		Within-country	
					SD	IQR	SD	IQR	SD	IQR
GDP growth (annual %)	4,967	3.336	-54.402	86.827	6.025	4.658	2.123	2.515	5.672	3.787
DGGHE/GDP (%)	4,540	6.232	1.223	27.090	2.863	3.827	2.606	3.524	1.221	1.146
Government debt/GDP (%)	4,442	54.987	0.002	600.109	44.691	40.331	34.071	36.594	29.559	21.004
Primary balance/GDP (%)	4,401	-0.432	-55.749	126.464	6.257	4.178	3.084	2.129	5.464	3.687
Gross capital formation/GDP (%)	4,063	24.167	-15.678	76.782	8.475	8.732	6.716	7.968	5.612	5.303
Population aged 65 years and older (%)	5,208	8.260	0.863	37.319	5.904	9.227	5.728	9.415	1.482	1.037
Trade openness/GDP (%)	4,252	90.413	2.474	863.195	58.704	53.696	56.475	54.138	22.404	15.973
Inflation, CPI (annual %)	4,345	6.716	-16.860	557.202	19.945	5.492	11.889	4.963	17.495	3.438

Abbreviations: CPI: Consumer Price Index; DGGHE: Domestic General Government Health Expenditure; GDP: Gross domestic product; IQR: Interquartile range; SD: Standard deviation.

Table 2. Pairwise correlation matrix

Variable	GDP growth	DGGHE/GDP	Government debt/GDP	Primary balance	Gross capital formation/GDP	Population aged 65 years and older	Trade openness	Inflation
GDP growth	1.000	–	–	–	–	–	–	–
DGGHE/GDP	–0.229	1.000	–	–	–	–	–	–
Government debt/GDP	–0.166	0.220	1.000	–	–	–	–	–
Primary balance	0.161	–0.170	–0.139	1.000	–	–	–	–
Gross capital formation/GDP	0.216	–0.158	–0.155	–0.073	1.000	–	–	–
Population aged 65 years and older	–0.178	0.619	0.238	–0.066	–0.063	1.000	–	–
Trade openness	0.050	0.049	–0.060	0.050	0.082	0.242	1.000	–
Inflation	–0.060	–0.110	0.155	–0.005	–0.088	–0.086	–0.092	1.000

Abbreviations: DGGHE: Domestic General Government Health Expenditure; GDP: Gross domestic product.

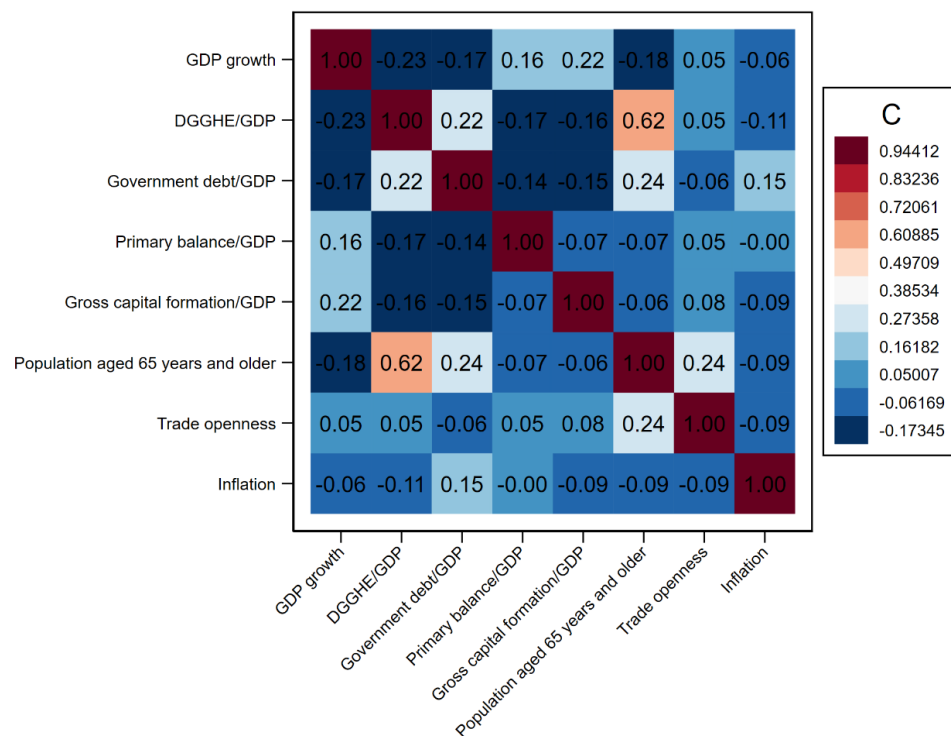


Figure 1. Pairwise correlation heatmap of the principal regression variables
Abbreviations: DGGHE: Domestic General Government Health Expenditure; GDP: Gross domestic product.

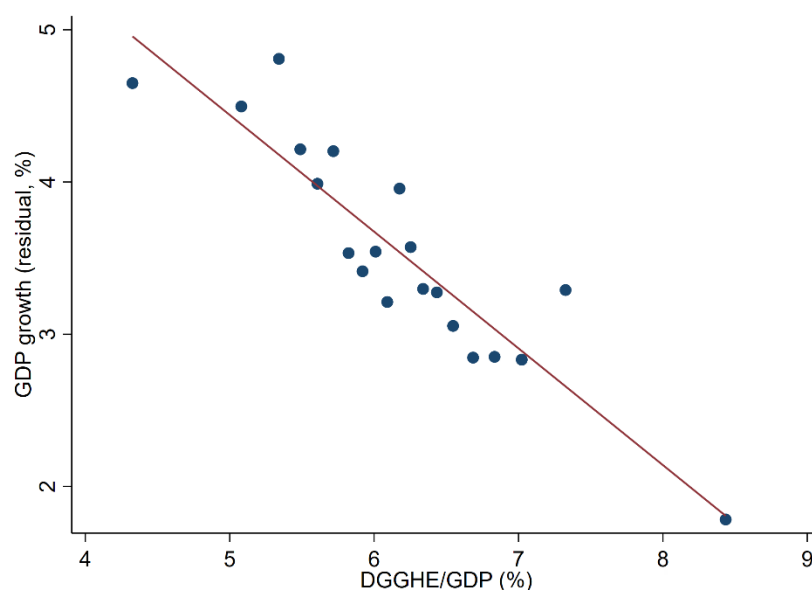


Figure 2. Binned scatter plot of GDP growth and DGGHE/GDP
Abbreviations: DGGHE: Domestic General Government Health Expenditure; GDP: Gross domestic product.

downward gradient, observed without imposing a specific parametric functional form, is consistent with a negative conditional association between public health expenditure and economic growth, which is formally estimated in the regression models that follow.

