

INTERACTIVE IMPACT OF HEALTH EXPENDITURE AND GOVERNANCE ON UNDER-FIVE MORTALITY: A PANEL EVIDENCE FROM SUB-SAHARAN AFRICA

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ABSTRACT

This study examines the interactive impact of health expenditure and governance on under-five mortality in Sub-Saharan Africa over the period 2000-2023. The study utilizes secondary data obtained from the World Bank's World Development Indicators (WDI). Methodologically, the study adopts the Generalized Method of Moments (GMM) estimation technique, which is suitable for addressing potential endogeneity, unobserved heterogeneity, and dynamic relationships inherent in panel data analysis. The study distinguishes between domestic public and private health expenditure while incorporating governance as a critical institutional factor influencing health outcomes. The empirical findings reveal that domestic public health expenditure has a negative and statistically significant effect on under-five mortality at the 5% level. Specifically, a one-unit increase in public health spending leads to a 0.8-unit reduction in under-five mortality. In contrast, domestic private health expenditure shows a negative but statistically insignificant relationship with under-five mortality, suggesting that private spending does not exert a substantial independent influence on mortality reduction. Governance is also found to have a negative and statistically significant effect on under-five mortality, with a one-unit improvement in governance reducing mortality by approximately 0.08 units. Furthermore the result reveals that, the interaction between domestic public health expenditure and governance is negative and statistically significant, indicating that

the effectiveness of public health spending is amplified in environments characterized by strong governance. A one-unit increase in the combined effect reduces under-five mortality by 0.34 units. Conversely, the interaction between domestic private health expenditure and governance is negative but statistically insignificant, implying a limited joint effect on mortality outcomes, likely due to structural inequalities and the predominance of out-of-pocket financing. The study concludes that while increasing public health expenditure is essential for reducing under-five mortality, its impact is significantly strengthened by improved governance. Policy efforts should therefore prioritize both increased public investment in health and the strengthening of governance frameworks to achieve sustainable improvements in child health outcomes in Sub-Saharan Africa.

Key Words: Under-five Mortality, Health Expenditure and Governance

1.0 Introduction

Under-five mortality (U5M) continues to serve as a vital measure of child health and broader socio-economic development, especially in Sub-Saharan Africa, where the burden remains disproportionately high. Globally, under-five deaths have declined from about 12.6 million in 1990 to approximately 4.9 million in 2022, reflecting significant improvement over time. However, Sub-Saharan Africa still accounts for about 56% of global under-five deaths, despite having a smaller share of the world's child population. The regional under-five mortality rate remains among the highest in the world, at roughly 74 deaths per 1,000 live births (2022 estimate), compared to the global average of about 37 per 1,000 live births. These deaths are largely driven by preventable conditions such as pneumonia, malaria, diarrhea diseases, and neonatal disorders (UNICEF, 2023; World Health Organization, 2022).

The under-five mortality rate in Sub-Saharan Africa remains high, averaging approximately 84.9 deaths per 1,000 live births based on the available data, reflecting persistent child health challenges in the region. This sustained high rate is strongly associated with underlying factors including widespread poverty, weak healthcare systems, low immunization coverage, malnutrition, and inadequate access to safe water and sanitation. (UNICEF, 2023). Moreover, ineffective governance

systems and limited public investment in health continue to hinder the provision of essential healthcare services, thereby worsening child health outcomes (World Bank, 2023).

Neonatal mortality constitutes a substantial share of these deaths, accounting for approximately 47% of all under-five deaths globally (about 2.3 million deaths annually) and remains particularly difficult to address. In Sub-Saharan Africa, neonatal mortality remains higher than the global average at about 27 deaths per 1,000 live births (2022). It is closely linked to maternal health conditions, access to quality antenatal services, and the availability of skilled birth attendants (World Health Organization, 2022; UNICEF, 2023).

Health expenditure is a key determinant of child survival. Evidence shows that countries allocating higher per capita health spending (often above US\$100 per capita) tend to record substantially lower under-five mortality rates, while many low-income Sub-Saharan African countries still spend below US\$50 per capita on health, limiting access to essential maternal and child health services (World Bank, 2023; WHO, 2023).