4.2. Baseline results

Table 3 presents the main results across four specifications: (i) fixed effects estimation with country-clustered standard errors; (ii) fixed effects estimation with Driscoll–Kraay standard errors; (iii) two-step System GMM with Windmeijer-corrected standard errors; and (iv) fixed effects estimation with income-group interactions to test heterogeneity (H4). As presented in Table 3, the estimation sample increases from 3,469 observations across 161 countries in the fiscal-space specifications to 3,564 observations across 164 countries in the heterogeneity specification. This difference arises because the fiscal-space specifications require non-missing government debt data, whereas the heterogeneity specification replaces debt interaction with income-group indicators available for all country–year observations, recovering 95 country–years and three countries without debt series.

In the baseline fixed-effects specification, a 1 percentage-point increase in DGGHE/GDP is associated with a 0.466 percentage-point decline in annual GDP growth, statistically significant at the 1% level. The magnitude is economically substantial: relative to the

sample mean growth rate of 3.3%, this corresponds to approximately a 14% reduction. The control variables exhibit the expected relationships. Gross capital formation is positively associated with growth ($\beta = 0.125$, $p < 0.01$), consistent with the predictions of the Solow–Swan growth framework. Trade openness also shows a positive and statistically significant association ($\beta = 0.046$, $p < 0.01$), whereas inflation is negatively associated with growth ($\beta = -0.077$, $p < 0.01$), consistent with the established growth costs of macroeconomic instability.

The DGGHE–government debt/GDP interaction is negative ($\beta = -0.002$) but does not reach conventional significance levels in the baseline specification ($p = 0.128$), providing limited support for H2. Under the Driscoll–Kraay specification, the DGGHE/GDP coefficient remains negative and significant at the 1% level (-0.466), with a smaller standard error (0.076) than under country-clustered inference (0.127).

The System GMM specification introduces the lagged dependent variable, which enters with a coefficient of 0.228 and is statistically insignificant, suggesting limited growth persistence after accounting for endogeneity. The coefficient on DGGHE/GDP remains negative ($\beta = -0.263$) but loses statistical significance under the stricter identification framework. Diagnostic tests indicate no evidence of second-order serial correlation (Arellano–Bond AR[2] test, $p = 0.253$) and no rejection of instrument validity (Hansen J test, $p = 0.721$). The model uses 193 instruments;

Table 3. Association between public health spending, fiscal space, and economic growth: Baseline results

Variable	FE model	Driscoll–Kraay standard errors	System GMM	Heterogeneity analysis
Lagged GDP growth	–	–	0.228 (0.164)	–
DGGHE/GDP	–0.466*** (0.127)	–0.466*** (0.076)	–0.263 (0.193)	–0.723*** (0.171)
DGGHE–debt/GDP	–0.002 (0.001)	–0.002 (0.001)	–0.002 (0.001)	–
DGGHE–LIC	–	–	–	0.305 (0.323)
DGGHE–LMIC	–	–	–	0.620*** (0.207)
DGGHE–UMIC	–	–	–	–0.393 (0.249)
GCF/GDP	0.125*** (0.020)	0.125*** (0.019)	0.085*** (0.024)	0.129*** (0.020)
Population aged 65 years and older	0.242** (0.104)	0.242 (0.147)	–0.084** (0.035)	0.212* (0.108)
Trade openness	0.046*** (0.008)	0.046*** (0.009)	0.006** (0.003)	0.043*** (0.008)
Inflation	–0.077*** (0.020)	–0.077*** (0.016)	–0.029* (0.016)	–0.083*** (0.017)
Year FE	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes
Observations	3,469	3,469	3,350	3,564
Countries	161	161	161	164
Within R^2	0.318	0.318	–	0.262
AR(2) p -value	–	–	0.253	–
Hansen J p -value	–	–	0.721	–
Instruments	–	–	193	–

Notes: Dependent variable: GDP growth (annual %). Specifications incorporating fiscal space are estimated using observations with available government debt data. The heterogeneity specification uses income-group indicators instead of the fiscal-space interaction, allowing inclusion of a larger set of country-year observations. * $p < 0.1$, ** $p < 0.05$, and *** $p < 0.01$ indicate statistical significance.

Abbreviations: DGGHE: Domestic General Government Health Expenditure; FE: Fixed effects; GCF: Gross capital formation; GDP: Gross domestic product; GMM: Generalized Method of Moments; LIC: Low-income country; LMIC: Lower-middle-income country; UMIC: Upper-middle-income country.

although this exceeds the number of countries, instrument validity is supported by the Hansen test.

The heterogeneity specification examines whether the association between the DGGHE/GDP coefficient

and economic growth differs across income groups. The baseline DGGHE/GDP coefficient ($\beta = -0.723$, $p < 0.01$) represents the estimated effect for high-income countries, which serve as the reference category. The DGGHE–lower-middle-income country interaction is positive and

statistically significant ($\beta = 0.620$, $p < 0.01$), implying a net effect of -0.103 percentage points for lower-middle-income countries, which is statistically indistinguishable from zero. The DGGHE–upper-middle-income country interaction is negative ($\beta = -0.393$) and marginally significant, indicating a stronger negative association among upper-middle-income countries, with an estimated net effect of -1.116 percentage points. The DGGHE–low-income country interaction is statistically insignificant, suggesting no statistically significant difference from the reference group.

Figure 3 presents the estimated coefficients of DGGHE/GDP across the four specifications. The estimated effect is negative and statistically significant in three of the four specifications, with point estimates ranging from -0.263 in the System GMM specification (representing the baseline coefficient for high-income economies). The consistent negative sign and the broadly overlapping confidence intervals across estimators indicate a robust negative direct association between DGGHE/GDP and economic growth.

4.3. Marginal effects of fiscal space

To facilitate interpretation of the conditional effects implied by the DGGHE–government debt/GDP interaction, Table 4 presents the marginal effects of DGGHE/GDP on GDP

growth at selected levels of government debt, estimated using the delta method implemented in Stata version 19 (StataCorp LLC, USA). At a government debt-to-GDP ratio of 20%, the marginal effect of DGGHE/GDP on growth is -0.499 percentage points (standard error = 0.119); at 60%, it is -0.564 percentage points; at 100%, it is -0.629 percentage points; and at 120%, it is -0.661 percentage points. The gradual decline in the marginal effect as debt increases—although modest in absolute magnitude—is consistent with the hypothesis that reduced fiscal space at higher debt levels may strengthen the negative association between public health expenditure and economic growth.

Figure 4 illustrates this relationship across the observed range of government debt (0%–150% of GDP), displaying the estimated marginal effect of DGGHE/GDP on GDP growth with 95% confidence intervals. The downward-sloping marginal effect and confidence intervals that remain below zero indicate that the negative association between public health expenditure and growth becomes stronger as government debt increases.

4.4. Income-group heterogeneity

Table 5 presents the net effects of DGGHE/GDP on GDP growth by income group, derived from the heterogeneity specification in Table 3, with statistical significance assessed using joint Wald tests. The results reveal a clear pattern of

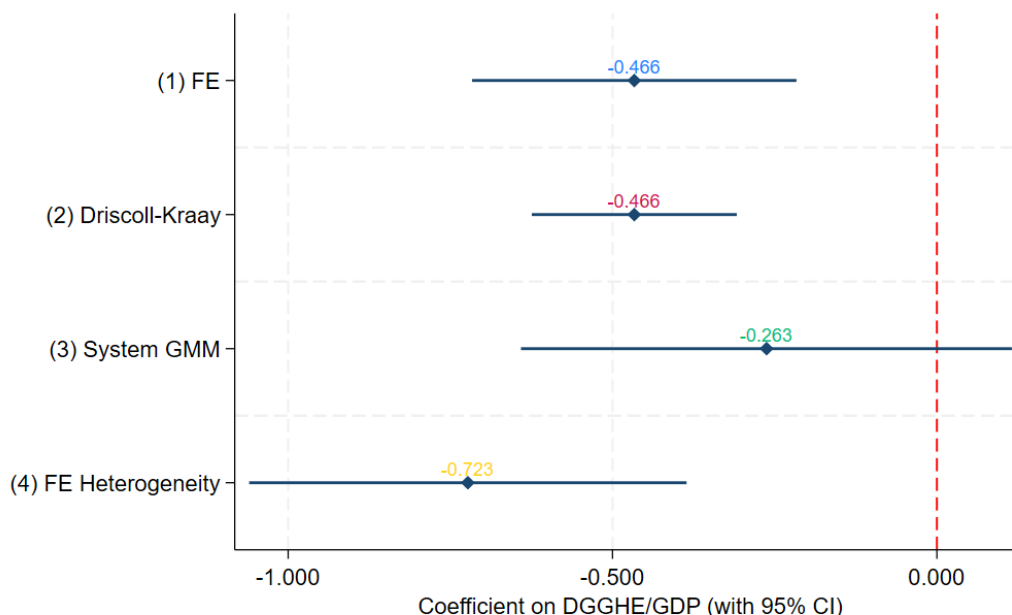


Figure 3. Estimated coefficient of DGGHE/GDP across alternative estimators

Abbreviations: CI: Confidence interval; DGGHE: Domestic General Government Health Expenditure; FE: Fixed effects; GDP: Gross domestic product.

Table 4. Marginal effect of DGGHE/GDP on growth at selected levels of government debt

Government debt/ GDP (%)	Marginal effect of DGGHE/GDP	Standard error	95% confidence interval
20	−0.499***	0.119	[−0.733, −0.265]
40	−0.531***	0.115	[−0.757, −0.306]
60	−0.564***	0.115	[−0.790, −0.338]
80	−0.596***	0.119	[−0.829, −0.363]
100	−0.629***	0.126	[−0.876, −0.381]
120	−0.661***	0.136	[−0.929, −0.394]

Note: *** $p < 0.01$ indicates statistical significance.

Abbreviations: DGGHE: Domestic General Government Health Expenditure; GDP: Gross domestic product.