Higher levels of public spending on healthcare are generally associated with better access to critical services such as immunization, maternal healthcare, and disease treatment, all of which contribute to reducing under-five mortality (World Bank, 2021). Nevertheless, health financing systems in many Sub-Saharan African countries are often insufficient, inefficient, and heavily dependent on out-of-pocket payments, thereby restricting access to care and increasing the financial burden on vulnerable populations (World Health Organization, 2021).

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According to the World Health Organization (2022), high-income regions such as Europe and the United States devote the largest share of their GDP to healthcare, averaging about 12.55%. In contrast, low-income countries allocate approximately 5.06% to 5.28% of GDP to health, while Sub-Saharan African countries spend roughly 5.08%, compared to the global average of 9.91%. (World Bank)

Healthcare financing both public and private represents a crucial factor influencing child mortality outcomes. Adequate funding is essential for the efficient functioning of health systems and for improving population health. Insufficient financial resources limit the capacity of governments and households to recruit skilled health personnel, acquire necessary medical technologies, and sustain effective disease prevention and health promotion initiatives (World Health Organization [WHO], 2020 2021). Furthermore, health expenditure reflects the overall prioritization and allocation of resources toward healthcare services, making it an important indicator of system performance (WHO, 2021).

However, increased financial investment alone does not automatically lead to lower child mortality, particularly when resources are poorly managed. Inefficiencies in the system may result in misallocation, leakages, and wastage of funds. In this regard, effective governance becomes a crucial factor in ensuring that health expenditure translates into improved health outcomes in Sub-Saharan Africa.

Governance plays a significant role in determining how health resources are allocated and utilized. Weak governance often characterized by corruption, lack of accountability, and inconsistent policies reduces the effectiveness of health spending and undermines health outcomes (World Bank, 2020). In contrast, strong governance frameworks enhance the efficiency of service delivery and ensure that investments in healthcare lead to measurable improvements in child survival.

Under-five mortality (U5M) in Sub-Saharan Africa (SSA) has declined significantly, falling from 139 deaths per 1,000 live births in 2000 to 68 in 2023. However, the rate remains substantially higher than in South Asia (34) and Europe (5.2), highlighting persistent regional disparities (World Bank, 2024). If these disparities are not further reduced, they may undermine human capital formation and constrain long-term economic growth. Previous studies (Arize et al., 2024; Sirag et al., 2017;

Gamette, 2021) have largely examined individual governance indicators in isolation, thereby neglecting the broader, interactive influence of overall governance quality on the relationship between health expenditure and child mortality. The remainder of the study is organized into sections covering the literature review, methodology, results, and conclusion with policy recommendations.

2.0 Literature Review

2.1 Concept of Under-Five Mortality

The under-five mortality rate (U5MR) is a crucial indicator in public health and demography, representing the likelihood that a child will die before reaching five years of age per 1,000 live births. It serves as a broad measure of population health by reflecting the interplay of socioeconomic conditions, maternal well-being, environmental influences, and the effectiveness of healthcare systems (UNICEF, 2023; WHO, 2022). This indicator is particularly significant because a large proportion of deaths among children under five are due to preventable and treatable illnesses, including pneumonia, malaria, diarrhoea, malnutrition, and complications during the neonatal period. Consequently, declines in U5MR are strongly associated with enhanced access to healthcare services, improved immunization coverage, better nutrition, adequate sanitation, and higher levels of maternal education. (World Bank 2024). Moreover, U5MR is widely used to monitor global development progress, especially under Goal 3 of the Sustainable Development Goals, which aims to end preventable deaths of newborns and children under five.

2.2 Concept of Health Expenditure

Health expenditure denotes the total financial resources devoted to health services over a specific period and is typically classified into public, private, total, and external components. Public health expenditure refers to government outlays on healthcare, financed through taxation and social insurance mechanisms, and reflects the state's commitment to improving population health and achieving universal health coverage. In contrast, private health expenditure encompasses out-of-pocket payments by households, private insurance contributions, and spending by non-governmental organizations, often highlighting the financial burden placed on individuals. Total health expenditure captures the combined value of public and

private spending, serving as a comprehensive indicator of a country's overall investment in health. External health expenditure includes financial support from foreign donors, international agencies, and development partners, which is particularly significant for low- and middle-income countries in advancing health system capacity and targeted interventions. Together, these components are critical for evaluating health system financing, equity, and access, especially in developing regions where dependence on external funding and out-of-pocket payments remains substantial (World Health Organization [WHO], 2023; World Bank, 2023).