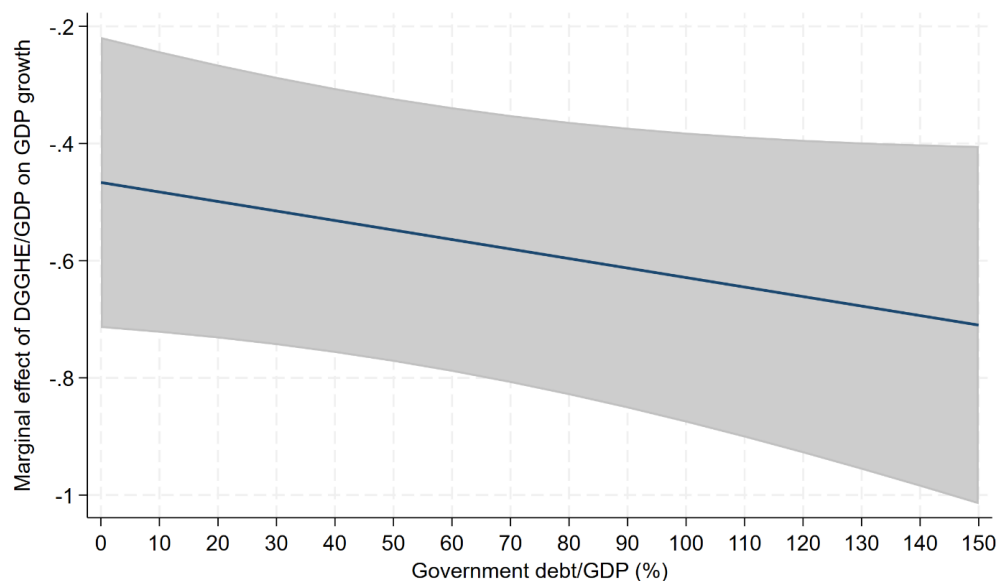


Figure 4. Marginal effect of DGGHE/GDP on GDP growth across the range of government debt-to-GDP ratios
Abbreviations: DGGHE: Domestic General Government Health Expenditure; GDP: Gross domestic product.

cross-country heterogeneity. The largest negative effects are observed among upper-middle-income countries (-1.116 , $p < 0.01$), followed by high-income countries (-0.723 , $p < 0.01$). In contrast, the estimated net effects for lower-middle-income and low-income countries are not statistically distinguishable from zero (-0.103 and -0.418 , respectively, both n.s.).

This pattern is consistent with the human-capital-based prediction of Bhargava *et al.* (2001), which suggests that the marginal productivity of health investment may be

greater where baseline health conditions remain weaker. It is also consistent with evidence from the broader public-finance literature on diminishing returns to additional public expenditure in relatively mature systems (Aschauer, 1989; Grigoli & Kapsoli, 2018). For high- and upper-middle-income countries—where health systems are more developed—additional public health spending may generate smaller incremental improvements in health outcomes, potentially increasing the opportunity cost of public resources and contributing to the negative growth association observed in this study.

Table 5. Net effect of DGGHE/GDP on GDP growth by income group

Income group	Net effect of DGGHE/ GDP on GDP growth	Standard error
High-income countries (reference)	−0.723***	0.171
Lower-middle- income countries	−0.103	0.149
Upper-middle- income countries	−1.116***	0.182
Low-income countries	−0.418	0.273

Notes: Statistical significance is based on joint Wald tests. *** $p < 0.01$ indicates statistical significance.

Abbreviations: DGGHE: Domestic General Government Health Expenditure; GDP: Gross domestic product.

Figure 5 illustrates these net effects. The figure highlights a nonlinear pattern across income groups, with the strongest negative association observed among upper-middle-income countries (−1.12), followed by high-income countries (−0.72), whereas lower-middle-income countries exhibit effects close to zero.

4.5. Robustness checks

Table 6 presents three robustness checks designed to address potential omitted-variable bias, alternative measures of fiscal space, and the distinction between short-run growth and long-run income-level effects.

The schooling specification introduces school life expectancy as a proxy for educational human capital. The coefficient on DGGHE/GDP remains negative and statistically significant ($\beta = -0.476, p < 0.01$). The DGGHE–government debt/GDP interaction becomes larger in magnitude and statistically significant ($\beta = -0.003, p < 0.05$), providing support for H2 that fiscal constraints associated with higher debt levels strengthen the negative association between public health expenditure and growth. Schooling itself enters with a positive coefficient ($\beta = 0.318, p < 0.10$), consistent with previous evidence on the relationship between education and economic performance (Baldacci *et al.*, 2008).

The primary balance specification replaces the government debt interaction with the DGGHE–primary balance interaction. The coefficient on DGGHE/GDP remains negative and statistically significant ($\beta = -0.380, p < 0.01$), while the interaction term is positive and statistically significant ($\beta = 0.021, p < 0.05$). This estimate implies that

a 1 percentage-point improvement in the primary balance is associated with a 0.021 percentage-point improvement in the marginal effect of DGGHE on GDP growth. The result is consistent with H3, suggesting that stronger fiscal positions may attenuate the negative association between public health expenditure and economic growth.

The log GDP per capita specification uses long-run income levels measured as GDP per capita at purchasing power parity in constant 2021 international dollars as the dependent variable rather than short-run growth dynamics. In this specification, the coefficient on DGGHE/GDP is small and statistically insignificant ($\beta = -0.006$), whereas the DGGHE–government debt/GDP interaction is negative and statistically significant ($\beta = -0.0003, p < 0.01$). This indicates that although DGGHE/GDP is not associated with average long-run income levels in isolation, the relationship becomes more negative as government debt increases. Overall, these robustness checks reinforce the central finding that fiscal space plays an important role in shaping the relationship between public health expenditure and economic performance.

Figure 6 presents the distribution of DGGHE/GDP across World Bank income groups. Considerable within-group heterogeneity is observed, particularly among high-income and upper-middle-income countries, where the IQR ranges approximately 4 percentage points of GDP. This considerable variation within income groups, alongside the between-group differences examined in the interaction analysis, highlights the importance of exploiting within-country variation through the fixed-effects estimation strategy.

5. Discussion

5.1. The direct association between public health spending and economic growth

The negative association between DGGHE/GDP and economic growth reported in Tables 3 and 6 is a robust empirical finding that warrants careful interpretation. At first glance, this result appears inconsistent with the canonical human-capital framework (Barro, 1996; Grossman, 1972a), which predicts that investments in health enhance human capital and, consequently, promote economic growth. However, the finding is compatible with broader theoretical perspectives that distinguish between productive and unproductive components of public expenditure (Aschauer, 1989; Barro, 1990; Devarajan *et al.*, 1996).