2.3 Concept of Governance

Governance broadly denotes the manner in which authority is exercised in the management of a country's economic and social resources, with particular emphasis on efficiency, accountability, transparency, and responsiveness in public resource administration (World Bank, 1992; Erkkilä et al., 2014). It further encompasses the institutions and mechanisms involved in the selection, oversight, and replacement of governments, including key bodies such as the executive, judiciary, and legislature (Eslamloueyan & Jafari, 2019; Khan et al., 2022).

According to the World Bank, governance is captured through six core dimensions: government effectiveness, regulatory quality, rule of law, control of corruption, voice and accountability, and political stability alongside the absence of violence (World Bank, 2008). The concept is inherently multidimensional. For instance, the World Bank (1992) underscores institutional strength and policy efficiency, while Kaufmann et al. (1999) emphasize quantifiable measures such as accountability and corruption control. Similarly, the UNDP (1997) highlights the importance of inclusive participation involving the state, private sector, and civil society, whereas Rhodes (1996) and Pierre et al. (2000) focus on governance as a system of network-based coordination.

2.4 Empirical literature review

Michael et al. (2024) offer a useful foundation by analyze how governance quality moderates the relationship between health expenditure and key health indicators including life expectancy, infant mortality, under-five mortality, crude mortality, and maternal mortality across 15 West African countries from 1996 to 2022. Using

Feasible Generalized Least Squares (FGLS) and data from the World Development Indicators and World Governance Indicators, their findings indicate that improved governance leads to better health outcomes, and that the interaction between governance and health expenditure further amplifies these improvements.

Broadening the analysis beyond Africa, Zounkifirou (2021) investigates the nexus between health expenditure, democracy, and child mortality in 126 developing countries between 1995 and 2017 using a two-stage dynamic panel Generalized Method of Moments (GMM) model. The results reveal that Sub-Saharan Africa is the only region where increased health spending significantly reduces child mortality.

In addition, Iheonu (2019) explores the effect of governance quality on mortality rates in Sub-Saharan Africa using World Bank data for 31 countries from 2002 to 2015. Applying a fixed effects model with Driscoll and Kraay standard errors on an unbalanced panel dataset, the study finds that control of corruption and political stability exert negative but statistically insignificant effects on infant mortality. In contrast, regulatory quality and overall governance show a negative and statistically significant impact, with regulatory quality playing a particularly strong role in reducing infant mortality. Overall, the findings suggest an inverse relationship between governance quality and mortality indicators.

More recently, Sibanda et al. (2024) examine the mediating role of institutional quality in the relationship between health expenditure and under-five mortality across 46 SSA countries from 2000 to 2021 using the System-GMM technique. Their results indicate that strong institutional frameworks enhance the effectiveness of health expenditure especially external health funding in lowering under-five mortality. In a related study, Ouedraogo et al. (2020) assess the link between institutional quality and health outcomes in Sub-Saharan Africa by integrating institutional indicators into a health production function. Using a Two-Stage Least Squares (2SLS) estimation on panel data for 45 countries from 1996 to 2018, the study identifies key institutional drivers of improved health outcomes, ranked as rule of law, control of corruption, government effectiveness, voice and accountability, and political stability with absence of violence.

Osinubi (2023) examines how governance shapes the link between globalization and life expectancy in 39 African countries using PSCC-LSDV and dynamic System-GMM to address endogeneity and spatial dependence. The results show that globalization improves life expectancy, but its interaction with governance is negative, implying a substitutive rather than complementary relationship between the two. Although the study is methodologically strong using GMM for endogeneity and PCA-style approaches to manage governance indicators there are concerns that instrument proliferation in System-GMM may bias the estimates.

In same vein, Onisanwa and Audi (2024) investigated the impact of health expenditure on child health outcomes in Sub-Saharan Africa (SSA) using data obtained from the World Bank database, covering 44 countries in the region. The study utilized two key indicators of child health outcomes: infant mortality rate and child mortality rate. A fixed effects model was estimated to analyze the relationship between health expenditure and child health outcomes. The findings indicated that total health expenditure had a significant negative effect on both infant and child mortality rates, demonstrating that increased health spending led to a reduction in under-five and infant mortality rates.

Arize et al. (2024) provide an important starting point by analyzing the interaction between health expenditure and health outcomes while incorporating the role of government effectiveness across 45 Sub-Saharan African (SSA) countries from 1960 to 2022. Using the Autoregressive Distributed Lag (ARDL) model, the study finds that poor health outcomes cannot be explained solely by inadequate health budget allocations.

Similarly, Gamette (2021) investigates the effects of health financing on infant mortality in 42 Sub-Saharan African countries (2000-2016) using System-GMM and PCA to construct a governance index and handle endogeneity and dynamic effects. The findings indicate that all forms of health financing reduce infant mortality, though with some regional differences, while governance negatively moderates the relationship between financing and infant mortality. Despite the methodological advantages of GMM and PCA in addressing endogeneity and dimensionality reduction,

the study also notes the risk of instrument proliferation, which may affect result reliability.

In a similar vein, Odhiambo et al. (2015) examined the relationship between health expenditure and under-five mortality, considering the role of the governance environment in Sub-Saharan Africa. The study used dynamic panel estimation to analyze data from 41 SSA countries spanning 2000 to 2009. The results indicated that public health expenditure, in contrast to private health expenditure, contributed to a reduction in under-five mortality rates in the region. The study also found that, when controlling for corruption, the effectiveness of public health expenditure in reducing under-five mortality became more evident. Additionally, there was a regional variation in the effectiveness of health expenditure on under-five mortality.

Studies that have examined the influence of governance quality on child mortality outcomes, including those by Arize et al. (2024), Sirag et al. (2017), and Iheonu (2019), have generally focused on isolated or individual indicators of governance quality rather than adopting a more comprehensive perspective. In most of these studies, emphasis is often placed on single dimensions such as government effectiveness, corruption control, or regulatory quality, without fully integrating the multidimensional nature of governance. As a result, the broader and potentially more interactive effects of governance structures are not fully captured in empirical analyses.

This narrow approach tends to overlook the fact that governance is inherently multidimensional and works as an interconnected system in shaping public policy outcomes, particularly in the health sector. For instance, improvements in transparency may not yield optimal health outcomes if accountability mechanisms remain weak, just as efficient public administration may be undermined by political instability or corruption. Therefore, examining governance through fragmented indicators may underestimate its true role in influencing how health expenditures translate into actual improvements in child health outcomes, especially under-five mortality rates in sub-Saharan Africa.

Furthermore, these studies have often paid limited attention to the combined or "interactive" effect of governance quality and health expenditure. This is a critical omission, as the effectiveness of health spending is likely to depend heavily on the institutional environment in which it is implemented. In settings with strong governance systems, public health resources are more likely to be efficiently allocated, properly managed, and directed toward high-impact interventions such as immunization, maternal care, and primary healthcare services. By not sufficiently considering the overall or composite influence of governance quality, existing literature in sub-Saharan Africa provides an incomplete understanding of how institutional factors condition the relationship between health expenditure and child mortality. A more integrated approach that captures governance as a holistic construct would therefore offer deeper insights into how policy effectiveness can be improved to achieve better child survival outcomes.

3.0 Methodology

This part of the study discusses the type and sources of data that are used in this research, model specification and techniques of data analysis.

3.1 Source/ Method of Data Collection

This study employs secondary data obtained from reputable international databases. Specifically, data on under-five mortality rate, domestic public health expenditure, and domestic private health expenditure are sourced from the World Bank (2024). While governance index is obtained from the Worldwide Governance Indicators (World Bank, 2024), the dataset comprises annual observations spanning a 23-year period from 2000 to 2023, selected based on data availability and the relevance of child mortality trends. The analysis covers a panel of 46 countries in Sub-Saharan Africa.

3.2 Model specification

To evaluate the interactive impact of health expenditure and governance on under-five mortality in Sub-Saharan Africa, this study employ health production theory by Grossman in 1972 as a theoretical framework of the study.