Several mechanisms may explain the observed negative association. First, public health expenditure is predominantly classified as current rather than capital

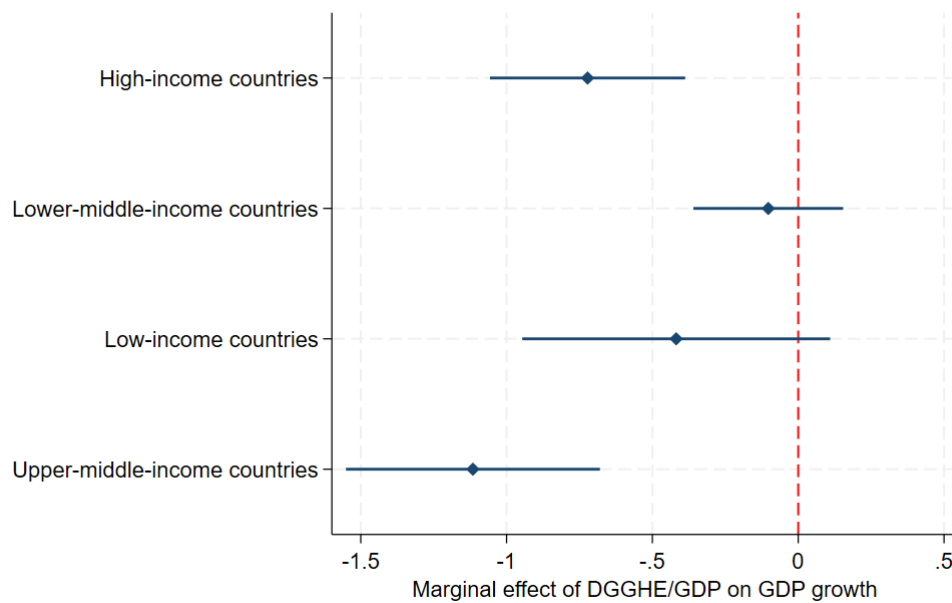


Figure 5. Net marginal effect of DGGHE/GDP on GDP growth by World Bank income group
 Note: One country without a World Bank income classification was excluded from this figure.
 Abbreviations: DGGHE: Domestic General Government Health Expenditure; GDP: Gross domestic product.

Table 6. Robustness analyses

Variable	Additional control for schooling	Primary balance specification	Log GDP per capita specification
DGGHE/GDP	-0.476*** (0.153)	-0.380*** (0.127)	-0.006 (0.009)
DGGHE-government debt/GDP	-0.003** (0.002)	–	-0.0003*** (0.0000)
DGGHE-primary balance	–	0.021** (0.009)	–
Schooling	0.318* (0.180)	–	–
GCF/GDP	0.106*** (0.033)	0.146*** (0.020)	0.002 (0.002)
Population aged 65 years and older	0.310* (0.166)	0.143 (0.107)	0.036*** (0.009)
Trade openness	0.031*** (0.010)	0.044*** (0.008)	-0.000 (0.001)
Inflation	-0.060** (0.028)	-0.068*** (0.021)	-0.002** (0.001)
Year FE	Yes	Yes	Yes
Country FE	Yes	Yes	Yes
Observations	1,677	3,439	3,470
Countries	142	158	161
Within R^2	0.301	0.280	0.578

Note: * $p < 0.10$, ** $p < 0.05$, and *** $p < 0.01$ indicate statistical significance.

Abbreviations: DGGHE: Domestic General Government Health Expenditure; FE: Fixed effects; GCF: Gross capital formation; GDP: Gross domestic product.

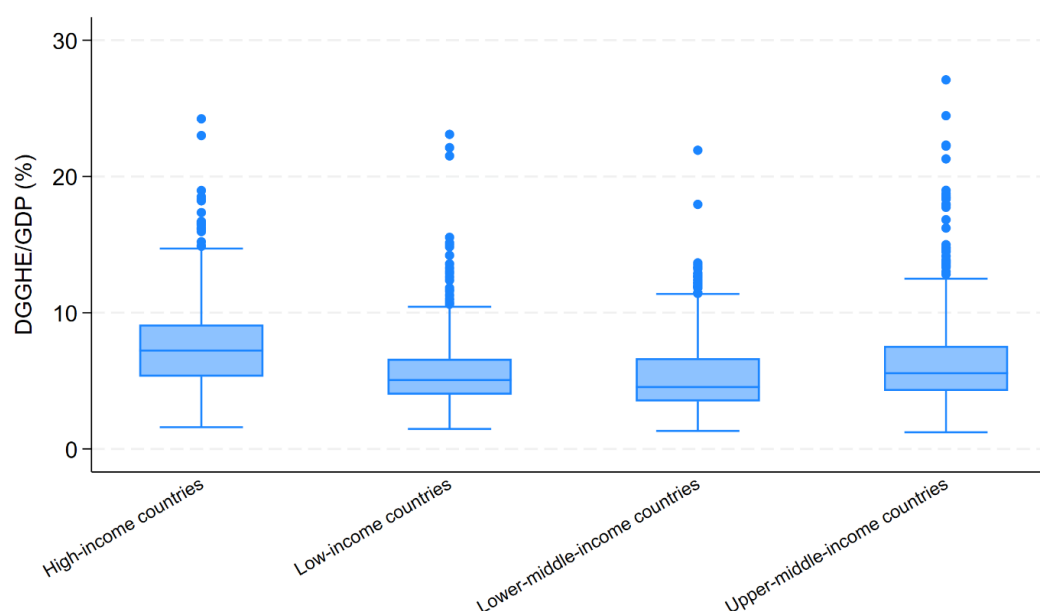


Figure 6. Distribution of DGGHE/GDP by World Bank income group

Note: One country without a World Bank income classification was excluded from this figure.