This study adapts the model of Osinubi et al., (2023) who examine the moderating role of governance in the globalisation-life expectancy nexus and its implications for

socioeconomic

development.

Osinubi et al. specify their interaction model empirically as:

$$LE_{it} = \alpha + \beta_1 GLOB_{it} + \beta_2 GOV_{it} + \beta_3 (GLOB_{it} \times GOV_{it}) + X_{it} + \varepsilon_{it} \quad \dots \dots \dots (1)$$

Where

LE_{it} = Life expectancy for country i at time t

α = Constant term

$GLOB_{it}$ = Globalization index for country i at time t.

β_1 = measures the effect of globalization on life expectancy when governance = 0.

GOV_{it} = Governance indicators for country i at time t.

β_2 measures the effect of governance on life expectancy when globalization = 0.

$(GLOB_{it} \times GOV_{it})$ = Interaction term between globalization and governance.

β_3 captures the moderating effect of governance on the globalization-life expectancy relationship.

X_{it} = Vector of control variables

ε_{it} = Error term

Following Osinubi et al. (2023), this study specify a dynamic panel model estimated using the system GMM technique as follows:

$$\begin{aligned} U5MR_{it} \\ = \alpha + \beta_1 Dphe_{it} + \beta_2 Dprh_{it} + \beta_3 GOV_{it} + \beta_4 (Dphe_{it} \times Gov_{it}) + \beta_5 (Dphe_{it} \times Gov_{it}) \\ + \varepsilon_{it} \quad \dots \dots \dots (2) \end{aligned}$$

Where

$U5MR_{it}$ = Under five Mortality rate

$Dphe_{it}$ = Domestic public health expenditure

$Dprh_{it}$ = Domestic private health expenditure

GOV_{it} = Governance indicators

$Dphe_{it} \times GOV_{it}$ = interaction term of Domestic public health expenditure and governance on mortality

$Dprh_{it} \times GOV_{it}$ = interaction term of Domestic private health expenditure and governance on mortality

α = Intercept

ε_{it} = error term

i: Country, t: Time

β_1 ($Dphe_{it}$): Effect of Domestic health expenditure on under five mortality when governance = 0

β_2 ($Dprh_{it}$): Effect of Domestic private health expenditure on under five when governance = 0

β_3 (Governance): Direct effect of governance on under five mortality

β_4 ($Dphe_{it} \times GOV_{it}$): interaction terms capture how governance modifies the effect of Domestic public health spending on under five mortality.

B_5 ($Dprh_{it} \times GOV_{it}$): interaction terms capture how governance modifies the effect of Domestic private health expenditure

Aprior expectation:

If the coefficients of β_4 and B_5 are negative and significant means governance strengthens the mortality-reducing effect of health expenditure, if the coefficients are positive, it implies that governance weakens the mortality-reducing effect of health expenditure, which is theoretically uncommon.

4.0 Analysis and Results

This part presents the analysis that examine the interaction impact of health expenditure and governance on under-five mortality in Sub-Saharan Africa from 2000 to 2023. The analysis begins with the presentation of Panel Unit Root Test and Result, Correlation Test and Result, Pool OLS, Fixed Effect and Difference GMM Results, System GMM Test and Result and System Diagnostic GMM Test and Result.

4.1 Panel unit Root Test Result

The study tests for stationarity of variables essential for avoiding spurious results in long-panel analyses by applying panel unit root tests. Second-generation method which is Cross-sectional Augmented Im, Pesaran and Shin (CIPS) is employed to robustly confirm the stationarity properties of the series (see Table 1).

Table 1: Panel Unit Root Test Results (CIPS)

Pesaran's CADF	Integrated of Order Zero	5% Critical value	1 st Difference	5% Critical value
U5MR	-2.329	-2.11**	-1.535	-2.11
Dphe	-2.003	-2.11	-5.108	-2.11**
Dprh	-2.493	-2.11**	-4.972	-2.11
Gov	-2.071	-2.11	-4.926	-2.11**

Note: The asterisk (**) denotes rejection of the null hypothesis that series has unit root at 5%

Source: Authors' Computation from STATA 17.

The CIPS test shows that under-five mortality rate (U5MR) and domestic private health expenditure (Dprh) are stationary at level (integrated of order zero, $I(0)$). In contrast, domestic public health expenditure and governance are stationary at first difference (integrated of order one, $I(1)$). Thus, the results in Table 1 indicate that the variables in the study have mixed orders of integration [$I(0)$ and $I(1)$], but none of the variables is integrated of order two [$I(2)$].

4.2 Correlation Analysis

The correlation test assesses multicollinearity among under-five mortality, domestic public and private health expenditure and governance indicators. Correlation coefficients (r), ranging from - to 1, indicate the strength and direction of relationships between variables. Following Noora (2020), multicollinearity is present when $|r| = 0.8$; otherwise, it is not a concern.

Table 2: Correlation Result

Variables	U5MR	Dphe	Dprh	Gov
U5MR	1.0000			
Dphe	-0.4508	1.0000		
Dprh	0.3944	-0.5575	1.0000	
Gov	-0.1722	0.2450	-0.1918	1.0000

Source: Authors' Computation from STATA 17

The correlation results indicate weak relationships among under-five mortality rate, domestic public and private health expenditure and governance indicators. Since all correlation coefficients are below 0.8 (Noora, 2020), there is no evidence of multicollinearity. This implies that the variables are relatively independent, enhancing the reliability, stability, and interpretability of the model's estimates.

4.3 Choosing between Difference Generalized Method of Moments (GMM) and System GMM

The selection of GMM in this study follows the rule of thumb proposed by Bond (2001). According to Bond (2001), an autoregressive model should first be estimated using pooled OLS and fixed effects methods. The pooled OLS estimate of the lagged

dependent variable (under-five mortality rate) is regarded as the upper-bound estimate, while the corresponding fixed effects estimate serves as the lower-bound estimate. If the Difference GMM estimate is close to or falls below the fixed effects estimate, it indicates that Difference GMM is downward biased due to weak instruments; hence, System GMM becomes more appropriate. Following Bond's (2001) procedure, the pooled OLS, fixed effects, and Difference GMM estimates are reported in Table 3.

Table 3: Pool OLS, Fixed Effect and Difference GMM Results (LEX as response variable)

Pool OLS		Fixed Effect		Difference GMM	
Variables	Coefficient	Variables	Coefficient	Variables	Coefficient
L.U5MR	0.8002537 (0.000)***	L.U5MR	0.307369	L. U5MR	0.2692326

Robust standard errors in parentheses, ** p<0.05

Source: Authors' Computation from STATA 17

The pooled OLS results in Table 3 indicate that the coefficient of the lagged under-five mortality rate is 0.800. In the fixed effects estimation, this coefficient declines to 0.307, while under the difference GMM specification it further falls to 0.269. According to Bond (2001), the fact that the difference GMM estimate is lower than the fixed effects estimate implies that system GMM is the more appropriate estimator. Consequently, the study employs system GMM, with a preference for the two-step estimator, since it is asymptotically more efficient than the one-step estimator as it applies optimal weighting of the moment conditions based on the variance-covariance structure of the error terms.

4.4 Interactive impact of health expenditure and governance on under-five mortality in Sub-Saharan Africa

This section presents results that examines the interactive impact of health expenditure and governance on under-five mortality in Sub-Saharan Africa.

Table 4: System GMM Result

Variables	coefficient	Standard Error	Probability
L.U5MR	0.1660226	.1721257	0.340
Dphe	-0.847204	0.1159101	0.000
Dprh	-0.393743	0.2599123	0.137
Gov	0.338878	.1364806	0.013
Dphe*Gov	-0.344317	.1718341	0.045
Dprh*Gov	-0.1179539	.0942676	0.218
yr2	57.59391	11.88409	0.000
yr3	52.83578	11.26772	0.000
yr4	48.51298	10.2243	0.000
yr5	44.07825	9.194803	0.000
yr6	39.16472	8.39236	0.000
yr7	34.34796	7.579492	0.000
yr8	30.56477	6.55435	0.000
yr9	26.95573	5.908296	0.000
yr10	26.98588	8.507371	0.003
yr11	19.81041	4.540251	0.000
yr12	17.47849	3.671636	0.000
yr13	15.51842	3.120049	0.000
yr14	12.55853	2.883683	0.000
yr15	11.02443	2.645892	0.000
yr16	8.480828	1.711999	0.000
yr17	6.989069	1.479401	0.000
yr18	5.553769	1.114138	0.000
yr19	3.371993	.6726793	0.000
yr20	3.533381	1.363953	0.013
yr21	.2069075	.4913533	0.676
yr23	.3754105	2.122586	0.860
yr24	-4.125285	1.480707	0.008
Cons	45.43997	11.36076	0.000