Abbreviations: DGGHE: Domestic General Government Health Expenditure; GDP: Gross domestic product.

expenditure, particularly in middle- and high-income countries, where much of the spending is devoted to salaries, medical supplies, and operating costs (Barroy & Gupta, 2021; Heller, 2006). Devarajan *et al.* (1996) argued that an excessive allocation of public resources to current expenditure may impede economic growth, particularly when complementary capital investment is constrained. Consistent with this interpretation, an additional percentage point of GDP allocated to current public health expenditure may displace more productive public investment or require distortionary taxation, thereby reducing private investment and slowing economic growth.

Second, the productivity of additional public health spending may be limited when allocative or technical efficiency is low. Grigoli and Kapsoli (2018) estimate that average inefficiency in public health expenditure across emerging and developing economies averages approximately 20%–40%, implying that a substantial share of additional spending does not translate into improved health outcomes. Consequently, higher expenditure in inefficient systems may impose fiscal costs without generating commensurate productivity gains. These findings suggest that expanding DGGHE without parallel improvements in service delivery, procurement, and public-sector management may yield limited or even

negative marginal effects on economic growth, particularly where health systems operate inefficiently.

Third, the method of financing additional public health spending is also important. If increases in DGGHE are financed through distortionary taxation or higher public borrowing, the associated deadweight losses or debt-servicing costs may offset the productivity gains arising from improvements in health capital. Barro (1990) formalized this trade-off in an endogenous growth model, demonstrating that economic growth initially increases with productive government expenditure but eventually declines once the marginal benefits of additional spending fall below its marginal financing costs. Consistent with this framework, the estimated negative association between DGGHE/GDP and economic growth becomes stronger as government debt increases (Tables 4 and 6), suggesting that fiscal constraints may amplify the adverse growth effects associated with higher public health expenditure.

5.2. Fiscal space as a moderator

The empirical findings provide support for H2, which proposes that government debt moderates the relationship between DGGHE/GDP and economic growth, and for H3, which posits that the primary balance exerts similar moderating role. Taken together, the baseline and

robustness analyses suggest that fiscal space is not only a determinant of the level of public health expenditure—as emphasized by Heller (2005, 2006) and Tandon and Cashin (2010)—but also an important factor shaping the relationship between public health spending and economic growth.

Two mechanisms may explain this moderating role. First, in countries with high public debt, additional public health spending is more likely to be financed through borrowing rather than through revenue mobilization or expenditure reprioritization. Reinhart and Rogoff (2010), Eberhardt and Presbitero (2015), and Chudik *et al.* (2017) show that elevated debt levels are associated with slower economic growth through several channels, including higher debt-servicing costs, increased sovereign risk premia, reduced private investment, and more limited countercyclical fiscal policy. Consistent with these arguments, the negative association between DGGHE/GDP and economic growth becomes stronger as government debt increases.

Second, the positive DGGHE–primary balance interaction observed in the primary balance specification (Table 6) is consistent with the view that stronger fiscal positions provide governments with greater policy flexibility, lower sovereign risk, and more favorable financing conditions. These conditions may enhance the effectiveness with which public resources are translated into economic outcomes. This interpretation is consistent with Baldacci *et al.* (2008), who argue that the growth effects of public health expenditure depend on governance quality, fiscal discipline, and institutional capacity. It also resonates with the findings of Gerald Iheoma (2024), who reports that the effects of fiscal policy shocks on health outcomes in Sub-Saharan Africa vary according to countries' fiscal positions.

Overall, these findings suggest that the concept of fiscal space, as articulated by Heller (2005, 2006) and operationalized by Kose *et al.* (2022), is relevant not only for determining government's capacity to finance public health expenditure but also for understanding how fiscal conditions shape the relationship between public health spending and economic performance. This perspective extends the existing literature by highlighting the moderating role of fiscal space in the public health expenditure–growth nexus.

5.3. Income-group heterogeneity

The income-group heterogeneity presented in Table 5 represents one of the most policy-relevant findings of this study. The negative association between DGGHE/GDP and economic growth is concentrated among high-income and upper-middle-income countries, whereas

lower-middle-income and low-income countries exhibit statistically insignificant effects.

This pattern is consistent with several complementary explanations. First, health systems in high-income and upper-middle-income countries are typically larger, more institutionally complex, and potentially closer to the production frontier (Hu & Wang, 2024). Under conditions of diminishing marginal returns, additional public health expenditure may generate smaller incremental improvements in health and economic outcomes, while still imposing substantial financing costs through taxation or borrowing. This mechanism does not appear to operate in lower-middle-income countries, where health systems are typically smaller and additional resources may address more fundamental health constraints.

Second, the composition of health expenditure differs systematically across income groups. In high-income economies, a larger proportion of health expenditure is directed toward managing aging populations and chronic non-communicable diseases, which generate substantial welfare benefits but may have weaker short-run links to measured economic growth compared with foundational public health interventions (Jakovljevic & Getzen, 2016). Consequently, the marginal association between additional health spending and economic growth may vary according to the stage of health-system development and epidemiological transition.

Third, institutional quality and governance, which are correlated with economic development, may also influence the effectiveness of public expenditure. Faruk *et al.* (2022) and Ikpe *et al.* (2024) show that institutional conditions shape the relationship between public health spending and economic outcomes in Middle East, North Africa, and Sub-Saharan Africa. Although institutional indicators are not included in the baseline models to preserve parsimony, the observed income-group differences may partly capture institutional heterogeneity correlated with development levels.

Importantly, the statistically insignificant effects observed among lower-middle-income and low-income countries should not be interpreted as evidence against health investment in these settings. The estimated coefficients remain negative but imprecisely estimated, with confidence intervals encompassing both modest positive and negative effects. Given the established welfare benefits of health expenditure in lower-income countries (Bloom *et al.*, 2004; Idris *et al.*, 2024; Sharma, 2018), the findings suggest that expanding public health spending in these contexts may involve limited growth-related risks while retaining substantial potential welfare benefits.