Source: Authors' Computation from STATA 17

The results from Table 4 indicate that the lagged dependent variable ($L.U5MR = 0.166$, $p = 0.340$) is positive but statistically insignificant. This suggests that past mortality levels have a weak and statistically unreliable influence on current under-five mortality in this specification. In other words, mortality does not exhibit strong persistence after controlling for other factors in the model.

DPHE has a negative and highly significant coefficient (-0.847 , $p = 0.000$). This implies that higher government health spending significantly reduces under-five mortality. Substantively, a one-unit increase in DPHE (percentage of total government health spending) is associated with a reduction in U5MR, confirming that stronger public health financing improves child survival through expanded access to immunization, maternal care, and primary healthcare services. This finding aligns with a priori expectations and is consistent with the empirical evidence of Zounkifirou (2021) and Onisanwa and Audi (2024).

DPRH has a negative but statistically insignificant effect (-0.394 , $p = 0.137$). Although the sign suggests that higher private spending may reduce child mortality, the effect is not statistically reliable. This implies that private health expenditure does not consistently translate into measurable reductions in under-five mortality in the sampled countries, possibly due to unequal access, out-of-pocket burden, or inefficiencies in private healthcare delivery.

Governance shows a positive and statistically significant coefficient (0.339 , $p = 0.013$). Given the governance scale ranges from -2.5 (weak governance) to $+2.5$ (strong governance), This counterintuitive result may reflect inefficiencies in governance structures, indicating that governance, in its current form, is ineffective in reducing mortality rates in Sub-Saharan Africa. It underscores the presence of weak institutional frameworks that limit the capacity of governance to independently improve health outcomes.

The interaction term DPHE*GOV is negative and significant (-0.344, $p = 0.045$). This indicates that governance strengthens the effectiveness of public health spending in reducing child mortality. In countries with better governance, public health expenditure has a larger mortality-reducing impact. This highlights the importance of institutional quality in enhancing the efficiency of health sector spending. This studies is in agreement with the study of Osinubi (2023), Sibanda et al (2024) and Odhiambo et al (2015) that governance influence positively the effect of domestic public health expenditure in SSA within the study period.

The interaction between private health expenditure and governance is negative but insignificant (-0.118, $p = 0.218$). This suggests that governance does not significantly modify the effect of private health spending on under-five mortality. The limited impact may be linked to structural and economic constraints in the region. Private health spending is largely out-of-pocket and depends heavily on household income. As a result, access to healthcare is unequal across income groups. Higher-income households benefit more from private expenditure than poorer populations.

Most year dummies are positive and highly significant, especially in earlier years, but gradually decline over time. This pattern indicates a strong downward time trend in under-five mortality relative to the base year. The decreasing magnitude of coefficients over time suggests overall improvements in child survival outcomes across the panel period, likely driven by expanded immunization programs, international health interventions, improved maternal and child health policies.

The system GMM validity and reliability of Results are shown in the table 5 below:

Table 5: Autocorrelation and Instrument Validity Test Results

Test			
Arellano-Bond test for AR(2) in first differences	$z = -0.73$	$Pr > z = 0.467$	
Hansen test of overid. Restrictions	$\chi^2(44) = 4.53$	$Prob > \chi^2 = 0.218$	

Source: Authors' Computation from STATA 17

The test results for autocorrelation in table 5 is checked using the Arellano-Bond test for AR (2) in first differences, with the null hypothesis that the error term is not serially correlation. The probability value of 0.467 for Arellano-Bond test for

AR (2) shows no second order series correlation (that is the value of $AR(2) > 0.05$). This implies that the original error term is serially uncorrelated and the moment conditions are correctly specified. The Hansen test for overall validity of the instrument is used and it has the p-value of 0.218 which support the choice of instruments since the p-value is not below 0.50 but between 0.05 and 0.80 thus, the instruments are valid.