5.4. Post-pandemic context and fiscal sustainability

The sample period extends through 2023, encompassing the COVID-19 pandemic and its immediate aftermath—a period characterized by substantial pressure on both fiscal positions and health systems. Kurowski *et al.* (2021) describe the pandemic as a “double shock” to health financing, with simultaneous increases in health expenditure requirements and government revenues. Almenfi *et al.* (2020) document the scale of the global fiscal response, reporting that 3,856 social protection and labor measures were planned or implemented across 223 economies between January 2020 and January 2022, reflecting an extensive mobilization of public resources.

The influence of major global disruptions is also reflected in the estimated year fixed effects from the baseline specification, as shown in Figure 7. The year effects capture common shocks affecting economic growth across countries during the sample period, including the large negative deviation associated with the global financial crisis in 2009 (−4.78), the prolonged period of weaker global growth observed after 2012, and the sharp contraction during the COVID-19 pandemic in 2020 (−8.24), followed by a positive adjustment in 2021 (+1.29). These patterns provide a useful diagnostic that the model captures major global macroeconomic shocks while identifying the within-country relationship between DGGHE/GDP and economic growth.

In our sample, the years 2020–2022 are associated with substantial increases in DGGHE/GDP across many countries, reflecting both higher public health expenditure during the pandemic and declines in GDP. Over the same period, government debt-to-GDP ratios increased across most income groups, while primary balances deteriorated. The findings of this study suggest that the post-pandemic combination of higher DGGHE/GDP and reduced fiscal space may have strengthened the negative growth association identified in the analysis, particularly among upper-middle-income economies, which exhibit the largest negative net effect (−1.116) in Table 5.

This finding has important forward-looking implications. As governments pursue fiscal consolidation following the pandemic (International Monetary Fund, 2018), reducing public health expenditure indiscriminately may improve fiscal indicators in the short term but could undermine health-system resilience, pandemic preparedness, and longer-term health capital formation (Jakovljevic *et al.*, 2024). The policy implication is therefore not to reduce health spending mechanically, but rather to improve the efficiency and effectiveness of public health expenditure through better resource allocation, stronger budget execution, and integration with broader fiscal management strategies (Barroy & Gupta, 2021; Tagem *et al.*, 2025).

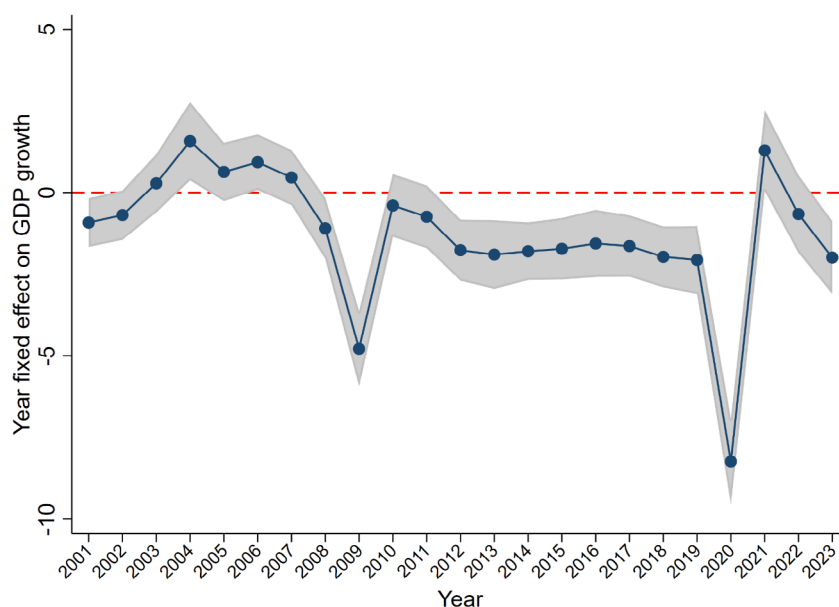


Figure 7. Estimated year fixed effects on GDP growth (2001–2023)
Abbreviation: GDP: Gross domestic product.

5.5. Limitations

Several limitations of this study should be acknowledged. First, although System GMM helps address potential endogeneity arising from reverse causality and simultaneity, it does not fully resolve concerns related to measurement error in DGGHE/GDP or omitted time-varying country-specific factors. The findings should therefore be interpreted as robust empirical associations, with causal interpretations remaining subject to the limitations inherent in cross-country panel analyses.

Second, DGGHE is treated as an aggregate measure, without accounting for differences in the composition of health expenditure across functions (e.g., preventive, curative, administrative), providers (e.g., public hospitals, primary care, pharmaceuticals), and inputs (e.g., wages, capital, supplies). Such compositional differences may influence the economic effects of health spending, as emphasized by Devarajan *et al.* (1996) and Grigoli and Kapsoli (2018). However, data constraints prevent systematic decomposition of expenditure components in a panel covering a large number of countries over time.

Third, the identification strategy relies primarily on within-country variation, which provides information on how changes in DGGHE/GDP are associated with changes in economic growth within countries over time. However, this approach cannot fully separate the effects of cross-country differences in health-system maturity, demographic structure, and institutional capacity. Future research using country-level case studies or quasi-experimental approaches could provide complementary evidence on these mechanisms.

Fourth, the inclusion of the post-pandemic period introduces structural-break concerns. Although year fixed effects and macroeconomic controls account for common shocks and major time-varying conditions, they may not fully capture the heterogeneous effects of the COVID-19 pandemic across countries. Future studies could examine this issue using pre-2020 subsamples or explicit identification strategies for pandemic-related shocks.

A further limitation concerns the scope of the expenditure measure. This study focuses on DGGHE, representing publicly financed health expenditure through government and social health insurance systems. It does not separately examine out-of-pocket payments or private voluntary health insurance, which constitute important financing sources in many low- and middle-income countries and operate through different incentive and risk-pooling mechanisms. This focus is intentional because the research question concerns the relationship between publicly financed health spending and fiscal

space; nevertheless, the estimates should be interpreted as relating to public rather than total health expenditure. Future research should examine how different financing sources interact to influence economic outcomes.

Finally, this study evaluates the relationship between public health expenditure and economic growth, while not capturing broader welfare gains that are not reflected in GDP, including improvements in longevity, quality of life, and protection against health-related financial hardship. A growth-based assessment should therefore be complemented by broader welfare analyses, particularly given evidence of the poverty-reducing effects of health expenditure in low- and middle-income countries (Idris *et al.*, 2024).

6. Conclusion and policy implications

This study examines the relationship between public health expenditure, fiscal space, and economic growth using a balanced cross-country panel of 161 countries over 2000–2023. Drawing on the WHO Global Health Expenditure Database, the Kose *et al.* (2022) fiscal space database, and the World Bank World Development Indicators, the analyses evaluate whether the association between domestic government health expenditure and economic growth varies according to fiscal conditions and country characteristics.

Four findings emerge in this study. First, a 1 percentage-point increase in DGGHE/GDP is associated with an approximately 0.47 percentage-point decline in annual GDP growth in the baseline specification, and this negative association remains stable across alternative estimators. Second, fiscal conditions significantly shape this relationship: the DGGHE–government debt/GDP interaction is negative and statistically significant in the extended specification, while the DGGHE–primary balance interaction is positive and statistically significant, indicating that fiscal space influences the growth association of public health expenditure. Third, substantial heterogeneity exists across income groups: the negative association is statistically significant in high-income (net effect = -0.72 , $p < 0.01$) and upper-middle-income countries (net effect = -1.12 , $p < 0.01$), whereas effects among lower-middle-income (-0.10) and low-income countries (-0.42) are not statistically distinguishable from zero. Fourth, System GMM estimates provide broadly consistent evidence under alternative identification assumptions, although the results should continue to be interpreted within the limitations of cross-country panel analysis.

These findings contribute to ongoing health-financing policy debates in three ways. First, the results indicate

that the growth effects of public health expenditure are conditional on fiscal space rather than uniformly positive or negative. This has direct implications for the design of universal health coverage strategies (Barroy *et al.*, 2021; Tagem *et al.*, 2025). Countries with limited fiscal space should expect more modest short-run growth gains from scaling up public health spending; however, this does not imply that such spending is unproductive. Rather, complementary reforms in expenditure efficiency, fiscal management, and revenue mobilization are critical to translating health investments into economic growth (Grigoli & Kapsoli, 2018; Tandon & Cashin, 2010).

Second, the observed income-group heterogeneity suggests that high- and upper-middle-income economies should focus on efficiency reforms—such as reducing waste, improving allocative efficiency, and shifting the composition of spending toward higher-value interventions—rather than on aggregate spending expansion. By contrast, lower-middle-income countries face a more favorable risk-reward profile: while the short-run growth benefit may be modest, the welfare benefits of health spending are substantial, and the estimated crowding-out effects are not statistically significant. Low-income countries present a more complex case, with welfare gains likely to be high but constrained fiscal capacity requiring careful prioritization within limited budgets.

Third, the post-pandemic context underscores the urgency of integrating fiscal space considerations into health-financing strategies. The simultaneous deterioration of fiscal positions and the expansion of health spending needs documented by Kurowski *et al.* (2021) and Jakovljevic *et al.* (2024) suggest that policymakers must navigate trade-offs between fiscal sustainability, pandemic preparedness, and growth recovery. Our findings suggest that indiscriminate reductions in health spending to consolidate fiscal positions may yield short-run fiscal improvements but could compromise longer-term human-capital formation. The preferable strategy is to combine targeted expenditure adjustments with substantial efficiency gains, supported by improved public financial management (Barroy *et al.*, 2021).

Three further implications follow. First, where fiscal space is limited, sequencing matters: efficiency gains (e.g., procurement reform, reallocation toward primary and preventive care, digital-health adoption) should precede or accompany spending expansion, ensuring that additional outlays generate productive health and economic returns rather than intensifying debt-service pressures. Second, the moderating role of the primary balance implies that credible medium-term fiscal frameworks—by lowering sovereign risk premia—can enhance the growth returns

of health investment, making fiscal consolidation and health expenditure expansion complements rather than substitutes. Third, upper-middle-income economies, where the negative association is more pronounced, should prioritize reallocating resources toward high-return interventions and away from low-value care, consistent with Grigoli and Kapsoli (2018). In contrast, lower-middle-income and low-income countries, which exhibit a more favorable balance between potential gains and fiscal constraints, can continue scaling up public health spending through carefully prioritized investments aligned with universal health coverage commitments.

Several directions for future research emerge from this analysis. First, disaggregating DGGHE by function (preventive, curative, administrative) and provider would allow more granular identification of which components of health spending drive the documented effects. Second, integrating institutional and governance indicators directly into the empirical specification—building on Faruk *et al.* (2022) and Ikpe *et al.* (2024)—could clarify whether the observed income-group heterogeneity reflects underlying differences in institutional quality rather than income status alone. Third, exploiting quasi-experimental variation arising from health-financing reforms, particularly those associated with universal health coverage implementation, could provide complementary causal evidence. Fourth, extending the analysis to incorporate broader welfare measures—including health-adjusted life years and financial protection—would provide a more comprehensive assessment of the public-finance returns to health investment. Finally, spatial-econometric approaches, as discussed by Baltagi *et al.* (2017), could further examine cross-country spillovers in health spending and economic growth.

As governments worldwide seek to balance the dual challenge of strengthening health systems in the post-pandemic era while restoring fiscal sustainability, the interaction between public health expenditure and fiscal capacity is likely to remain central to policy and academic debate. The findings of this study suggest that this relationship is more nuanced than a simple positive or negative effect: the productivity of public health spending depends critically on the fiscal environment in which it is deployed and on the institutional capacity to translate resources into improved outcomes. Policy frameworks that overlook this conditionality risk both inefficient resource allocation and missed opportunities for inclusive, health-promoting growth.

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Availability of data

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