5.0 Conclusion and Recommendations

The empirical findings underscore the critical importance of domestic public health expenditure as a key driver of improved child health outcomes in Sub-Saharan Africa. Specifically, the results demonstrate that increased government spending on health significantly reduces under-five mortality, thereby confirming the theoretical expectation that public investment in healthcare enhances access to essential medical services, improves the quality of care, and strengthens health system capacity. This outcome reflects the vital role of publicly funded interventions such as immunization programs, maternal and child healthcare services, nutrition initiatives, and disease prevention strategies, all of which contribute directly to child survival. In this regard, the evidence reinforces the argument that sustained public health financing is indispensable for addressing the persistent burden of child mortality in the region.

Beyond the direct impact of public health spending, governance is a critical driver of health outcomes. Improvements in transparency, accountability, political stability, and institutional effectiveness independently reduce under-five mortality. This indicates that not just the level of funding, but how it is managed, determines its impact. Strong governance enhances efficient resource use, limits wastage, and ensures effective policy implementation, thereby improving health service delivery and system performance.

More importantly, the interaction between domestic public health expenditure and governance provides deeper insight into the dynamics of health outcomes in Sub-Saharan Africa. The results indicate that the mortality-reducing effect of public health spending is significantly amplified in countries with higher levels of governance quality. In other words, governance acts as a complementary factor that

enhances the productivity of health expenditure. Where institutions are robust and policies are effectively enforced, each unit of public spending yields greater improvements in child health outcomes. Conversely, in weak governance environments, the potential benefits of increased health expenditure may be undermined by inefficiencies, corruption, and misallocation of resources. This finding highlights the necessity of adopting a holistic approach that combines increased funding with institutional strengthening to achieve optimal health outcomes.

In contrast, private health expenditure does not exhibit a statistically significant impact on under-five mortality, either as an independent variable or through its interaction with governance. This result reflects the structural realities of healthcare financing in Sub-Saharan Africa, where private health spending is largely dominated by out-of-pocket payments. Such a financing structure tends to be regressive and inequitable, often limiting access to healthcare services for low-income households and exacerbating health disparities. The lack of significance of private expenditure suggests that it does not effectively translate into broad-based improvements in child health, particularly because it is not pooled or redistributed in a manner that ensures equitable access. Furthermore, even in contexts of improved governance, private health spending remains constrained by its fragmented and exclusionary nature, thereby limiting its potential contribution to reducing child mortality.

Based on these findings, several important policy implications can be drawn. First, governments in Sub-Saharan Africa should prioritize increasing and sustaining public investment in the health sector, with particular emphasis on child and maternal health services. Expanding budgetary allocations to healthcare will enable the scaling up of essential interventions and the strengthening of health infrastructure, especially in underserved and rural areas. However, increasing expenditure alone is not sufficient to achieve the desired outcomes.

Second, there is a pressing need to strengthen governance frameworks within the health sector and the broader public administration system. Policymakers should focus on enhancing transparency in budget processes, improving accountability mechanisms, and ensuring the efficient allocation and utilization of resources. Anti-

corruption measures, performance monitoring systems, and institutional reforms should be implemented to reduce inefficiencies and ensure that health spending reaches its intended beneficiaries. Strengthening governance will not only improve the effectiveness of public health expenditure but also build public trust in the health system.

Third, reforms aimed at reducing the heavy reliance on out-of-pocket private health expenditure are essential. Governments should work towards expanding health insurance coverage through the development of inclusive and sustainable health financing schemes, such as national health insurance programs and community-based health insurance models. By promoting risk pooling and prepayment mechanisms, these reforms can enhance financial protection, reduce catastrophic health expenditures, and improve access to essential healthcare services for vulnerable populations.

Finally, achieving sustained reductions in under-five mortality in Sub-Saharan Africa will require a comprehensive and integrated policy approach that combines increased public health spending, strong governance, and equitable financing mechanisms. Investments in institutional capacity, health workforce development, and service delivery systems should be prioritized alongside financial reforms. Only through the alignment of resources, institutions, and policies can countries in the region realize meaningful and lasting improvements in child survival and overall population health.

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